bow-mounted helideck with the vessel heading steaming into wind (i.e. a second heliport name marking painted between the outboard edge of the shipboard heliport and the yellow touchdown/positioning marking (T/PM) circle facing toward the helicopter will assist the pilot with positive recognition earlier on in the approach), and by extinguishing the touchdown and lift-off area (TLOF) floodlights and or circle-H lighting, at night, in the case where a helideck or shipboard heliport is unprepared and potentially unsafe when it is not expecting to receive helicopters.

5.2 WIND DIRECTION INDICATOR

5.2.1 An offshore facility or ship should be equipped with at least one wind direction indicator to provide a visual indication of the wind conditions prevailing over the facility during helicopter operations.

5.2.2 The location of the primary wind direction indicator should be in an undisturbed airstream avoiding any effects caused by nearby structures (see also Chapter 3, 3.2.2), and unaffected by rotor downwash from the helicopter. The location of the wind direction indicator should not compromise the established obstacle protected surfaces (see Chapter 4). Typically, a primary wind direction indicator will consist of a coloured windsock.

5.2.3 The windsock should be easy visible to the pilot on the approach (at a height of at least 200 m (656 ft)), in the hover and while touched down on the surface of the TLOF, and prior to take-off. Where these operational objectives cannot be fully achieved by the use of a single windsock, consideration should be given to locating a second windsock in the vicinity of the helideck or shipboard heliport, which could also be used to indicate a specific difference between the local wind over the TLOF and the free stream wind at the installation or ship (which the pilot will reference for an approach).

5.2.4 A windsock should be a truncated cone made of a suitable lightweight fabric with a minimum length of at least 1.2 m (4 ft), a diameter at the larger end of at least 0.3 m (1 ft) and a diameter at the smaller end of at least 0.15 m (0.5 ft). The colour should contrast well with the operating background in the offshore environment. Ideally a single coloured windsock, preferably orange or white, should be selected. However, where a combination of colours is found to provide better conspicuity against a changing operating background, orange and white, red and white or black and white colour schemes could be selected, arranged as five alternate bands with the first and last band being the darker colour.

5.2.5 If a helideck or shipboard heliport is intended to be operated at night, the windsock(s) will need to be illuminated. This can be achieved by internal illumination, perhaps a floodlight pointing through the wind cone. Alternatively, the windsock can be externally highlighted using, for example, area floodlighting. Care should be taken to ensure that any system used to illuminate a windsock highlights the entire cone section while not presenting a source of glare to a pilot operating at night.

5.3 HELIPORT IDENTIFICATION (H) MARKING

5.3.1 A heliport identification marking should be provided for a helideck or a shipboard heliport in the form of a white “H” with a height of 4 m (13 ft), an overall width not exceeding 3 m (10 ft) and a stroke width not exceeding 0.75 m (2.5 ft). In circumstances where the D-value of a helideck or shipboard heliport is less than 16 m (52.5 ft), Annex 14, Volume II permits the size of the marking to be reduced such that the dimensions of the “H” are 3 m (10 ft) (in height) with an overall width not exceeding 2.25 m (7.4 ft) and a stroke width not exceeding 0.5 m (1.6 ft). A typical ‘standard-size’ heliport identification marking is shown in Figure I-5-2.

5.3.2 A heliport identification “H” marking should ideally be located in the centre of the final approach and take-off (FATO), except where the results of an aeronautical survey indicate that an offset marking may be beneficial to helicopter operations and still allow for the safe movement of personnel around the helicopter, in which case the centre

of the "H" may be offset by up to 0.1 D towards the outboard edge of the FATO. An example of where this measure may be used could be for an oversized helideck — one that exceeds the minimum 1 D dimensional requirement — but that also has immovable obstructions close to the inboard perimeter, in the limited obstacle sector (LOS). In this case, moving the touchdown marking location away from the centre of the FATO towards the outboard edge will improve clearances from dominant obstacles, while, in theory, still facilitating adequate on deck clearance around the helicopter for the safe movement of passengers and for the efficiency of helideck operations, such as refuelling. A comparison of the location of the touchdown markings, whether centralized or fully offset, are shown in Figure I-5-3, examples A and B.

5.3.3 The heliport identification marking, regardless of whether it is based on the centre of the FATO or not, should always be established in the centre of the touchdown/positioning marking circle (see Chapter 5, 5.7). For a helideck, and for a purpose-built shipboard heliport, the centreline of the cross bar of the "H" should be passed through by the bisector of the obstacle-free sector (OFS). Where, in exceptional cases, it is necessary for the chevron marking (see Chapter 5, 5.9) to be swung for a helideck (e.g. to clear an immovable obstacle which might otherwise penetrate the 210-degree sector), it will be necessary to swing the "H" marking by the corresponding angle, to indicate to aircrew on approach that the sector has been swung. The maximum swung sector should not exceed ± 15 degrees from the normal for the OFS. A 'swung' heliport identification "H" marking is illustrated in Figure I-5-4.

5.4 MAXIMUM ALLOWABLE MASS MARKING

5.4.1 A maximum allowable mass marking should be arranged so as to be readable from the preferred final approach direction (on a fixed facility this will usually be in a direction lining up with the prevailing wind direction for the facility).

5.4.2 The maximum allowable mass marking should be expressed as a one-, two- or three-digit number corresponding to the maximum allowable mass of the heaviest helicopter permitted to use the TLOF in accordance with the structural requirements detailed in Chapter 3, 3.1. In most cases the maximum allowable mass marking will correspond to the maximum (certificated) take-off mass (MTOM) for the design helicopter type, but this need not necessarily be the case if the structural calculations performed for the helideck or shipboard heliport confirm a structural limit that is different from (i.e. exceeding) the MTOM of the design helicopter. Where the MTOM is expressed in metric tonnes, the suffix "t" will be painted with the numerical marking. For States where the marking is expressed as an imperial measure i.e. in lbs, it is not appropriate to suffix with a "t" — in this case no suffix is provided.

5.4.3 For a maximum allowable mass marking expressed in metric units the minimum requirement is to depict a marking rounded to the nearest 1 000 kg. A Recommendation is made in Annex 14, Volume II for the marking to be expressed to the nearest 100 kg. The following examples are offered, based on current manufacturer derived data. The figures should be regarded for illustrative purposes only, and as a helicopter's MTOM can increase, especially following introduction to service of a new type, designers are advised to verify specific helicopter data with the manufacturer or offshore helicopter operator:

Bolkow 117: MTOM 3 200 kg is expressed as "03 t" or "3.2 t"

Super Puma AS 332L: MTOM 8 599 kg is expressed as "09 t" or "8.6 t"

Sikorsky S92: MTOM 12 565 kg is expressed as "13 t" or "12.6 t"

5.4.4 For a maximum allowable mass marking expressed in imperial (customary to the United States) units, the recommended method of designating the helideck limitations is to indicate the MTOM of the helicopter in terms of a two- or three-digit number with one decimal point rounded to the nearest 100 pounds, with 50 pounds rounded up (i.e. for 15 750 lbs marked as 15.8). The following examples are offered based on current manufacturer derived data. The

figures should be regarded for illustrative purposes only, and as a helicopter MTOM can increase, especially when a new type is first introduced into service, designers are advised to verify specific helicopter MTOM's with the manufacturer, or with the offshore helicopter operator.

Sikorsky S76: MTOM 11 700 lbs is expressed as 11.7

Bell 212: MTOM 11 200 lbs is expressed as 11.2

AW101: MTOM 34 400 lbs is expressed as 34.4

5.4.5 For helicopter types with a MTOM of less than 3 175 kg (7 000 lbs) there is acceptance for the use of a TLOF which is less than 1 D, but is no less than 0.83 D. The following examples are presented for helicopter types which have a MTOM of less than 3 175 kg:

Bolkow 105 MTOM 2 400 kg to be expressed as "02 t" or "2.4 t" (metric); or
MTOM 5 291 lbs to be expressed as 5.3.

EC 135T2 MTOM 2 910 kg to be expressed as "03 t" or "2.9 t" (metric); or
MTOM 6 400 lbs to be expressed as 6.4.

5.4.6 The recommended size of the characters to be used for the maximum allowable mass marking is presented in Annex 14, Volume II, Figure 5-4, which represents the full character height of 1.5 m (5 ft) applicable for the largest helidecks and shipboard heliports. For smaller helidecks and shipboard heliports, character heights may be reduced to 90 cm (3 ft) or 60 cm (2 ft). In each case, the thickness of characters should be correspondingly reduced. The characteristics applicable for the decimal point, where required, are also included.

FATO D-value	*Min. height of characters*	*Dimensions of decimal point*
< 15 m	0.6 m	12 cm^2
15 m to 30 m	0.9 m	18 cm^2
> 30 m	1.5 m	30 cm^2

5.4.7 The numbers and, where appropriate, the letter of the marking and the decimal point, should be painted in a colour contrasting with the background. For a helideck or purpose-built shipboard heliport to contrast effectively with the background (see Section 5.10), the maximum allowable mass marking would normally be white.

5.5 D-VALUE MARKINGS

5.5.1 D-value markings should be displayed within the broken white TLOF perimeter line at three locations, as presented in Figure I-5-8 and Figure I-5-9, for least one marking to be readable from the final approach direction. For a purpose-built shipboard heliport in an amidships location, having a chevron at either end (see Figure I-5-5), two D-value markings are required to be displayed — one on the portside of the heliport and the other on the starboard side.

5.5.2 The D-value marking should be painted white in not less than 90 cm (3 ft) characters where the dimension of the FATO is 15 m or greater and not less than 60 cm (2 ft) characters where the dimension of the FATO is less than 15 m (49 feet). Where the FATO is greater than 30 m (98 ft), the characters should be increased to at least 1.5 m (approximately 5 ft). This is summarized in the table below. The thickness of the 1.5 m characters should accord with Annex 14, Volume II, Figure 5-4, with a corresponding reduction in thickness for 0.9 m and 0.6 m height characters.

FATO D-value	*Min. height of characters*
< 15 m	0.6 m
15 m — 30 m	0.9 m
> 30 m	1.5 m

5.5.3 The D-value should be expressed to the nearest whole number with 0.5 rounded up, e.g. EC 225 has a D-value of 19.50 m (64 ft), therefore this is expressed as “20”.

5.5.4 Where imperial units are used in preference to metric measurements

5.5.4.1 The recommended method of designating the helideck limitations is to have the weight and D size marked in a box, outlined in red, in red numerals on a white background, as shown below in Figure I-5-5A. The height of the figures should be 3 ft. (0.9 m) with the line width of the box approximately 5 in (12 cm). For smaller helidecks where space may be limited, provided the box and numerals are discernible at a range which is compatible with a pilot’s landing decision point (LDP), giving sufficient time to affect a go-around if necessary, the height of the figures may be reduced to no less than 18 in (45 cm).

5.5.4.2 The weight/size limitation box marking should be visible from the preferred direction of approach. It is recommended that on square or rectangular helidecks, the box should be located relative to the preferred direction of approach (when facing the helideck). For circular, hexagonal and other similarly-shaped helidecks, the box should be located on the right-hand side of the TLOF and outside the touchdown/positioning marking (TD/PM) circle, when viewed from the preferred direction of approach.

5.6 TLOF PERIMETER MARKING

5.6.1 A TLOF perimeter marking denoting the extent of the TLOF should be painted around the edge of the TLOF using a continuous white line having a thickness of at least 30 cm (12 in).

5.6.2 The TLOF perimeter line should follow the physical shape of the helideck or shipboard heliport, such that where the deck shape is octagonal or hexagonal, the shape of the painted white TLOF marking will correspond to an octagon or hexagon. A TLOF marking should only be circular where the physical shape of the helideck or shipboard heliport is also circular.

5.7 TOUCHDOWN/POSITIONING MARKING CIRCLE

5.7.1 A TD/PM circle should be provided on a helideck or shipboard heliport to assist a helicopter to touchdown and be positioned accurately by the pilot. The TD/PM is so located that when the pilot’s seat is over the marking, the whole of the undercarriage is comfortably within the TLOF and all parts of the helicopter are clear of any obstacles by a safe margin. Figure I-5-6 illustrates how the TD/PM should be used by aircrew to position the helicopter, facilitate requisite clearances from all obstacles, and allow passengers to make a safe approach to alight the helicopter (and a safe passage for egress).

5.7.2 A TD/PM circle should ideally be located in the centre of the FATO, except where the results of an aeronautical survey indicates that an offset marking may be beneficial to the safety of helicopter operations, and not detrimental to the safe movement of personnel, in which case, the centre of the circle may be offset by up to 0.1 D away from the centre towards the outboard edge of the FATO. An example of where an offset marking may be beneficial is for an oversized helideck, one that exceeds the minimum 1 D dimensional requirement, that also has immovable obstructions close to the inboard perimeter, in the LOS. In this case, moving the TD/PM circle location away from the centre of the FATO and towards the outboard edge will improve clearances to dominant obstacles, while, in theory, still allowing adequate on deck clearance around the helicopter for the safe movement of passengers and for the efficiency of helideck operations, such as refuelling. For helidecks that are less than 1 D, it is not recommended that an offset marking be utilized. A comparison of the location of the touchdown markings, whether centralized or offset, is shown in Figure I-5-3, examples A and B.

5.7.3 The TD/PM circle should be painted yellow and have a line width of at least 1 m (3 ft) for helidecks and purpose-built shipboard heliports having a D-value of 16 m (52.5 ft) or greater. For those facilities having a D-value of less than 16 m (52.5 ft), the line width of the marking may be reduced to 0.5 m (1.6 ft).

5.7.4 For a 1 D or greater helideck, and for a shipboard heliport, the inner diameter of the touchdown/positioning marking should be 0.5 D of the design helicopter. So for a helideck designed for the Sikorsky S92 (D = 20.88 m (68.5 ft)) the inner diameter of the touchdown/positioning marking circle is 10.44 m (34.3 ft). The thickness of the marking is 1 m (3 ft). For helidecks which are less than 1 D, the inner diameter of the TD/PM should be 0.5 D of the notional FATO. Generic dimensions, for helidecks and shipboard heliports which are 1 D or greater and/or 16 m (52.5 ft) or greater, are shown in Figure I-5-7.

5.8 HELIPORT NAME MARKING

5.8.1 The heliport name marking should be painted on the helideck or shipboard heliport in minimum 1.2 m (3.9 ft) preferably white painted characters between the chevron (see Section 5.9) and the TD/PM circle (see Section 5.7). Care should be taken to ensure that the name is to no degree obscured by a helideck net (where fitted).

5.8.2 The heliport name marking should consist of the name or the alphanumeric designator of the helideck or shipboard heliport as used in the radio-telephony (R/T) communications. Providing a name that is unique and simple will ensure that the mental process of recognition for aircrew is kept to a minimum at a time when a pilot's concentration is being exercised by the demands of the final approach and landing manoeuvre.

5.8.3 To allow for recognition of the facility or vessel further up the approach manoeuvre, consideration should be given to increasing the character height of the heliport name marking from 1.2 m (4 ft) to 1.5 m (5 ft). Where the character height is 1.5 m (5 ft), the character widths and stroke widths should be in accordance with Annex 14, Volume II, Figure 5-4. The character widths and stroke widths of nominal 1.2 m characters should be 80 per cent of those prescribed in Figure 5-4 of Annex 14, Volume II. Where the heliport name marking consists of more than one word, it is recommended that the space between words be approximately 50 per cent of character height.

5.8.4 In accordance with Section 5.1.5, some types of floating facilities and vessels may benefit from a second name marking diametrically opposite the first marking, with the characters facing the opposite direction (so that the feet of characters are located adjacent to the outboard edge of the TD/PM circle. Having a name marking on both ends of the TD/PM circle will ensure that one marking is always readable the right way up for aircrew on approach, e.g. for a bow-mounted helideck on a vessel that is steaming into wind, a second name marking oriented towards the main vessel structure (aft) and located between the outer edge of the circle and the outboard edge of the helideck will be more easy to process for aircrew approaching into wind than will a heliport name marking located in the normal location. In this case aircrew would be required to process a marking which is upside down.

5.9 HELIDECK OBSTACLE-FREE SECTOR (CHEVRON) MARKING

5.9.1 A helideck or shipboard heliport with obstacles that penetrate above the level of the TLOF is required to display an OFS (chevron) marking to denote the origin of the OFS. For a 1 D or greater helideck, the apex of the chevron is located at a distance from the centre of the TLOF that is equal to the radius of the largest circle which can be drawn in the TLOF. The arrangement is shown in Figure I-5-7. For a purpose-built shipboard heliport in an amidships location, the marking scheme will consist of a chevron at both ends (see Figure I-5-5).

5.9.2 The origin of the OFS should be marked on the helideck or shipboard heliport by a black chevron, each leg being 79 cm (2.6 ft) long and 10 cm (4 in) wide, forming the angle of the obstacle-free sector in the manner shown in Figure I-5-7. Where exceptionally the OFS is swung (by up to ± 15 degrees — see also Section 5.3.3 and Figure I-5-4) then the chevron is correspondingly swung. Where there is insufficient space to accommodate the chevron precisely, the chevron marking, but not the point of origin of the OFS, may be displaced by up to 30 cm (11 in) towards the centre of the TLOF.

5.9.3 The purpose of the chevron is widely misunderstood to provide a form of visual indication to the aircrew that the OFS is clear of obstructions. However, the marking is too small for the purposes of aircrew and instead is intended as a visual tool for a helicopter landing officer (HLO) (who has charge of the helideck operation on the ground) to ensure that the 210-degree OFS is clear of any obstructions, fixed or mobile, before giving a helicopter clearance to land. The black chevron may be painted on top of the white TLOF perimeter line to achieve maximum clarity for helideck crew.

5.9.4 Adjacent to and where practical inboard of the chevron, the certified D-value of the helideck is painted in 10 cm (4 in) alphanumeric characters. The D-value of the helideck should be expressed in metres to two decimal places (e.g. “D = 16.05 m”). Where imperial measurements are used, the D-value of the helideck should be expressed in feet and inches.

5.9.5 For a TLOF which is less than 1 D, but not less than 0.83 D, the chevron is positioned at 0.5 D from the centre of the FATO which will take the point of origin outside the TLOF. If practical, this is where the black chevron marking should be painted. If impractical to paint the chevron at this location, then the chevron should be relocated to the TLOF perimeter on the bisector of the OFS. In this case the distance and direction of displacement along with the words “WARNING DISPLACED CHEVRON” are marked in a box beneath the chevron in black characters not less than 10 cm (4 in) high. An example of the arrangement for a sub-1 D helideck is shown in Figure I-5-9.

5.10 HELIDECK AND SHIPBOARD HELIPORT SURFACE MARKING

5.10.1 A surface background marking is provided to assist a pilot in identifying the location of the helideck or shipboard heliport during an approach to land by day and to emphasize the position of the touchdown markings etc. The helideck or shipboard heliport surface encapsulated by the white TLOF perimeter marking should be dark green using a high friction coating.

5.10.2 Aluminium helidecks are now widely in use throughout the offshore industry. Some of these are a natural light grey colour and may present painting difficulties. The natural light grey colour of aluminium may be acceptable provided the conspicuity of helideck markings is assessed, preferably from the air, and if necessary, enhanced. How this is achieved in practice is discussed further in Section 5.1.3.

5.11 PROHIBITED LANDING SECTOR MARKING

5.11.1 Helideck-prohibited landing sector markings are used where it is necessary to protect the helicopter from landing or manoeuvring in close proximity to limiting obstructions which, being of an immovable nature, may compromise the sectors and surfaces established for the helideck (an example might be a jack-up leg penetrating the 150-degree limited obstacle sector or a crane on the edge of the LOS).

5.11.2 A prohibited landing sector (PLS) is therefore established utilizing the marking arrangement shown in Figure I-5-10. The hatched marking is overlaid on the portion of the yellow TD/PM circle and extending out to the TLOF perimeter marking within the relevant headings, for which it would be deemed unsafe to place the nose of the helicopter (due to the presence of an obstacle behind the tail of the aircraft, which due to the landing orientation of the helicopter would be beyond the field of view of the aircrew).

5.11.3 The arc of coverage should be sufficient to ensure that the tail rotor system will be positioned clear of the obstruction when hovering above, and touching down on, the yellow circle at any location beyond the PLS marking. As a guide it is recommended that the PLS marking extends by a minimum 10 to 15 degrees either side of the edge of the obstacle (this implies that even for a simple whip aerial infringement the PLS arc applied will be an arc of no less than 20 to 30 degrees of coverage).

5.11.4 The sector of the TD/PM circle, opposite from the personnel access point, should be bordered in red with the words “no nose” clearly marked in red on a white background as shown in Figure I-5-10. When positioning over the TD/PM circle, helicopters should be manoeuvred so as to keep the aircraft nose clear of the “no nose” marked sector of the TD/PM circle at all times. The minimum prohibited “no nose” marking should cover an arc of at least 30 degrees.

5.11.5 The following figure shows the required location and dimensions of the marking scheme. Colours of markings may vary depending on the underlying surface colour of the vessel. This is discussed in more detail in Chapter 5, 5.1.2 and Figure I-5-1. For guidance on mapping of obstructions see Chapter 4, 4.6. For TLOF lighting systems, special considerations for non-purpose-built shipboard heliports are addressed in Section 5.15.

5.12 GENERAL CONSIDERATIONS FOR LIGHTS INCLUDING SCREENING

5.12.1 The specification for the TLOF lighting system presented in the following sections assumes that the performance of the lighting will not be diminished due to the relative intensity, configuration or colour of other lighting sources present on a fixed or floating facility or on a vessel. Where other non-aeronautical lighting has potential to cause confusion, or to diminish or prevent the clear interpretation of aeronautical ground lights, it will be necessary for the facility or vessel operator, and if possible, the HLO, to extinguish, screen, or otherwise modify, non-aeronautical light sources to ensure the effectiveness of helideck or shipboard heliport lighting systems are not compromised. To achieve this, operators should give consideration to shielding any high intensity light sources from approaching helicopters by fitting screens or louvers.

5.12.2 The helideck and shipboard heliport lighting systems specified in the following sections, and detailed in Annex 14, Volume II (Chapter 5), and Appendix I-B of this document, are designed on the assumption that operations occur in typical night viewing conditions, with an assumed eye threshold illuminance of Et = $10^{-6.1}$ llux. If there is an expectation for aeronautical lighting to be used in more demanding viewing conditions, such as at twilight or during typical day conditions, (where Et = $10^{-5.0}$ lux for twilight and Et = $10^{-4.0}$ lux for normal day), it should be recognized that the ‘true night’ viewing ranges achieved by the system design will decay considerably in more demanding viewing conditions (i.e. the range at which a particular visual aid becomes detectable and conspicuous at night will decrease if that same aid is used at twilight or by day because the higher background brightness leads to a decreasing probability of detection). It is not the intention of this manual to discuss these issues in detail — suffice to say, that to achieve the

same 'night' detection range for a particular visual aid, viewed in the most demanding typical day conditions, will require a very much brighter lighting system. Further guidance is provided in the *Aerodrome Design Manual (Doc 9157),* Part 4 — *Visual Aids*.

5.13 TLOF LIGHTING SYSTEMS UTILISING FLOODLIGHT SOLUTIONS

5.13.1 The TLOF, as defined by the white TLOF perimeter marking (see Section 5.6) should be delineated by fixed omnidirectional green TLOF perimeter lights visible from on or above the level of the TLOF (the whole pattern formed by the perimeter lights should not be visible to aircrew from below the level of the landing area, whether on a fixed or floating facility or vessel). The photometric specification of TLOF perimeter lights is provided in the isocandela diagrams in Annex 14, Volume II, Figure 5-11 (Illustration 6)**.**

5.13.2 TLOF perimeter lights, around the edge of the area designated for use as the TLOF, should be spaced at not more than 3 m (10 ft) intervals (measured between light sources) and should follow the shape of the helideck or shipboard heliport (e.g. for an octagonal helideck, the TLOF perimeter lights should be arranged to form an octagon). To avoid lights creating a trip hazard at points of access and egress it may be necessary to provide sources that are flush-mounted (i.e. recessed) into the surface. The pattern of lights should be formed using regular spacing. However, to avoid potential trip hazards, blocking foam dispensing nozzles, etc., it may be desirable to move lights to one side. In this case, TLOF perimeter lights may be relocated by up to ± 0.5 m (1.6 ft) such that the maximum gap between two adjacent TLOF perimeter lights is no more than 3.5 m (11.5 ft) and the minimum no less than 2.5 m (8.2 ft).

5.13.3 TLOF floodlights should be arranged around the perimeter of the TLOF so as to avoid glare to pilots in flight or to personnel working on the area. Floodlighting can easily become misaligned and the HLO should instigate daily checks to ensure that misaligned lights are corrected and do not create a hazard to flight operations by providing a source of glare (the glare issue may be reduced by fitting appropriate hoods (louvers) onto deck-mounted floodlights). Notwithstanding, lights should be realigned when, in the opinion of aircrew, they are creating a glare hazard during flight operations.

5.13.4 Another issue with deck-mounted floodlighting, given their shallow angle of attack and the potentially very large area needing to be illuminated, especially over the touchdown markings, is what is commonly known as the *black hole effect.* In this case, adequate illumination is dispensed in areas adjacent to the perimeter lights, but a black hole is left in the centre of the landing area where the lights cannot properly illuminate the central touchdown area markings. Designers should aim to create a lighting environment which achieves an average horizontal illuminance of the floodlighting which is at least 10 lx, with a uniformity ratio (average to minimum) of not more than 8:1, measured on the surface of the TLOF. Furthermore, the spectral distribution of TLOF area floodlights should ensure adequate illumination of the surface markings (especially the TD/PM circle) and obstacle markings (this may include a prohibited landing sector marking, where present).

5.13.5 Given the challenges of meeting the above specifications, designers may be tempted to provide multiple floodlighting units, in seeking to achieve the recommendations for spectral distribution and average horizontal illuminance for floodlighting set in Annex 14, Volume II. However, being very much brighter than the TLOF perimeter lights, floodlighting has a tendency to make the pattern of the green perimeter lights less obvious, due to the number and intensity of much brighter floodlights. As the green pattern provided by the TLOF perimeter lights generates the initial source of helideck acquisition for aircrew, the desire to specify multiple sets of floodlights should be resisted. For all but the largest helidecks a compliment of between four and six floodlights should be sufficient (up to eight for the largest helidecks). Providing that technologies are selected which promote good, sharp, beam control, this should optimize their effectiveness and offer the best opportunity to effectively illuminate touchdown markings. To mitigate the glare issue as much as possible, floodlights should be mounted to ensure the centreline of the floodlight beam is at a 45-degree angle to the reciprocal of the prevailing wind direction. This will minimize any glare or disruption to the pattern formed by the green perimeter lights for the majority of approaches. Figure I-5-12 provides a typical floodlighting arrangement.

5.13.6 The height of the installed TLOF perimeter lights and floodlights should not exceed 25 cm (10 in) above the level of the TLOF, but ideally should not exceed 15 cm (6 in) for helidecks which are 1 D or greater and/or have a D-value greater than 16 m (52.5 ft), and 5 cm (2 in) for helidecks which are sub-1 D, but not less than 0.83 D, and/or have a D-value of 16 m (52.5 ft) or less. TLOF lighting should be inset when a light extending above the surface could endanger helicopter operations (see also Chapter 3, 3.4.10).

5.13.7 In addition to providing the visual cues needed for helideck recognition for approach and landing, helideck floodlighting may be used at night to facilitate on deck operations such as passenger movements, refuelling operations, freight handling, etc. Where there is potential for floodlights to dazzle a pilot during the approach to land or during take-off manoeuvres, they should be switched off for the duration of the approach and departure. Therefore all floodlights should be capable of being switched off at a pilot's request. All TLOF lighting should be fed from an uninterrupted power supply (UPS) system.

5.13.8 For some helidecks or shipboard heliports, it may be possible to site additional high-mounted floodlighting away from the TLOF perimeter, such as a ship's bridge or pointing down from a hangar. In this case, extra care should be taken to ensure that additional sources do not cause a source of glare to a pilot, especially when lifting in the hover to transition into forward flight, and do not present a competing source to the green TLOF perimeter lights. Screens or louvers should be considered for any additional high-mounted sources.

5.14 TLOF LIGHTING SYSTEMS UTILIZING "H" AND CIRCLE LIGHTING — DETAILS OF A SCHEME FIRST ADOPTED IN THE UNITED KINGDOM

5.14.1 As an effective alternative to providing illumination of the touchdown markings by the use of deck-mounted floodlighting, operators may wish to consider a scheme for a lit TD/PM and a lit heliport identification marking. This scheme is presented in detail in Appendix I-B, together with the photometric specification for green TLOF perimeter lights.

5.14.2 The lit TD/PM and the lit heliport identification marking scheme has been developed to be compatible with helicopters having wheeled undercarriages. Although the design specification presented in Appendix I-B ensures segments and subsections are compliant with the maximum height for obstacles on the TLOF surface (2.5 cm (1 in)), and are likely to withstand the point loading presented by typically lighter skidded helicopters, due to the potential for raised fittings to induce dynamic rollover, it is important to establish compatibility with skid-fitted helicopter operations before lighting is installed on helidecks and shipboard heliports used by skid-fitted helicopters.

5.14.3 The specification for a complete helideck/shipboard heliport lighting scheme is presented in Appendix I-B. The detail therein is not considered mandatory but it is nevertheless reproduced here to demonstrate an acceptable alternative means of compliance for any State wishing to take advantage of the United Kingdom specification, based on dedicated and in-service offshore trials. Figure I-5-13 shows the illumination of the TLOF for a helideck using the lit TD/PM and the lit heliport identification marking scheme described in the previous section and in Appendix I-B alongside a helideck, which utilizes the conventional floodlighting solution described above.

5.15 LIGHTING SYSTEMS — SPECIAL CONSIDERATIONS FOR NON-PURPOSE-BUILT SHIPBOARD HELIPORTS

Given the possible presence of obstructions within the landing area (see Chapter 4, 4.6) some States may decide not to permit night operations unless a risk assessment can demonstrate it is safe to do so. Where night operations are permitted, specific lighting schemes for non-purpose-built shipboard heliports may utilize an area floodlighting solution to illuminate the TLOF and markings as illustrated in Figure I-5-14.

5.16 VISUAL AIDS FOR DENOTING OBSTACLES — MARKING AND LIGHTING (INCLUDING FLOODLIGHTING)

5.16.1 Fixed obstacles which present a hazard to helicopters should be readily visible from the air. If a paint scheme is necessary to enhance identification by day, alternate black and white, black and yellow, or red and white bands are recommended, not less than 0.5 m (1.6 ft), or more than 6 m (20 ft) wide. The colour should be chosen to contrast with the background to the maximum extent.

5.16.2 Obstacles to be marked in these contrasting colours include any lattice tower structures and crane booms which are close to the helideck or to the LOS boundary. Similarly parts of the leg (or legs) of a self-elevating jack-up unit that are adjacent to the helideck and which extend, or can extend above it, should also be marked in the same manner.

5.16.3 Omnidirectional low intensity steady red obstruction lights having a minimum intensity of 10 cd for angles of elevation between 0 degrees and 30 degrees should be fitted at suitable locations to provide the helicopter pilot with visual information on the proximity and height of objects which are higher than the landing area and which are close to it, or to the LOS boundary. This should apply, in particular, to all crane booms on an offshore facility or vessel. Objects which are more than 15 m (50 ft) higher than the landing area should be fitted with intermediate low intensity steady red obstruction lights of the same intensity spaced at 10 m (33 ft) intervals down to the level of the landing area (except where such lights would be obscured by other objects). It is often preferable for some structures, such as flare booms and towers, to be illuminated by floodlights as an alternative to fitting intermediate steady red lights, provided that the lights are arranged such that they will illuminate the whole of the structure and not dazzle a helicopter pilot. Facilities may, where appropriate, consider alternative equivalent technologies to highlight dominant obstacles in the vicinity of the helideck.

5.16.4 An omnidirectional low intensity steady red obstruction light should be fitted to the highest point of the installation. The light should have a minimum intensity of 50 cd for angles of elevation between zero and 15 degrees, and a minimum intensity of 200 cd between 5 and 8 degrees. Where it is not practicable to fit a light to the highest point of the installation (e.g. on top of flare towers) the light should be fitted as near to the extremity as possible.

5.16.5 In the particular case of jack-up units, it is recommended that when the tops of the legs are the highest points on the facility, they should be fitted with omnidirectional low intensity steady red lights of the same intensity and characteristics as described in the above paragraph. In addition, the leg (or legs) adjacent to the helideck should be fitted with intermediate low intensity steady red lights of the same intensity and characteristics as described in Section 5.16.3 at 10 m (33 ft) intervals down to the level of the landing area. As an alternative, the legs may be floodlit providing the helicopter pilot is not dazzled.

5.16.6 Any ancillary structure within one kilometre of the helideck, and which is 10 m (33 ft) or more above helideck height, should be similarly fitted with red lights.

5.16.7 Red lights should be arranged so that the locations of the objects which they delineate are visible from all directions of approach above the landing area.

5.16.8 Facility/vessel emergency power supply design should include all forms of obstruction lighting. Any failures or outages should be reported immediately to the helicopter operator. The lighting should be fed from a UPS system.

5.16.9 For some helidecks, especially those that are on not permanently attended installations (NPAIs), it may be beneficial to improve depth perception by deploying floodlighting to illuminate the main structure (or legs) of the platform. This can help to address the visual illusion that a helideck appears to be floating in space. Care should be taken to ensure that any potential source of glare from structure lighting is eliminated by directing it away from the approach path of the helicopter and/or by providing louvers.