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Working Party on Inland Water Transport

Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation

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Item 3 (b) of the provisional agenda

Standardization of technical and safety requirements in inland navigation:

Signs and Signals on Inland Waterways (SIGNI) (Resolution No. 22, revised)

Draft proposal for the third revision of the Signs and Signals on Inland Waterways (SIGNI)

RECOMMENDATIONS

1 GENERAL

1.1 General principles

1.1.1 In terms of the objective pursued, the marking comprises three categories of buoyage and marking:

(a) Buoyage of fairway limits in the waterway by means of buoys or spars, hereafter floating signs. This category will normally be used only on sections of waterway where the fairway cannot be indicated sufficiently clearly by marks placed on the banks;

(b) Buoyage and marking of danger points and obstacles, i.e. navigational hazards including:

- danger points, e.g. campshot, projections of the bank, low banks liable to flooding, fixed obstacles;
- obstacles, e.g. grounded or sunken vessels or floating equipment; work sites in the waterway, lost anchors, structures protruding into the fairway or in its vicinity etc.;

(c) Marks on land indicating the position of the fairway, hereafter bank marks, indicating the position of the fairway in relation to the banks and, where appropriate, its crossover from one bank to the other. The marks may also be used to provide isolated reference points for boatmasters.

1.1.2 Signs and signals comprise:

(a) Signs used to regulate navigation on the waterway, set out in Section 3.5, Chapter 4 and Appendix 1, as well as annex 7 of the European code for inland waterways (CEVNI); and

(b) Floating signs and bank marks, set out in Chapter 3 and annex 8 of CEVNI.

1.1.3 The signs set out in annex 7 to CEVNI are prohibitory, mandatory, restrictive, recommendatory or informative signs and auxiliary signs.

1.1.4 In the case of lakes and broad waterways, the three categories of buoyage and marking referred to above are used. In addition, special provisions are prescribed under Section 3A.

1.1.5 In accordance with article 5.01 of CEVNI, vessels' crew members shall obey the requirements and take account of the recommendations or indications brought to their attention by these signs.

1.1.6 The number of signs, bank marks floating signs and their on-site locations shall meet the requirements of navigation safety.

1.1.7 In order to increase navigation safety, the competent authorities ~~referred to in article 1.9~~ shall place kilometre markings along the inland waterway wherever waterway dimensions allow, as well as mark off each hectometre wherever possible.

1.1.8 Where the competent authorities decide to install a system of marking on a particular waterway or inland navigation network, they may:

- select from among the marks covered by these recommendations those which they deem suitable for the waterway or waterway network in question;
- supplement the marks selected with additional marks not included in the system defined below, provided always that the shape and colour of such marks and the nature of any symbol employed are consistent with the system and are such that the additional marks cannot be confused with any of the system's existing marks.

In cases where these recommendations permit alternatives, the competent authorities shall, unless there are overriding reasons to the contrary, agree on the alternative to be adopted on all of the several parts of the same waterway.

1.1.9 The choice of the marks and the establishment of their number depend on the local characteristics of the fairway and the function of each mark. Their installation shall be effected in cases when it is required by navigation criteria on the respective river section, in such a way as to ensure visibility from one mark to the next.

1.1.10 The term "left and right banks" means the sides of the waterway when moving from the source to the mouth.

On canals, lakes and broad waterways the competent authorities shall decide the matter in the light of local conditions. However, it is recommended that for canals the terms "right" and "left" should be defined as meaning to the right and to the left respectively of an observer facing in the direction in which the numbers indicated on successive kilometer markings rise.

1.1.11 The designations "right-hand side" and the "left-hand side" of the waterway or fairway are to be understood as for an observer facing downstream. On canals, lakes and broad waterways, the terms "right-hand side" and the "left-hand side" shall be defined by the competent authorities.

1.1.12 Where the prescribed mark consists of:

- (a) Lights only: the lights may be used both by day and by night;
- (b) Boards only: the boards may be used as night marks if illuminated;
- (c) Boards and lights: by day, either boards or lights may be used;
by night, either lights or illuminated boards may be used.

1.1.13 The marks shall be installed by the competent authorities which:

- (a) Regularly observe the state of the river bed and the changes taking place in it and, on the basis of the results of these observations, correct the positioning of the signs and marks and, where necessary, add to them so that they indicate the fairway dimensions;
- (b) Regularly measure the depth and the width of the marked fairway and provide boatmasters with the necessary information concerning minimum fairway depths and widths and the river level regime;
- (c) Establish the plan for the installation of signs and marks (hereinafter the marking plan) in their respective sectors and establish the type and number of floating signs and bank marks to be used, in terms of the requirements of navigational safety and local conditions;
- (d) Ensure as far as possible the uninterrupted operation of all floating signs and bank marks;
- (e) Inform boatmasters in good time of the date of the installation and removal of signs, of all alterations of importance to navigation to their number, type, positioning and lighting, and the rules they establish permitting the passage of vessels in restricted sections where meeting and passing are prohibited.

1.1.14 The numbering of the sketches of signal signs and marks including lights corresponds to numbering given in annexes 7 and 8 of CEVNI.

1.2 Lights

1.2 For the purpose of SIGNI and CEVNI, the following definitions are used:

“Light”: a distinctive light used as a marking.

“Fixed light”: an uninterrupted light of constant intensity and colour.

“Rhythmic light”: a light of constant intensity and colour operating in a characteristic and regularly repeated succession of spells of illumination and extinction.

1.2.2 In principle, the use of rhythmic lights shall be reserved for the marking of the waterway. Rhythmic lights shall also be used under the conditions specified in Section 4.3.

1.2.3 In principle, the use of fixed lights shall be reserved for purposes other than those referred to in 1.2.2.

For the meanings of the fixed lights recommended, see para. 4.2.2.

1.2.4 The luminous intensity of lights is established by the competent authorities ~~of the respective countries~~ in terms of local navigational conditions. In classifying the luminous intensity, it is recommended to use the classification of luminous intensity in Appendix 2 to the present Recommendations, which also includes calculations for luminous range.

1.2.5 In principle, the colours of lights should be in keeping with the standard of the International Commission on Illumination (CIE) ("Colours of Light Signals", CIE S 004/ E-2001, class A).

1.3 Boards and buoys

1.3.1 Boards bearing special signs recommended are all rectangular.

They are divided into two categories according to the signs they bear:

(a) Signs giving instructions: these shall be coloured white and bordered in red and display black symbols. Where they indicate a prohibition, the boards shall also bear a diagonal red bar;

(b) Signs giving information or indicating the end of an instruction for vessels proceeding in one direction only: all boards shall be rectangular and blue in colour, with white symbols.

1.3.2 The visibility of the boards may be improved by a narrow white border.

1.3.3 If necessary, these signs may be supplemented by additional boards, indicator plates and inscriptions referred to in para. 3.5.2 or additional luminous signals referred to in para. 4.4.

1.3.4 The chromaticity of the surface coatings of buoys and boards should lie within the chromaticity areas defined in the recommendations on the surface colours of visual signs and signals published by the International Commission on Illumination (see para. 1.2.5). The back of the panel, if visible from the navigable zone, shall be of such a colour as not to be misleading.

1.4 Lighting

1.4.1 In certain cases lighting may be provided at night (e.g. lighting of the lower part of a bridge, of the piers of a bridge, of the approaches to a lock, of a section of a canal, etc.). Such lighting may be used to supplement the marks.

1.4.2 Lighting shall be so designed as to avoid dazzle.

1.5 Geographical limits of applicability of the marking system recommended

1.5.1 The competent authorities shall if necessary determine the boundaries between inland waterways (to which the recommended marking system applies) and maritime waterways.

1.5.2 The principles of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Aids to Navigation system have been taken, where applicable to inland waterways, as the basis for the following provisions. These provisions have been defined in such a way as to avoid, as far as possible, any risk of conflict or confusion between the two systems of buoyage.

2 VISIBILITY OF SIGNS AND LIGHTS

2.1 General provisions

2.1.1 Whatever the position of the vessel in relation to the sign or the marker light, the characteristics of the sign or light shall remain unchanged. For daytime signs, these characteristics are: the form (topmark) and the colour; for signs at night: the type and colour of the lights.

2.1.2 The forms and the colours of the topmarks and the types and colours of the lights are set out in detail in Sections 3.2-3.4 and their minimal dimensions are set out in Appendix 1.

2.1.3 The basic requirement to be met by signs and marking is the guarantee of good visibility of all signs and lights by day or night.

2.1.4 In accordance with the recommendations of IALA¹ there are three degrees of visibility of signs:

(a) First: the sign is visible to the naked eye. The meaning of the sign is not yet identifiable (simply visible);

(b) Second: when the sign is clearly visible and identifiable according to these recommendations and in CEVNI (identifiable);

(c) Third: the sign is identifiable and distinguishable from its surrounding background (conspicuous).

Signs that must be seen by a boatmaster at some imperative distance (“no entry”, “keep a particular sharp lookout”, etc.) must have a visibility (due to their proper dimensions) of second or third degree. The type and dimensions of signs should be selected accordingly.

Third degree visibility is required when the sign or light is identifiable in principle, but cannot be easily seen at night owing to the surrounding background (presence of construction or a large number of light sources).

2.1.5 The degree of visibility of signs and lights depends on the following conditions:

Signs:

- Angle of sight;
- Colour contrast and differences;
- Lighting (including natural day light) and weather conditions.

Lights:

- Luminous intensity;
- Competing lights and background lighting;
- Weather conditions.

2.2 Conditions of visibility and dimensions of signs

2.2.1 In order to ensure the first degree visibility, in daytime the sign shall be visible with an angle of more than 1 angular minute and with sufficient contrast in relation to the environment. Detailed form and colour of the sign (second and third degree visibility) can only be distinguished with a larger angle of sight or with a reduction in the distance L to the object being observed.

2.2.2 The minimal angle of distinction in daytime for simple shapes (cylinder, cone, sphere, etc.) is between 3 and 5 angular minutes, and for complex shapes (numbers, letters, etc.) between 5 and 8 angular minutes. For the boatmaster to be able to recognize the daymark (without any optical aids) at appropriate distances and visibility, the following formula can be used for the calculation of the required-minimum dimensions of simple and complex shapes (see fig. 2.1):

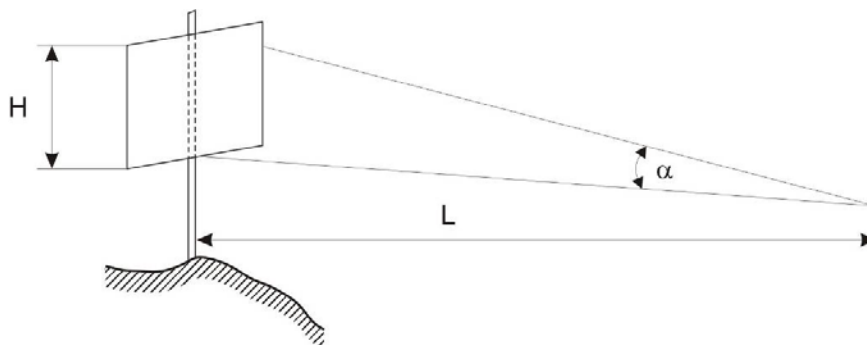
¹ IALA Guideline No. 1094 On Daymarks for Aids to Navigation, Edition 1, December 2012.

$$H = L \cdot \operatorname{tg} \alpha \cong L \cdot \sin \alpha$$

H (m) — height of the sign;

L (m) — distance;

α (') — viewing angle.



(fig. 2.1)

Values for H (m) as a function of L (m) and α (') are presented in table 2.1.

Table 2.1

	α	L				
		500	1 000	2 000	3 000	4 000
For signs of simple shapes (cylinder, cone, circle, etc.)	3	0.44	0.87	1.74	2.61	2.48
	4	0.58	1.16	2.32	3.48	4.64
	5	0.73	1.45	2.90	4.35	5.80

Table 1 shows that a shape of a sign with dimension $H = 0.5$ m is recognizable at distance $L = 500$ m and viewing angle $\alpha = 4'$; when $L = 1,000$ m, then $H = 1$ m, etc.

When there are simple drawings (dot, line, arrow) on the signs, a 15 per cent visibility reduction must be taken into account, while with complex drawings it shall be 30 per cent.

2.2.3 Examples of the minimum measurements for the signs, marks and buoys from Sections 3.2-3.5 as well as annexes 7 and 8 to CEVNI are given in Appendix 1 to these Recommendations. Alphanumeric characters on signs should intend to provide a standard for the various signs.

The letters, figures and analogous symbols should be of a height not less than one five-hundredth of the maximum distance from which they must be read, and the thickness of the stroke should be not less than one-seventh of that height.

For bank marks and signs, the minimal height from the lower rim of the board down to the base of the lowest sign shall be 3 m. In places where it is necessary due to the configuration of the terrain (relief), a height of 2 m is allowed. At highest navigation water levels, the height between the water surface and the lower rim of the board of the lowest sign should not be less than 1.5 m.²

2.2.4 As regards the signs and signals of Sections 3.2-3.5 as well as of annex 8 to CEVNI, unlighted buoys and unlighted bank mark boards shall be covered with reflective

² If this requirement cannot be met due to local conditions, the competent authorities may prescribe other requirements to ensure proper visibility.

material. Light buoys and lighted bank mark boards may also be so covered. The colours of these materials shall correspond to those established for the buoy lights or the boards. In all cases, the topmarks of light buoys shall be covered with reflective paint.

2.2.5 In order to ensure that bank marks are clearly visible, their dimensions shall be determined in terms of their purpose, the distance between the fairway and the banks, the nature of the region and the characteristics or other specific conditions of the sector in question.

2.2.6 The good visibility of a sign or signal depends on the contrast between the luminance of the sign or signal and the background. This shall be taken into consideration in choosing a site for signs. For example, of two boards, one red and the other white positioned one beside the other against a light background, the red board will be more visible and visible at a greater distance than the white board while, in contrast, the white board will be easier to see than the red board against a dark background.

2.2.7 The visibility of signs in Appendix 1 as well as annex 7 to CEVNI regulating navigation on the waterway shall be ensured at night by lighting them with fixed directional white lights, operating uninterruptedly and so positioned that the light does not incommode the boatmasters.³

If electric lighting cannot be used, the sign boards shall be covered with reflective material of a corresponding colour on which the symbol shall be clearly visible to vessels.

2.2.8 In order to guarantee the visibility of lighted boards, the back lighting must conform with the provisions of Appendix 5, where, in addition to luminance and its regularity, the colour for the white light source is established to ensure that colours under artificial light look the same as when seen in daylight.

For reliable identification at night the surface of the sign must be smooth and even, and if possible reflective.

2.3 Conditions for the visibility of lights

2.3.1 In certain cases lighting may be provided at night (e.g. lighting of the lower part of a bridge, of the piers of a bridge, of the approaches to a lock, of a section of a canal, etc.). Such lighting may be used to supplement the markings. Lighting shall be so designed as to avoid dazzling.

2.3.2 Luminous intensity is broken down into three categories in terms of navigation lights for inland waterway vessels (see Appendix 2 to the present Recommendations).⁴

2.3.3 Light signals are identified according to their characteristics. The characteristics are given by their colour and the rhythmicity the light source in accordance with Chapter 4 and Appendices 2 and 4.

2.4 Obligation not to hinder road and rail traffic

2.4.1 Signs and marking shall be installed in such a way that their lights do not hinder the movements of other modes of transport if the road runs close to the river.

2.4.2 In a sector in which a road or a railway runs close to a river, the installation of all the above-mentioned signs and signals shall be carried out in consultation with the respective competent authorities.

³ The competent authorities may waive these requirements.

⁴ The alternative proposal is to refer to IALA Recommendations E-200 on Marine Signal Lights.

3. BUOYAGE AND MARKING OF THE WATERWAY

3.1 Requirements to be met by signs and marks and their marking plan

3.1.1 The marking shall be in operation continuously (by day and by night) all along the navigable section of the river, and, as far as possible, as from when the waterway is free from ice until the ice appears; it shall be corrected as changes occur in the water level and in the fairway.

In accordance with the state of the fairway, the marking shall be positioned in such a way that the vessels navigating downstream can use the part of the river with the high current speed and the vessels navigating upstream can use the part of the river with the low current speed.

3.1.2 During periods of high water and icing, the regular floating signs removed to preserve it from possible damage shall be replaced, as far as possible, by marker posts and spars, the topmarks and colours of which shall correspond to those adopted for the respective side of the fairway.

3.1.3 Floating signs shall be installed so as to ensure the safety of vessels on the fairway. Floating signs are anchored at approximately 5 m distance from the limits that they indicate.

3.1.4 Groynes and shallows can be marked using fixed marks or buoys. These marks or buoys are usually placed on the borders of groynes and shallows or in front of them.

3.1.5 Buoys shall be unsinkable and shall remain unsinkable in all storms, and their main body shall therefore be watertight; they shall not only float but also be stable, i.e. conserve a vertical position as far as possible and not be tipped excessively by waves and wind.

3.1.6 The basic condition which the marking plan shall meet is to ensure the safety of the vessels and the continuity of traffic, by day and by night, throughout the sailing season and to give boatmasters clear and unambiguous indications concerning the direction and the limits of the fairway.

3.1.7 The marking plan shall be prepared in such a way as to permit a rational combination of bank marks and floating signs. When the plan is drawn up, it should be based on the conditions of navigation and specific hydrographic and hydro-meteorological conditions, the need to ensure the established dimensions of the fairway and create the necessary conditions for the safety and continuity of navigation of all river vessels and, where necessary, of seagoing vessels.

3.1.8 Bank marks serve to guide boatmasters and to indicate the direction of the fairway. Floating signs supplement bank marks in sectors where, in order to ensure the safety of navigation, it is essential to indicate not only the direction of the fairway but also its limits, and to mark places where there are obstacles.

3.1.9 In preparing the marking plan, the following requirements should be taken into account:

(a) Only the signs set out in Sections 3.2-3.5, as well as annexes 7 and 8 to CEVNI are to be used to mark the fairway and regulate navigation; in exceptional cases, special additional bank marks may also be used, provided, however, that the marks are not in contradiction with those contained in CEVNI;

(b) The dimensions of the marked fairway shall correspond to the dimensions published by the competent authorities;

(c) The choice of where the signs are to be placed shall be based on the most recent measurements, acquired experience and available data on the state of the fairway, critical points, water levels, etc.;

(d) Signs and marker lights shall be visible, whatever the level of the water, at all points of the fairway and as long as may be necessary for the guidance of boatmasters;

(e) The marking plan shall contain information on the type of placed signs, bank/side whereon placed, river kilometre of the set-up and recapitulation of all floating signs and bank marks used for marking.

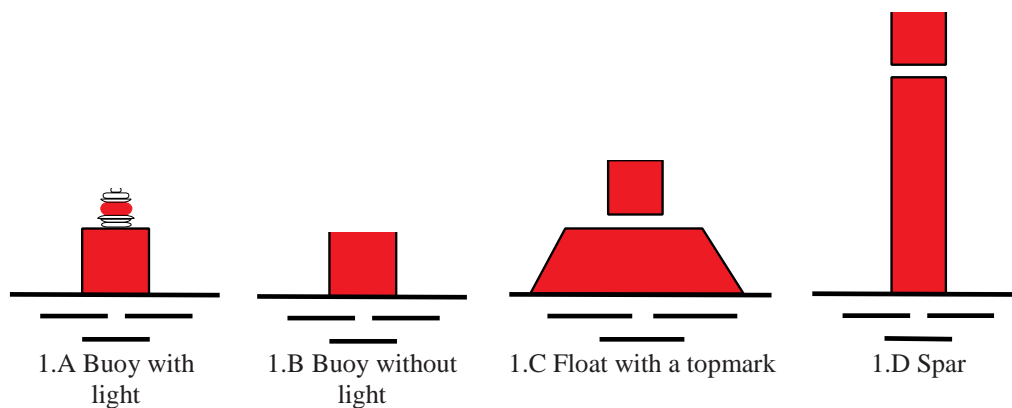
3.1.10 If there is a subsequent drop in the level of the water, reconnaissance soundings shall be taken on some sections of the river in order to check whether the positioning of the signs is adequate and to establish whether the marking needs to be supplemented by new signs.

3.1.11 The frequency of these soundings shall be determined by changes in water level. The more rapid the drop in levels, the more frequent the soundings need to be.

3.1.12 Examples of the application of the signs are given in figs. 3.10, 3.11 and in Chapter 5.

3.2 Buoyage of fairway limits in the waterway

3.2.1 Right-hand side of the fairway



(fig. 3.1)

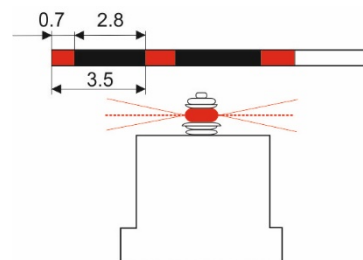
Colour: red

Form: cylindrical buoy or buoy with a topmark, or spar

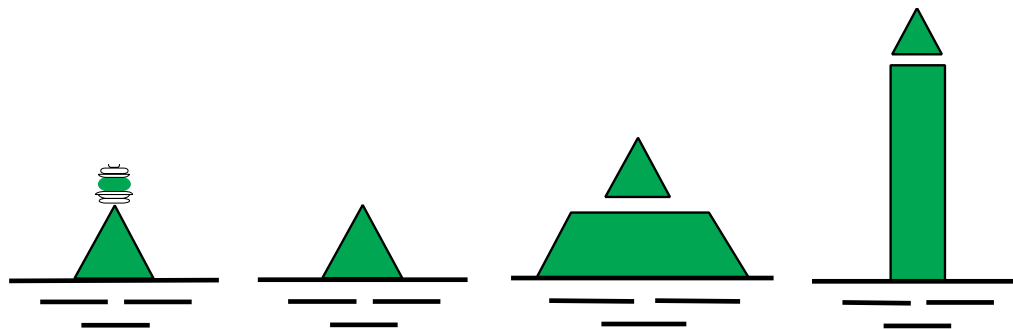
Topmark (if any): red cylinder

Light (when fitted): rhythmic red light

Generally with radar reflector.



3.2.2 Left-hand side of the fairway



2.A Buoy with light

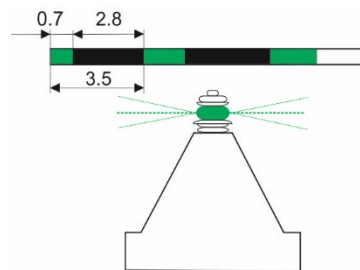
2.B Buoy without light

2.C Float with a topmark

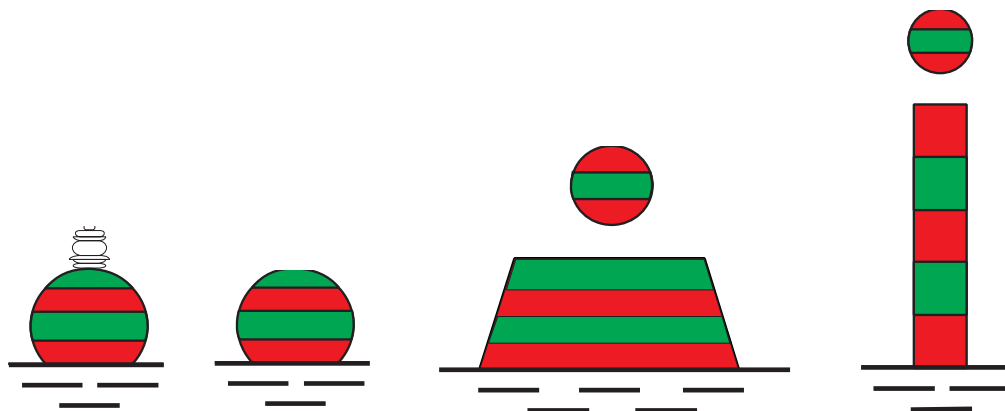
2.D Spar

(fig. 3.2)

Colour: green
 Form: conical buoy or buoy with a topmark, or spar
 Topmark (if any): green cone, point upwards
 Light (when fitted): rhythmic green light
 Generally with radar reflector.



3.2.3 Bifurcation of the fairway



3.A Buoy with light

3.B Buoy without light

3.C Float with a topmark

3.D Spar

(fig. 3.3)

Colour: horizontal red and green bands

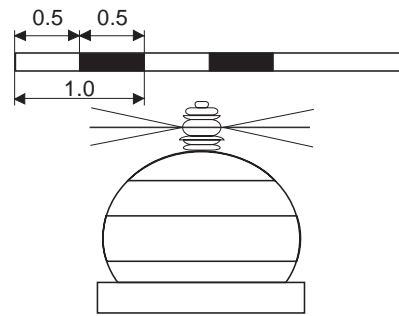
Form: spherical buoy or buoy with a topmark, or spar

Topmark (if any): sphere with horizontal red and green bands

Light (when fitted): continuous
scintillating white light,

or isophase white light

(may be group-flashing white light
with a group of three flashes)



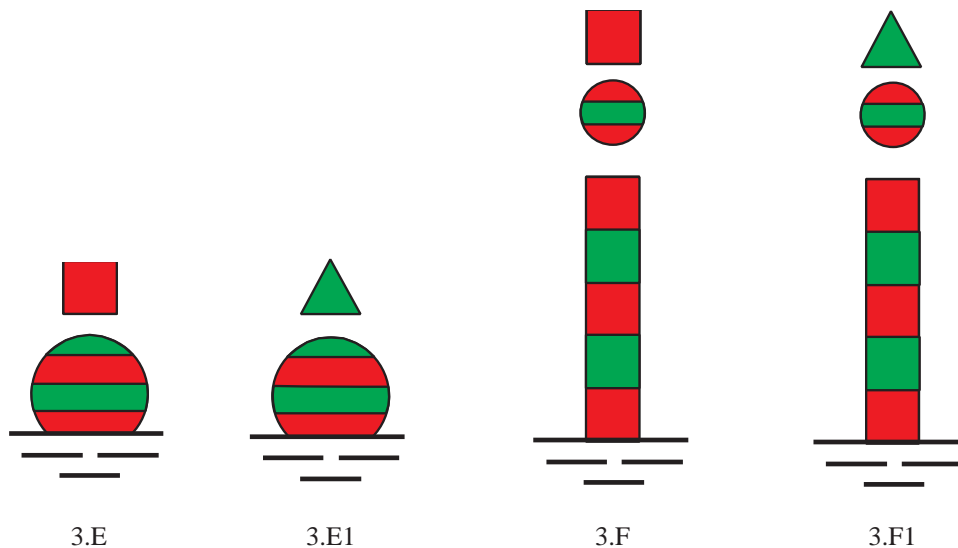
Generally with radar reflector.

Where there is a risk of confusion with maritime signs and signals or with signs and signals for lakes and broad waterways as defined in 2.4, the above-mentioned rhythm of light shall not be used and shall be replaced by the group-flashing rhythm (group of three flashes).

When a bifurcation mark is used on lakes and broad waterways, care should be taken to avoid any risk of confusion with the marks provided for in Section 3A.

Where necessary, a red cylindrical topmark or green conical topmark placed above the bifurcation mark indicates on which side it is preferable to pass (main fairway).

The mark shall then bear a rhythmic red light or a rhythmic green light, as appropriate.



(fig. 3.4)

3.2.4 A letter "P" painted in white on the buoys described in paras. 3.2.1 and 3.2.2 indicates that the fairway is adjacent to a berthing area. If the buoys showing the letter "P" carry a light, its rhythm shall be different from that of the lights of other buoys placed along the fairway limit.

3.2.5 The buoyage described above may not be used for the fairways and special zones referred to in Chapter 9.

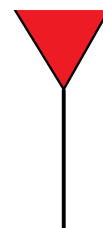
3.3 Buoyage and marking of danger points and obstacles

3.3.1 Where it is desired merely to draw attention to an obstacle or danger point without requiring vessels under way to move in a particular direction, the following may be used:

- (a) For obstacles and danger points in the fairway: the buoys, spars, topmarks and lights prescribed in Section 3.2 for marking the fairway limits.
- (b) For obstacles and danger points outside the fairway, either fixed marks (see para. 3.3.2) or buoys (see para. 3.3.3) in the waterway.

3.3.2 Fixed marks are indicated below:

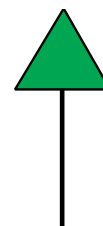
- (a) Right-hand side
Colour: red
Form: post with topmark
Topmark: red cone, point downwards
Light (when fitted): rhythmic red light.



4.F

(fig. 3.5)

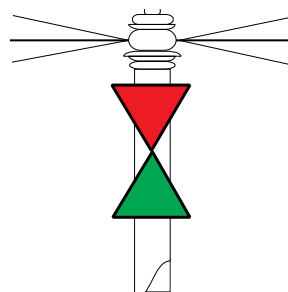
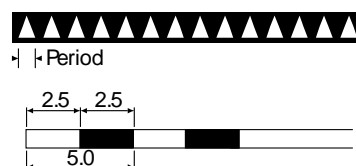
- (b) Left-hand side
Colour: green
Form: post with topmark
Topmark: green cone, point upwards
Light (when fitted): rhythmic green light.



5.F

(fig. 3.6)

- (c) Bifurcation
Colour: red/green
Form: post with topmark
Topmark: red cone, point downwards, above a green cone, point upwards
Light (when fitted): continuous scintillating white light or isophase white light (may be the group-flashing white light a group of three flashes)



6.A



6.B

(fig. 3.7)

The above cones may be replaced by triangular panels with a white background and a red or green border.

3.3.3 Secondary arms of the waterway, mouths of waterways and entrances to harbours

On the approach to secondary arms of the waterway, to mouths of waterways and to harbour entrances, the bank walls on both sides of the waterway may be marked as far as the head of the dividing mole by the fixed marks described in para. 3.3.2, (a) and (b). Vessels entering the harbour are regarded as upstream traffic.

3.3.4 Buoys are described below:

(a) Right-hand side

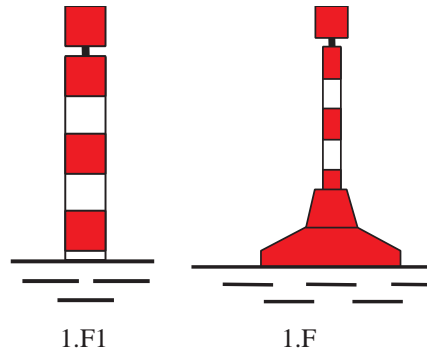
Colour: horizontal red and white bands

Form: spar-buoy or spar

Topmark: red cylinder

Light (when fitted): rhythmic red light

Generally with radar reflector.



(fig. 3.8)

(b) Left-hand side

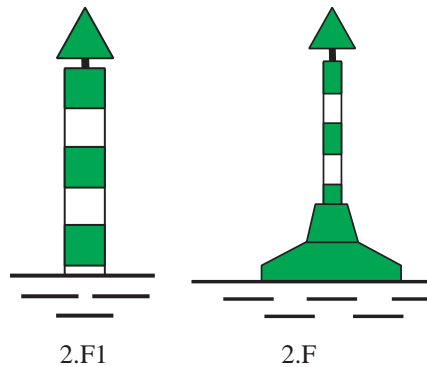
Colour: horizontal green and white bands

Form: spar-buoy or spar

Topmark: green cone, point upwards

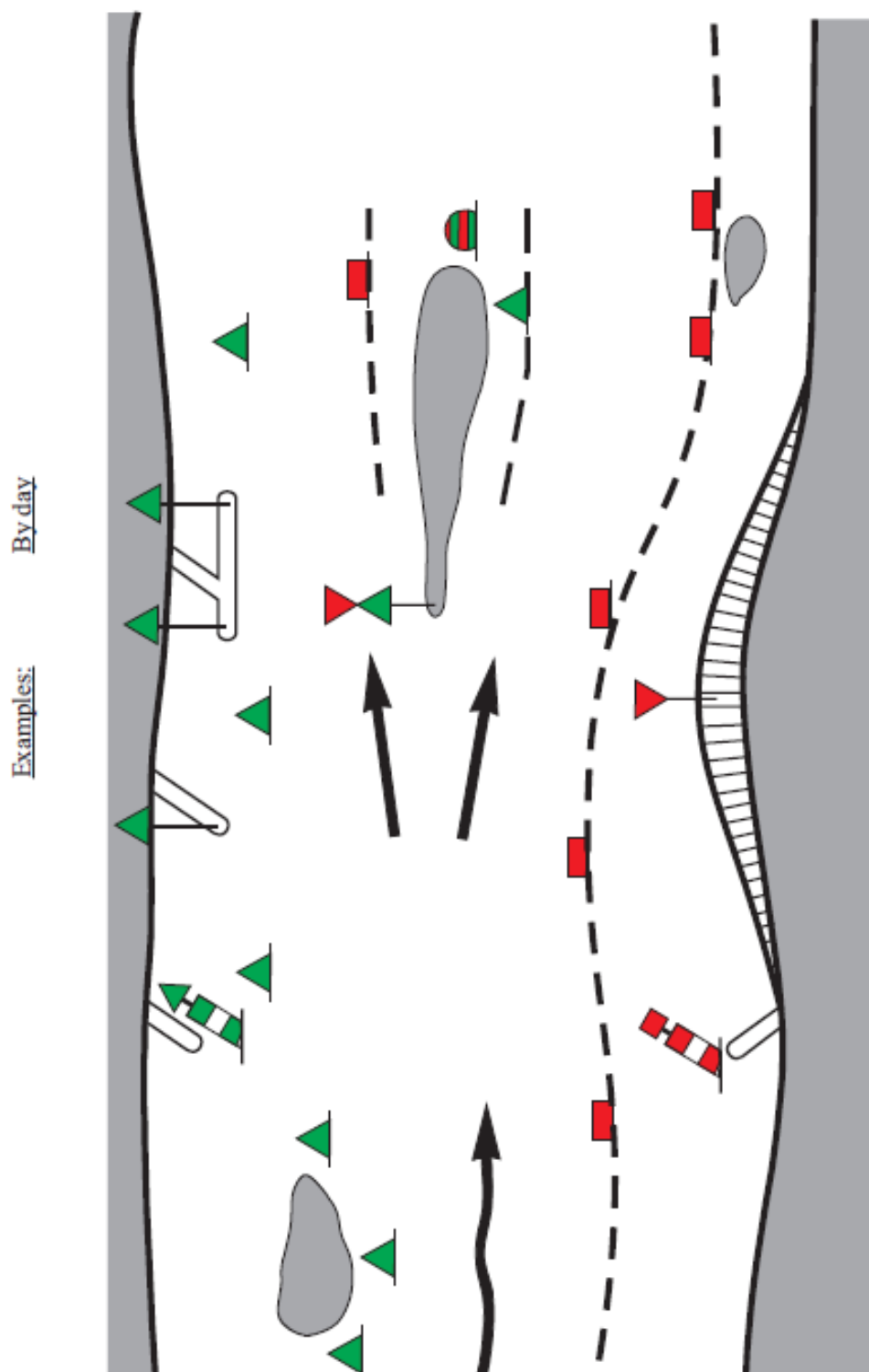
Light (when fitted): rhythmic green light

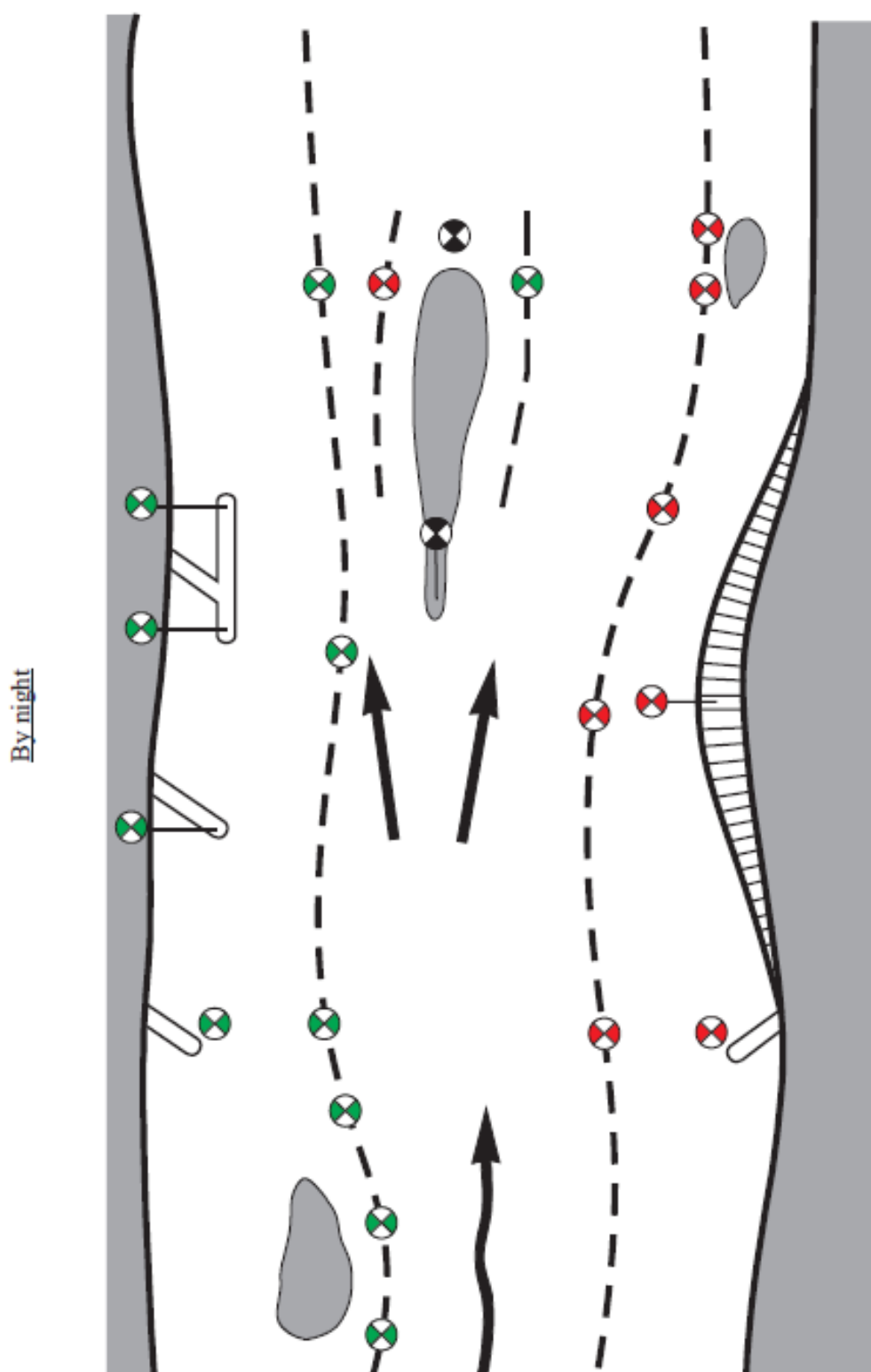
Generally with radar reflector.



(fig. 3.9)

3.3.5 Examples of using the signs in paras. 3.3.2-3.3.4 are given in figs. 3.10 and 3.11.

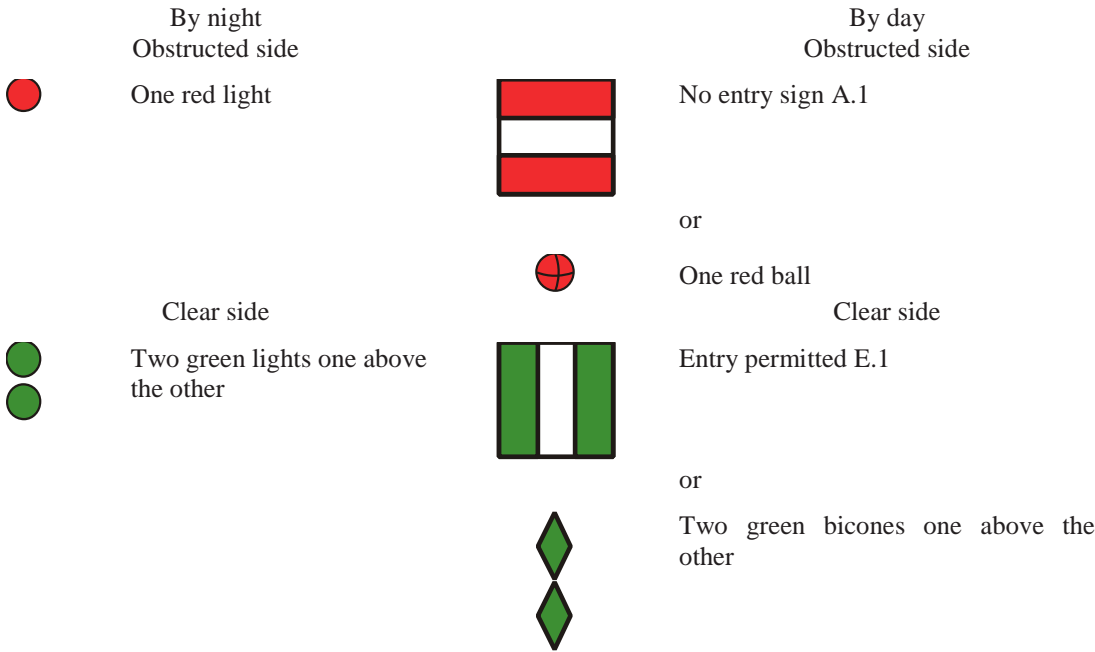




(fig.3.11)

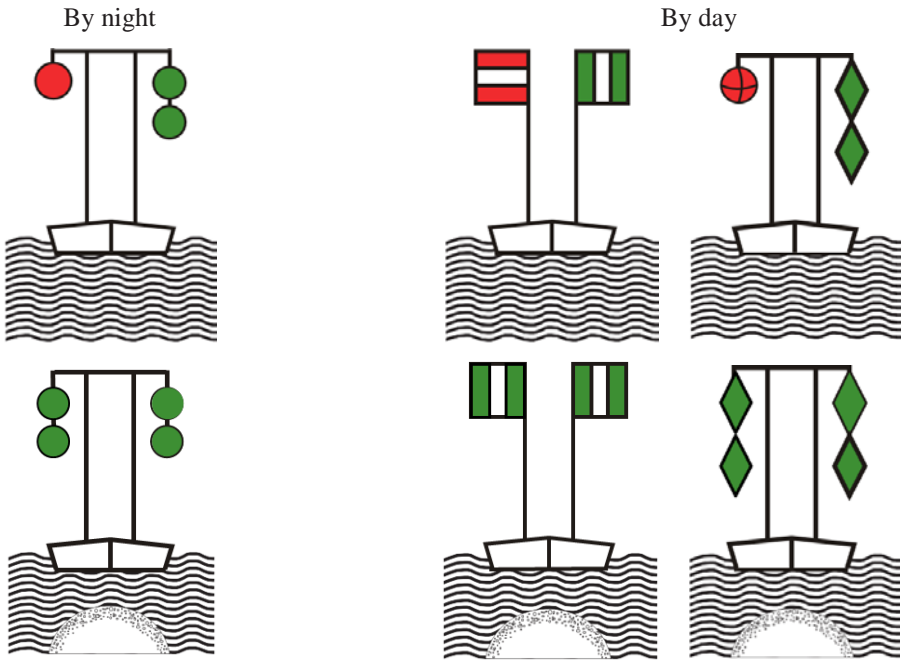
3.3.6 Where it is desired to draw attention to the obstacles and danger points and to prescribe only the side on which vessels must pass, the following marking (which may be placed on auxiliary craft) shall be used:

Passage permitted on the clear side without reducing speed



(fig. 3.12)





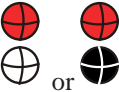
Examples:



(fig. 3.12a)

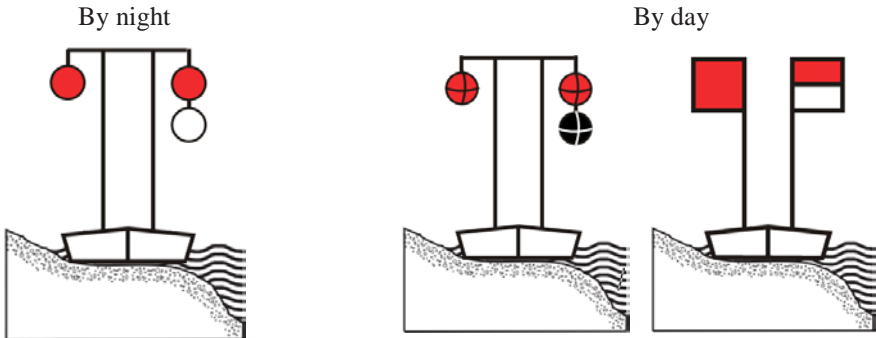
3.3.7 Where it is desired both to draw attention to such obstacles and danger points and to require vessels under way to reduce speed in order to avoid causing wash, the flags, boards, balls or lights shown below shall be used; they may be placed whether on the obstacle itself or on an auxiliary craft.

Passage permitted on the clear side at reduced speed (avoid creating wash)

By night Obstructed side		By day Obstructed side	
	One red light		One red flag or red board
Clear side		Clear side	
	One red light above one white light		One red flag or board above one white flag or board
		or	
			A red ball above a white or black ball (according to the background against which it is required to stand out)

(fig. 3.13)

Examples:



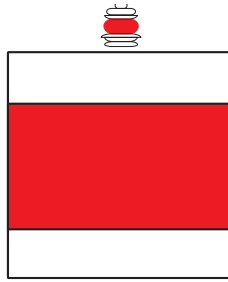
(fig. 3.13a)

3.4 Bank marks indicating the position of the fairway

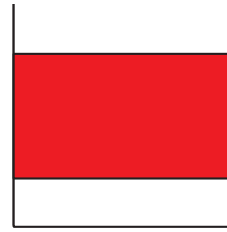
3.4.1 Bank marks indicating the position of the fairway in relation to the banks

These signs indicate the position of the fairway in relation to the bank and, together with the buoyage of the waterway, mark the fairway at points where it approaches a bank; they also serve as landmarks.

(a) Fairway near the right bank



4.A With light



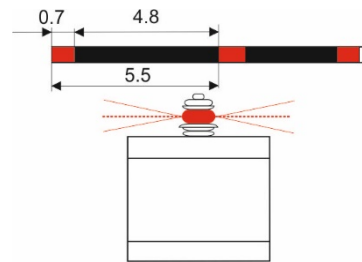
4.B Without light

(fig. 3.14)

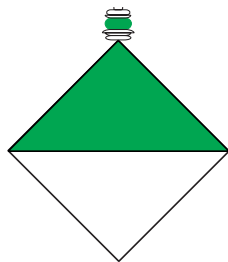
Colour: red/white

Form: post with topmark

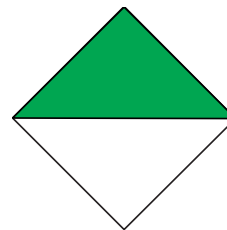
Topmark: square boards
(sides horizontal and vertical), red,
with two horizontal white stripes
Light (when fitted): rhythmic red
light.



(b) Fairway near the left bank



5.A With light



5.B Without light

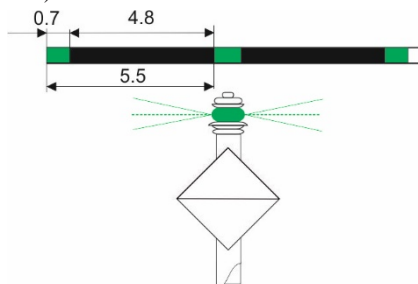
(fig. 3.15)

Colour: green/white

Form: post with topmark

Topmarks: square board
(diagonals horizontal and vertical),
upper half painted green and
lower half white

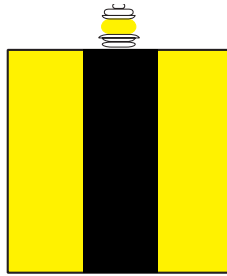
Light (when fitted): rhythmic
green light.



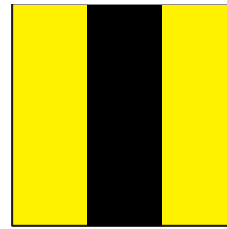
3.4.2 Marking of cross-overs

Marking of cross-overs indicate at what point the fairway passes from one bank to another and also give the axis of this cross-over:

(a) Right bank



4.C With light



4.D Without light

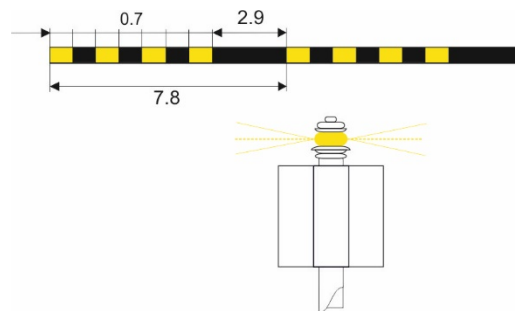
(fig. 3.16)

Colour: yellow/black

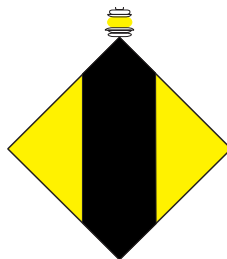
Form: post with topmark

Topmarks: square yellow board (sides horizontal and vertical), with a central vertical black stripe

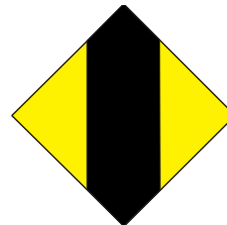
Light (when fitted): yellow light, flashing or occulting, with an even-number characteristic other than the group-flashing rhythm with a group of two flashes.



(b) Left bank



5.C With light



5.D Without light

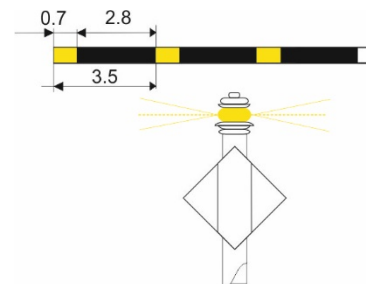
(fig. 3.17)

Colour: yellow/black

Form: post with topmark

Topmark: square yellow board (diagonals horizontal and vertical), with a central vertical black stripe

Light (when fitted): yellow light, flashing or occulting, with an odd-number characteristic other than the group-flashing rhythm with a group of three flashes.



3.5 Buoyage and marking of lakes and broad waterways

Main navigation signs

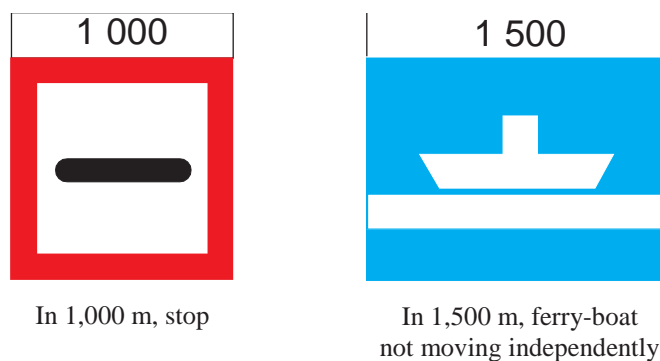
3.5.1 The main navigation signs are given in annex 7 to CEVNI. The signs with their minimal dimensions are given in Appendix 1.

Auxiliary navigation signs

3.5.2 The main signs may be supplemented by the following auxiliary signs:

(a) Panels showing the distance at which the regulation applies or the special feature indicated by the main sign is to be found. The panels are placed above the main sign.

Examples:



(fig. 3.18)

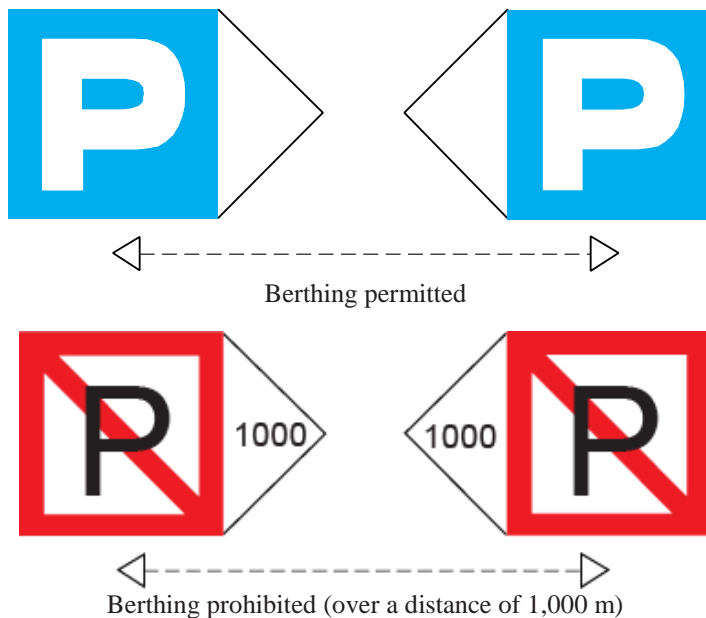
(b) Additional luminous signal

Additional luminous signals are given in Section 4.4.

(c) Pointers showing the direction of the section to which the main sign applies.

Note: The pointers need not necessarily be white and may be placed beside or below the main sign.

Examples:

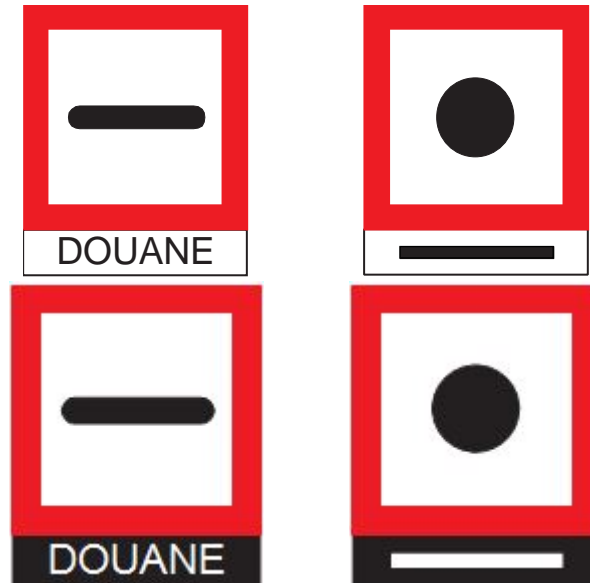


(fig. 3.19)

(d) Panels giving explanations or additional information

Note: These panels are placed below the main sign.

Examples:



Stop for Customs
(fig. 3.20)

Give one long blast

(e) Panels indicating the type of craft concerned

Where a prohibition, a mandatory requirement or an indication applies only to a particular type of craft or activity, the symbol for such craft or activity shall be shown in black on a white ground on a panel below the sign.

Example:

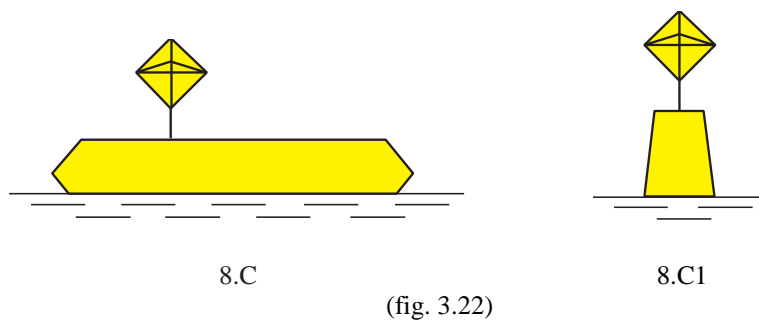


Mandatory requirement
for motorized craft to
take a specified direction

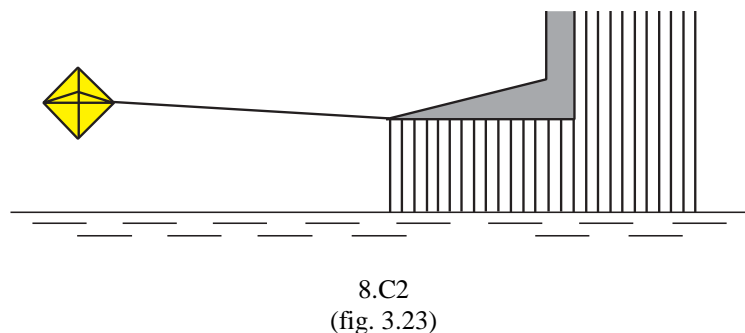
(fig. 3.21)

3.6 Additional marking for navigation by radar

3.6.1 Yellow floats with radar reflectors are placed upstream and downstream from piers.



3.6.2 Pole with radar reflector is placed upstream and downstream from bridge piers.



3.7 Buoys for miscellaneous purposes

Buoys required for purposes other than those referred to above shall be predominantly white, to avoid confusion with red, green or yellow buoys. They may carry pictograms.

3.8 Warning posts

3.8.1 In special cases where it is necessary to set up warning posts (e.g. on winding sections of waterway where the visual range is limited), the competent authorities shall determine the signals to be given by such posts so far as possible on the basis of these recommendations, and in such a way as to avoid confusion or conflict with the signals described in them.

3A BUOYAGE AND MARKING OF LAKES AND BROAD WATERWAYS

3A.1 General

3A.1.1 Subject to the exception referred to in para. 3.2.3, the provisions of Sections 3.2 to 3.4 shall apply to lakes and broad waterways. However, additional marks, taken from the IALA Maritime Buoyage System may be used if required:

- marking of danger points, obstacles and special features: cardinal marks, isolated danger marks, marking of new dangers;
- safe water marks;
- special marks for marking of prohibited or restricted zones;
- weather signs and signals on lakes.

3A.1.2 In addition, danger points, obstacles and special features may be marked by other electronic means, such as automatic identification system (AIS).

3A.1.3 If the competent authorities consider the risk to navigation to be especially high, at least one of the marks should be duplicated. Any duplicate mark shall be identical to its partner in all respects.

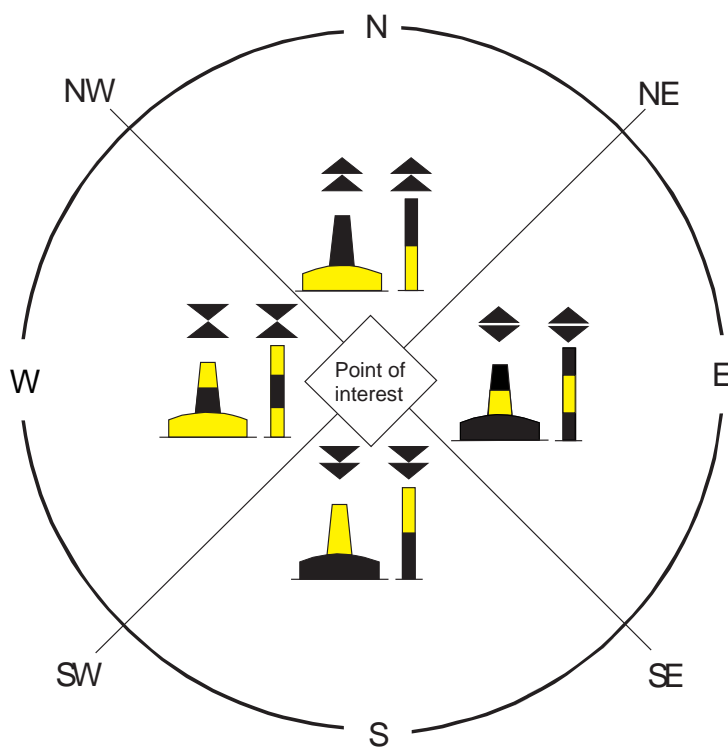
3A.2 Marking of danger points, obstacles and special features

3A.2.1 Cardinal marks

The four quadrants (North, East, South and West) are bounded by the true bearings NW-NE, NE-SE, SE-SW, SW-NW taken from the point of interest.

A cardinal mark is named after the quadrant in which it is placed.

The name of a cardinal mark indicates that the mark should be passed on the side of the quadrant named.



(fig. 3.24)

North cardinal mark

Topmark: two black cones, one above the other, points upward

Colour: black above yellow

Form: pillar or spar, with topmark

Light (when fitted):

Colour: white

Rhythm: continuous quick scintillating or continuous scintillating.

South cardinal mark

Topmark: two black cones, one above the other, points downward

Colour: yellow above black

Shape: pillar or spar, with topmark

Light:

Colour: white

Rhythm: group quick scintillating or group scintillating, with a group of six flashes followed by a long flash of not less than two seconds duration.

East cardinal mark

Topmark: two black cones, one above the other, base to base

Colour: black with a single broad horizontal yellow band

Form: pillar or spar, with topmark

Light (when fitted):

Colour: white

Rhythm: group quick scintillating or group scintillating, with a group of three flashes.

West cardinal mark

Topmark: two black cones, one above the other, point to point

Colour: yellow with a single broad horizontal black band

Form: pillar or spar, with topmark

Light:

Colour: white

Rhythm: group quick scintillating or group scintillating, with a group of nine flashes.

A cardinal mark may be used for example:

To indicate that the deepest water in that area is on the named side of the mark;

To indicate the safe side on which to pass a danger;

To draw attention to a particular feature in a fairway such as a bend, a junction, a bifurcation or the extremity of a shoal.

3A.2.2 Isolated danger marks

An isolated danger mark is a mark erected on, or moored above an isolated danger which has safe water all around it.

Colour: black with one or more broad horizontal

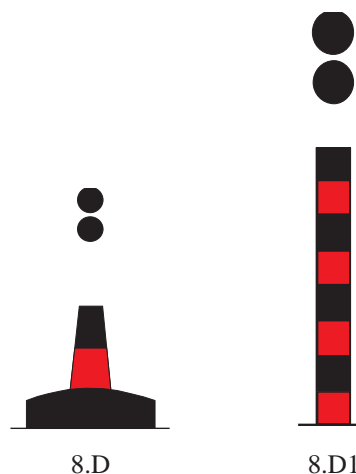
Form: any (generally pillar or spar) with topmark

Topmark: two black spheres, one above the other

Light (when fitted):

Colour: white

Rhythm: group flashing (group of two flashes)



(fig. 3.25)

3A.2.3 Marking of new dangers

The term “New Danger” is used to describe newly discovered hazards not yet shown in nautical documents. New Dangers include naturally occurring obstructions such as sandbanks or rocks or man-made dangers such as wrecks.

Colour: Blue and yellow vertical stripes in equal number dimensions (minimum 4 stripes and maximum 8)

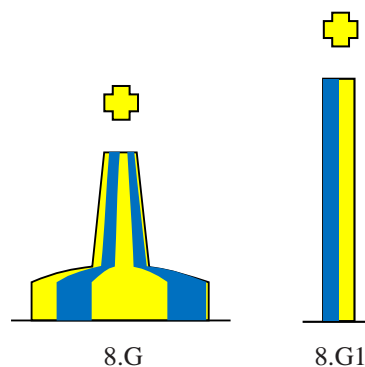
Form: pillar or spar

Topmark (if any): vertical or perpendicular yellow cross

Light (when fitted):

Colour: yellow/blue alternating

Rhythm: one second of blue light and one second of yellow light with 0.5 seconds of darkness between.



(fig. 3.26)

3A.3 Marking of the axis of a channel, the middle of a channel or a landfall

3A.3.1 Safe-water marks

Safe water marks serve to indicate that there is navigable water all round the mark; these include centre line marks and mid-fairway marks. Such a mark may also be used as an alternative to a cardinal or lateral mark to indicate a landfall.

Colour: red and white vertical stripes

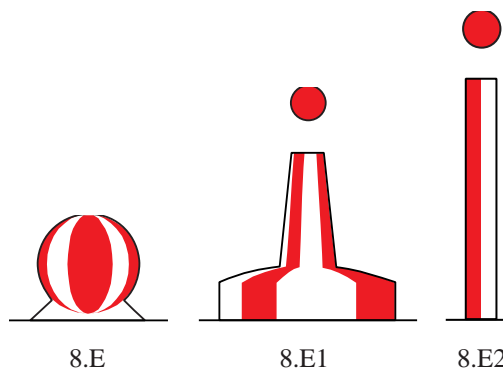
Form: spherical buoy or pillar or spar with topmark

Topmark (if any): single red sphere

Light (when fitted):

Colour: white

Rhythm: isophase, single-occulting, one long flash every 10 seconds or Morse code “A”



(fig. 3.27)

3A.4 Special marks

Marks not primarily intended to assist navigation but which indicate a special area or feature referred to in appropriate documents, such as military exercise zone marks, recreation zone marks.

Colour: yellow

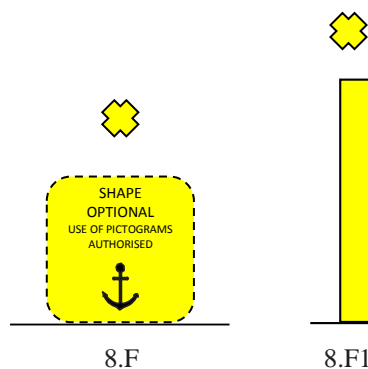
Shape: optional, but not conflicting with navigational marks

Topmark if any: single yellow, "X" shape

Light:

Colour: yellow

Rhythm: any, other than those described in 3A.2, 3A.3 and 3A.5



(fig.3.28)

3A.5 Weather signs and signals on lakes

3A.5.1 "Caution" warning

A yellow light producing about 40 flashes per minute constitutes a "caution" warning.

The "caution" warning indicates the probable onset of a dangerous phenomenon without specifying the time thereof.

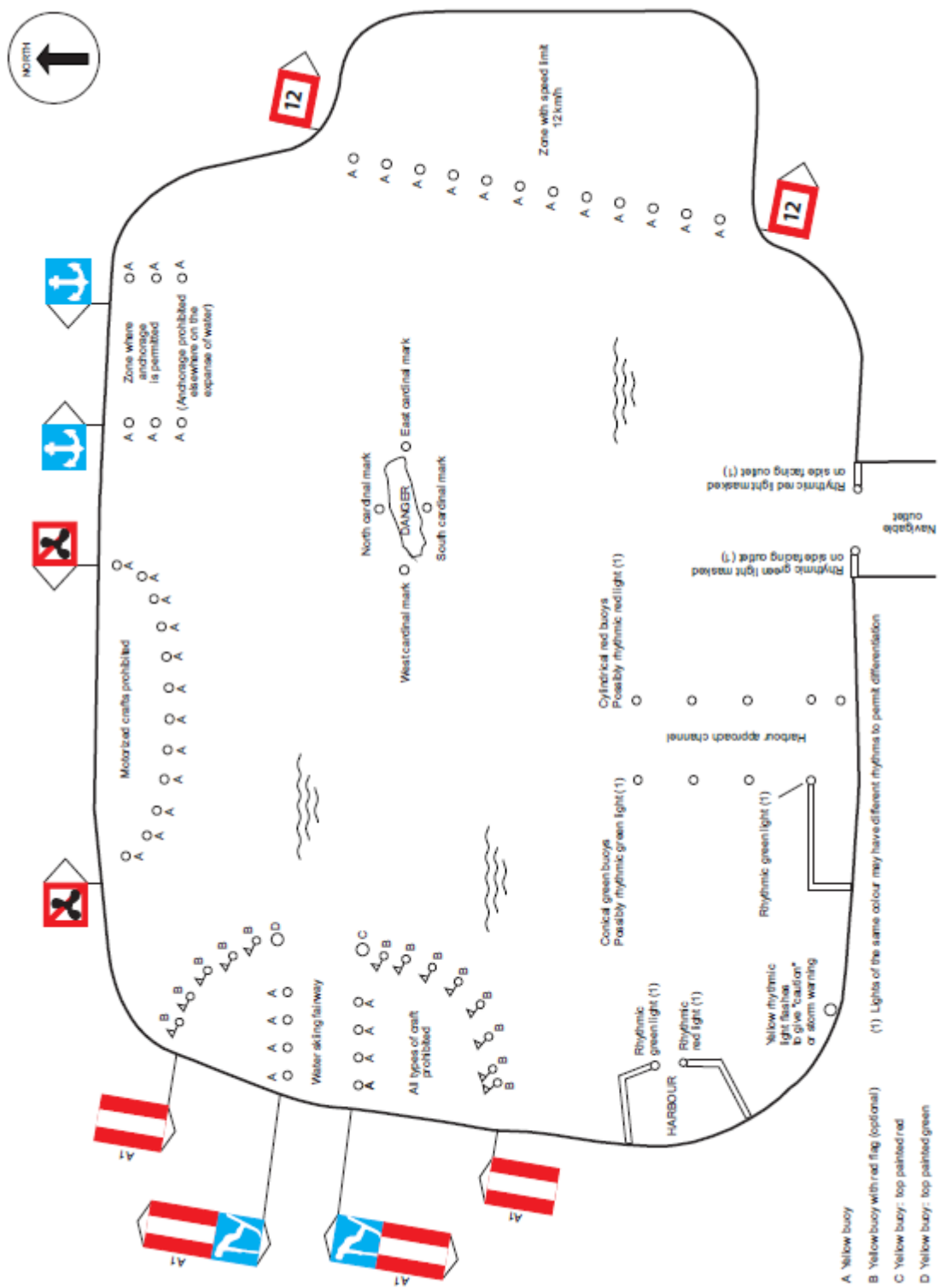
3A.5.2 "Imminent danger" warning

A yellow light producing about 90 flashes per minute constitutes a "danger" warning.

The danger warning indicates the imminent arrival of a dangerous phenomenon.

3A.6 Example of signs and signals on lakes and broad waterways

Fig. 3.29 illustrates the provisions of this section for lakes and broad waterways.



(fig. 3.29)

4. LIGHTS

4.1 Definitions

4.1.1 The terms “white light”, “red light”, “green light”, “yellow light” and “blue light” mean lights of colours according to the provisions referred to in Appendix 2.

4.1.2 The terms “scintillating light” and “quick scintillating light” mean rhythmic lights flashing 40–60 times per minute and 100–120 times per minute.

4.2 Fixed lights

4.2.1 The basic principle of marking by fixed lights is as follows:

- A fixed red light means "Stop";
- A fixed green light means "Go ahead".



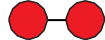

The meaning of the other marks comprising red or green lights derives from that principle. In particular, a fixed red light combined with other lights means either "Stop" or "Caution".


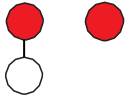
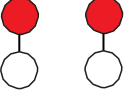
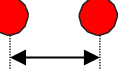



However, since green lights are always placed at the side of the waterway or fairway, vessels must never steer towards a green light. It has therefore been found necessary to provide for another signal authorizing passage towards which vessels may steer: a yellow light.

Pairs of lights should form a visual angle of not less than 5' ($\tan 5' = 0.00145$) to distinguish them from one another.


4.2.2 The meaning of the signals given by fixed lights is given in table 4.1.

Table 4.1

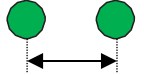




<i>Numbering</i>	<i>Signal</i>	<i>Description</i>	<i>Meaning</i>
A. Prohibitory signs			
A.1c ¹		Single red light	“No passage” This signal shall apply: Either to some of the fairways or arms of the waterway (prohibited fairways under bridges, prohibited arms, etc.). Or to the whole of the waterway (stoppage of navigation, locks, etc.). The use of this signal shall be limited to cases where a single red light is sufficient to indicate the intended prohibition clearly. In other cases, the use of two or more red lights is recommended (see below)
A.1b ¹		Two red lights placed one above the other (a pair)	Complete and prolonged stoppage of navigation (blockage of waterway, bridges or locks out of service, etc.)
A.1d ¹		Two red lights placed side by side (a pair)	Complete but brief stoppage of navigation. This signal shall always be operable as required (movable bridges, locks, narrow fairways, etc.)
A.11c ¹			Extinction of one of the red lights means: “Passage forbidden (passage about to be authorized)”

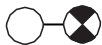



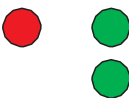
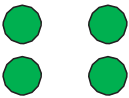




Numbering	Signal	Description	Meaning
A.9b		A red light above a white light	"Do not cause wash"
A.9c		One red light above a white light, a second red light being placed alongside the first	"Presence of an obstacle. Pass only on the side showing both the red and the white lights, and do not cause wash"
A.9d		Two red lights, each above a white light	"Presence of an obstacle. Pass on either side, but do not cause wash"
A.10b ¹		Two or more red lights set apart	"No passage" (between the lights). See also A.10c
A.10c ¹		Two red lights set apart with a yellow light between them	"No passage (between the lights) except in conformity with the restrictions in force" (closed movable bridge, etc.). A yellow light may also be combined with the signal A.1d
A.11a ¹		A red light and a green light placed side by side (a pair) or a red light above a green light	"No passage now but stand by to go ahead". This signal is always operable as required.
A.11b ¹			

B. Mandatory signs

B.10		Two isophase yellow lights placed one above the other (a pair)	Vessels proceeding on the main waterway must, if necessary, change course and speed to allow vessels to leave harbours or tributary waterways
------	---	--	---

D. Recommadatory signs

D.2b ¹		Two green lights set apart	"Go ahead between the lights"
D.1b ¹		Single yellow light, alone or between green lights	"Go ahead, but look out for traffic coming the other way". Vessels may steer towards the yellow light, which is placed above the navigable fairway
D.1g ¹			
D.1f ¹		A pair of yellow lights (placed one above the other, or, if necessary, side by side), alone or between green lights	"Go ahead; traffic in the opposite direction is prohibited". Vessels may steer towards the yellow lights, which are placed above the fairway
D.1e ¹			

<i>Numbering</i>	<i>Signal</i>	<i>Description</i>	<i>Meaning</i>
D.3b		A fixed white light and an isophase white light placed side by side (a pair)	"You are recommended to steer towards the side showing the isophase light". Signal to be used, for example, on the approach to a double lock
E. Informative signs			
E.1b ¹		Single green light	"Go ahead" (the green light is always placed at the side of the fairway). The use of this signal shall, however, be restricted to cases where a single green light is sufficient clearly to indicate the clear passage. In other cases, the use of two green lights set apart and indicating the passage is recommended.
E.1c ¹		Two green lights placed side by side (a pair)	"Go ahead" (this signal is always placed at the side of the fairway). It is always operable as required, the permission to pass being limited in time
E.1d ¹		Two green lights placed one above the other (a pair)	"Go ahead" (this signal is always placed at the side of the fairway). This signal may be used in particular cases (lock out of service with all gates open)
E.1e ¹		One red light and two green lights placed one above the other	"Pass only on the side showing two green lights"
E.1f ¹		Two pairs of green lights placed one above the other	"Pass on either side"
E.12		One or two white lights: ²	"Difficulty ahead - Stop if the regulations so require"
E.12a		Fixed light(s): advance signal	Examples: Lock closed, vessel navigating in the opposite direction
E.12b	or 		
E.12c		Isophase light(s): advance signal "You may proceed"	Examples: Lock open, no vessel navigating in the opposite direction.
E.12d	or 		

¹ Each fixed red, green or yellow light may be replaced by a red-white-red, a green-white-green or a yellow board respectively, as provided below in Chapters 7 and 8.

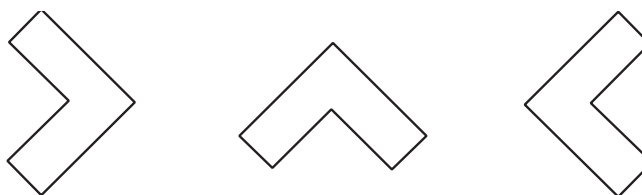
² Single fixed white lights shall not be used except as advance signals. Fixed white lights must be used with care as they may be confused with other white lights (for instance, public lighting).

4.3 Rhythmic lights

Rhythmic lights are described in Sections 3.2-3.4, Chapter 3A and Appendix 4.

4.4 Additional luminous signal

Additional luminous signal is a luminous white arrow combined with certain lights from Section 4.2. The signal relates to the direction of navigation shown by the arrow.

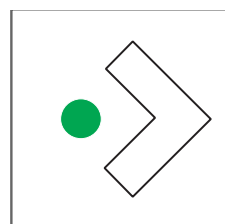


(fig. 4.1)

Examples: On a main waterway, at the entrance to a basin, this signal means:

(a) With green light

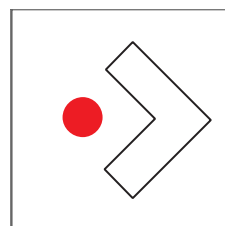
Permission to enter the basin to which the arrow is pointing.



(fig. 4.2)

(b) With red light

No entry to the basin to which the arrow is pointing



(fig. 4.3)

4.5 Semaphores

4.5.1 In special cases where a semaphore is required to regulate navigation (e.g. in harbours), the competent authorities shall determine the signals to be given by the semaphore in such a way as to avoid any confusion or conflict with the signals described in these recommendations.

4.5.2 The competent authorities shall preferably choose a signalling system using red and green lights, operable as required.

5 INSTALLATION OF SIGNS AND MARKING IN CHARACTERISTIC SECTIONS OF THE RIVER

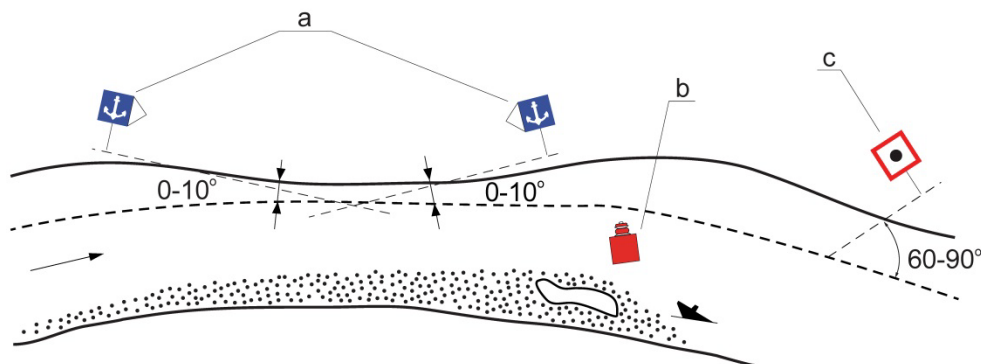
5.1 General

5.1.1 Signs have two possible orientations, namely:

- (a) Parallel to the axis of the fairway;
- (b) Perpendicular to the axis of the fairway.

5.1.2 Signs of the type mentioned under para. 5.1.1(a), are predominantly prohibitory or indicative signs, and are placed on the side of the fairway to which the prohibition or the indication applies.

Bank marks which are used in relation to navigation in both directions (upstream and downstream) shall be oriented as under para. 5.1.1(a). In some cases, (better visibility) the angle between the mark and the axis of the fairway can be 10° or less (fig. 5.1, sign *a*).



(fig. 5.1)

5.1.3 Most signs are positioned as described under para. 5.1.1 (b), and generally do not apply to one side of the fairway only. These signs are erected at right angles to the axis of the fairway so that they are visible to a user when under way.

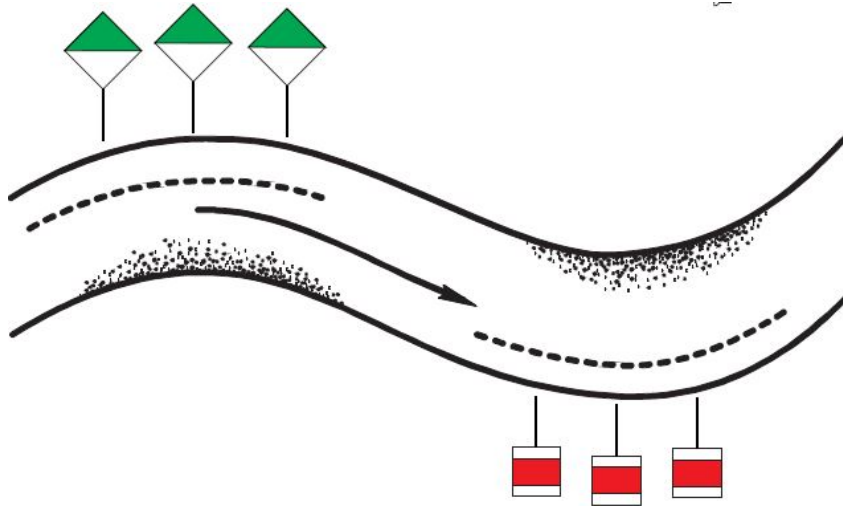
Bank marks which are used in relation to navigation in one direction (upstream or downstream) shall be oriented as under para. 5.1.1 (b). In some cases, (better visibility) the angle between the mark and the axis of the fairway cannot be less than 60° (fig. 1, sign *c*).

5.1.4 The use of a particular floating sign or bank mark and how it is installed depends on the one hand on the local features of the river (speed of current, variation in levels, meanders, width of the river bed, existence of sills, branches, islands, etc.), and on the other hand on the density of traffic in a given sector and the form and size of convoys.

5.1.5 The position of each floating sign indicating the side of the fairway shall be determined on the basis of the marking plan based on the results of measurements. Depths within the limits of the width of the marked fairway shall under no circumstances be less than the minimum depth reported for the sector in question.

5.1.6 When floating signs are installed, it is essential to take the direction of the current into account. If the current flows in the direction of a navigational hazard (obstacle), the sign or signal shall always be placed a long way from it; if, on the other hand, it flows in the opposite direction, the sign or signal shall be placed nearer.

5.1.7 An example of the installation of the marks indicating the position of the fairway is given in fig. 5.2.



(fig. 5.2)

5.1.8 Obstacles on the sides of the fairway are always marked with floating signs. When the obstacle is indicated by a single sign, it shall be placed on the upstream extremity of the obstacle, on the fairway side (fig. 5.1, sign *b*).

5.1.9 As a rule, lighted buoys or unlighted buoys shall be used to mark the upstream and downstream extremities of sills, banks which narrow the fairway in meandering sectors, banks protruding into the fairway, piles of stones, reefs, water supply engineering structures, and underwater hazards or obstacles (sunken vessels, anchors, etc.).

5.1.10 Marker posts and spars shall be used as additional signs supplementing buoys in order to give a clearer indication of the limits of the fairway over difficult sills and in order to mark underwater obstacles. In some cases and in some sectors, buoys may be replaced by marker posts or spars.

5.1.11 In order to avoid damage to buoys during the period when ice is carried down, they shall be replaced by spars or marker posts.

5.1.12 On sectors of the river where there is day and night navigation, forks, junctions and the axis of the fairway, along with obstacles to navigation lying within the fairway, shall be marked by light buoys or bank marks and lights. Floating signs shall be installed at such a depth and at such a distance from the obstacle that the safety and ease of movement of vessels shall be guaranteed at night and in poor visibility.

5.1.13 On sectors where the river bed is narrow, preference shall be given to bank marks.

5.1.14 Each bank mark shall be established following reconnaissance of the area and selection of the most appropriate site. The need to ensure the visibility of the sign whatever the level of the water should be taken into consideration.

5.1.15 Where it is necessary to ensure good visibility of the symbol on the sign over a long distance, both for vessels proceeding upstream and vessels proceeding downstream, two boards may be installed on the sign pole at an angle to each other, one pointing upstream and the other downstream.

5.1.16 In selecting the site of bank mark, account shall be taken of the need to ensure easy maintenance and to protect it against ice and flooding.

5.1.17 Before a bank sign or signal is installed, the depth in the area in front of it and in the direction it indicates shall always be measured.

5.1.18 As a general rule, the objective is that only the network of bank marks shall provide an uninterrupted indication of the position of the fairway as a whole, while the floating signs shall help boatmasters to determine the limits of the fairway.

5.2 Marking of meandering sectors

Installation of cross-over marks and bank lights

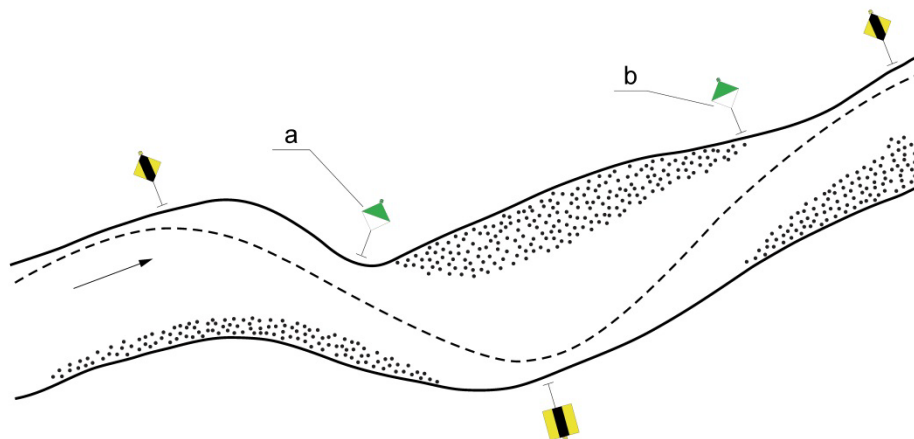
5.2.1 Cross-over marks and bank lights may be used in meandering sectors in order to indicate that the fairway crosses over from one bank to the other (signs featured in 4.C, 4.D, 5.C, 5.D in para. 3.4.2).

5.2.2 Cross-over marks and bank lights are placed when the fairway is sufficiently broad, its safety is ensured, and when the direction only requires to be indicated approximately.

5.2.3 Bank lights and cross-over marks shall be selected in such a way as to differentiate cross-overs in terms of their length, in other words in terms of the distance between two neighbouring signs. The length of the cross-over is relative, since it depends on the width of the fairway.

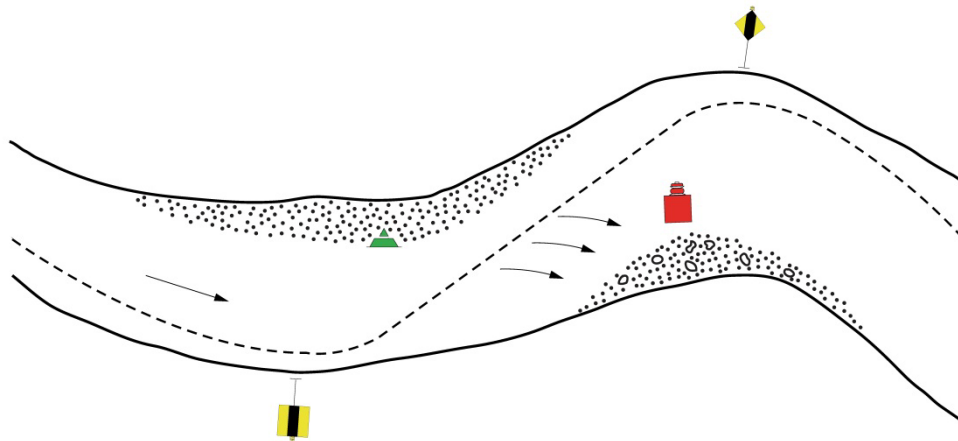
5.2.4 Cross-over marks and bank lights have best results on distances up to 3 km. On such sections, cross-over marks and bank lights (without floating signs) can be placed under conditions where the available width for navigation is more than two times wider than the minimum prescribed width of the fairway for a particular sector. If the available width for navigation is less than the minimum prescribed width of the fairway for a particular sector, cross-over marks and bank lights (without floating signs) cannot be placed at distance greater than 1-1.5 km.

5.2.5 If the distance between two neighbouring cross-over marks is larger than the calculated visibility, and when the fairway passes close to the bank, the bank mark with light, which additionally marks the position of the fairway, is placed between those two neighbouring cross-over marks (fig. 5.3, sign *a*). The bank mark with light is also placed when the fairway passes near the bank (fig. 2, sign *b*).



(fig. 5.3)

5.2.6 In case the direction of the current makes an angle with the fairway, when strong side winds or a similar situation occurs, the fairway can be marked by additional navigation marks according to the local conditions (fig. 5.4).

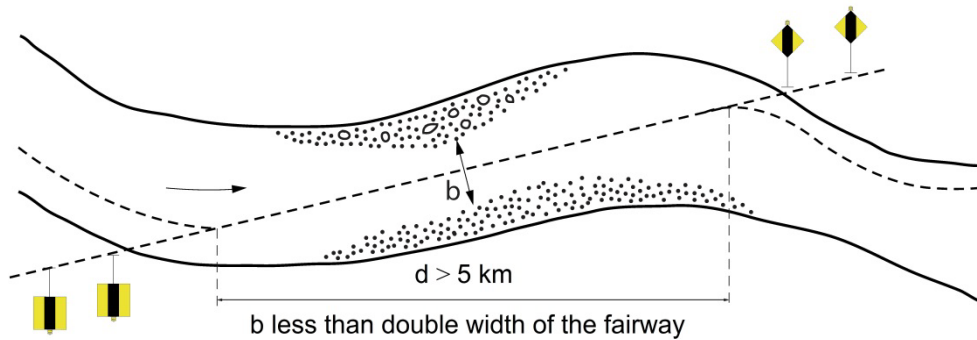


(fig. 5.4)

5.2.7 When the fairway follows the middle of the river bed over a long distance or when it crosses abruptly from one bank to the other, its axis may be indicated by a pair of cross-over marks on each side of the fairway, as shown in fig.5.5.

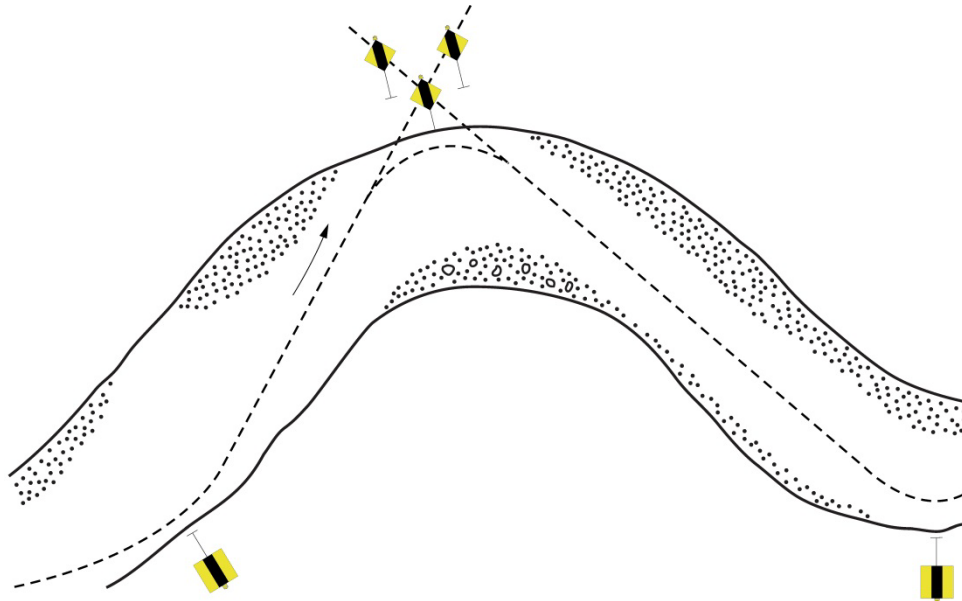
The advantage is given to two cross-over marks on each side of the fairway in case of straight-line sections longer than 5 km, where the available width for navigation is less than double the width of the minimum prescribed width of the fairway for a particular sector. In that case and when the bank configuration allows so, the cross-over marks are placed on both margins of the transition (fig. 5.5).

It is always preferable to have two cross-over marks on each side of the fairway when the fairway is narrowed by certain obstacles constituting threats to navigation or other hazards marked by floating signs.



(fig. 5.5)

5.2.8 In sectors where the fairway, after moving to the opposite bank, abruptly crosses to the other bank, three cross-over marks (the front shall have two boards) must be placed (fig. 5). In this case, lights of the back cross-over marks shall be oriented strictly on the axis of the fairway, one upstream and the other downstream.



(fig. 5.6)

5.2.9 Interrelationships of the front and back marks at hidden routes shorter than 4 km are presented in Table 5.1.

Table 5.1

L (m)	d (m)	h_o (m)	a (m)	$2a$ (m)
200	17	8.50	2.6	5.0
300	25	8.70	4.0	8.0
400	33	8.85	5.2	10.5
500	42	9.00	6.5	13.0
600	50	9.10	8.0	16.0
700	58	9.20	9.0	18.0
800	67	9.35	10.0	20.0
900	75	9.50	12.0	24.0
1 000	83	9.60	13.0	26.0
1 500	125	10.25	19.0	38.0
2 000	166	10.90	26.0	52.0
2 500	207	11.50	33.0	66.0
3 000	250	12.15	39.0	78.0
3 500	290	12.75	46.0	92.0
4 000	330	13.40	52.0	104.0
> 4 000	760	14.20	25.0	50.0

Where (see fig. 5.7):

L (m) — maximal distance when cross-over marks can be used;

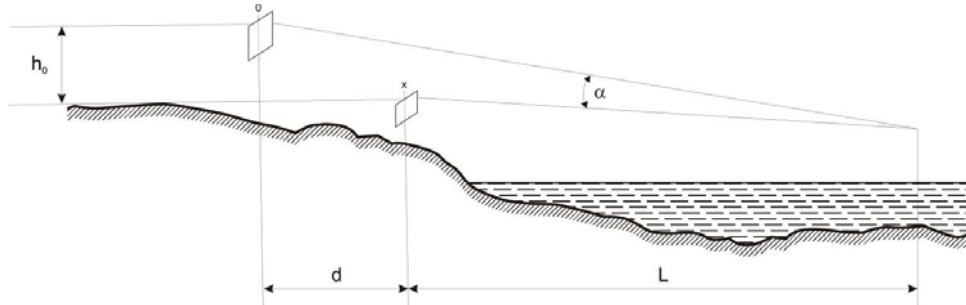
d (m) — distance between front and back signs (is approximately $1/12 L$);

h_o (m) — height between lights of front and back mark;

a (m) — distance necessary for a vessel to adjust its course if the vessel does not go along the cross-over;

α (') — viewing angle.

Table 3 also assumes that the observer's sight is 5 m above the water level, and the light of the lower (front) sign is 8 m above the water level.



(fig. 5.7)

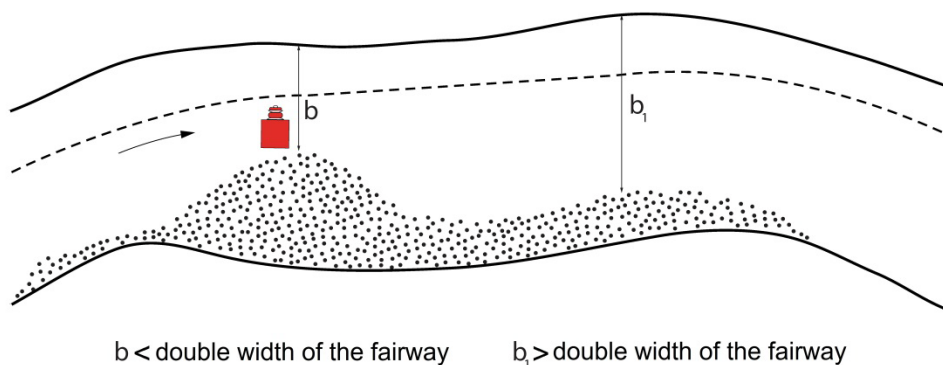
Value a describes accuracy of the route and it is of significance while navigating through a narrow fairway. Accuracy is, in principle, increased by approaching the cross-over marks.

To ensure proper recognition of cross-over marks and their lights, the viewing angle α cannot be less than 4 angular minutes in relation to the vertical.

Installation of floating signs

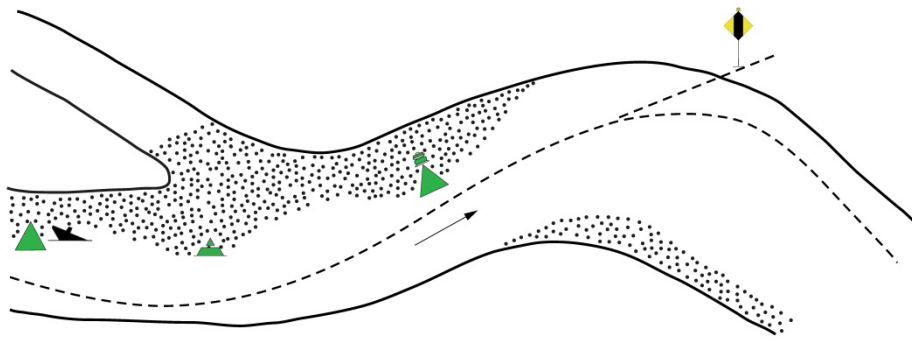
5.2.10 In meandering sectors, where the fairway passes along the middle of the river bed, or along the bank or passes slowly from one bank to the other, floating signs are used to mark formations in the river bed or obstacles, both natural and artificial, on the sides of the fairway (banks, shores, islands, stones, sunken vessels, wrecks of bridges, etc.), when these obstacles protrude into the fairway and reduce its width (fig. 5.8).

These underwater obstacles are marked in meandering sectors by floating signs if, within the limits of width indicated above, the depth of water over such obstacles does not exceed the minimum depth reported for the sector. If the obstacle is not very wide, a floating sign with light shall be installed on its upstream section. A marker post or a spar may be installed on its downstream section, depending on its length.



(fig. 5.8)

5.2.11 Floating signs marking underwater obstacles of considerable length are installed in such a way that the parts situated closest to the fairway are marked by light signals between which unlighted signs are placed, thus enabling a given obstacle to be marked completely (fig. 5.9).



(fig. 5.9)

5.2.12 In the parts of the river bed where the shore opposite that followed by the fairway is bordered by an inshore bank which favours upstream navigation in calm water, the bank is marked by floating signs independently of the width of the river bed.

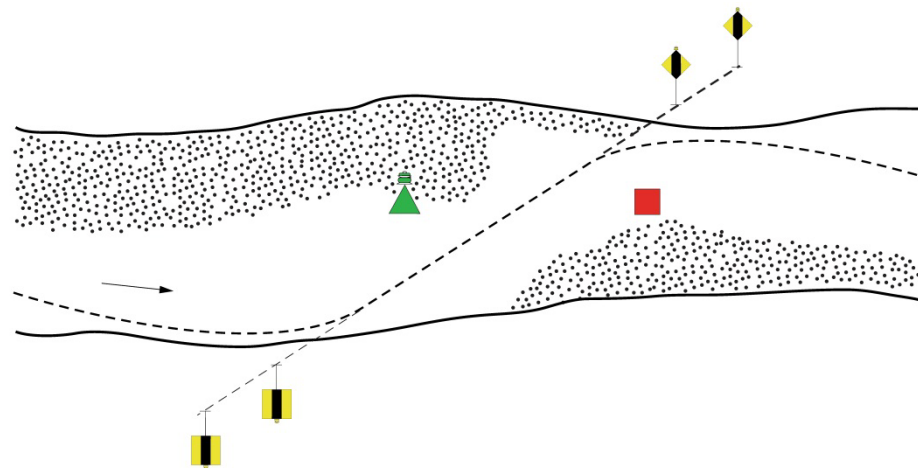
5.2.13 In meandering sectors the bank marking system in periods of high water generally remains the same as in periods of lowest water level, except in sectors where, when water levels are high, it is advisable to find another fairway with better navigational features. In this case, the selected fairway shall be marked appropriately.

5.3 Marking of shoals

5.3.1 In shoals, as in other sections, the principle of the continuous marking of the direction of the fairway shall be applied.

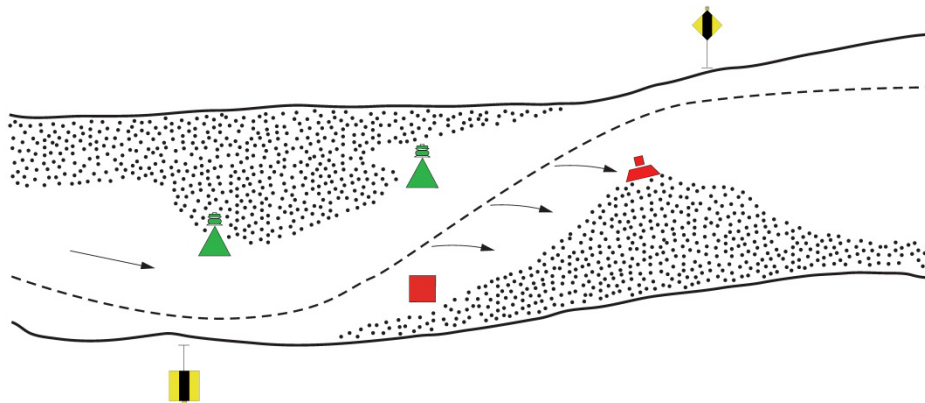
In shoals the fairway can be marked by cross-over marks, bank marks and floating signs.

5.3.2 Alternately located shoals may also be marked by cross-over marks, with sufficient available width for navigation in which vessels are passing in a straight line (fig. 5.10).



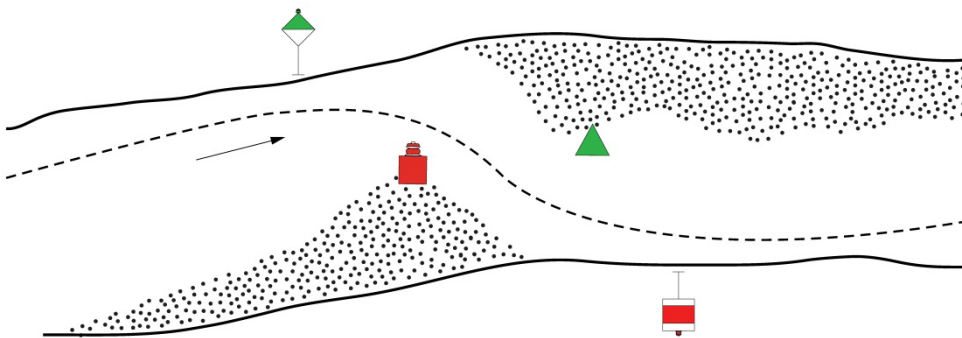
(fig. 5.10)

5.3.3 A fairway passing over shoals is usually marked by floating signs (figs. 5.10 and 5.11).



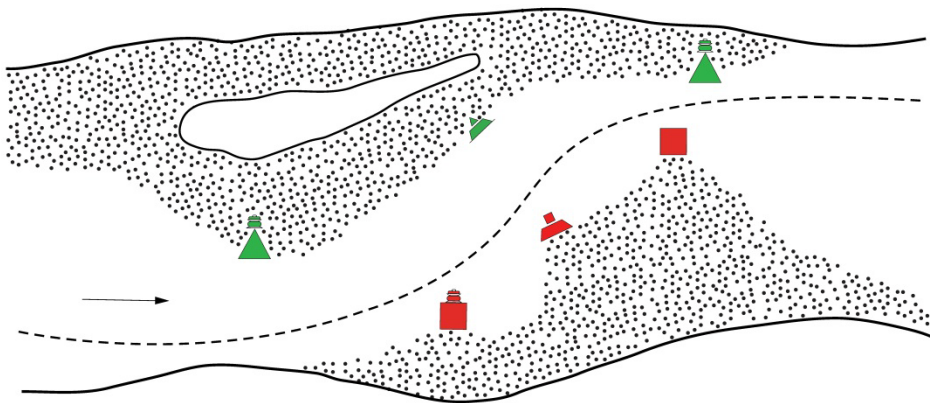
(fig. 5.11)

5.3.4 If the fairway passes in a straight line between sandbars, reaching far into the river bed, it is necessary to place at least two floating signs at the entry and the exit of such a section: one at the top of the upstream and one on the top of the downstream sandbar (fig. 5.12).



(fig. 5.12)

5.3.5 If the fairway is curved in the section between sandbars, it is necessary to place additional floating signs (fig. 5.13).



(fig. 5.13)

5.3.6 Additional floating signs shall also be placed on the entry and exit of rugged sections with sandbars, which also characterize the side streams.

5.3.7 In case the application of cross-over marks is impossible, the fairway across a shoal may be marked only by floating signs, on one or both sides, depending on the width of the fairway and hydrological conditions.

5.4 Marking of the vicinity of bridges and passages through bridges

5.4.1 The navigation of vessels and convoys in the vicinity of bridges and through bridge passages requires particular attention and precautions on the part of boatmasters because of the narrow fairway. These sections must therefore be marked with the greatest care.

5.4.2 The basic condition to be met to ensure safe passage through bridges is the marking of the direction of the fairway and also, where necessary, its sides. Floating signs and bank marks may be used in addition to boards and lights for marking the navigable passage through bridges.

5.4.3 The choice and positioning of the marking signs depends in each case on local conditions in the bridge section.

5.4.4 The installation of marking signs in the vicinity of bridges and the buoying of navigable passages shall comply with the following conditions:

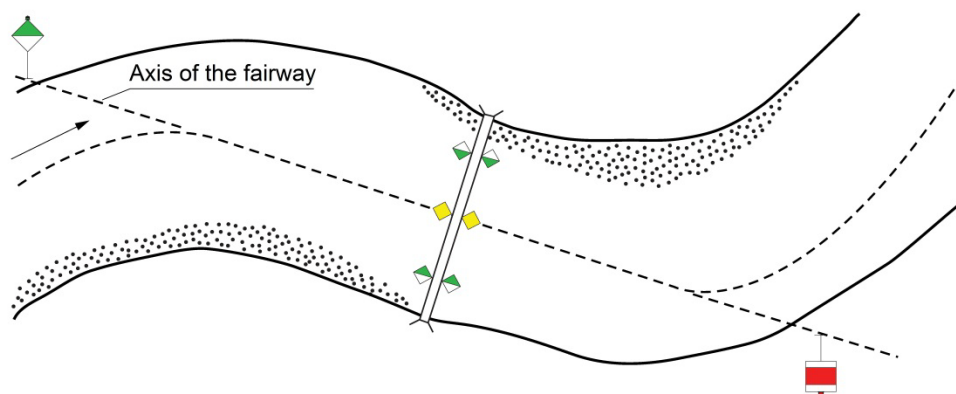
- (a) In order to indicate permission to use the navigable passage of a bridge, only signs A.10, D.1 or D.2 in annex 7 to CEVNI shall be used;
- (b) The installation of marking signs shall be based on depth and current direction measurements, both in the immediate vicinity of the bridge and in the approach sections;
- (c) The positioning of the signs installed in the vicinity of a bridge shall be modified in due course, as conditions of navigation change;
- (d) If, when approaching the bridge or the navigable passage, the direction of the current forms an angle with the bridge, giving rise to eddies around the pillars of the bridge, the floating signs shall be so installed as to indicate the direction of the eddies.

5.4.5 Floating signs may be installed at the approach to the navigable passage to give an exact indication of the position of the fairway.

5.4.6 The following examples show the placement of the aforementioned signs marking the section near bridges:

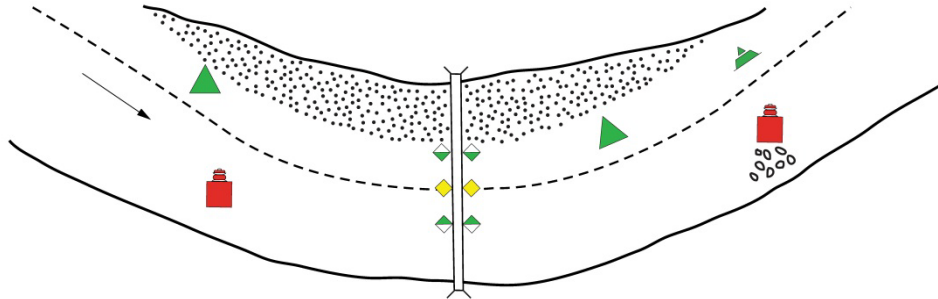
- (a) If a bridge is in a meandering section of the river, the direction of vessels passing through the bridge passages may be marked by bank marks (fig. 5.14);

Figure 12



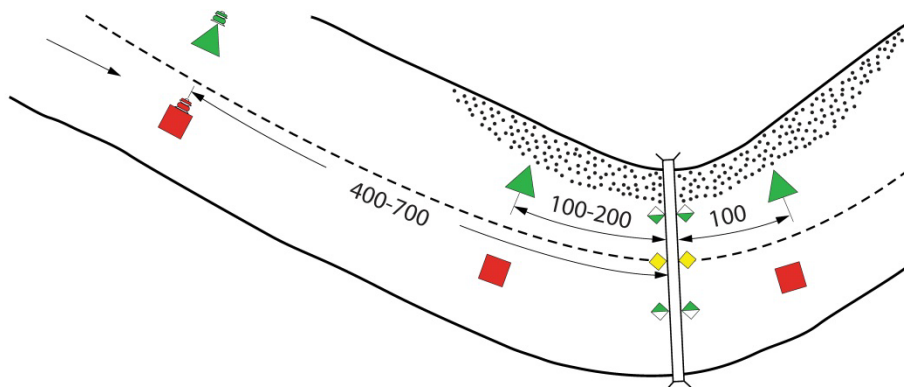
(fig. 5.14)

(b) If, due to a larger curvature of the fairway or for some other reasons, marking by the aforementioned signs is not possible, floating signs (buoys, etc.), placed in order to follow the river flow, may be used (fig. 5.15);



(fig. 5.15)

(c) If the bridge is positioned on the section where the current makes an angle with the axis of the navigable passage, marking may be done by two pairs of buoys upstream of the bridge. One pair of buoys is placed at a distance of 100 m-200 m upstream of the bridge, and a second pair, 400 m-700 m upstream of the bridge. Buoys further away from the bridge are placed in such a way that, in combination with the pair of buoys closer to the bridge, they mark the river flow. Another pair of buoys may be placed downstream of the bridge at a distance of 100 m from the bridge (fig. 5.16).



(fig. 5.16)

5.5 Installation of floating signs restricting berthing points

5.5.1 Where there is increased intensity of vessels' traffic and the substantial accumulation of vessels in inner harbour basins of ports, not only bank marks should be used in order to restrict berthing places but also floating signs.

5.6 Reference numbers on buoys and marker posts

5.6.1 On buoys and marker posts the use of alphanumeric characters and capital letters is recommended. Where both letters and figures are used, their heights should be the same. Where two such combinations occur, as on junction markers, a hyphen should be used.

5.6.2 Characters should not be less than 200 mm high, white on red or green buoys, or black on yellow buoys.

5.6.3 The characters on a lighted buoy can be black on a white background. Signs are usually affixed to special nameplates. It is recommended that the characters be displayed on both sides of buoys.

6 MARKING OF HARBOUR ENTRANCES

6.1 In this Chapter, the expression “entrances to harbours” also includes entrances to tributary waterways, entrances to secondary arms of waterways and entrances to docks.

6.2 If day marking at the harbour entrance is necessary, the entrance shall be marked:

- To port of a vessel entering: by painting the light pillar, preferably cylindrical, red; or by means of a cylindrical red topmark; or by painting red rectangles on the jetty;
- To starboard of a vessel entering: by painting the light pillar, preferably conical, green; or by means of a conical green topmark; or by painting green triangles, point upwards, on the jetty.

6.3 At night, for small harbours, it shall be sufficient to illuminate the day markings described above.

If lights are considered necessary, the entrance shall be marked:

- To port of a vessel entering: by a red light, preferably rhythmic;
- To starboard of a vessel entering: by a green light, preferably rhythmic.

In the case of a narrow or specially shaped entrance, one of these lights may be sufficient to help a boatmaster to enter the harbour. Such a single light shall be rhythmic.

Fig. 3.29 illustrates the provisions of this section for lakes and broad waterways.

6.4 The same rules shall apply to the colours and shapes of buoys and marks on fairways leading into the harbour.







It is recommended that lights of the same colour used for signalling the entrance to the harbour and buoying the fairway should have different rhythms to permit differentiation.

The installation of the above lights for marking the entrance to the harbour does not preclude the installation of fixed lights having the meaning attached to them in Chapter 4, with a view to regulating navigation. In such cases, the lights marking the entrance to the harbour shall be rhythmic.

7 MARKING OF PERMANENT STRUCTURES

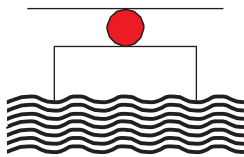
7.1 General principle

The following may be replaced:

Each fixed red light		by a rectangular red board with a horizontal white stripe	
Each fixed green light		by a rectangular green board with a vertical white stripe; and	
Each fixed yellow light		by a square yellow board with the diagonals horizontal and vertical	

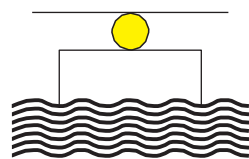
7.2 Fixed bridges

7.2.1 Fairway strictly prohibited

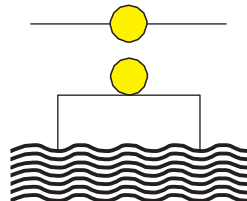


(fig. 7.1)

7.2.2 Fairway recommended



Two-way traffic



One-way traffic (in this case the other face of the bridge must display a red light).

If necessary for practical reasons, the lights may be placed side by side.

(fig. 7.2)

To mark the width of the fairway by showing the site of the piers, or if appropriate, to show the boundaries between which the fairway is normally usable (e.g. where the depth of water or headroom near the piers is insufficient), the following marks may be used as desired:

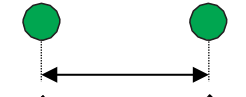
D.2a



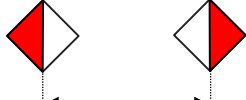
Mere recommendation to vessels to keep between the limits indicated

or

D.2b



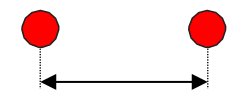
A.10a



Passage prohibited outside the limits indicated

or

A.10b



For the convenience of boatmasters, inverted scales showing the headroom available under the bridge may be affixed to the piers.

7.2.3 Fairway not expressly recommended

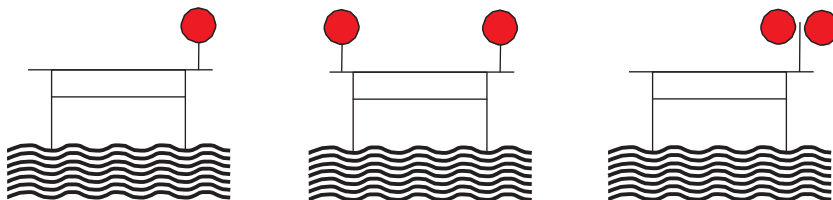
Where there are one or more recommended fairway, fairways which, while not expressly recommended, may be used at the boatmaster's own risk shall either bear no marking or

exhibit the restrictive signs prescribed under Subsection C “Restrictive signs”, Section 2.1, Appendix 1 as well as Section C of annex 7 to CEVNI.

7.3 Movable bridges

7.3.1 Passage prohibited

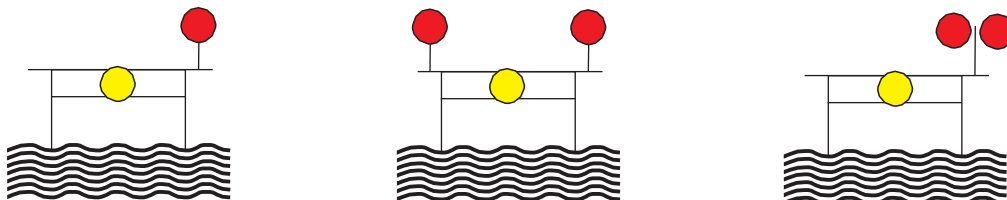
(a) General prohibition



(fig. 7.3)

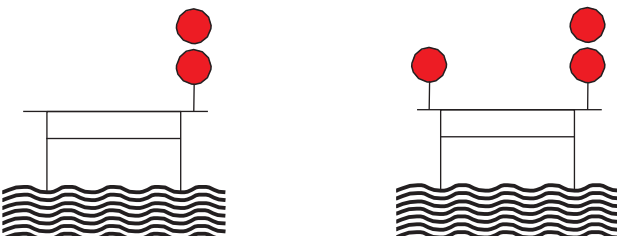
Where there are several red lights side by side the extinction of one of them means: “Passage prohibited (movable bridge being prepared for opening).”

(b) No passage except for low-built vessels



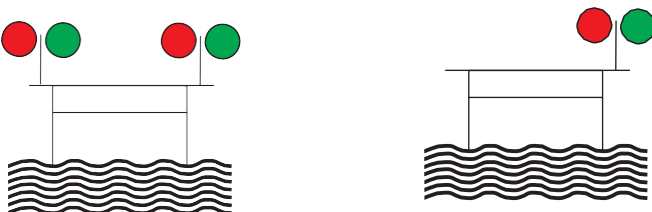
(fig. 7.4)

(c) Bridge out of service



(fig. 7.5)

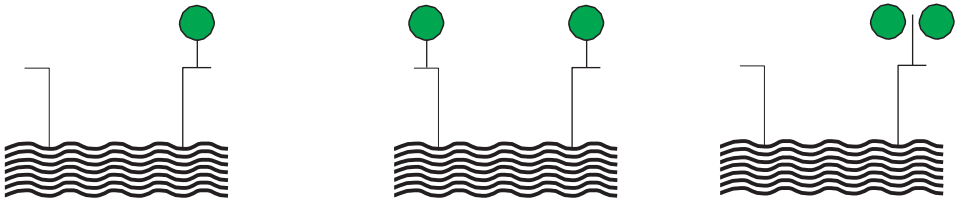
(d) “No passage now; but stand by to go ahead” (passage will shortly be clear).



(fig. 7.6)

The lights can be placed either side by side or one above the other.

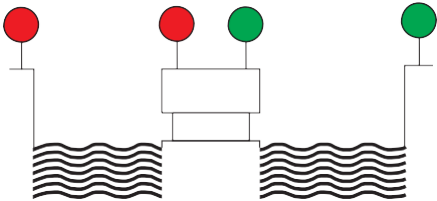
7.3.2 Passage authorized
(a) General authorization



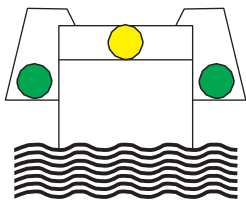
(fig. 7.7)

(b) Special cases:

(i) swing bridge



(ii) lift-bridge



The following may be used:

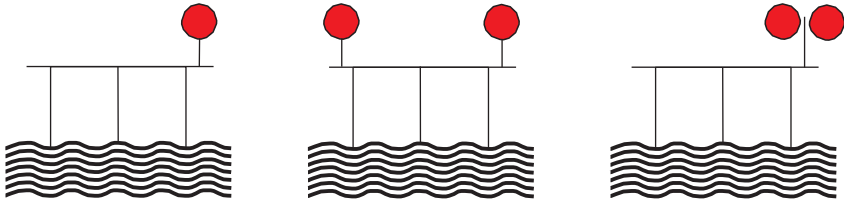
- green lights; or
- yellow light; or
- green lights combined with yellow light.

(fig. 7.8)

7.4 Locks

7.4.1 Entry or exit prohibited

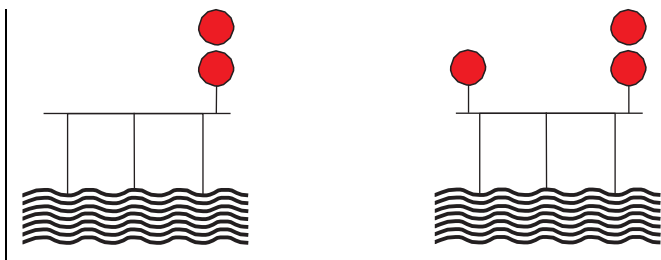
(a) General prohibition



(fig. 7.9)

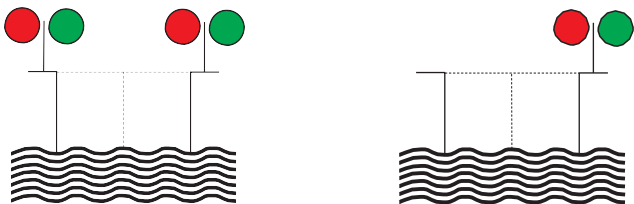
Where there are several red lights side by side, the extinction of one of them means: entry or exit forbidden (gates being prepared for opening).

(b) Lock out of service



(fig. 7.10)

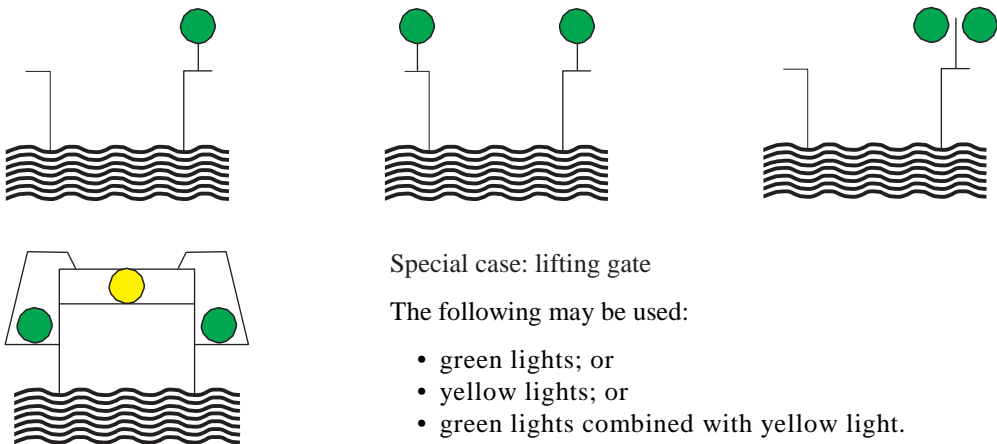
(c) “Stand by to proceed” (entry or exit will shortly be authorized)



(fig. 7.11)

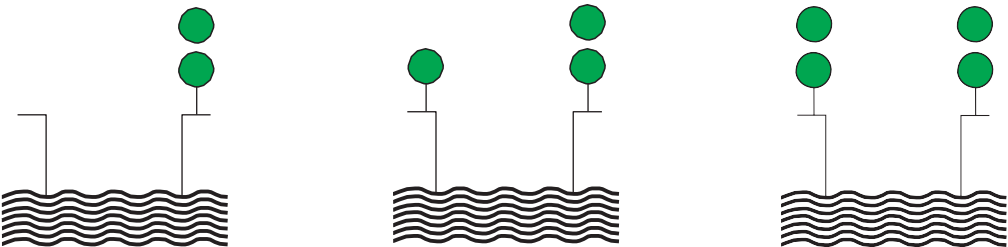
The lights may be placed either side by side or one above the other.

7.4.2 Entry or exit authorized



(fig. 7.12)

7.4.3 Passage clear: lock with all gates open







(fig. 7.13)

8 BLOCKAGE OF THE WATERWAY


8.1 General principle


The following may be replaced:

Each fixed red light		by a rectangular red board with a horizontal white bar	
Each fixed green light		by a rectangular green board with a vertical white bar; and	

8.2 Complete and protracted stoppage of navigation


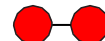
A.1b  In general

A.1c  However, a single red light may be used if it is sufficient clearly to indicate the prohibition and cannot be confused with lights extraneous to the waterway marking lights.

A.1f or A.1e  In case of emergency, red flags may be used provisionally by day pending marking with the lights or boards prescribed above.

8.3 Temporary stoppage of navigation

This situation arises, for example, when passage through a narrow section of the waterway is authorized in each direction alternately. The signals are then operable as required.

 or  "Stop"

A.1c  or A.1d  Stand by to "proceed"

A.11a  or A.11b  "Go ahead"

E.1b  E.1c 

Where there are several red lights side by side, the extinction of one of them means: "Passage forbidden (passage about to be authorized)".

The lights may be either side by side or one above the other.

9 MARKING OF PROHIBITED OR RESTRICTED ZONES

9.1 If the limits of prohibited or restricted zones need to be indicated, the special marks prescribed in para. 3A.4 shall be used. The nature of the prohibition or restriction shall so far as possible be notified to users in writing (for instance, in charts) and by local information.

This information shall preferably be given by means of boards on the bank showing one of the prohibitory or informative signs prescribed in Appendix 1 and annex 7 to CEVNI, or by means of the red rectangular board with a white horizontal bar. Such boards shall if necessary be supplemented by an arrow showing the direction of the area to which the sign prescribed in para. 3.5.2(c) applies.

9.2 Alternatively, the local information may be carried on the yellow buoys of para. 3A.4. It may also be given by means of topmarks placed on the buoys in lieu of a topmark as prescribed in 3A.4. For example, buoys at the edge of a zone where navigation is totally prohibited may carry a staff with a rigid triangular red pennon. If other topmarks are used, they shall be clearly different from this red pennon and from the topmarks prescribed in Sections 3.2-3.4.

9.3 If a shore zone in which one or more types of craft or activity are prohibited or restricted is crossed by a fairway in which one such kind of craft or activity is not prohibited or restricted (except as regards an entrance to a harbour to which Section 3.2 applies), the sides of the fairway also shall be marked by yellow buoys. The two buoys at the entrance shall be twice the size of the other buoys, and if necessary their upper parts shall be painted red on the right-hand side and green on the left-hand side for a boatmaster leaving the fairway.

9.4 On the bank, boards as prescribed in Subsection E “Informative signs”, Section 2.1, Appendix 1 as well as Section E of annex 7 to CEVNI shall indicate the type of craft or activity permitted (e.g., the “water skiing” permission sign to indicate a water-skiing fairway across an area where all navigation, or only water skiing, is prohibited); the markings may be supplemented by the arrow prescribed in para. 3.5.2(c).

9.5 Where a zone open for more than one activity is crossed by a fairway in which only one activity is permitted, the sides of the fairway shall be marked as in the above case. If possible, a board on the bank shall indicate the activity permitted.

9.6 Fig. 3.29 illustrates the provisions of this section as applied to lakes and broad waterways.

10 VARIABLE MESSAGE SIGNS TO REGULATE TRAFFIC

10.1 When variable message signs are used to regulate traffic, attention must be paid to the following:

(a) If variable message signs regulating traffic show images of signs from annex 7 to CEVNI, the images must be depicted using a mechanical display system. Appendices 1 and 3 are applicable with regard to colour selection and dimensions;

(b) By night, mechanical display systems shall be externally lighted. Appendix 5 may be applicable;

(c) The use of auto-illumination display systems should be avoided for the signs in annex 7 to CEVNI. Inverse representation (e.g. inversion of black and white surfaces for prohibitory signs) shall not be allowed;

(d) A remote controlled auto-illumination matrix display may constitute a reasonable alternative in order to indicate frequently changing information, such as water levels and the height of navigable passages through bridges. Technically, it is possible to display images using light emitting diodes, liquid crystals and light guides;

(e) By day, there must be sufficient luminosity to ensure the sign can be read; by night, luminosity must be reduced in order to prevent any dazzling and to ensure that the sign can be identified. The image must thus be regulated according to light measurements in the surroundings.

10.2 Examples of variable message signs to regulate traffic are contained in Appendix 6.

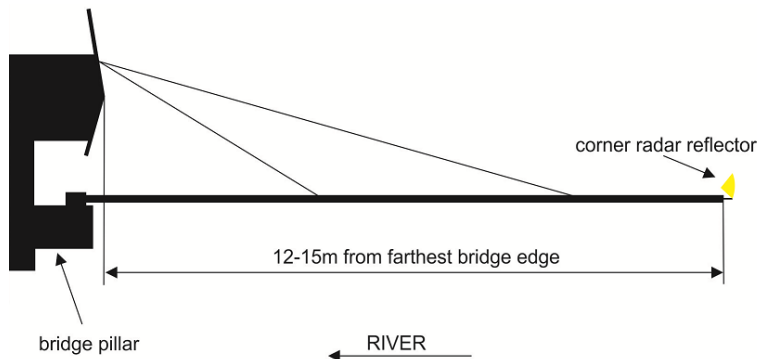
11 INSTALLATION OF RADAR REFLECTORS

11.1 Installation of radar reflectors on marking signs and signals and navigable passes through bridges

11.1.1 It is important to equip floating signs and bank marks with radar reflectors to ensure their visibility.

11.1.2 When marking signs equipped with radar reflectors are installed, account must be taken of the furthest distance between the vessel and the sign in terms of the perception of the sign on the radar screen. This distance depends on the technical characteristics of the radar equipment, the reflective capacity of the radar reflectors and the specific conditions of the river and the height of the antenna installed on the vessel, as well as the height of the radar reflector, both in relation to the water surface.

11.1.3 Since the visibility of bridge pillars is usually insufficient on radar screens, the bridge pillars for the passage of vessels upstream and downstream must be marked either by buoys equipped with radar reflectors placed not less than 15-20 m before the bridge, or by radar reflectors installed on the bridge itself not less than 12-15 m from the farthest edge of bridge construction (fig. 11.1). A sketch of the recommended radar reflector is contained in section 3.4 of appendix 1.



(fig. 11.1)

11.1.4 Since the radar reflector improves navigation safety, every effort should be made to install them by means of supports on the framework of bridges to mark the navigable passage through the bridge.

11.1.5 Navigational hazards and water supply engineering structures (sunken vessels, groynes, cross-beams, etc.) located in the river bed may also be marked by signs equipped with radar reflectors. If the groynes or cross-beams marked by radar reflector signals are located along one of the banks while the fairway follows the opposite bank, which is low and flat, the radar reflector signals may also be placed on that bank so as to facilitate the orientation of vessels navigating by radar.

11.1.6 When radar reflectors are used on marking signs and signals, the visibility of the sign must not be diminished. Their colour shall also correspond to the colour of the sign in question.

11.1.7 Radar reflectors on fairway buoys are most often manufactured using two vertical metal plates set as a cross, with a horizontal metal plate intersecting them at a right angle. The reflectors should be made of aluminium or stainless steel.

11.1.8 Practical experience has shown that there is a need for at least two standard sizes of reflectors on floating signs. Recommended dimensions are as follows:

Type 1: tip to tip height 420 mm;

Type 2: tip to tip height 850 mm.

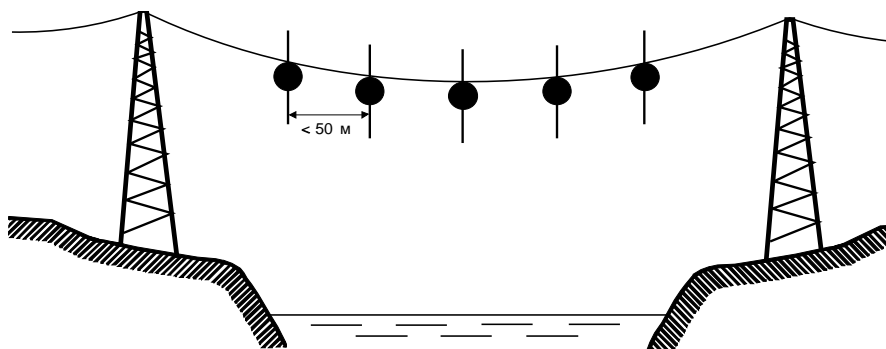
11.1.9 The square plate referred to in para. 11.1.7 has a diagonal of 300 or 600 mm respectively and sides of 210 or 425 mm respectively.

11.2 Buoys and poles with radar reflectors

11.2.1 Examples of buoys and poles with radar reflectors are given in Section 3.6.

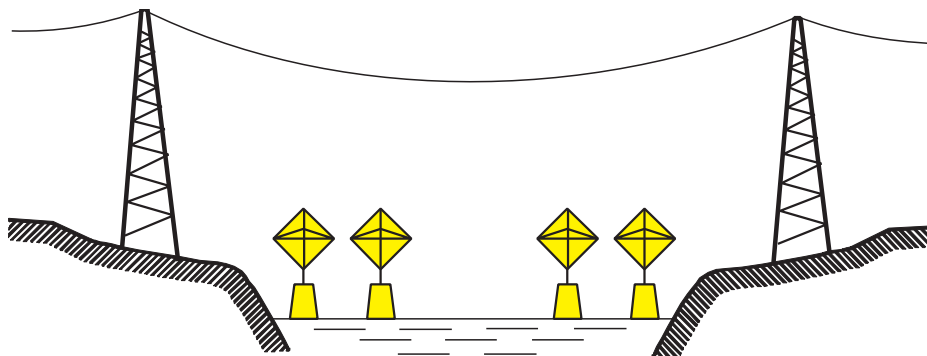
11.3 Marking of overhead cables (where applicable)

11.3.1 Radar reflectors secured to the overhead cable (giving a radar image of a series of points to identify the overhead cable)



8.C3
(fig. 11.2)

- 11.2.2 Radar reflectors placed on yellow floats arranged in pairs near each bank (each pair giving a radar image of two points side by side to identify the overhead cable)



8.C4
(fig. 11.3)

12 MONITORING OF SIGNS AND MARKING BY AIS AIDS TO NAVIGATION⁵

(left void)

13 REGIONAL AND NATIONAL SPECIAL REQUIREMENTS⁶

(left void)

⁵ ECE/TRANS/SC.3/WP.3/2017/12.

⁶ ECE/TRANS/SC.3/WP.3/2017/13.

Appendix 1⁷

Minimal dimensions of the waterway signs

Appendix 2

Properties of lights

1. Categories of luminous intensity

Lanterns are classified according to their horizontally emitted photometric luminous intensity I_{ph} , in candelas (cd).

By analogy with luminous intensity for lights on board vessels, three distinct categories have been established, according to power.

Table 1

<i>Category</i>	<i>By analogy with light</i>	<i>Intensity of white light [cd]</i>	<i>Intensity of red/green/yellow light [cd]</i>
1	Ordinary	2-9	0.8-3.5
2	Bright	9-35	3.5-20
3	Strong	35-100	20-50

2. Acceptable colours of lights

The colours of lights are described in a standard chromatic diagram pursuant to ISO 11664/CIE S 014. The range of colours accepted in the standard chromatic diagram is determined according to standard CIE S 004/E-2001, Class A.

The chromatic coordinates for the acceptable ranges are as follows:

⁷

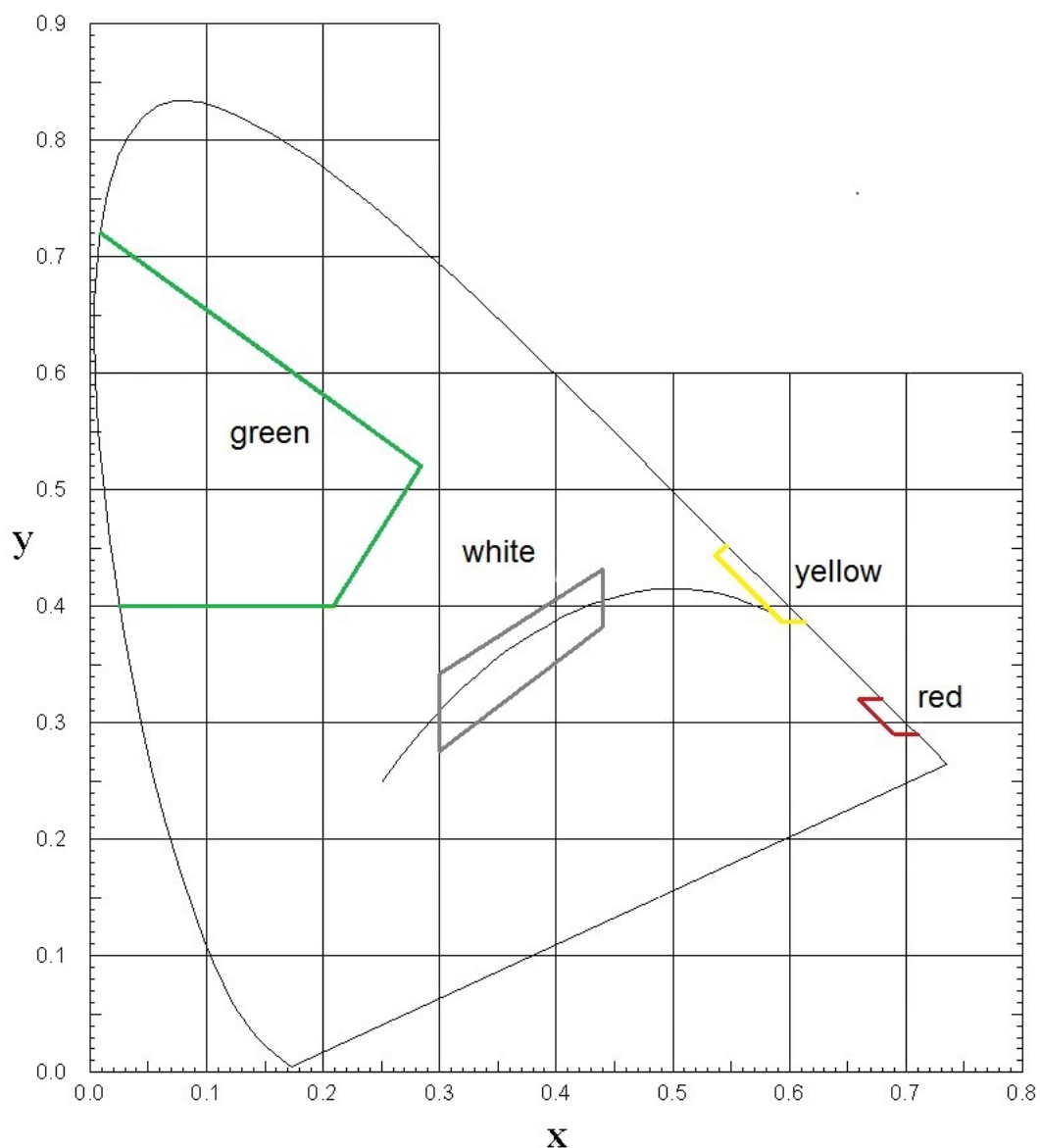
See Appendix 1 to Resolution No. 59, Revision 2 (ECE/TRANS/SC.3/169/Rev.2).

Table 2

<i>Colour</i>		<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
White	<i>x</i>	0.300	0.440	0.440	0.300
	<i>y</i>	0.342	0.432	0.382	0.276
Yellow	<i>x</i>	0.536	0.547	0.613	0.593
	<i>y</i>	0.444	0.452	0.387	0.387
Red	<i>x</i>	0.660	0.680	0.690	0.710
	<i>y</i>	0.320	0.320	0.290	0.290
Green	<i>x</i>	0.009	0.284	0.209	0.028
	<i>y</i>	0.720	0.520	0.400	0.400

The yellow/red/green colour ranges are limited in addition by the curve of the colour spectrum. The ranges of colours are set out in figure 1.

Figure 1



3. Calculation of light range

The range of a signal light intended for the guidance of shipping is calculated according to the procedure contained in IALA Recommendation E-200, Part 2 — Calculation, Definition and Notation of Luminous Range, which applies only to signal lights perceived as points by the observer.

Different criteria than those used to establish the range of on-board lights (navigation lights) have been developed for signals intended for the guidance of shipping, which use other values.

The calculations are performed using the following formula:

$$D^2 \times E_t = I_{\text{eff,B}} \times T_M^{\frac{D}{1852 \text{ m}}},$$

Where

D is the range of light;

$I_{\text{eff,B}}$ is the operational luminous intensity of the lantern;

T_M is the value for calculating visibility (describes the atmospheric transmissivity);

E_t is the established limit of luminosity.

The calculation must be done numerically; the formula cannot be solved according to D .

The parameters given are as follows:

$$T_M = 0.6;$$

$E_t = 2 \times 10^{-7}$ lx for buoys with lights and simple bank lights with no background lighting;

$E_t = 10^{-6}$ lx to mark a cross-fairway axis with 2 or 3 lights with no background lighting;

$E_t = 2 \times 10^{-6}$ lx for all lights with average background lighting (e.g. in a city);

$E_t = 2 \times 10^{-5}$ lx for all lights with substantial background light (e.g. industrial facilities).

The operational luminous intensity $I_{\text{eff,B}}$ is a derivative of the photometric values I_{ph} according to the following calculations:

$$I_{\text{eff,B}} = b \times k \times I_{\text{ph}}.$$

Where $b = 0.75$ is the conventionally accepted loss factor owing to dirt and light source degradation.

The effective intensity of rhythmic lights is taken into account by the degree of transmission k , which is usually calculated according to IALA Recommendation E-200, Part 4 — Determination and Calculation of Effective Intensity.

For the light emitting diodes (LEDs) that are used in most cases and that permit very high frequency commutation, the calculations may be simplified to the following:

$$k = \frac{t}{0,2s + t}$$

Where t equals the shortest time of light for the rhythm of light used (e.g. 0.5 s for “Fkl. 1s” and 2 sec. for “Glt. 4s”).

Table 3

The typical range with visibility $T_M = 0.6$

<i>Background lighting</i>	<i>No</i>	<i>No</i>	<i>Average</i>	<i>Substantial</i>
<i>Light limit E_t [lx]</i>	2×10^{-7}	10^{-6} (marking of the axis)	2×10^{-6}	2×10^{-5}
<i>Luminous intensity $I_{eff,B}$ [cd]</i>	<i>Range [m]</i>			
1	1 760	890	650	220
2	2 300	1 200	890	300
5	3 210	1 760	1 320	470
10	4 050	2 300	1 760	650
20	5 010	2 970	2 300	890
50	6 470	4 050	3 210	1 320
100	7 720	5 010	4 050	1 760
200	9 060	6 100	5 010	2 300
500	11 000	9 060	6 470	3 210

Appendix 3

Colours of reflected light for navigation signs

The colours of light reflected by navigation signs (day markings) must conform with CIE publication No. 39-2 (TC-1.6) 1983 “Recommendations for Surface Colours for Visual Signalling”.

The following is taken from the Recommendations:

- Ordinary colours of materials (standard colours), in this case: red, yellow, green, blue, white and black;
- Fluorescent colours of materials (luminescent in daylight), in this case: red, green.

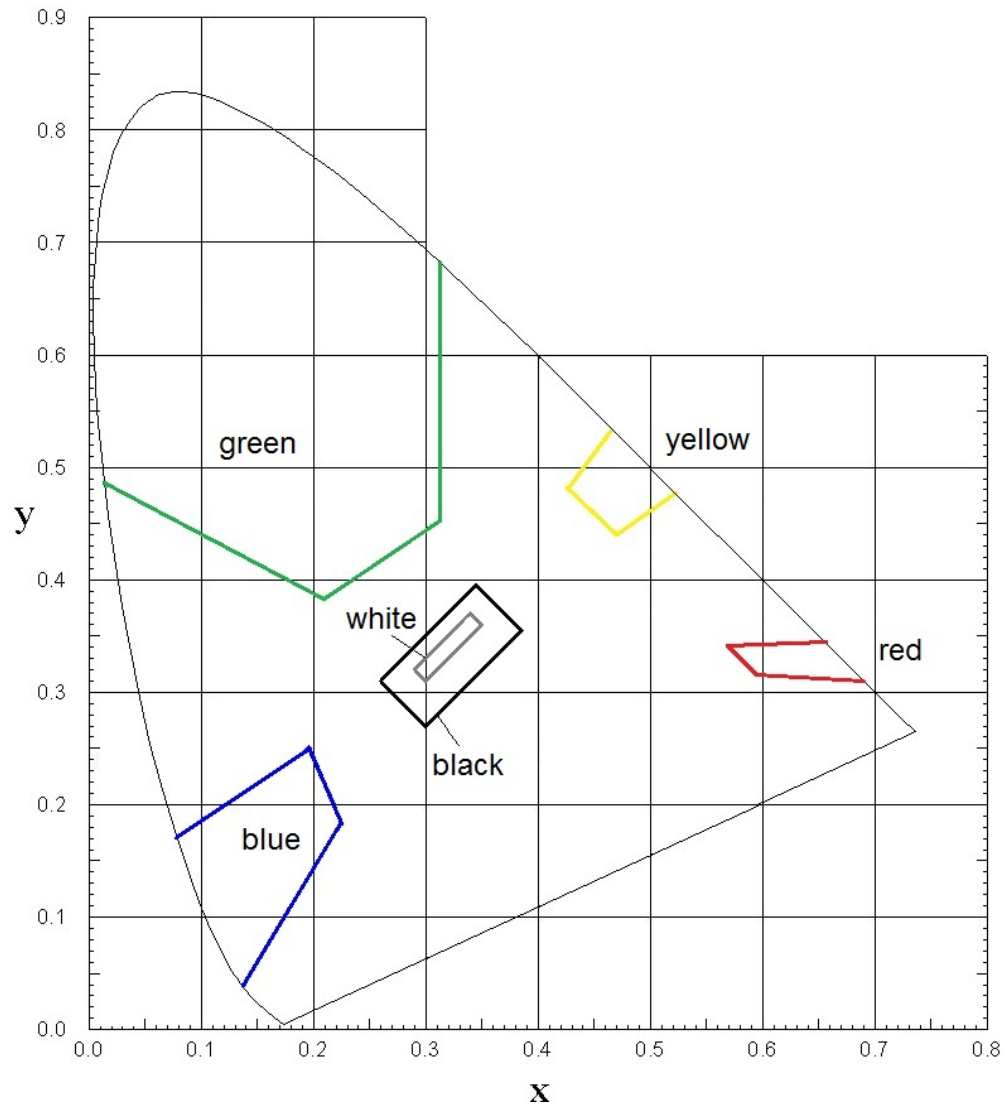
The acceptable colours are given in ranges and with a standard chromaticity diagram, specifying as well the requirements for intensity coefficients (luminance factors). The chromaticity coordinates for the ranges and intensity coefficients are shown in Table 1. For colours adjacent to the spectral colour curve, the curve represents their external limit.

Table 1

<i>Colour of the reflected light</i>	<i>Intensity coefficient</i>	<i>1</i>		<i>2</i>		<i>3</i>		<i>4</i>	
		<i>x</i>	<i>y</i>	<i>x</i>	<i>y</i>	<i>x</i>	<i>y</i>	<i>x</i>	<i>y</i>
<i>Standard colours</i>									
Red	> 0.07	0.690	0.310	0.595	0.315	0.569	0.341	0.655	0.345
Yellow	> 0.45	0.522	0.477	0.470	0.440	0.427	0.483	0.465	0.534
Green	> 0.10	0.313	0.682	0.313	0.453	0.209	0.383	0.013	0.486
Blue	> 0.05	0.078	0.171	0.196	0.250	0.225	0.184	0.137	0.038
White	> 0.75	0.350	0.360	0.300	0.310	0.290	0.320	0.340	0.370
Black	< 0.03	0.385	0.355	0.300	0.270	0.260	0.310	0.345	0.395
<i>Colours luminescent in daylight</i>									
		<i>x</i>	<i>y</i>	<i>x</i>	<i>y</i>	<i>x</i>	<i>y</i>	<i>x</i>	<i>y</i>
Red	> 0.25	0.690	0.310	0.595	0.315	0.569	0.341	0.655	0.345
Green	> 0.25	0.313	0.682	0.313	0.453	0.209	0.383	0.013	0.486

Figure 1 shows the admissible colour ranges on the standard chromaticity diagram. The ranges for ordinary colours and those that are luminescent in daylight (red/green) are identical; the colours differ only in their intensity coefficients.

Figure 1



A simplified description of the admissible colours can be presented using the RAL numbers from the internationally recognized RAL-Classic colour system.⁸

The colours below correspond with the CIE Recommendations and are preferred for use in transport technologies.

⁸ www.ralcolor.com, www.ral-farben.de.

Table 2

<i>Number</i>	<i>Designation</i>	<i>Recommended use</i>
RAL 1023	Traffic yellow	Traffic signs, buoys
RAL 3020	Traffic red	Traffic signs
RAL 3024	Luminous red	Buoys, strongly visible traffic signs
RAL 3028	Pure red	Buoys, sufficiently visible traffic signs
RAL 5017	Traffic blue	Traffic signs
RAL 6024	Traffic green	Traffic signs
RAL 6037	Pure green	Buoys, sufficiently visible traffic signs
RAL 6038	Luminous green	Buoys, strongly visible traffic signs
RAL 9016	Traffic white	Traffic signs, buoys
RAL 9017	Traffic black	Traffic signs, buoys

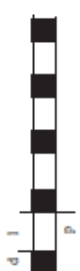


It is recommended that navigation sign surfaces, when they are not a part of the signs themselves, should be RAL 7042 traffic grey A or RAL 7043 traffic grey B.




It may be advisable to use adhesive light-reflective films on markers that are not equipped with lights. For the colours of light-reflective films, reference may be made to the relevant international standards for road transport.






Appendix 4


Rhythmic lights

60

CLASS	ABBREVIATION	GENERAL DESCRIPTION	SPECIFICATION	PARTICULAR USE
1. OCCULTING LIGHTS		A light in which the total duration of light in a period is clearly longer than the total duration of darkness and all the intervals of darkness (eclipses) are of equal duration.		
1.1 Single-occluding light	Oc	An occulting light in which an eclipse is regularly repeated.	<p>The duration of an appearance of light should not be less than three times the duration of an eclipse.</p> <p>The duration of an eclipse should preferably be between 0.5 s and 1 s.</p> <p>The period should not be less than 2 s.</p>  <p>Example: $l = 3 \text{ s}$; $d = 1 \text{ s}$; $p = 4 \text{ s}$</p>	<p>A single-occluding white light indicates:</p> <ul style="list-style-type: none"> a safe-water mark. <p>A single-occluding yellow light indicates:</p> <ul style="list-style-type: none"> a cross-over mark.
1.2 Group-occluding light	Oc ()	An occulting light in which a group of eclipses, specified in number, is regularly repeated.	<p>The appearance 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.</p> <p>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.</p> <p>The duration of an appearance of light within a group should not be less than the duration of an eclipse.</p> <p>The duration of an eclipse should preferably be between 0.5 s and 1 s.</p> <p>In a group of two eclipses, the duration of an eclipse together with the duration of an appearance of light within the group should not be less than 1 s.</p> <p>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.</p> <p>The number of eclipses in a group should not be greater than four in general.</p>  <p>Example: $l' = 6 \text{ s}$; $l = 2 \text{ s}$; $d = 1 \text{ s}$; $c = 3 \text{ s}$; $p = 10 \text{ s}$</p>	<p>A group-occluding yellow light may indicate:</p> <ul style="list-style-type: none"> a special mark; a cross-over mark.
2. ISOPHASE LIGHT	ISO	A light in which all the duration of light and darkness are clearly equal.	 <p>Example: $l = d = 2 \text{ s}$; $p = 4 \text{ s}$</p>	<p>An isophase white light may indicate:</p> <ul style="list-style-type: none"> a safe-water mark; a bifurcation mark; a mark outside the fairway indicating obstacles and danger points; if they can be passed on either side; an advance signal.

CLASS	ABBREVIATION	GENERAL DESCRIPTION	SPECIFICATION	PARTICULAR USE
3. FLASHING LIGHT		A light in which the total duration of light in a period is clearly shorter than the total duration of darkness and all the appearance of light (flashes) are of equal duration.		
3.1 Single-flashing light	FI	A flashing light in which a flash is regularly repeated at a rate of 30 or less flashes per minute.	<p>The duration of the interval of darkness (eclipse) between two successive flashes should not be less than three times the duration of a flash.</p> <p>The duration of a flash should not be longer than 1 s. The period should not be less than 2 s.</p>  $\begin{aligned} d &\geq 3l \\ l &\leq 1 \text{ s} \\ p &\geq 2 \text{ s} \end{aligned}$ <p>Example: $d = 3 \text{ s}; l = 1 \text{ s}; p = 4 \text{ s}$</p>	<p>A single-flashing yellow light may indicate:</p> <ul style="list-style-type: none"> - a special mark; - a cross-over mark.
3.2 Long-flashing light	LFI	A single-flashing light in which an appearance of light of not less than 2 s duration (long flash) is regularly repeated.	 $\begin{aligned} d &\geq 3l \\ l &\geq 2 \text{ s} \\ p &= 10 \text{ s} \end{aligned}$ <p>Example: $d = 8 \text{ s}; l = 2 \text{ s}$</p>	<p>A long-flashing white light with a period of 10 s indicates:</p> <ul style="list-style-type: none"> - a safe-water mark.
3.3 Group-flashing light	FI ()	A flashing light in which a group of flashes, specified in number, is regularly repeated.	<p>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.</p> <p>The duration of an eclipse between groups should not be less than three times the duration of an eclipse within a group.</p> <p>The duration of an eclipse within a group should not be less than the duration of a flash.</p> <p>The duration of a flash should not be longer than 1 s.</p> <p>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.</p> <p>In a group of three or more flashes, the duration of a flash together with the duration of an eclipse within the group should not be less than 2 s.</p> <p>The number of flashes in a group should not be greater than five in general.</p>  $\begin{aligned} d' &\geq 3d \\ d &\geq l \\ l &\leq 1 \text{ s} \\ c &\geq 1 \text{ s} \end{aligned}$ <p>Example: $d' = 6 \text{ s}; d = 2 \text{ s}; l = 1 \text{ s}; c = 3 \text{ s}; p = 10 \text{ s}$</p>	<p>A group-flashing white light with a group of two flashes, in a period of 5 s or 10 s, indicates:</p> <ul style="list-style-type: none"> - an isolated-danger mark. <p>A group-flashing white light with a group of three flashes indicates:</p> <ul style="list-style-type: none"> - a bifurcation mark. <p>A group-flashing yellow light with a group of four, five or (exceptionally) six flashes may indicate:</p> <ul style="list-style-type: none"> - a special mark; - a cross-over mark.

CLASS	ABBREVIATION	GENERAL DESCRIPTION	SPECIFICATION	PARTICULAR USE
3.4 Composite group-flashing light	FI(+)	A light similar to a group-flashing light except that successive groups in a period have different numbers of flashes.	<p>The duration of the eclipse after the single flash should not be less than three times the duration of the eclipse after the group of flashes.</p> <p>Light characters should be restricted to (2+1) flashes in general, and should be (3+1) flashes only as an exception.</p>  <p>FI(2+1)</p> <p>Example: $d'' = 9\text{ s}$; $d' = 3\text{ s}$; $d = 1\text{ s}$; $c = 2\text{ s}$; $p = 16\text{ s}$</p> <p>The duration of an eclipse should not be less than the duration of a flash.</p>	<p>A composite group-flashing yellow light indicates:</p> <ul style="list-style-type: none"> - a special mark. <p>$d'' > 3 d'$ $d' \geq 3 d$ $d \geq l$ $l \leq 1\text{ s}$ $c \geq 1\text{ s}$</p>
4. SCINTILLATING LIGHT				
4.1 Continuous scintillating light	Q	A light in which identical flashes are repeated at a rate between 40 and 60 flashes ' per minute.	 <p>Example: $l = d = 0.5\text{ s}$; $p = 1\text{ s}$</p> <p>The number of flashes in a group should be three or nine.</p> <p>An exceptional light character is reserved to indicate a south cardinal mark.</p> <p>The duration of the long eclipse should not be less than 3 s.</p>	<p>A continuous scintillating white light may indicate:</p> <ul style="list-style-type: none"> - a north cardinal mark; - a bifurcation mark; - a mark outside the channel indicating obstacles and danger points, if they can be passed on either side. <p>$d \geq l$ $1\text{ s} \leq p \leq 1.5\text{ s}$</p>
4.2 Group scintillating light	Q ()	A scintillating light in which a specified group of flashes is regularly repeated.	<p>Q(3)</p>  <p>Example: $d'' = 7.5\text{ s}$; $l = d = 0.5\text{ s}$; $c = 1\text{ s}$</p> <p>Q(6) + LFI</p>  <p>Example: $d'' = 7\text{ s}$; $l' = 2\text{ s}$; $l = d = 0.5\text{ s}$; $c = 1\text{ s}$</p> <p>Q(9)</p>  <p>Example: $d'' = 6.5\text{ s}$; $l = d = 0.5\text{ s}$; $c = 1\text{ s}$</p>	<p>A group scintillating white light with a group of three flashes, in a period of 10 s, indicates:</p> <ul style="list-style-type: none"> - an east cardinal mark. <p>$d'' \geq 3\text{ s}$ $d \geq l$ $1\text{ s} \leq c \leq 1.5\text{ s}$ $p = 10\text{ s}$</p> <p>A group scintillating 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:</p> <ul style="list-style-type: none"> - a south cardinal mark. <p>$d'' \geq 3 l'$ $d \geq l$ $l' \geq 2\text{ s}$ $1\text{ s} \leq c \leq 1.5\text{ s}$ $p = 15\text{ s}$</p> <p>A group scintillating white light with a group of nine flashes, in a period of 15 s, indicates:</p> <ul style="list-style-type: none"> - a west cardinal mark. <p>$d'' \geq 3\text{ s}$ $d \geq l$ $1\text{ s} \leq c \leq 1.5\text{ s}$ $p = 15\text{ s}$</p>

CLASS	ABBREVIATION	GENERAL DESCRIPTION	SPECIFICATION	PARTICULAR USE
5. QUICK SCINTILLATING LIGHT		A light in which identical flashes are repeated at a rate between 100 and 120 flashes ² per minute.	The duration of an eclipse should not be less than the duration of a flash.	
5.1 Continuous quick scintillating light	VQ	A quick scintillating light in which a flash is regularly repeated.		A continuous quick scintillating white light indicates : - a north cardinal mark.
5.2 Group quick scintillating light	VQ ()	A quick scintillating light in which a specified group of flashes is regularly repeated.	Identical with group scintillating light except for the frequency of the flashes $0.5 < c < 0.6s^{-1}$ and the period.	A group quick scintillating white light with a group of three flashes in a period of 5 s, indicates: - an east cardinal mark. A group quick scintillating white 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, indicates : - a south cardinal mark. A group quick scintillating white light with a group of nine flashes, in a period of 10 s, indicates - a west cardinal mark.
6. MORSE CODE LIGHT	Mo ()	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)  Example: $f = 1.5 \text{ s}$; $l = 0.5 \text{ s}$; $d = 0.5 \text{ s}$; $d' = 4.5 \text{ s}$; $p = 7 \text{ s}$	A Morse Code white light with the single character "A" indicates : - a safe-water mark. A Morse Code yellow light, but not with the single character "A" or "U" indicates: - a special mark.

² The competent authorities should choose the rates for all their scintillating lights and all their quick scintillating lights : either 60 and 120 flashes per minute or 50 and 100 flashes per minute.

Appendix 5

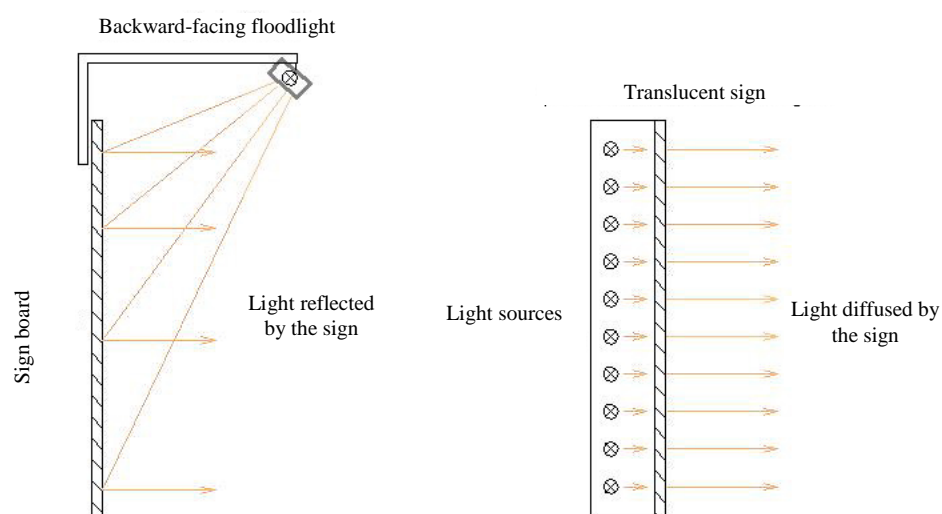
Recommendations for the lighting of traffic signs⁹

1. General provisions

The lighting of signs shall be turned on only at night. During daytime, the sign must be identifiable with natural lighting.

The lighting may be arranged either with an external, backward-facing floodlight located in front of the sign or with lighting from the inside of translucent panels (internally backlit signs) as shown in figure 1.

Figure 1



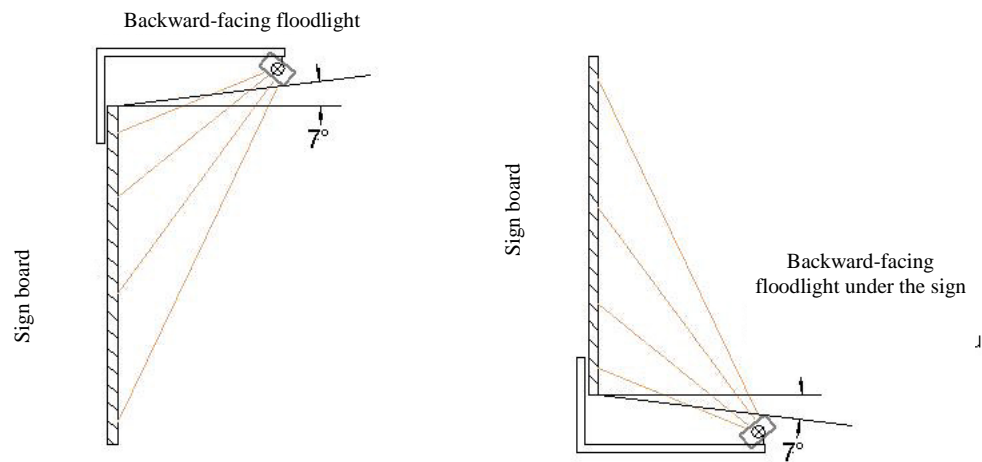
2. External backward-facing lighting of signs

External backward-facing lighting from a floodlight located above the sign is generally arranged with floodlights affixed above or below the sign board. For tall signs it is advisable to affix two floodlights (above and below). For wide signs it is possible to affix several floodlights in a line.

To avoid undesirable dark spots and glare, the floodlights must be located in such a way that they do not block a view from an angle of 7 degrees from the horizontal, drawn from the sign's top or bottom edge.

⁹ This appendix is based on the provisions of European standard EN 12899-1 "Fixed, vertical road traffic signs". The competent authorities can apply other international or national standards provided that the same safety level is ensured.

Figure 2



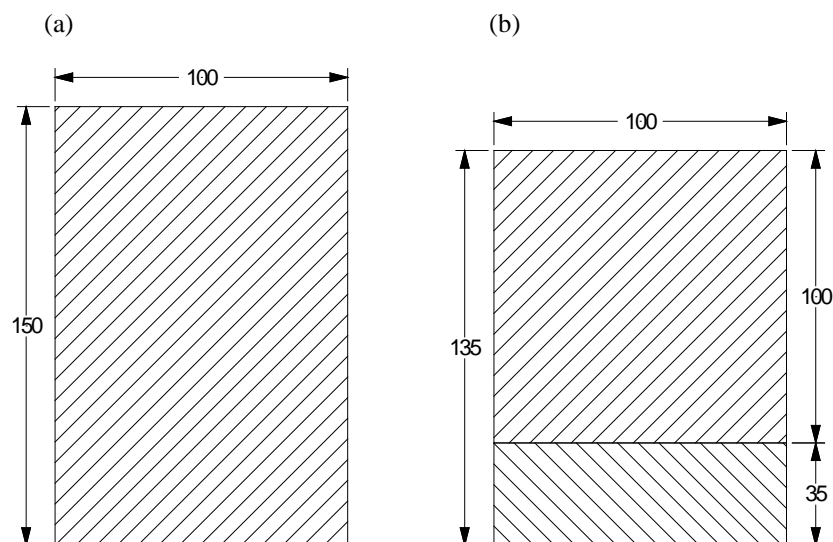
The type of lighting is always determined by the readability of the sign illuminated by the backward-facing light. Minimum dimensions of signs are given in appendix 1 to these Recommendations.

With some boards, the illuminated surface is identical to the board itself. If several boards conveying a single message are installed, for instance with additional text plates, the lighting requirements refer to the overall surface of the combined boards.

The recommended dimensions of the backward-illuminated surface of a sign board are shown in figure3:

- (a) a single board;
- (b) a board with an additional plate.

Figure 3



As for the backward-illuminated surface, the following lighting parameters are recommended:

- in areas with insignificant background light levels (for example, outside of city limits), the luminosity measured on-site should range from 40 lx to 100 lx;¹⁰
- in areas with increased background light levels (for example, within city limits), the luminosity measured on-site should range from 100 lx to 400 lx.¹¹

The uniformity of lighting is established by the ratio between the minimum luminosity (E_{\min}) and the maximum luminosity (E_{\max}) on the back-illuminated surface. In all cases $E_{\min}:E_{\max} \geq 1:10$.¹²

For the lighting, a white lamp with a colour temperature between 3500 K and 4500 K is used. Care must be taken to ensure that the sign colours are reproduced when the backward-facing light is white.

3. Internally backlit signs

It is recommended to use intensity class L1¹³ for signs in areas with insignificant background light and intensity class L2 for those with increased background light levels.

As for the uniformity of the lighting, the aim should be to reach class U1 (1:10).

¹⁰ Class E1 of EN 12899.

¹¹ Class E2 of EN 12899.

¹² Class UE1 of EN 12899.

¹³ Intensity and uniformity classes in EN 12899.

Appendix 6

Examples for variable-message traffic signs¹⁴

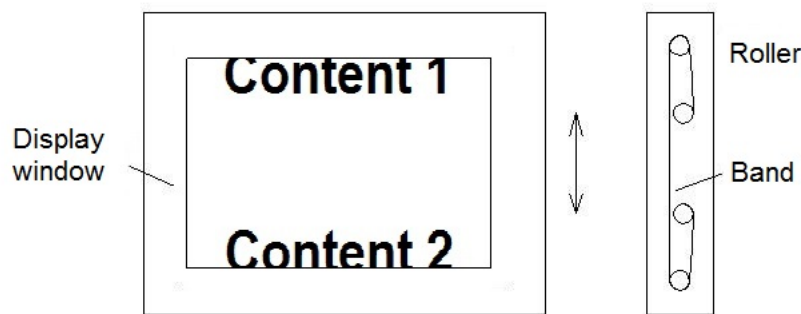
1. Mechanical boards

A. Scrolling sign boards

boards with a scrolled band of sign images are useful as variable message traffic signs, in particular for displaying the signs in annex 7 to CEVNI.

The sign images are placed on a band that is scrolled vertically on rollers. The rollers place the currently valid image in the window for display.

Figure 1

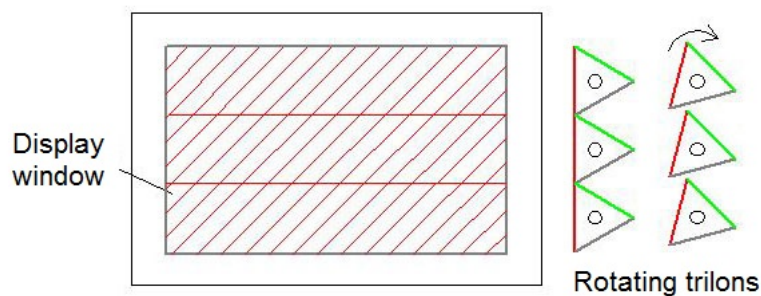


The advantage of scrolling sign boards is that they make it possible to display a large number of signs.

B. Trivision boards

Trivision boards are used preferably to display two different signs from annex 7 to CEVNI. This technique is limited to displaying three distinct sign images. Generally, the third position is reserved as blank, with a grey surface.

Figure 2



¹⁴ This appendix is based on the provisions of European standard EN 12966-1 “Vertical road signs — Variable message signs — Part 1: Product standard”. The competent authorities can apply other international or national standards provided that the same safety level is ensured”.

In comparison with boards using scrolling bands, the advantage of trilons is that they are mechanically more robust. At the same time, it is not necessary to produce sign images on a flexible surface, which makes it possible to use paints and films of proven value for use on navigation signs.

C. Other mechanical boards

There are many mechanical systems for information boards (for example, including flip-disk boards), with many designed for use in indoor spaces (such as transport terminals or stations). For navigation signs, which generally have to bear the brunt of weather conditions, the service life of such systems is often negligible; they often require servicing.

2. Electronic boards

Purely electronic systems for information boards have the basic advantage of incorporating absolutely no moving parts. The ones that are best known are boards using LEDs, liquid crystals or optical fibres. Such messages are displayed as white or yellow digits or letters on a black background. During manufacture, the characters are converted into groups of constituent dots to ensure that they can be read.

While mechanical boards are visible with natural light during daylight hours, electronic boards emit light both day and night. At the same time, a contrasting frame is required, the aim being to reduce the so-called phantom effects caused by sunlight. Reflection angles must be sufficiently large to reliably eliminate reflections on the fairway segments in question. As a direct consequence, electronic boards consume significantly more energy than mechanical ones.

At the same time, in daylight, the boards must be sufficiently luminous so that their messages can be seen even in clear and sunny weather. At night, they must be darkened so as to avoid unwanted brightness or dazzle. Adjustments are made by measuring the background luminous intensity and adapting the intensity of the board accordingly.¹⁵

The boards' reflection angles should also be observed.¹⁶

For horizontally illuminated sectors there are classes with ranges up to $\pm 30^\circ$ (60°). Technically, it is possible to display sectors ranging up to $\pm 60^\circ$ (120°) at an acceptable cost.

A. Optical waveguide (optical fibre) boards

Optical fibre boards have been used for many years on variable message road traffic signs (for example, to display temporary speed limits). The sign's image is divided into distinct points of light, with each point backlit by an optical fibre.

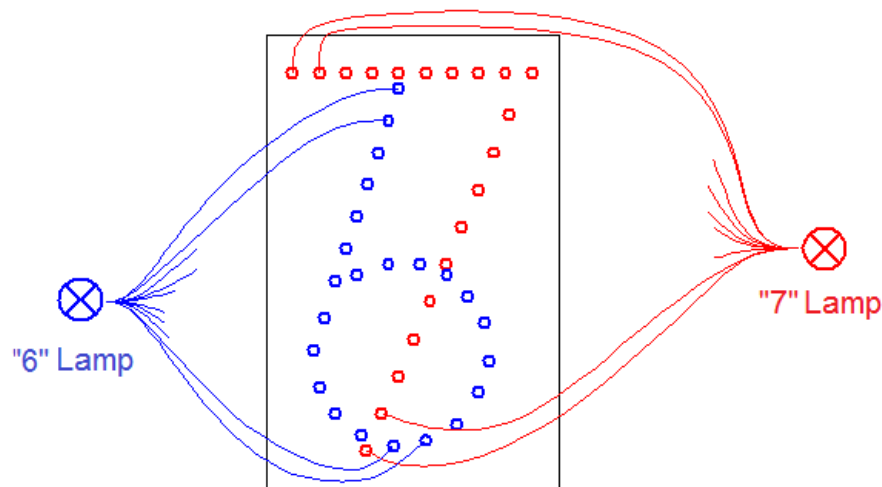
When a digit is displayed, the optical fibres of the digit in question are grouped and backlit with a lamp. For each digit there is thus a separate lamp, and each point of light can be used for just one digit. The points thus cannot be individually controlled. Each image must in turn have a source lamp.

¹⁵ If standard EN 12966-1 is used for this purpose, the adjustment coefficient (the board's maximum-to-minimum luminosity ratio) exceeding 100:1 is applied.

¹⁶ The luminance classes described in standard EN 12966-1 are intended for road traffic and would presuppose that the boards are installed at least as high as the minimum height of a bridge allowing for navigation.

Figure 3

Depiction of light points corresponding with lamps for two digits (for clarity, only some of the optical fibres are shown)



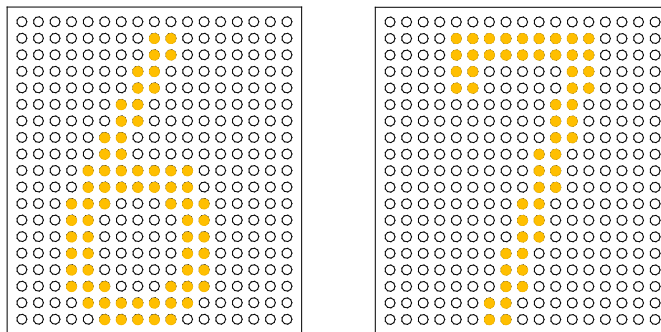
In recent years, optical fibre boards have to a great extent been replaced by LED matrix boards.

B. Light-emitting diode (LED) matrix boards

In the case of a LED matrix, each separate point of the image is displayed by a diode that can be independently turned on and off. In principle, such boards can be freely programmed (using a complete matrix), thus making it possible to display any message.

Figure 4

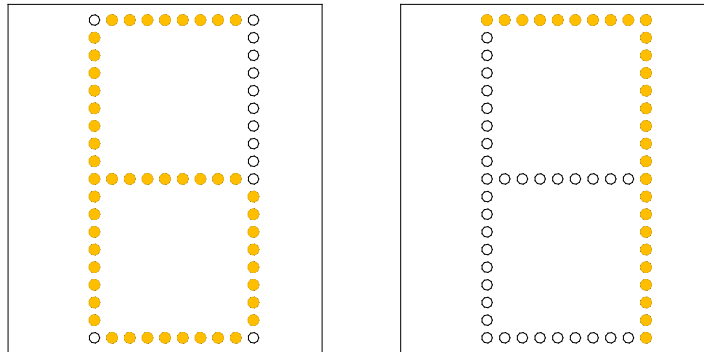
Board with individually controlled light emitting diodes displaying digits



Often, though, only seven segments required to display digits are connected. As fewer diodes are used, the electronic control is simplified, which results in savings. To reduce costs, it is possible to pre-programme groups of LEDs to display only the messages that are required.

Figure 5

Board composed of seven segments with separate light emitting diodes



C. Liquid crystal displays (LCDs)

Boards using liquid crystal displays (LCDs) are composed of a regularly illuminated surface placed behind a film of liquid crystals, which blocks areas of the image, thus creating the desired figure. For large boards, monochrome images are preferred, although colour images are possible as well. Diodes have recently been employed to backlight the surface, while fluorescent lamps were previously used.

The advantage of this kind of board is that it produces a very sharp, detailed image, with such high luminosity and contrast that the boards can be used in daylight.

There is a technical disadvantage, though, as the optical characteristics of the liquid crystal film are such that only a small part (less than 25 per cent) of the generated light is displayed. For the same luminosity, boards of this kind require significantly more power than those using LED matrices.

In addition, liquid crystal displays shall be protected against temperature changes and humidity, which involves high costs.