Safety Regulation Group

Civil Aviation Authority

CAP 437

Offshore Helicopter Landing Areas - Guidance on Standards

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The CAA has made many of the documents that it publishes available electronically (in addition to traditional printed format). Where practical, the opportunity has been taken to incorporate a clearer revised appearance to the documents. Any significant changes to the content of this document will be shown in the Explanatory Note. If no such changes are indicated the material contained in this document, although different in appearance to the previously printed version, is unchanged. Further information about these changes and the latest version of documents can be found at www.caa.co.uk.

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Explanatory Note

1 Introduction

1.1 The CAA has made many of the documents that it publishes available electronically. Where practical, the opportunity has been taken to incorporate a clearer revised appearance to the document.

1.2 This is a living document and will be revised at intervals to take account of changes in regulations, feedback from industry, and recognised best practice. Contact addresses, should you have any comments concerning the content of this document or wish to obtain subsequent amendments, are given on the inside cover of this publication.

2 Revisions in this Edition

2.1 The material contained in this document incorporates editorial corrections and updates to cross-references, the technical content is unchanged.

Foreword

1 This publication has become an accepted world-wide source of reference. The amendments made to this edition incorporate the results of the valuable experience gained by CAA staff during their 3½ years of offshore helideck inspecting with the Health and Safety Executive (HSE) and from co-operation with the British Helicopter Advisory Board (BHAB). Analysis of the results of the inspection regime, completed in April 1995, has resulted in changes to the way in which helidecks are now authorised for use by helicopter operators. Other changes reflect knowledge gained from accidents, incidents, occurrences, and research projects. Notably the section concerning the airflow environment, and the impact on this environment from exhaust and venting systems, has been re-visited. Paragraph numbering has been changed for easier reference.

2 CAP 437 gives guidance on the criteria required by the Authority in assessment of the standard of helicopter offshore landing areas for world-wide use by helicopters registered in the United Kingdom. These landing areas may be located on:

fixed offshore installations;
mobile offshore installations;
vessels supporting offshore mineral exploitation;
other vessels.

In this publication the term 'helideck' refers to all helicopter landing areas on fixed and mobile installations and vessels unless specifically differentiated. The term 'offshore' is used to differentiate from 'onshore'.

3 The criteria described in CAP 437 form part of the guidance issued by the Authority to United Kingdom helicopter operators which is to be accounted for in Operations Manuals required under United Kingdom aviation legislation and by the Joint Aviation Authority (JAA). If an offshore helideck does not meet the criteria, or if a change to the helideck environment is proposed, the case should be referred to the BHAB or helicopter operator in the first instance, prior to implementation. It is important that such changes are not restricted to consideration of the physical characteristics and obstacle protected surfaces of the helideck. Of equal, and sometimes even more importance are changes to the installation or vessel, and to adjacent installation or vessel structures which may affect the airflow, temperature, or quality of the air over the helideck (and adjacent helidecks) or on approach and take-off paths.

4 The procedure in the UK for authorising the use of helidecks is co-ordinated by the BHAB Helideck Sub-Committee in a process which (for UK Installations) involves the United Kingdom Offshore Operators' Association (UKOOA); the British Rig Operators' Association (BROA); and the International Association of Drilling Contractors (IADC) members' individual owner/operator safety management sytems. The process is designed to provide BHAB with accurate information (controlled drawings and survey) from which compliance with criteria can be assessed. The BHAB sub-committee has representation from all offshore helicopter operators in the UK. The process has been developed by the CAA and all parties mentioned above. BHAB publish the Installation/ Vessels Limitations List (IVLL) which contains details of all known helidecks together with any operator-agreed limitations applied to specific helidecks in order to compensate for any failings or deficiencies in meeting CAP 437 criteria; so that the safety of flights is not compromised. In the case of 'New – Builds' or major modifications to existing Installations that may have an effect on helicopter

operations, the CAA are available to give guidance on design criteria and the application of CAP 437 but the BHAB should be consulted at the earliest stage of design and will provide guidance and information as required so that their process of authorising the use of the helideck can be carried out in a timely fashion. Early consultation is essential if maximum helicopter operational flexibility is to be realised and incorporated into design philosophy.

5 A United Kingdom registered helicopter, therefore, shall not operate to an offshore helideck unless the helideck has been authorised and properly described in the helicopter operator's Operations Manual. Although the process described above is an industry-agreed system, the legal responsibility for acceptance of the safety of landing sites rests with the helicopter operator. The CAA accepts the process described above as being an acceptable way in which the assessment of the CAP 437 criteria can be made. The CAA, in discharging its regulatory responsibility, will audit the helicopter operators' application of the process.

6 The criteria in this publication relating to fixed and mobile Installations in the area of the UKCS provide guidance which is accepted by the Health and Safety Executive (HSE) and referred to in HSE offshore legislation. The criteria are guidance on **minimum** standards required in order to achieve a clearance which will attract no helicopter performance (payload) limitations. CAP 437 is an amplification of internationally agreed standards contained in the International Civil Aviation Organization Annex 14 to the Convention on International Civil Aviation, Volume 2, 'Heliports'. Additionally it provides advice on 'best practice' obtained from many aviation sources. 'Best Practice', naturally, should be moving forward continuously and it must be borne in mind that CAP 437 reflects 'current' best practice at the time of publication. There may be alternative means of meeting the criteria in the guidance and these will be considered on their merits.

7 Additional criteria are given relating to vessels used in support of offshore mineral exploitation which are not necessarily subject to HSE offshore regulation and also for tankers, cargo, passenger and other vessels.

8 Whenever the term 'Authority' is used in this publication, it means the Civil Aviation Authority unless otherwise indicated.

9 The United Kingdom Offshore Operators Association (UKOOA) publishes guidance material on the management of Offshore Installations for both Normally Attended and Unattended Installations (NAIs and NUIs). The Authority has assisted in the compilation of this guidance material.

10 As guidance this document will be under continuous review resulting from technological developments and experience; comments will be welcome on its application in practice.

11 It can be seen from the above that major changes have taken place to the way in which helidecks are cleared for operations. Such changes are reflected in future UK Aviation law as contained in JAR-OPS 3 (Joint Aviation Requirements – Commercial Air Transportation [Helicopters]) and in associated guidance. The CAA should be contacted on matters relating to interpretation and applicability of this guidance and Aviation Law.

Glossary of Terms and Abbreviations

Aiming Circle	Described in other publications as 'landing circle' or 'touch down marking'; the aiming point for normal landing, so designed that the pilot's seat can be placed directly above it in any direction with assured main and tail rotor clearances.
ANO	The Air Navigation Order 2000 (as amended).
BHAB	British Helicopter Advisory Board. The relevant body is the Offshore Helideck Sub-Committee c/o BHAB, Graham Suite, Fairoaks Airport, Chobham, Woking, Surrey, GU24 8HX. The current Chairman will be a member of staff of one of the offshore helicopter operators at his company address. In the text of this document the term 'BHAB' is used in relation to the UK system for clearing helidecks for helicopter operations. Outside UK, where this system is not in place, the term should be replaced by 'Helicopter Operator(s)'
C of F	The Certificate of Fitness. Any reference to this is equally applicable (in the context of this publication) to the Verification of Safety Critical items in the HSE Design and Construction Regulations. C of F will cease to exist after a transitional period.
D-Value	The largest overall dimension of the helicopter when rotors are turning. This dimension will normally be measured from the most forward position of the main rotor tip path plane to the most rearward position of the tail rotor tip path plane (or the most rearward extension of the fuselage in the case of Fenestron or Notar tails).
D-Circle	A circle, usually imaginary unless the helideck itself is circular, the diameter of which is the D-Value of the largest helicopter the helideck is intended to serve.
FOD	Foreign object debris/damage.
Helideck	A landing area on an offshore installation or vessel.
ICAO	International Civil Aviation Organization.
IVLL/HLL	Installation/Vessel Limitation List **or** 'Helideck Limitation List' (JAR-OPS 3); published and distributed by the BHAB **or** other JAA National Authority accepted bodies.
Landing Area	A generic term referring to any area primarily intended for the landing or take-off of aircraft.
NAI	Normally Attended Installation.
NUI	Normally Unattended Installation.
Perimeter D Marking	The marking in the perimeter line in whole numbers; i.e the D-Value (see above) rounded up or down to the nearest whole number. See also Chapter 4 paragraph 4.2.2.

SLA	Safe Landing Area. The area bounded by the perimeter line and perimeter lighting. N.B. The construction of the OFS and LOS segments (see below) should ensure that the main rotor will not risk conflict with obstacles when the nose of the helicopter is butted-up to, but not projecting over, the perimeter line. Thus the pilot, when landing in unusual circumstances, has confidence that he can touch down provided that all wheels are within the SLA and the nose of the helicopter is not projecting over the nearest perimeter line ahead. It must be noted, however, that only correct positioning over the aiming circle (see 'Aiming Circle' above) will ensure proper clearance with respect to physical obstacles **and** provision of ground effect **and** provision of adequate passenger access/egress.
OFS	Obstacle Free Sector. The 210° sector, extending outwards to a distance of 1000 metres within which no obstacles above helideck level are permitted.
LOS	Limited Obstacle sector. The 150° sector within which obstacles may be permitted, provided the height of the obstacles is limited.
Run-Off Area	An extension to the Landing Area designed to accommodate a parked helicopter.
UKCS	United Kingdom Continental Shelf (Geographical area).
Verification	A scheme for the development and maintenance of a safe installation under the (UK) requirements of the Offshore Installations and Wells (Design and Construction, etc) Regulations 1996.

Chapter 1 Introduction

1.1 History of Development of Criteria for Offshore Helicopter Landing Areas, 1964-1973

In the early 1960s it became apparent that there would be a continuing requirement for helicopter operations to take place on fixed and mobile offshore installations. Various ideas were put forward by oil companies and helicopter operators as to the appropriate landing area standards for such operations. In 1964, draft criteria were published which used helicopter rotor diameter as a determinant of landing area size and associated obstacle-free area. In the light of experience and after further discussions, the criteria were amended and re-published in 1968. These criteria were then, and still are, based upon helicopter overall length (from most forward position of main rotor tip to most rearward position of tail rotor tip, or rearmost extension of fuselage if 'fenestron' is used). This length is commonly referred to as 'D' for any particular helicopter as the determinant of landing area size, associated characteristics, and obstacle protected surfaces.

1.2 Department of Energy and the Health and Safety Executive Guidance on the Design and Construction of Offshore Installations, 1973 Onwards

1.2.1 In the early 1970s, the Department of Energy began the process of collating guidance standards for the design and construction of 'installations' – both fixed and mobile. This led to the promulgation of the Offshore Installations (Construction and Survey Regulations) 1974, which were accompanied by an amplifying document entitled 'Offshore Installations: Guidance on the design and construction of offshore installations' (the 4th Edition Guidance). This guidance included criteria for helicopter landing areas which had been slightly amended from those issued in 1968. During 1976 and 1977, the landing area criteria were developed even further during a full-scale revision of this Guidance document, following consultations between the Civil Aviation Authority, the British Helicopter Advisory Board and others. This material was eventually published in November 1977 and amended further in 1979. This latter amendment introduced the marking of the landing area to show the datum from which the obstacle-free area originated, the boundary of the area, and the maximum overall length of helicopter for which operations to the particular landing area were suitable. The first edition of CAP 437 was published in 1981, amended in 1983 and revised in December 1993. Since 1990 further changes have been introduced which include the latest helideck criteria internationally agreed and published as Volume II (Heliports) of Annex 14 to the Convention on International Civil Aviation.

1.2.2 In April 1991 the Health and Safety Commission and the Health and Safety Executive (HSE) took over from the Department of Energy the responsibility for offshore safety regulation. The Offshore Safety Act 1992, implementing the Cullen recommendations following the Piper Alpha disaster, transferred power to HSE on a statutory footing. HSE also took over sponsorship of the 4th Edition Guidance and Section 55 'Helicopter landing area' referring to all installations.

1.2.3 Since April 1991, HSE has introduced four sets of modern goal setting regulations which contain provisions relating to helicopter movements and helideck safety on offshore installations. These update and replace the old prescriptive legislation. The provisions are as follows:

	Regulations	Covers
1.	The Offshore Installations (Safety Case) Regulations 1992 (SCR) (SI 1992/2885)	**Regulation 2(1)** defines a major accident and this includes the collision of a helicopter with an installation. **Regulation 8** requires that a safety case should demonstrate that hazards with the potential to cause a major accident have been identified, their risks evaluated and measures taken to reduce personal risk to the lowest level that is reasonably practicable.
2.	The Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995 (PFEER) (SI 1995/743)	**Regulation 6(1)(c)** requires a sufficient number of personnel trained to deal with helicopter emergencies to be available during helicopter movements. **Regulation 7** requires the operator/owner of a fixed/mobile installation to ensure that equipment necessary for use in the event of an accident involving a helicopter is kept available near the helicopter landing area. Equipment provided under **Regulation 7** must comply with the suitability and condition requirements of **Regulation 19(1)** of PFEER. **Regulations 9, 12 and 13** make general requirements for the prevention of fire and explosion, the control of fire and explosion which would take in helicopter accidents. **Regulation 17** of PFEER requires arrangements to be made for the rescue of people near the installation from helicopter ditchings.

Regulations		Covers
3.	The Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995 (MAR) (1995/738)	**Regulation 8** requires people to co-operate with the Helicopter Landing Officer to enable him to perform his function referred to in **Regulation 13**. **Regulation 11** requires comprehensible instructions to be put in writing and brought to the attention of everybody to whom they relate. Circumstances where written instructions might be needed include helideck operations (particularly if involving part-time helideck crew). **Regulation 12(b)** requires arrangements which are appropriate for health and safety purposes, to be in place for effective communication between an installation, the shore, aircraft and other installations. Arrangements must also be in place for effective communication where a helicopter is to land on or take-off from an installation aboard which there will be no person immediately before landing or after the take-off, between a suitable offshore installation with persons on board or where there is no suitable installation, suitable premises ashore. **Regulation 13** requires the operator/owner of a fixed/mobile installation to ensure that a competent person is appointed to be in control of helideck operations on the installation (i.e. the Helicopter Landing Officer), is present on the installation, is in control throughout such operations and procedures are established and plant provided as will secure so far as is reasonably practicable that helideck operations including landing/ take-off are without risks to health and safety. **Regulation 14** requires the duty holder to make arrangements for the collection and keeping of meteorological, oceanographic and information relating to the movement of the offshore installation. This is because environmental conditions may affect helicopter operations and the ability to implement emergency plans. **Regulation 19** requires the operator/owner of an offshore installation to ensure that the installation displayed its name in such a manner as to make the installation readily identifiable by sea or air; and displays no name, letters or figures likely to be confused with the name or other designation of another offshore installation.

Regulations		Covers
4.	The Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996 (DCR) (SI 1996/913)	**Regulation 11** – Helicopter Landing Area requires the operator/owner of a fixed/ mobile installation to ensure that every landing area forming part of an installation is large enough and has sufficient clear approach/departure paths to enable any helicopter intended to use the landing area safely, to land and take-off in any wind and weather conditions permitting helicopter operations and is of a design and construction adequate for its purpose.
HSE has published guidance documents on SCR, MAR and DCR and in the case of PFEER, combined guidance and an Approved Code of Practice.		

The DCR which came into effect on 30 June 1996, revoke the 1974 Regulations. The regime requiring installations to possess a Certificate of Fitness issued by an HSE appointed Certifying Authority are now replaced by requirements for operators/ owners to introduce verification schemes in respect of the safety critical elements of their installations. The 4th Edition will be maintained throughout the two-year transitional period for the introduction of the new verification arrangements as it contains information which the industry continues to find useful. HSE will continue to discuss with the industry and others the future of such technical guidance.

1.3 **Applicability of Standards in Other Cases**

1.3.1 For vessels engaged in supporting mineral exploitation (such as crane or derrick barges, pipe-laying vessels, fire and rescue vessels, seismic research vessels, etc), which are not offshore installations and so do not require a Certificate of Fitness or verification scheme, the Authority recommends the application of the same standards for the helicopter landing areas contained in this CAP and as are given in the 4th Edition Guidance. Compliance with this recommendation will enable helicopter operators to fulfil their own legal obligations and responsibilities.

1.3.2 On other merchant vessels where it is impracticable for these standards to be achieved, for example, where the landing area has to be located amidships, the criteria to be used are included in Chapter 9 of this publication. Also in that chapter is guidance applicable to vessels involved on infrequent helicopter services in parts of the world other than the UKCS, or which may require facilities for helicopter winching activities only. Whilst this material covers the main aspects of criteria for a helicopter landing or manoeuvring area, there may be operational factors involved with these vessels such as air turbulence; flue gases; excessive helideck motion; or the size of restricted amidships landing areas, on which guidance should be obtained from the helicopter operator or BHAB and from competent specialists.

1.4 **Review of CAP 437**

Between 1992 and 1995 a programme of offshore installation helideck inspections was carried out. The inspections were carried out jointly by the Authority's Aerodrome Standards Inspectorate and the Health and Safety Executive (Offshore Safety Division). Experience gained during the inspections has been incorporated, where relevant, in this text.

1.5 **Worldwide Application**

1.5.1 It should be noted that references are made to United Kingdom legislatory and advisory bodies. However, this document is written so that it may provide useful guidance on minimum standards applicable for the safe operation of helicopters to offshore helidecks throughout the world.

1.5.2 The guidance is therefore particularly relevant to UK registered helicopters operating within **and outwith** the UKCS areas; whether or not they have access to the BHAB process. In cases where the accepted BHAB process is not applicable or available and where reference is made to BHAB in this document it can be substituted by the phrase ‘the helicopter operator’ – who should have in place a system for assessing and authorising the operational use of each helideck. Within Europe, under the control of the Joint Aviation Authority (JAA) through Joint Aviation Requirements (JAR-OPS 3), authorisation of each helideck is a specific Requirement (JAR-OPS 3.220) and guidance on the criteria for assessment is given in an ‘acceptable means of compliance’ (AMC) to this Requirement.

1.5.3 Outside UKCS other European helicopter operators will have in place systems which comply with the JAR-OPS 3 Requirement but which may not utilise the BHAB process in favour of a more local system which satisfies the National Authority. Throughout the range of operations covered by JAR-OPS agreement has been made to share all helideck information between helicopter operators by the fastest possible means.

1.5.4 Other helicopter operators, who operate outside the areas covered by the JAA and who are using this guidance document, are recommended to establish a system for assessing and authorising each helideck for operational use. It is a fact that many Installations and vessels do not fully comply with the criteria contained in the following chapters. A system for the assessment of the level of compliance **plus** a system for imposing compensating operational limitations is the only way of ensuring that the level of safety to flights is not compromised.

Chapter 2 Aircraft Performance Considerations

2.1 General Considerations

The guidance for helicopter landing areas on offshore installations or vessels results from the need to ensure that United Kingdom registered helicopters are able to operate safely at all times. Public transport helicopters operate in accordance with performance criteria and handling techniques contained in the aircraft flight manual and the operator's Operations Manual, both of which are examined by the Authority as part of the requirements for the grant and maintenance of an Air Operator's Certificate (AOC).

2.2 Safety Philosophy

2.2.1 Aircraft performance data is scheduled in the Flight Manual to enable the operator to comply with the principal performance requirement that, in the event of a power unit failure, the safety of the aircraft and its occupants remains assured in the ambient conditions. This means, in general terms, that following an engine failure the aircraft can either re-land at the take-off point, continue with landing at the intended landing point, or fly to a place where a safe landing can be made.

2.2.2 Operations Manuals outline flying procedures and the criteria to be used to ensure that helicopters are operated in a way which minimises exposure of the aircraft and its occupants during the short critical period following a power unit failure during the initial stage of take-off, or final stage of landing.

2.2.3 The Authority is currently researching the effects upon helicopter performance and control created by the offshore helideck environment in order to establish whether there is a need for additional procedures and/or revised criteria.

2.3 Factors Affecting Performance Capability

Helicopter performance is a function of many factors including the actual all-upweight; ambient temperature; pressure altitude; effective wind speed component; and operating technique. Other factors, concerning the physical and airflow characteristics of the helideck and associated or adjacent structures, will also combine to affect the length of the exposure period referred to in paragraph 2.2 above. These factors are taken into account in the determination of specific and general limitations which may be imposed in order to ensure adequate performance and to ensure that the exposure period is kept to a minimum. In many circumstances the period will be zero. It should be noted that, following a power unit failure, it will frequently be necessary for the helicopter to descend below deck level to gain sufficient speed to subsequently fly away, or in rare circumstances, to land on the water. In certain circumstances, where exposure periods would otherwise be unacceptably long, it may be necessary to reduce helicopter weight (and therefore payload) to reduce the risk to an acceptable level; or it may be necessary to suspend flying operations. In many cases, other than those due to the effects of severe weather conditions, these circumstances relate primarily to failings and deficiencies in application of the criteria documented in the following text.

Chapter 3 Helicopter Landing Areas – Physical Characteristics

3.1 General

3.1.1 This chapter provides guidance on the physical characteristics of helicopter landing areas (helidecks) on offshore installations and vessels. It should be noted that where a Verification Scheme is required it should state for each helicopter landing area the maximum size of helicopter in terms of D-value for which that area is certificated or verified with regard to strength and size in accordance with these requirements. Where these criteria cannot be met in full for a particular size of helicopter, the Verification Agency should consult the BHAB Helideck Sub-Committee on any operational restrictions that may be considered necessary in order to compensate for deviations from and non-compliance with these criteria. The BHAB will inform helicopter operators of any such restrictions through the IVLL.

3.1.2 The criteria which follow are based on helicopter size and weight. This data is summarised in Table 3.1 below.

Table 3.1 D-Value and Helicopter Type Criteria

Type	D-value (metres)	Rotor diameter (metres)	Max weight (kg)	't' value	Landing net size
Bolkow Bo 105D	12.00	9.90	2400	2.4t	Not required †
Bolkow 117	13.00	11.00	3200	3.2t	Not required †
Agusta A109	13.05	11.00	2600	2.6t	Small
Dauphin SA 365N2	13.68	11.93	4250	4.3t	Small
Sikorsky S76	16.00	13.40	5307	5.3t	Medium
Bell 212	17.46	14.63	5080	5.1t	Not required †
Super Puma AS332L	18.70	15.00	8599	8.6t	Medium
Bell 214ST	18.95	15.85	7936	8.0t	Medium
Super Puma AS332L2	19.50	16.20	9300	9.3t	Medium
Sikorsky S61N	22.20	18.90	9298	9.3t	Large
EH101	22.80	18.60	14600	15t	Large
Boeing BV234LR* Chinook	30.18	18.29	21315	21t	Large

* The BV234 is a tandem rotor helicopter and in accordance with ICAO Annex 14 Volume II, the helideck size required is 0.9 of the helicopter D, i.e. 27.16 m. The BHAB should be consulted if it is intended to use tandem rotor helicopters on offshore helidecks. See Chapter 10 – 'Tandem Rotor Helicopter Helidecks'.

† Where skid fitted helicopters are used routinely, landing nets are not recommended.

3.2 **Location**

The location of a specific helideck is often a compromise given the competing requirements for space but the following general points should be considered:-

a) it is located on the installation, with respect to prevailing wind conditions, in such a position that any structure induced airflow and temperature effects are minimised (see paragraph 3.3);

b) the clear approach and take-off sector recommended in paragraph 3.7 is available, with due regard to prevailing winds;

c) air turbulence and the quality of the airflow due to adjacent structures, hydrocarbon emissions, and temperature gradients created by such items as hot plumes and gas turbine exhausts are minimised and remain acceptable for all wind directions (see paragraph 3.3). If these conditions cannot be met it may be necessary to impose limitations on payloads or on certain approach directions. In extreme cases these limitations may create unacceptably severe restrictions for the owner/ operator. In such cases consideration can be given to providing a second landing area at the opposite side of the installation to cater for wind directions unfavourable to the primary site;

d) installation emergency (blowdown) systems which are designed to discharge hydrocarbon gases should be designed so that any emissions are controllable, and are not initiated automatically and instantaneously without consideration of sufficient warning to helicopter operators. All such blowdown or similar systems should be discussed in detail with the BHAB at an early stage in the design process. Systems which can discharge hydrocarbons without sufficient warning may attract permanent approach bans in certain wind directions and a total approach ban when the wind conditions are 'nil' or 'light and variable';

e) helidecks should be at or above the highest point of the main structure. This is a desirable feature but it should be appreciated that if this entails a landing area much in excess of 60 metres above sea level, the regularity of helicopter operations may be adversely affected in low cloud base conditions;

f) from the helicopter pilot's point of view, the preferred approach and take-off path for the helicopter would be in such a direction(s) that the Captain, in the right-hand seat, has the best view of the obstacle environment in the prevailing wind;

g) taking into account and allowing for all the points above, on balance the bisector of the obstacle free sector should be positioned facing into the prevailing wind so that the helicopter can approach into wind with the deck in the right-hand quadrant as viewed from the helicopter and facilitating an into wind overshoot in the clear (OFS) sector;

h) ready and protected access to and from the accommodation area is provided without the need to pass through working areas;

i) attention must also be paid to the probability of positioning other helidecks and structures (e.g. flotels, crane barges, drilling rigs, additional modules etc.) in close proximity to the design deck. Consideration must be given to the effect of adjacent structures of one installation (or vessel) affecting air quality and obstacle protected surfaces of another installation (or vessel).

3.3 Air Turbulence, Temperature Gradient and the Helideck Environment

3.3.1 The Authority, in conjunction with the HSE, is currently carrying out a research project into Helideck Environmental Issues. A CAA paper will be published in due course. This ongoing work will highlight new information for consideration by offshore installation and vessel designers, owners/operators and helicopter operators.

NOTE: Disturbances to a smooth airflow, regardless of cause or the properties of the phenomena, are generally described as 'turbulence'. Whereas the effects felt inside an aircraft may be similar, it is important to appreciate the differences between turbulence, windshear and flight in the vicinity of hot exhausts.

3.3.2 Turbulent airflows across the landing area can be caused by wind flow around other parts of the installation or vessel structure (and by adjacent structures) and by other system exhausts (in particular gas turbines), which can also cause temperature gradients. These effects can seriously influence helicopter handling and/or performance. The quality of the air on approach and over the helideck can be seriously degraded by hot and cold hydrocarbon vents.

3.3.3 All aircraft will perform to their maximum efficiency in smooth airflow. This is particularly important during take-off and landing manoeuvres where disruptions to smooth airflow are particularly unwelcome when the aircraft is close to the ground (or sea, or landing platform). It is a paradoxical fact that an offshore helideck and associated or adjacent structures may well be the only generator of turbulent airflow in the helicopter's flight path. For this reason the helideck must be considered always to sit within turbulence generators and every effort must be made to 'design out' such generators and minimise the effects. Turbulence generators and degraded air quality can be created by two distinct sources:

a) solid objects and structures which create turbulent airflow and/or vertical wind components around, above and downwind of the structure and

b) exhaust emissions, and efflux from cold gas outlets and hot gas outlets.

3.3.4 In the case of paragraph 3.3.3 a) above, the path of the turbulence can be reasonably predicted given that information is available as to the direction and speed of the (unaffected) natural wind. Clad derricks can provide considerable control difficulties for a helicopter pilot; whereas open, lattice-type structures generate less turbulent effects. Light and variable, or nil wind conditions will probably result in generation of no significant turbulence (even from clad derricks and other solid structures) as there is little or no 'downwind effect'. Turbulence generated by solid structures can be said to increase as a direct function of the natural (unaffected) wind speed.

3.3.5 Landing areas situated directly on top of deep slab-sided structures such as accommodation modules, have been known to suffer from excess vertical airflow components unless there is sufficient separation to allow airflow beneath the helideck. Sufficient airspace directly beneath the helideck itself will have the effect of smoothing out the flow over the surface of the helideck and minimise the vertical wind component. Such airspace should be preserved and protected and not allowed to become cluttered by later installation of other large objects which may negate the effect which the airspace is designed to provide.

3.3.6 As a general rule, the vertical component of airflows resulting from horizontal wind velocities up to 25 metres per second (48.6 kt) should not exceed ±0.9 metres per second (1.75 kt) over the landing area at main rotor height.

3.3.7 The case of paragraph 3.3.3 b) above, is more complex and can be more insidious. An approaching helicopter will probably be downwind of the efflux from the platform emission sources. Such efflux can extend a considerable distance downwind of the installation; and in conditions of poor visibility and at night the pattern of efflux may not be obvious to the pilot. It is essential therefore that such emission patterns are properly identified and documented through model testing and this information is made available to the BHAB for inclusion in the IVLL. Plume studies can be carried out to show dispersion and temperature gradients in various wind speeds and directions. In general, all sources of emission should be designed to be as far away from the helideck as possible and located so that the prevailing wind will ensure maximum separation between plume and helicopter approach path. In light and variable wind conditions or in conditions of 'nil wind' it will be difficult to predict the pattern of any emission plume. Pockets of gases could conceivably accumulate, unseen, in an unpredictable, haphazard dispersion pattern dictated by random effects of air densities and air movement. The gases could establish a presence in the vicinity of the helideck and could provide the pilot with a dangerous combination of control and power disadvantage. The insidious nature of this effect is exacerbated in the absence of any warning. It therefore follows that all exhaust and venting emissions must be properly identified and documented; and that these may attract limitations in certain specific wind direction segments; and on a 360° (total approach ban) basis in light or nil wind conditions. One helicopter accident in the UKCS (S61, August 1995) has been attributed to the effect of gas turbine exhaust emissions in nil or light and variable wind conditions. Such conditions are currently difficult to model and plume studies under these test conditions have not historically been considered. The North Sea is usually a windy place and wind, apart from any turbulence effect, is generally seen to have a beneficial effect on available power and controllability during take-off and landing. Flight crews should note in particular the adverse and potentially hazardous effects which nil or light and variable winds can have on exhaust emission and cold gas dispersion.

3.3.8 Hot (lit) gas plumes provide a good visual indication of their presence and of the plume characteristics and are generally therefore avoidable; though they can create unacceptable operational conditions. For example, they can increase ambient temperatures in the vicinity of the helideck to the extent that helicopter performance is degraded and must be accounted for. Where such effects are shown to be possible the helideck environment should be monitored. It may be necessary to impose limitations when such effects are taken into account.

3.3.9 In consideration of the effects of ambient temperature increases over the helideck area due to flare plumes or exhaust emissions, unless it is obvious that the air temperature in the vicinity of the flight paths to and from the helideck or adjacent helidecks will not be affected by the exhaust plume, a survey of ambient temperatures should be conducted. Where ambient temperature, in the vicinity of the flight paths and over the landing area, is increased by more than 2°C the BHAB should be informed. Rises of 2°C or more above ambient temperatures become an operational issue and require helicopter operators' review.

Ambient temperature information is required for computation of the helicopter's maximum all up weight. Current research findings indicate that additional considerations should be made by installation and helideck designers and by testing facilities to ensure that the 2°C ambient temperature rise is that occurring over a 3 second time interval, at a height above helideck level which takes into consideration the airspace required above the helideck to accommodate helicopter landing and take-off decision points. A CAA Paper on the subject of helideck environmental issues, including ambient temperature, will be published in due course.

3.3.10 Cold gas emissions have, over the last few years, become a feature of installation design due to the incorporation of certain safety sytems. These systems, known as 'Blowdown Systems' or 'Rapid Blowdown Systems', can release varying amounts of cold gas in certain platform malfunction situations. Such systems should always be designed to preclude unannounced release of cold gas. No matter how remote the possibility, any release of cold gas in the vicinity of a helicopter could have very serious results. Some systems in current use have the facility of containment of the release of hydrocarbons in dealing with the malfunctions for which they are designed to cope. Such release can be programmed to ensure that helicopter operations do not take place coincidentally. It is also understood, however, that some systems can produce cold gas with very little warning. It is essential that the BHAB is given a full understanding of the nature of any cold gas release system design; under what circumstances hydrocarbons may be released; and the highest volumes anticipated, so that an assessment of the risk can be made. The risk due to the possibility of unannounced cold gas release is a serious one due to the probable catastrophic effect on a helicopter (and its passengers and crew). Consideration must be given in this case to applying permanent approach bans in certain conditions of wind speed and direction. The installation of 'Status Lights' (see Chapter 4, paragraph 4.3.6) is not considered to be a solution to all potential flight safety issues arising from cold gas emissions; these lights are only a warning that the helideck is in an unsafe condition for helicopter operations.

Recent research into helideck environmental issues indicates that a limit of 10% LFL should be the maximum permissible concentration of hydrocarbon gas within the helicopter operating area. This level of concentration has been shown to have little significant effect on engines and rotor systems. However, helicopters will not knowingly operate in any level of hydrocarbon gas. Installation operators must have in place a management system which ensures that all helicopters in the vicinity of any release are immediately advised to stay clear.

3.3.11 All hydrocarbon cold vent systems should be designed to terminate and discharge at a location on the Installation as far from the helideck environs as possible. The potential release volumes, flammable concentrations, and dispersal characteristics should be quantified. This approach allows the helideck designer to apply a 'no fly zone' around the hazardous area. A similar approach should be taken when designing Installation exhaust and flare systems. If there is evidence on the process control panel of a major process upset condition arising, the General Alarm should be sounded, alternatively the Gas Alarm. The Radio Operator/HLO should already have been advised if helicopter movements are taking place, so that the he can advise helicopters to stay clear. Helideck Status Light Systems should be activated at this stage.

3.3.12 The combined effects of airflow direction and turbulence; prevailing wind; installation exhaust emissions; and the plumes from hot and cold gas vents and releases should be determined for each installation. Further information on these matters can be found in Davies et al 1977 and 1979, and Davies 1979 (see Appendix B, ref 1). Suitable model tests should be carried out to confirm the suitability of the arrangements. The resulting information, in summary format, should be made available to the BHAB.

3.3.13 In assessment of helideck physical characteristics, and the quality of the surrounding air attention must always be paid to adjacent fixed installations (whether separate or bridge-linked), mobile installations and vessels, of a permanent or temporary nature. These can affect helicopter operations due to infringement of obstacle protected surfaces and also due to the presence of (additional) emissions and turbulence generators. For practical purposes, in this context and until research results (see paragraph 3.3.1 above) indicate otherwise, each helideck protection zone should be considered to be the airspace extending from sea level to 2000 feet above sea level and within 1000 metres of the helideck.

3.3.14 Previous editions of CAP 437 have suggested that 'some forms of exhaust plume indication should be provided for use during helicopter operations, for example, by the production of coloured smoke'. There appears to have been a reluctance on the part of installation operators to consider this. In some circumstances introduction of smoke into exhaust emissions would not only make visible an otherwise invisible hazard but could also enable operational strategies to be developed which could minimise operational restrictions.

3.4 Structural Design

Offshore installations may be designed for a specific type of helicopter. Optimum operational flexibility will be gained from consideration of the potential life and usage of the facility together with developments in helicopter design and technology. Some comfort may be gained from the fact that a considerable period of time is required to translate a conceptual design into commercial production of a helicopter. The landing and take-off area should be designated for the heaviest and largest helicopter it is anticipated will use the facility (Table 3.1). Consideration in the design must also be given to other types of loading such as personnel, traffic, snow, freight, fuelling equipment etc. For the purpose of design it is to be assumed that single main rotor helicopters will land on the wheel or wheels of two main undercarriages or skids (if fitted) and that the tandem main rotor helicopter will land on the wheel or wheels of all main undercarriage centres of the specified helicopter and divided equally between the two main undercarriages. For tandem main rotor helicopters the total loads imposed on the structure should be taken as concentrated loads on the undercarriage centres of the specified helicopter and distributed between the main undercarriages in the proportion in which they carry the maximum static loads. The concentrated undercarriage loads should normally be treated as point loads but where advantageous a tyre contact area may be assumed in accordance with the manufacturer's specification. The maximum take-off weight and undercarriage centres for which the platform has been designed and the maximum size and weight of helicopter for which the deck is suitable should be stated in the Installation/Vessel Operations Manual, the Certificate of Fitness or; the Verification documentation. Plastic design considerations may be applied for the deck (i.e. plating and stiffeners only) but elastic considerations must be applied to the main supporting members (i.e. girders, trusses, pillars, columns etc.).

Notes: **1** Helideck strength requirements contained in this paragraph and the following paragraphs 3.5 and 3.6 are those defined in the Health and Safety Executive Guidance Notes (Offshore Installations: Guidance on design, construction and certification, Section 55.5).

2 Consideration should be given to the possibility of accommodating an unserviceable helicopter on the side of the deck while a relief helicopter is required to land. If this contingency requirement is designed into the construction/operating philosophy the helicopter operator must be informed of any weight restrictions imposed on the relief helicopter by the structural integrity.

3 Alternative loading criteria equivalent to those recommended here and in paragraphs 3.5 and 3.6 may be used where aircraft specific loads have been derived by the aircraft manufacturer from an appropriate assessment which takes account of the full range of potential landing conditions, including failure of a single engine at a critical point, and the behaviour of the aircraft undercarriage. The aircraft manufacturer must be able to provide information to interested parties, including the owner or operator of the installation and the helicopter operator to justify any such alternative criteria. The aircraft manufacturer may wish to seek the opinion of the Authority on the basis of the criteria to be used. In consideration of alternative criteria the Authority is content to assume that the single engine failure is the case among likely survivable emergencies which would generate the highest vertical rate of descent on to the helideck.

3.5 **Loads – Helicopters Landing**

The helicopter landing area should be designed to withstand all stresses that result from a helicopter landing. The following must be taken into account:

a) **Dynamic load due to impact landing**. This must cover both a heavy normal landing and an emergency landing. For the former, an impact load of 1.5 x maximum take-off weight (MTOW) of the helicopter should be used, distributed as described in paragraph 3.4 above. This should be treated as an imposed load, applied together with the combined effect of b) to f) below in any position on the safe landing area so as to produce the most severe landing condition for each element concerned. For the latter an impact load of 2.5 x MTOW should be applied in any position on the landing area together with the combined effects of b) to f) inclusive.

b) **Sympathetic response of landing platform**. The dynamic load (see a) above) should be increased by a structural response factor depending upon the natural frequency of the deck structure when considering the design of supporting beams and columns. Unless values based upon particular undercarriage behaviour and deck frequency are available, it is recommended that a minimum structure response factor of 1.3 should be used. For the Boeing BV 234LR Chinook refer to Chapter 10.

c) **Overall superimposed load on the landing platform**. To allow for snow load/ personnel etc; in addition to the wheel loads an allowance of 0.5 kN/m2 should be included in the design.

d) **Lateral load on landing platform supports**. The supports of the platform should be designed to resist concentrated horizontal imposed loads equivalent to 0.5 x maximum take-off weight of the helicopter, distributed between the undercarriages in proportion to their vertical loading. This should be applied in the direction which will produce the most severe loading conditions for each element concerned.

e) **Dead load of structural members**.

f) **Wind loading**. Wind loading should be allowed for in the design of the platform in accordance with Section 11 of the HSE Guidance (Environmental considerations). This should be applied in the direction which, together with the imposed loading in d) above, will produce the most severe loading condition for each element concerned.

g) **Punching shear**. A check should be made for the punching shear of an undercarriage wheel with a contact area of 65×10^3 mm^2. Particular attention to detailing should be taken at the junction of the supports and the platform deck.

3.6 **Loads – Helicopters at Rest**

The helicopter platform should be designed to withstand all stresses that result from a helicopter at rest; the following must be taken into account:

a) **Imposed load from helicopter at rest**. The entire helicopter platform must be designed to carry an imposed load equal to the maximum take-off weight of the helicopter. This should be distributed between all the undercarriages of the helicopter. It should be applied in any position on the helicopter platform so as to produce the most severe loading condition for each element concerned.

b) **Overall superimposed load, dead load and wind load**. The values for these loads are the same as given in paragraph 3.5 above and should be used in combination with a) above. Consideration should also be given to the additional wind loading from a secured helicopter.

c) **The effect of acceleration forces and other dynamic** amplification forces arising from the predicted motions of the installation, principally mobiles and vessels, in the appropriate environmental condition should be considered where applicable.

3.7 **Size and Obstacle Protected Surfaces**

3.7.1 For any particular type of single main rotor helicopter, the helideck should be sufficiently large to contain a circle of diameter D equal to the largest dimension of the helicopter when the rotors are turning. This D circle should be totally unobstructed (see Table 3.1 for D values). Due to the actual shape of most offshore helidecks the D circle will be 'imaginary' but the helideck shape must be capable of accommodating such a circle within its physical boundaries.

3.7.2 From any point on the periphery of the above mentioned D circle an obstacle-free approach and take-off sector should be provided which totally encompasses the safe landing area (and D circle) and which extends over a sector of at least 210°. Within this sector, and out to a distance of 1000 metres from the periphery of the landing area, only the following items may exceed the height of the landing area, but should not do so by more than 0.25 metres:

- the guttering or slightly raised kerb (associated with the requirements in paragraph 3.8.2);

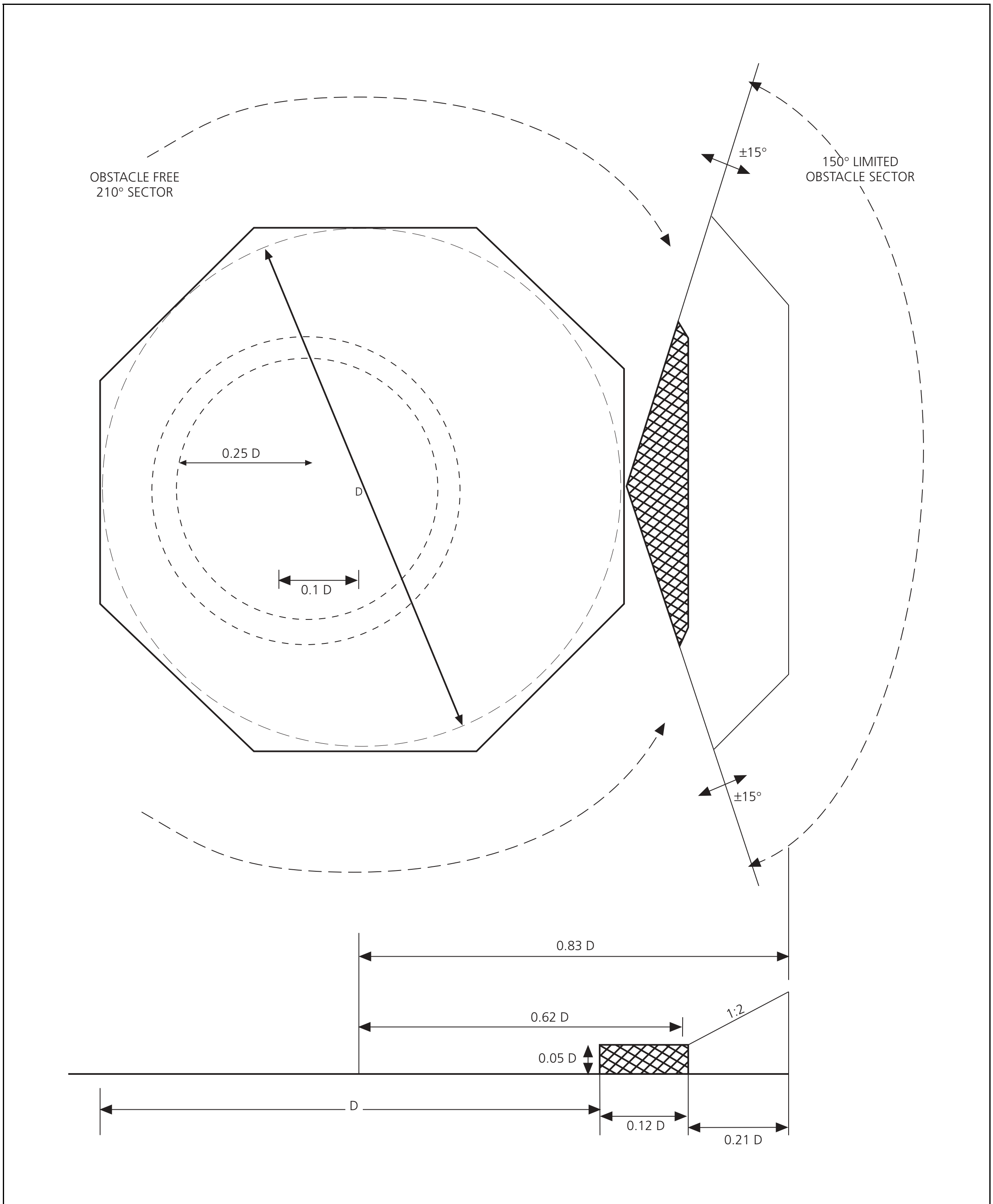


Figure 3.1 Obstacle Limitation (Single Main Rotor and Side by Side Main Rotor Helicopters) showing position of Aiming Circle

- the lighting required by Chapter 4;
- the outboard edge of the safety net required in paragraph 3.10;
- the foam monitors;
- those handrails and other items associated with the landing area which are incapable of complete retraction or lowering for helicopter operations.

3.7.3 The bisector of the 210° obstacle free sector should normally pass through the centre of the D circle. The sector may be 'swung' by up to 15° as illustrated in Figure 3.1 and paragraph 10.2 but not for bi-directional landing rectangles (See Chapter 10). Acceptance of the 'swung' criteria will normally only be applicable to existing Installations.

3.7.4 The Diagram at Figure 3.1 shows the extent of the two segments of the 150° Limited Obstacle Sector (LOS) and how these are measured from the centre of the (imaginary) 'D' Circle and from the perimeter of the SLA. This diagram assumes, since most helidecks are designed to the minimum requirement of accommodating a 1 'D' Circle, that the 'D' Circle perimeter and SLA perimeter are coincidental. No objects above 0.05D are permitted in the first (hatched area in Figure 3.1) segment of the LOS. The first segment extends out to 0.62D from the centre of the 'D' Circle, or 0.12D from the SLA perimeter marking. The second segment of the LOS, in which no obstacles are permitted within a rising 1:2 slope from the upper surface of the first segment, extends out to 0.83D from the centre of the 'D' Circle, or a further 0.21D from the edge of the first segment of the LOS.

The exact point of origin of the LOS is assumed to be at the periphery of the 'D' Circle.

Some helidecks are able to accommodate a SLA which covers a larger area than the declared 'D' value; a simple example being a rectangular deck with the minor dimension able to contain the 'D' Circle. In such cases it is important to ensure that the origin of the LOS (and OFS) is at the SLA perimeter as marked by the perimeter line. Any SLA perimeter must guarantee the obstacle protection afforded by both segments of the LOS. The respective measurements of 0.12D from the SLA perimeter line, plus a further 0.21D are to be applied. On these larger decks there is thus some flexibility in deciding the position of the perimeter line and SLA in order to meet the LOS requirements and when considering the position and height of fixed obstacles. Separating the origin of the LOS from the perimeter of the 'D' Circle in Figure 3.1 and moving it to the right of the page will demonstrate how this might apply on a rectangular SLA.

The extent of the LOS segments will, in all cases, be lines parallel to the SLA perimeter line and follow the boundaries of the SLA perimeter (see Figure 3.1). Only in cases where the SLA perimeter is circular will the extent be in the form of arcs to the 'D' circle. However, taking the example of an octagonal SLA as drawn at Figure 3.1, it would be possible to replace the angled corners of the two LOS segments with arcs of 0.12D and 0.33D centred on the two adjacent corners of the SLA; thus cutting off the angled corners of the LOS segments. If these arcs are applied they must not extend beyond the two corners of each LOS segment so that minimum clearances of 0.12D and 0.33D from the corners of the SLA are maintained. Similar geometric construction may be made to a square or rectangular SLA but care must be taken to ensure that the LOS protected surfaces minima can be satisfied from all points on the SLA perimeter.

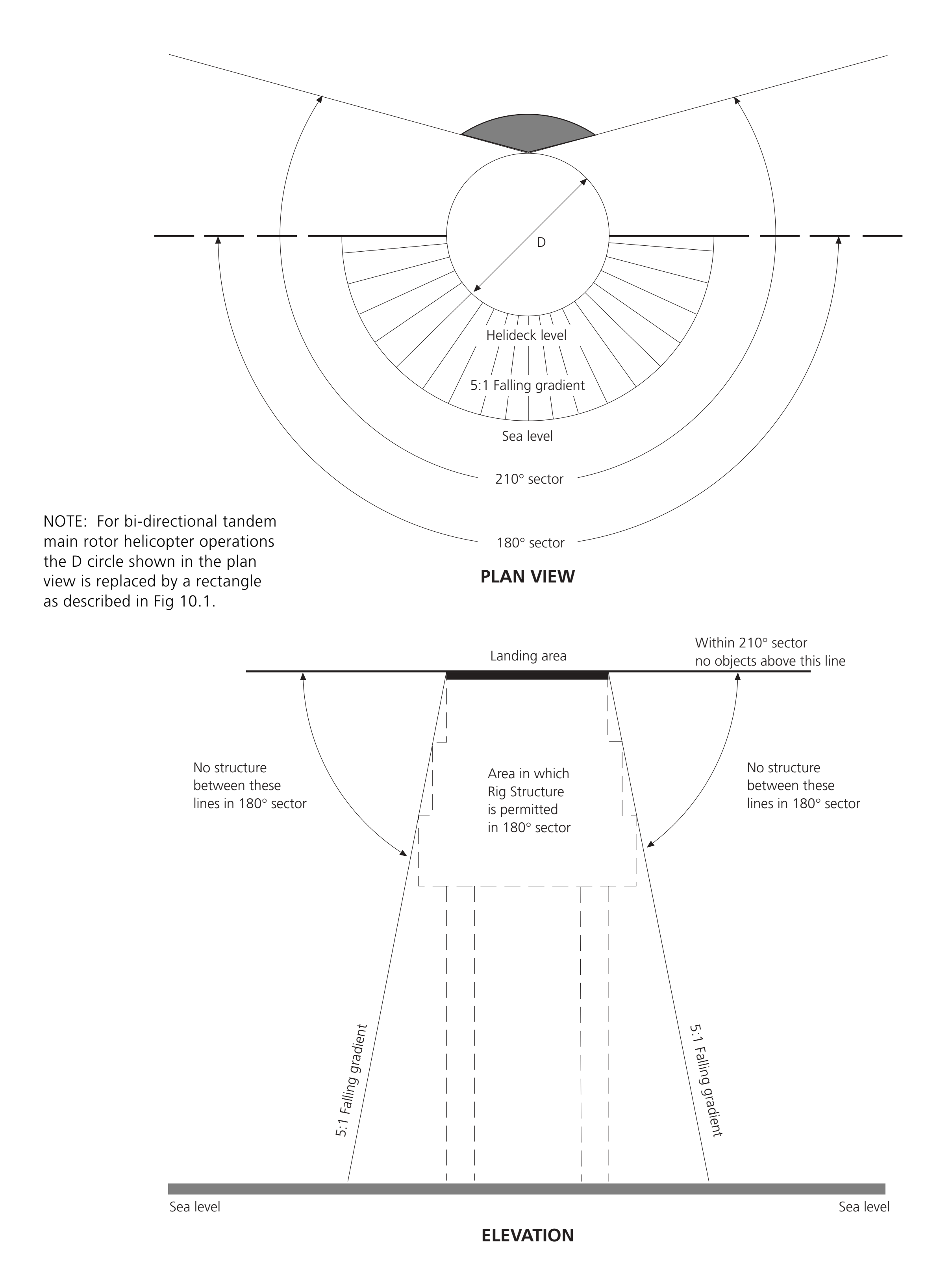


Figure 3.2 Obstacle Free Areas – Below Landing Area Level (For all types of helicopters)

3.7.5 Whilst application of the criteria in paragraph 3.7.2 above will ensure that no unacceptable obstructions exist above the helicopter landing area level over the whole 210° sector, it is necessary to consider the possibility of helicopter loss of height due to power unit failure during the latter stages of the approach or early stages of take-off. Accordingly, a clear zone should be provided below landing area level on all fixed and mobile installations. This clear zone should be provided over **at least** 180°, with an origin at the centre of the 'D' Circle, and with a falling gradient of 5 in 1 from the edges of the landing area to the surface of the sea (see Figure 3.2). This falling 5:1 protected surface should ideally cover the whole of the 210° OFS and extend outwards for 1000 metres. All objects that are underneath anticipated final approach paths should be assessed.

NOTE: For practical purposes the falling obstacle limitation surface can be assumed to be defined from points on the outboard edge of the helideck perimeter safety netting supports (1.5 metres from deck edge). Minor infringements of the surface by foam monitor platforms or access/escape routes may be accepted only if they are essential to the safe operation of the helideck but may also attract helicopter operational limitations.

3.7.6 It is recognised that when support installations, such as 'flotels' and crane-barges are operating close to other installations, it will not always be possible to meet the horizontal and vertical obstacle protected surface requirements. In these circumstances, installation operators should attempt to meet the above criteria as closely as possible when planning the siting of a combination of installations or an installation and a vessel, and should forward drawings of the proposed configuration to the BHAB as early as possible in the process for assessment and consultation on the operational aspects. Consultation with the helicopter operators in the early planning stages will help to optimise helicopter operations for support installation location.

NOTE: **As a general rule, on helidecks where obstacle protected surfaces are infringed by other installations or vessels which are positioned within 1000 metres of the point of origin of the sector, it may be necessary to impose helicopter operating restrictions on one or all helidecks affected.**

3.7.7 It is accepted that, at times, short term infringement to obstacle protected surfaces cannot be avoided when supply/support vessels work close to an installation. It may be impractical to assess such situations within the time available. However, the helicopter operator may need to apply operational limitations in such circumstances. It is therefore important for helicopter crews to be kept informed of all temporary infringements.

3.8 Surface

3.8.1 The landing area should have an overall coating of non-slip material and all markings on the surface of the landing area should be made with the same non-slip materials. Whilst extruded section or grid construction aluminium (or other) decks may incorporate adequate non-slip profiles in their design, it is preferable that they are also coated with a non-slip material unless adequate friction properties have been designed into the construction. It is important that the friction properties exist in all directions. Over-painting friction surfaces on such designs may compromise the friction properties. Recognised surface friction material is available commercially.

3.8.2 Every landing area should have a drainage system which will direct any rainwater and fuel spills within its boundary to a safe place. Any distortion of the helideck surface on any installation due to, for example, loads from a helicopter at rest should not modify the landing area drainage system to the extent of allowing spilled fuel to remain on the deck. A system of guttering or a slightly raised kerb should be provided around the perimeter to prevent spilled fuel from falling on to other parts of the installation and to conduct the spillage to an appropriate drainage system. The capacity of the drainage system should be sufficient to accept a maximum spillage of fuel on the deck. The calculation of the amount of spillage to be contained should be based on an analysis of helicopter type, fuel capacity, typical fuel loads and uplifts. The design of the drainage system should preclude blockage by debris. The helideck area should be properly sealed so that spillage will only route into the drainage system.

3.8.3 Tautly-stretched rope netting should be provided to aid the landing of helicopters with wheeled undercarriages in adverse weather conditions. The intersections should be knotted or otherwise secured to prevent distortion of the mesh. It is preferable that the rope be 20 mm diameter sisal, with a maximum mesh size of 200 mm. The rope should be secured every 1.5 metres round the landing area perimeter and tensioned to at least 2225 N. Netting made of material other than sisal will be considered but netting should not be constructed of polypropylene type material which is known to rapidly deteriorate and flake when exposed to weather. Tensioning to a specific value may be impractical offshore. As a rule of thumb, it should not be possible to raise any part of the net by more than approximately 250 mm above the helideck surface when applying a vigorous vertical pull by hand. The location of the net should ensure coverage of the area of the Aiming Circle but should not cover the helideck Identification marking or 't' value markings. Some nets may require modification to outboard corners so as to keep the Identification Marking uncovered. In such circumstances the dimensions given in Table 3.2 may be modified.

3.8.4 There are three sizes of netting as listed below in Table 3.2. The minimum size depends upon the type of helicopter for which the landing area is to be used as indicated in Table 3.1.

Table 3.2 Helicopter Deck Netting

Small	6 metres by 6 metres
Medium	12 metres by 12 metres
Large	15 metres by 15 metres

3.8.5 For fixed NAIs, where no significant movement due to environmental conditions occurs, provided the helideck can be shown to achieve an average surface friction value of not less than 0.65 determined by a test method approved by the Authority, the helideck landing net may be removed. The installation operator should ensure thereafter that the helideck is kept free from oil, grease, ice, snow or any other contaminant, particularly guano, that could degrade surface friction. Assurance must be provided to the helicopter operator that procedures are in place for elimination and removal of contaminants prior to helicopter movement. Following removal of the netting, the helideck should be re-tested at regular intervals. The criteria for initial removal and the frequency of subsequent testing should be approved by the Certifying Authority or Verification Agency, subject to the guidance contained in CAA Paper 98002. Friction testing periodicity can be determined using a simple trend analysis as described in this paper. Table 3.3 indicates typical frequencies of inspection for given ranges of friction value.

Consideration to remove landing nets on NUIs may only be given if procedures are in place which guarantee that the helideck will remain clear of contaminants such that there is no risk of helideck markings and visual cues being compromised or friction properties reduced.

Landing nets on Mobile Installations have generally, in the absence of any research, been regarded as essential. However, it may be possible to present a Safety Case to BHAB for specific installations. The Safety Case must consider pitch, roll and heave limitations and will require flight testing and a certain amount of research work.

Table 3.3 Friction Requirements for Landing Area Net Removal

Average surface friction value	Maximum period between tests
0.85 and above (Recognised Friction Surface)[1]	36 months
0.7 to 0.84	12 months
0.65 to 0.69	6 months
Less than 0.65	Net to be retained

1. Refer to CAA Paper 98002

NOTE: See also Cranfield University (College of Aeronautics) Paper FS–2191

3.8.6 Recent experience has shown that the removal of landing nets on some installations has provided undesirable side-effects. Although the landing net was designed specifically to enhance the friction properties of helideck surfaces, it would appear that its textural properties can also provide pilots with a rich set of visual cues in terms of rate of closure and lateral movement which are essential for pilots in what can otherwise be a poor cueing environment. Serious consideration must be given to this aspect before a landing net is removed. The helicopter operator should be consulted before existing landing nets are removed and Installation operators should be prepared to replace landing nets if so advised by the helicopter operator in the case that visual cueing difficulties exist. For these reasons it is also recommended that the design of new Installations should incorporate the provision of landing net fittings regardless of the type of friction surface to be provided.

3.9 Helicopter Tie-Down Points

3.9.1 Sufficient flush fitting (when not in use) or removable semi-recessed tie-down points should be provided for securing the maximum sized helicopter for which the helideck is designed. They should be so located and be of such strength and construction to secure the helicopter when subjected to weather conditions pertinent to the installation design considerations. They should also take into account, where significant, the inertial forces resulting from the movement of floating units.

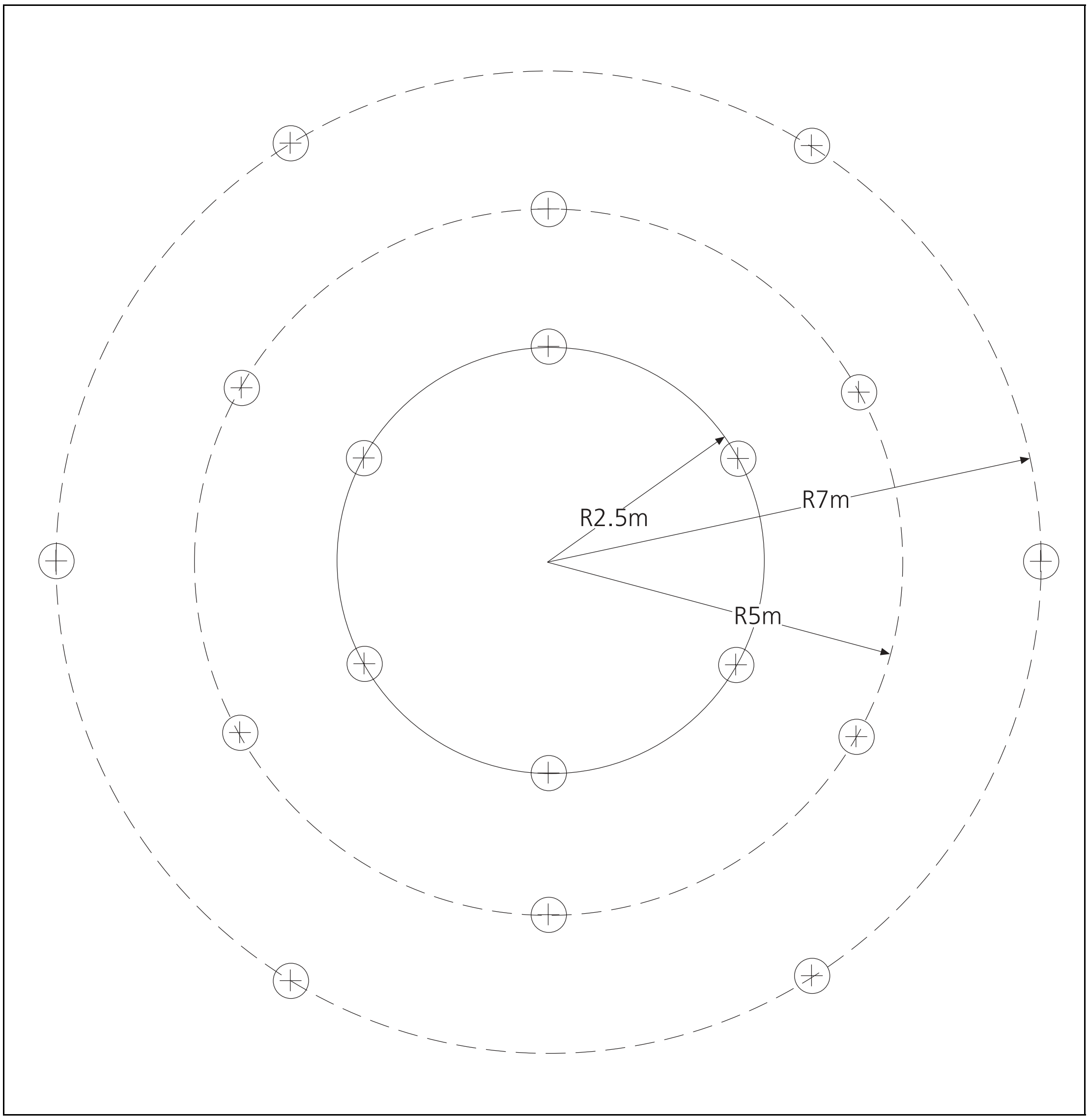


Figure 3.3 Example of Suitable Tie-down Configuration

NOTES:

1 The tie-down configuration should be based on the centre of the Aiming Circle marking.

2 Additional tie-downs will be required in a parking area.

3 The outer circle is not required for 'D' values of less than 22.2m.

3.9.2 Tie-down rings should be compatible with the dimensions of tie-down strop attachments. Tie-down rings should be stressed to 5000 kg, as should any tie-down strops. The maximum bar diameter of the tie-down should be 22 mm in order to match the strop hook dimension of the tie-down strops carried in UK offshore helicopters. Advice on recommended safe working load requirements for strop/ring arrangements for specific helicopter types can be obtained from the helicopter operator.

3.9.3 An example of a suitable tie-down configuration is shown at Figure 3.3. The BHAB will provide guidance on the configuration of the tie-down points for specific helicopter types.

3.10 Safety Net

3.10.1 Safety nets for personnel protection should be installed around the landing area except where adequate structural protection against falls exists. The netting used should be of a flexible nature, with the inboard edge fastened level with, or just below, the edge of the helicopter landing deck. The net itself should extend 1.5 metres in the horizontal plane and be arranged so that the outboard edge is slightly above the level of the landing area, but by not more than 0.25 metres, so that it has an upward and outward slope of at least 10°. The net should be strong enough to withstand and contain, without damage, a 75 kg weight being dropped from a height of 1 metre.

3.10.2 A safety net designed to meet these criteria should not act as a trampoline giving a 'bounce' effect. Where lateral or longitudinal centre bars are provided to strengthen the net structure they should be arranged and constructed to avoid causing serious injury to persons falling on to them. The ideal design should produce a 'hammock' effect which should securely contain a body falling, rolling or jumping into it, without serious injury. When considering the securing of the net to the structure and the materials used, care must be taken that each segment will meet adequacy of purpose considerations. Polypropylene deteriorates over time; various wire meshes have been shown to be suitable if properly installed.

3.11 Access Points

3.11.1 Many helicopters have passenger access on one side only and helicopter landing orientation in relation to landing area access points becomes important because it is necessary to ensure that embarking and disembarking passengers are not required to pass around the helicopter tail rotor, or under the main rotor of those helicopters with a low profile rotor, when a 'rotors-running turn-round' is conducted (in accordance with normal offshore operating procedures).

3.11.2 There should be a minimum of two access/egress routes to the helideck. The arrangements should be optimised to ensure that, in the event of an accident or incident on the helideck, personnel will be able to escape upwind of the landing area. Adequacy of the emergency escape arrangements from the helideck should be included in any evacuation, escape and rescue analysis for the installation, and may require a third escape route to be provided.

3.11.3 The need to preserve, in so far as possible, an unobstructed falling 5:1 gradient (see paragraphs 3.7.5 and 3.7.6 above) and the provision of up to three helideck access/escape routes, with associated platforms, may present a conflict of requirements. A compromise may therefore be required between the size of the platform commensurate with its effectiveness and the need to retain the protection of an unobstructed falling 5:1 gradient. In practice, the 5:1 gradient is taken from the outboard edge of the helideck perimeter safety net supports. Emergency access points which extend outboard from the perimeter safety net constitute a compromise in relation to an unobstructed falling 5:1 gradient which may lead, in some instances, to the imposition of helicopter operating limitations. It is therefore important to construct access point platforms in such a manner as to infringe the falling 5:1 gradient by the smallest possible amount but preferably not at all. Suitable positioning of two major access points clear of the requirements of the protection of the falling 5:1 gradient should always be possible. However, the third access referred to at paragraph 3.11.2 will probably lie within the falling 5:1 sector and where this is the case it should be constructed within the dimensions of the helideck perimeter safety net supports (i.e. contained within 1.5 metres of the edge of the landing area).

3.11.4 Where foam monitors are co-located with access points care should be taken where possible to ensure that no monitor is so close to an access point as to cause injury to escaping personnel by operation of the monitor in an emergency situation.

3.11.5 Where handrails associated with helideck access/escape points exceed the height limitations given at paragraph 3.7.2 they should be retractable, collapsible or removable. When retracted, collapsed or removed the rails should not impede access/egress. Handrails which are retractable, collapsible and removable should be painted in a contrasting colour scheme. Procedures should be in place to retract, collapse, or remove them prior to helicopter arrival. Once the helicopter has landed, and the crew have indicated that passenger movement may commence (see Note below), the handrails may be raised and locked in position. The handrails must be retracted, collapsed, or removed again prior to the helicopter taking-off.

NOTE: The helicopter crew will switch off the anti-collision lights to indicate that the movement of passengers and/or freight may take place (under the control of the HLO). Installation/Vessel safety notices placed on approach to the helideck access should advise personnel not to approach the helicopter when the anti-collision lights are on.

3.12 Winching Operations

It should be noted that for any installation or vessel, attended or unattended, fixed or mobile for which helicopters are a normal mode of transport for personnel, a helicopter landing area should be provided. Winching should not be adopted as a normal method of transfer. However, if winching operations are required, they should be conducted in accordance with procedures agreed between the helicopter operator and the Authority and contained within the Helicopter Operator’s Operations Manual. Requirements for winching operations should be discussed with the specific helicopter operator well in advance.

3.13 Normally Unattended Installations

3.13.1 The CAA provides guidance for helicopter operators on the routeing of helicopters intending to land on NUIs. The CAA will also provide such guidance and advice to helicopter operators and installation operators in consideration of specific Installation Safety Cases and risk analyses which address routeing philosophy.

3.13.2 Guano and associated bird debris is a major problem for NUIs. Associated problems concern the health hazard on board; degradation of visual aids (markings and lighting) and friction surfaces; and the potential for FOD. Helicopter operators should monitor the state of NUI helidecks and advise the owner/operator **before** markings and lighting degradation becomes a safety concern. Experience has shown that, unless adequate cleaning operations are undertaken or effective preventative measures are in place, essential visual aids will quickly become obliterated. NUIs should be monitored continuously for signs of degradation of visual cues and flights should not be undertaken to helidecks where essential visual cues for landing are insufficient.

3.13.3 Guano is an extremely effective destroyer of friction surfaces whenever it is allowed to remain. Because of the difficulty of ensuring that a friction surface is kept clear of contaminants (see paragraph 3.8.5 above), permanent removal of the landing net on NUIs is not normally a viable option unless effective preventative measures are in place.

Chapter 4 Visual Aids

4.1 General

4.1.1 The name of the installation should be clearly displayed in such positions on the installation so that it can be readily identified from the air and sea from all normal angles and directions of approach. For identification from the air the helideck name and the side identification panels are used. It is not necessary, neither is it a legal requirement, to complicate recognition processes by inclusion of 'Block Numbers', Company logos, or other designators. In fact, complication of identifiers can be confusing and will unnecessarily, and undesirably, extend the mental process of recognition at the critical time when the pilots' concentration is being maximised by the demands of the landing manoeuvre. The names on both identification markings should be identical, simple and unique and provide for unambiguous understanding on the radio. The approved radio callsign of the installation should be the same name as the helideck and side panel identifier. Where the inclusion of 'block numbers' on side identification panels is deemed to be **essential (i.e. for purposes other than recognition)**, the **name** of the installation should also be included; e.g. 'NAME. BLOCK NO.' The installation identification panels should be highly visible in all light conditions. They should be suitably illuminated at night and in conditions of poor visibility. In order to minimise the possibility of 'wrong rig landings' use of new technology should be made so that identification can be confirmed in the early stages of the approach (say out to 600 metres) by day and night. Modern technology is capable of providing such brightness in most ambient conditions. Use of high-intensity cluster LED or fibre-optic systems in other applications have been shown to be effective even in severely reduced visibility. Sole reliance on retro-reflective signage for side identification panels has been shown to be generally ineffective for early recognition by flight crews at night and in poor visibility. (HSE Operations Notice 39, dated December 1997, also refers).

4.1.2 Helideck markings (specifically the installation identification marking) and side identification panels are used by pilots to obtain a final pre-landing confirmation that the correct helideck has been selected. It is therefore **VITAL** that the helideck markings and side identification panels are maintained in the best possible condition, regularly re-painted and kept free of all visibility-reducing contaminants. Helideck owners/operators should ensure that specific inspection and re-painting maintenance procedures and schedules for helideck markings and side identification panels take account of the importance of their purpose. Side identification panels should be kept free of any obscuring paraphernalia (draped hoses etc.) and be as high as possible on the structure.

4.1.3 The installation identification (see paragraphs 4.1.1 and 4.1.2) should be marked on the helideck surface between the origin of the obstacle-free sector and the aiming circle in symbols not less than 1.2 metres high and in a colour (normally white) which contrasts with the background. The name should not be covered by the deck netting. Where there is insufficient space to place the helideck marking in this position, the marking position shall be agreed with BHAB. See also Chapter 3, paragraph 3.8.3.

4.1.4 Helideck perimeter line marking and lighting serves to identify the limits of the Safe Landing Area (SLA – see Glossary) for day and night operations.

4.1.5 A wind direction indicator (windsock) should be provided and located so as to indicate the (clean) **area** wind conditions at the installation/vessel location. It is often inappropriate to locate the windsock as close to the helideck as possible where it may reduce obstacle protected surfaces, create its own dominant obstacle or be subjected to the effects of turbulence from structures resulting in a confused wind indication. The windsock should be illuminated for night operations. Specific installations may benefit from a second windsock to indicate a specific difference from the area wind.

4.1.6 For character marking dimensions, where character bar width is not specified, use 15% of character height with 10% of character height between characters (extreme right-hand edge of one character to extreme left-hand edge of next character) and approximately 50% of character height between words. Characters having an arc at top or bottom are extended slightly above or below the height of horizontal character tops and bottoms.

4.2 Helideck Markings (See Figure 4.1)

4.2.1 The colour of the helideck should be dark green or dark grey. The perimeter of the SLA should be clearly marked with a white painted line 0.3 metres wide. (See Chapter 3, paragraph 3.8.1)

Aluminium helidecks are in use throughout the offshore industry. Some of these are a natural light grey colour and may present painting difficulties. The natural light

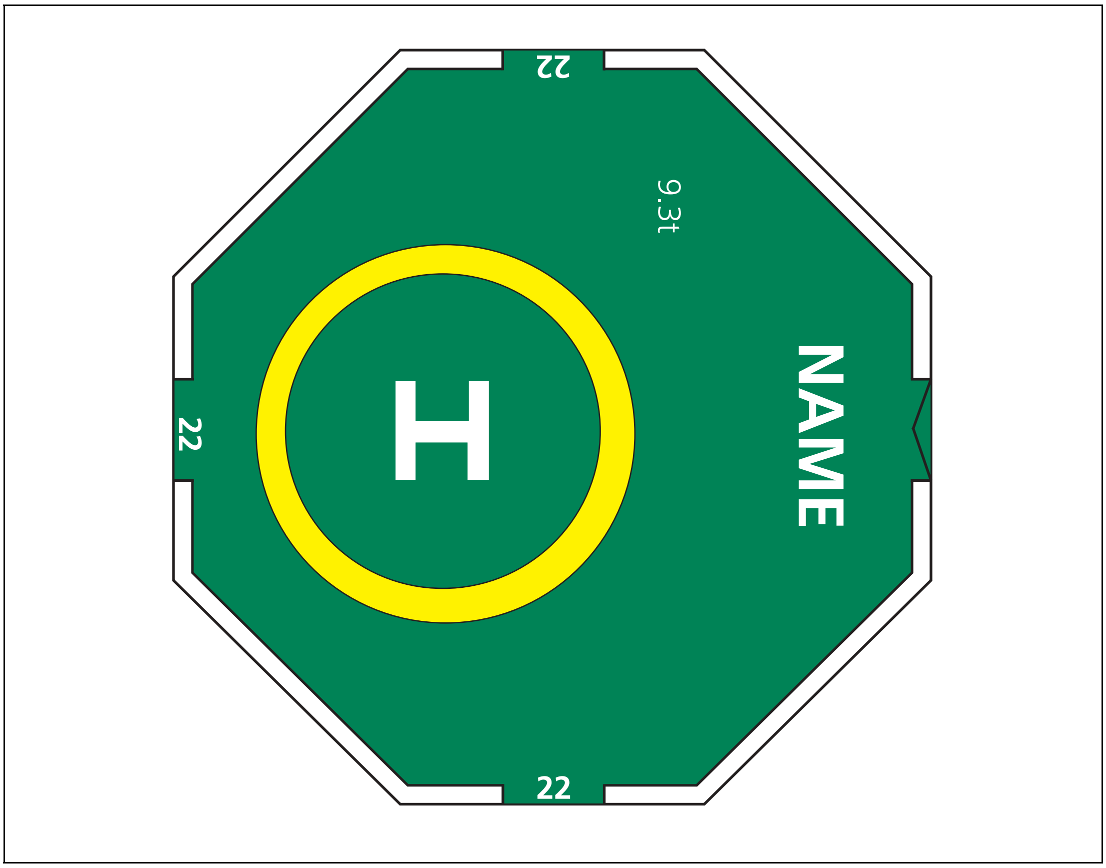


Figure 4.1 Markings (Single Main Rotor Helicopters)

grey colour of aluminium may be acceptable in specific helideck applications where these are agreed with the BHAB. This should be discussed in the early design phase. In such cases the conspicuity of the helideck markings may need to be enhanced by, for example, outlining the deck marking lines and characters with a thin black line.

4.2.2 The origin of the 210° obstacle-free sector for approach and take-off as specified in Chapter 3 should be marked on the helideck by a black chevron, each leg being 0.79

metres long and 0.1 metres wide forming the angle in the manner shown in Figure 4.2. On mimimum sized helidecks where there is no room to place the chevron, the chevron marking, but **not** the point of origin, may be displaced towards the D circle centre. The BHAB must be consulted in situations where this is necessary. Where the obstacle-free sector is swung in accordance with the provision of Chapter 3 paragraph 3.7.3 this should be reflected in the alignment of the chevron. The purpose of the chevron is to provide visual guidance to the HLO so that he can ensure that the 210° OFS is clear of obstructions before giving a helicopter clearance to land. The black chevron can be painted on top of the (continuous) white perimeter line to achieve maximum clarity for the helideck crew.

The actual D-value of the helideck (See Chapter 3, paragraph 3.7.1) should be painted on the helideck inboard of the chevron in alphanumeric symbols of 0.1 metres high. Where a helideck has been accepted which does not meet the normal obstacle-free sector requirements of 210°, the black chevron should represent the angle which has been accepted and this value should be marked inboard of the chevron in a similar manner to the certificated D-value.

The helideck D-value should also be marked around the perimeter of the helideck in the manner shown in Figure 4.1 in a colour contrasting (preferably white: avoid black or grey for night use) with the helideck surface. The D-value should be to the nearest whole number with 0.5 rounded down e.g. 18.5 marked as 18. Helidecks designed specifically for AS332L2 helicopters should be rounded up to 20 in order to differentiate between helidecks designed specifically for L1 models.

4.2.3 A maximum allowable weight marking should be marked on the helideck in a position which is readable from the preferred final approach direction i.e. towards the obstacle-free sector origin. The marking should consist of a two digit number followed by the letter ‘t’ to indicate the allowable helicopter weight in tonnes (1000 kg). The height of the figures should be 0.9 metres with a line width of approximately 0.12 metres and be in a colour which contrasts with the helideck surface (preferably white: avoid black or grey). Where possible the weight marking should be well separated from the installation identification marking (see paragraph 4.1.1) in order to avoid possible confusion on recognition. Refer also to Figure 4.1 and Chapter 3 paragraph 3.8.3 and Table 3.1.

4.2.4 Aiming circles should be provided as follows: (see Figures 4.1 and 4.3).

The marking should be a yellow circle with an inner diameter of 0.5 of the certificated D-value of the helideck and a line width of 1 metre. Its centre should be located 0.1 D from the centre of the D circle towards the outboard edge of the helideck on the bisector of the obstacle-free sector in order to achieve an increased safety margin for tail rotor clearance. On smaller helidecks and bow-mounted helidecks on vessels there is a case for making the aiming circle concentric with the helideck centre to ensure that there is a maximisation of space all round for safe personnel movement and an enhanced visual cueing environment. (See Figure 4.3).

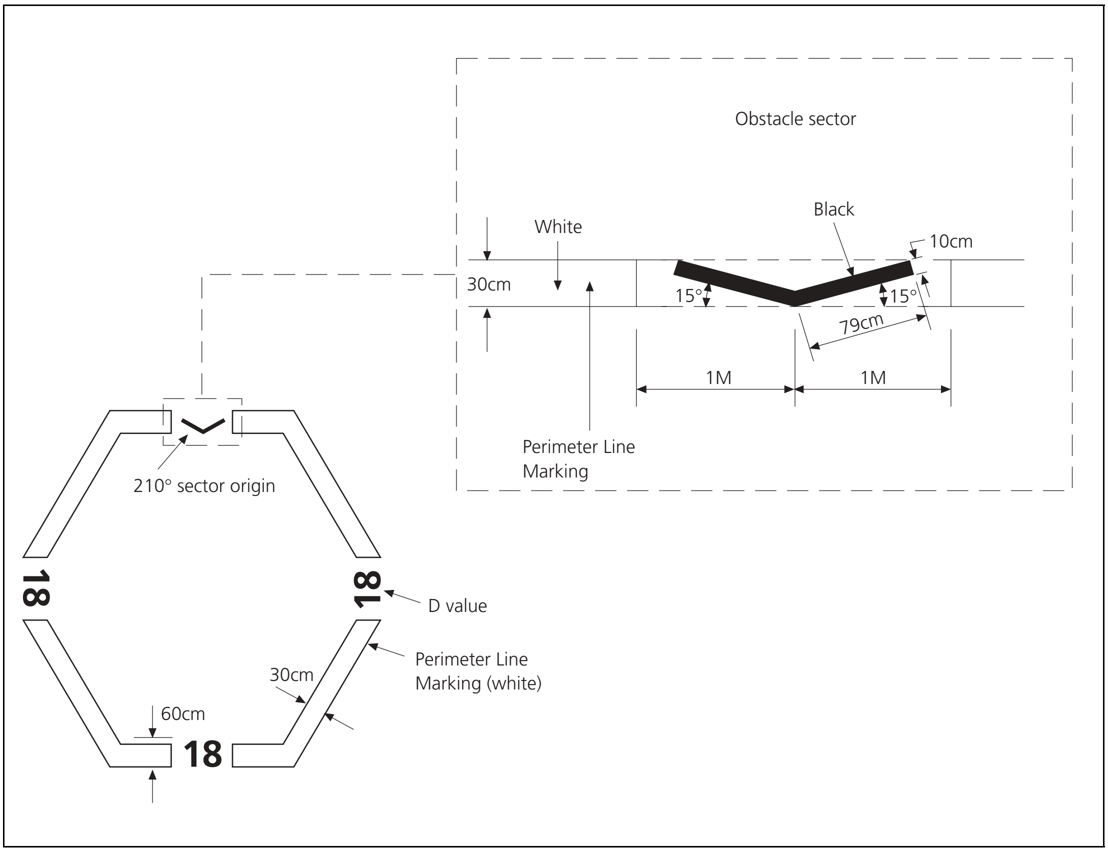


Figure 4.2 Helideck D Value and Obstacle-free Marking

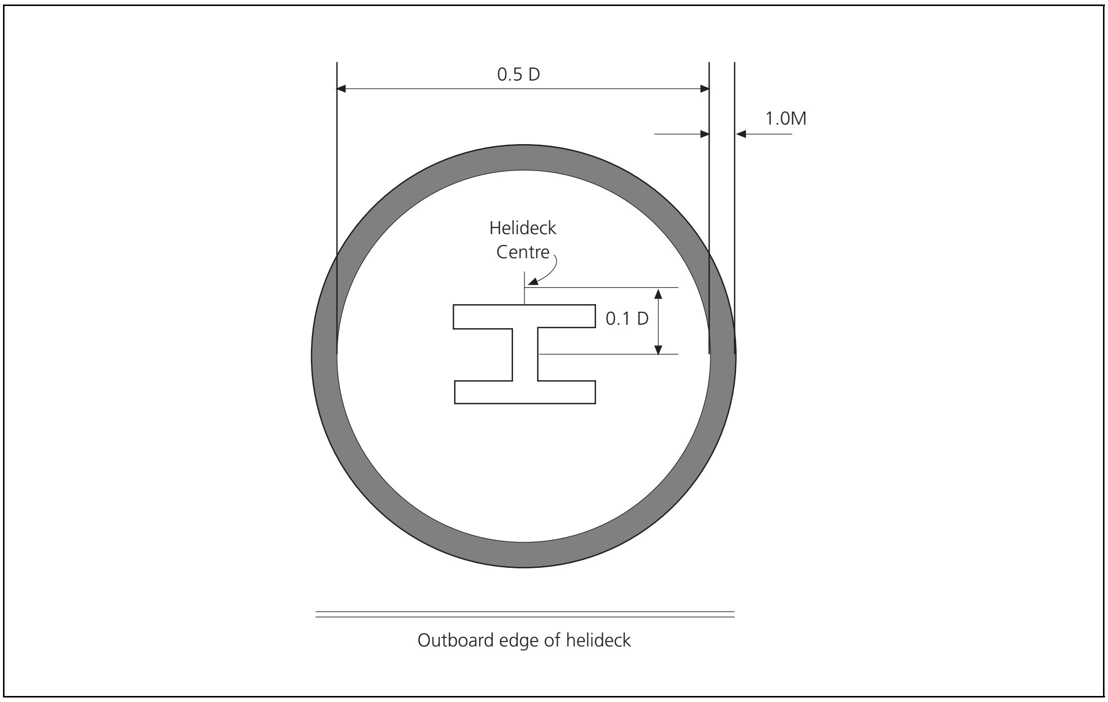


Figure 4.3 Aiming Circle Marking
(Aiming Circle to be painted yellow)

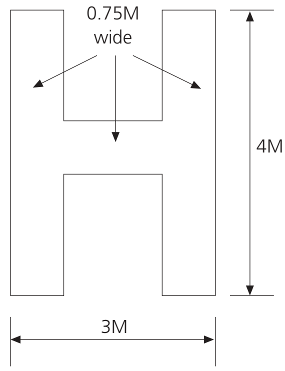


Figure 4.4 Dimensions of 'H'
('H' to be painted white)

NOTE: On those decks where the aiming circle is concentric with the centre of the D circle, the need for some mitigation against concerns over tail rotor clearances must be addressed; either by achieving more obstacle clearance in the 150° LOS or by adopting appropriate operational procedures (e.g. vessel to provide relative wind from beam or stern).

A white H should be marked co-located with the touchdown marking with the bar of the H lying along the bisector of the obstacle-free sector. Its dimensions are as shown in Figure 4.4.

Where the obstacle-free sector has been swung in accordance with Chapter 3 paragraph 3.7.3 the positioning of the touchdown marking and H should comply with the normal unswung criteria. The H should however be orientated so that the bar is parallel to the bisector of the swung sector.

4.2.5 Prohibited landing heading sectors should be marked where it is necessary to protect the helicopter from landing or manoeuvring in close proximity to limiting obstructions which, for example, infringe the 150° limited obstacle sector protected surface. The prohibited sector(s) are shown by white and red hatching of the touchdown reference circle with the hatching extending out to the edge of the safe landing area as shown in Figures 4.5 and 4.6.

When positioning over the touchdown area helicopters should be manoeuvred so as to keep the aircraft nose clear of the hatched prohibited sector(s) at all times.

4.2.6 For certain operational or technical reasons an installation may have to prohibit helicopter operations. In such circumstances, where the helideck cannot be used, the 'closed' state of the helideck will be indicated by use of the signal shown in Figure 4.7. This signal is the standard 'landing prohibited' signal given in the Rules of the Air and Air Traffic Control Regulations, except that it has been altered in size to just cover the letter 'H' inside the aiming circles.

4.2.7 **Exceptionally**, helicopter markings which do not comply with the above may be agreed with the BHAB.

4.2.8 Colours should conform with the following BS 381C (1988) standard or the equivalent BS 4800 colour.

a) RED

BS 381C: 537 (Signal Red)
BS 4800: 04.E.53 (Poppy)

b) YELLOW

BS 381C: 309 (Canary Yellow)
BS 4800: 10.E.53 (Sunflower Yellow)

c) DARK GREEN

BS 381C: 267 (Deep Chrome Green)
BS 4800: 14.C.39 (Holly Green)

d) DARK GREY

BS 381C: 632 (Dark Admiralty Grey)
BS 4800: 18.B.25 (Dark Admiralty Grey)

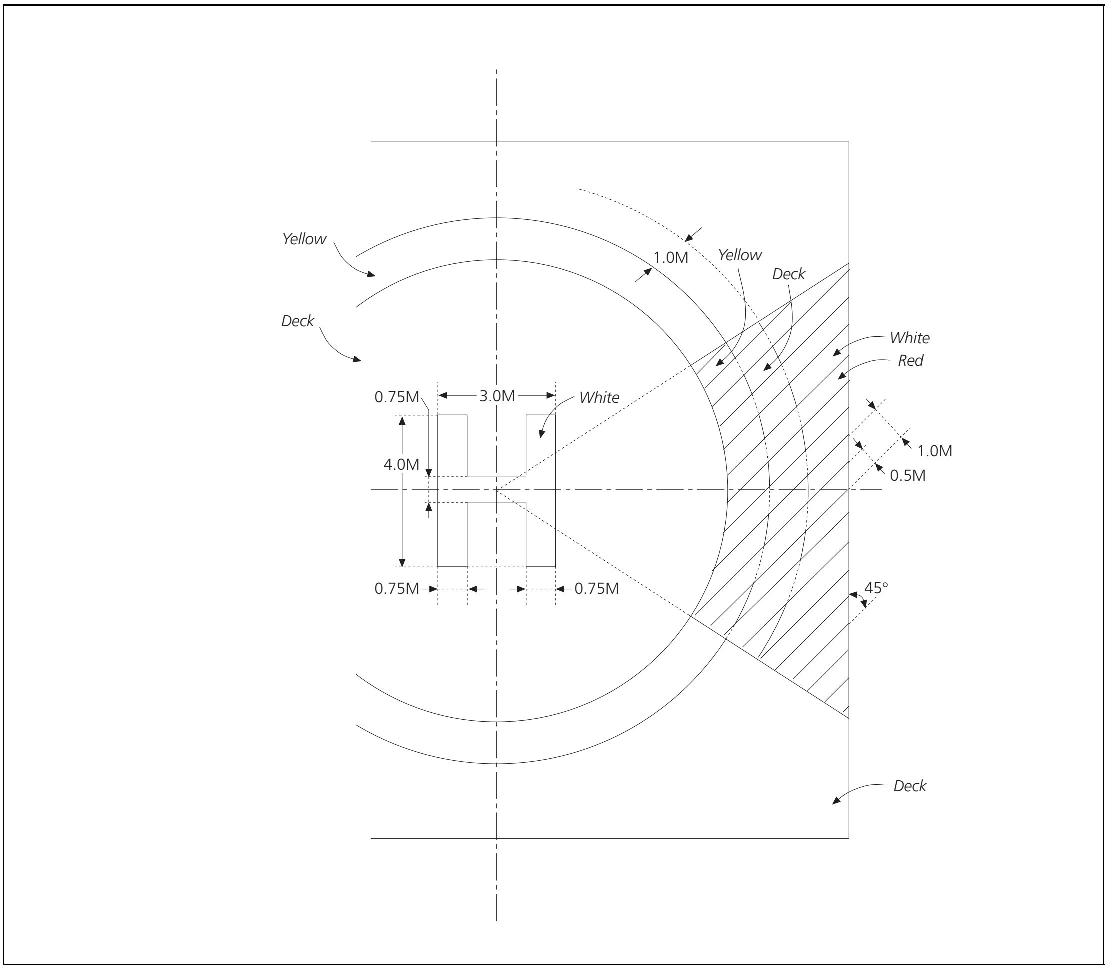


Figure 4.5 Specification for the layout of prohibited landing heading segments on helidecks

Figure 4.6 Example of Prohibited Landing Heading Marking

NOTE: The position of the H and the orientation of the prohibited landing heading segment will depend on the obstacle.

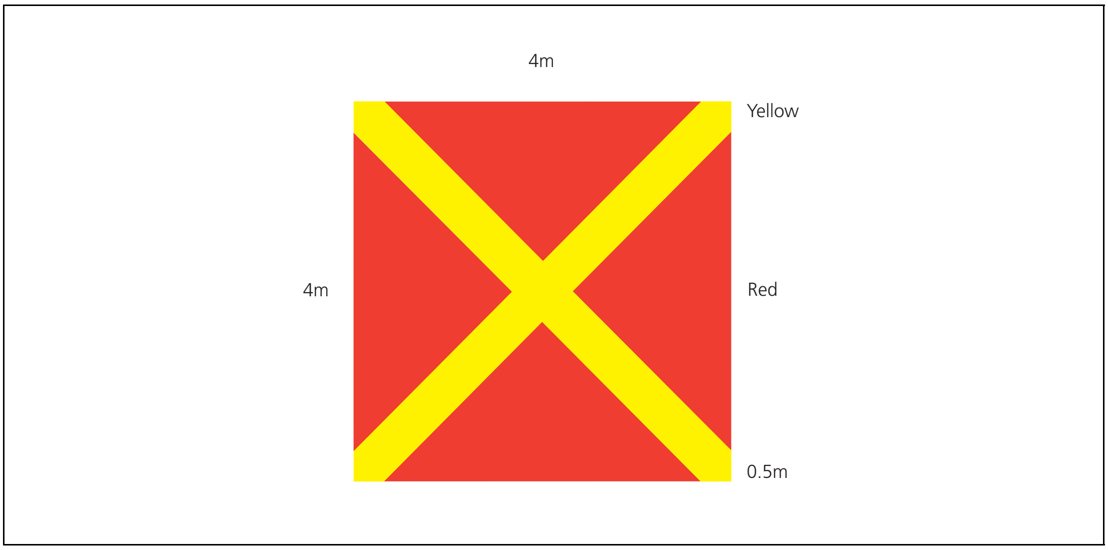


Figure 4.7 Landing on Installation/Vessel Prohibited

NOTE: Signal covers 'H' in aiming circle.

4.3 Lighting

4.3.1 The safe landing area should be delineated by all yellow lights visible omnidirectionally above the landing area level. These lights should not be below the level of the deck and should not exceed the height limitations in Chapter 3 paragraph 3.7.2. The lights should be equally spaced at intervals of not more than 3 metres around the perimeter of the SLA, coincident with the white line mentioned in paragraph 4.2.1. In the case of square or rectangular decks there should be a minimum of four lights at each side including a light at each corner of the safe landing area.The yellow lights should be of at least 25 candelas intensity. Higher intensity lighting can be of assistance in conditions of poor visibility in daylight, but where such lighting is fitted it should incorporate a brilliance control to reduce the intensity to the values quoted for night use. Flush fitting lights or Electroluminescent panels may be used at the inboard (150° LOS origin) edge of the SLA.

4.3.2 Where the declared D-value of the helideck is less than the physical helideck area, the perimeter lights should delineate the limit of the safe landing area so that the helicopter could land by reference to the perimeter lights on the limited obstacle sector (LOS -150°) side of the helideck without risk of main rotor collision with obstructions in this sector. By applying the LOS clearances from the perimeter marking, which are given at Chapter 3 paragraph 3.7.4, adequate main rotor to obstruction separation should be achieved. A suitable **temporary** arrangemnent to modify the lighting delineation of the SLA, where this is found to be marked too generously, can be agreed with the BHAB by replacing existing yellow lights with red lights of 25 candelas around the 'unsafe' portion of the SLA. The perimeter line, however, should be repainted in the correct position immediately. Use of flush fitting lights or Electro-luminescent panels in the 150° sector perimeter will provide adequate illumination whilst affording minimum obstruction to personnel and equipment movement.

4.3.3 The landing area should also be floodlit if intended for night use. The floodlighting should be arranged so as not to dazzle the pilot and, if elevated and located off the landing area, the system should not present a hazard to helicopters landing or taking-off and should be clear of the LOS. Such floodlights should be capable of being switched on and off at the pilot's request. The average illuminance should be at least 10 lux with a uniformity ratio (average to minimum) of not more than 8 to 1. Setting up of the lights must be undertaken with care to ensure that the luminosity and anti-dazzle issues are properly addressed and regularly checked. It may be necessary to enhance the lighting to improve depth perception, possibly by using discrete floodlighting of the main structure or 'legs'. One of the problems associated with major platforms and flotels etc., is that there is too much undirected, and therefore unnecessary, light from the main installation 'polluting' the helideck area. The helideck lighting may meet the required specification but will appear to be in a 'black hole' compared with the higher levels of other installation lighting. Installations should be aware of this phenomena ('Light Pollution') and lights not necessary for helicopter operations should, where possible, be shielded from the helideck. Adequate shielding of helideck polluting light sources can be achieved in the early design stage and can also be minimised on existing installations by simple measures. Temporary working lights which pollute the helideck lighting environment should be switched off for helicopter operations.

4.3.4 It is also important to confine the helideck lighting to the landing area, since any light overspill may cause reflections from the sea. The floodlighting controls should be controlled by, and be readily accessible to, the HLO or Radio Operator.

4.3.5 The quoted intensity values for lights apply to the intensity of the light emitted from the unit when fitted with all necessary filters and shades (see also paragraph 4.4 below).

4.3.6 If a condition can exist on an installation which may be hazardous for the helicopter or its occupants a visual warning system should be installed. The system (Status Lights) should be a flashing red light (or lights) which is visible to the pilot from any direction of approach and on any landing heading. The aeronautical meaning of a flashing red light is either; do not land, aerodrome not available for landing or; move clear of landing area. The system should be automatically initiated at the appropriate hazard level (for example, gas alarm*, crane moving etc.) as well as being capable of manual activation by the HLO. It should be visible at a range in excess of the distance at which the helicopter may be endangered or may be commencing a visual approach. CAA paper 98003 provides a specification for status lights which are summarised below:

Red flashing at frequency 2Hz; visible at all azimuth angles (see CAA Paper 98003 for vertical beam spread); effective intensity at least 3250 cd between 5° and 10° above the horizontal and 1000 cd up to 90° above the horizontal; response time to full intensity not exceeding 3 seconds; brightness control facility for access by HLO or Radio operator; integrated into installation safety systems automatically; manual 'switch on' for HLO. The specification may require the use of more than one light on some installations. Refer to CAA Paper 98003 for the full detail of the specification.

Lights meeting a current operational requirement to be conspicuous in bright and sunny conditions at 1400 m visibility; i.e. having a minimum intensity of 700 cd over a vertical angle of 5°–10° above the horizontal and 215 cd over the remainder of the beam-spread, will be considered acceptable while the minimum decision range (currently on an instrument radar approach) remains at 0.75 nm (1400 m). Development of offshore approach aids which provide lower minima (e.g. GPS) will require satisfaction of the appropriate intensity as specified in CAA Paper 98003 and as modified appropriately by the table below.

Table 4.1 Required Intensity/Operational Visibility

Operational Visibility[1] (m)	Required Intensity (cd – red light)
600	3250
800	1225
1000	1000
1200	800
1400	700

1. For the purposes of the above table, Minimum Decision Range is deemed to be the same as Operational Visibility.

*** NOTE:** Recent research into the helideck environmental issues indicates that the appropriate hazard level for helicopters in terms of hydrocarbon gas release should be set at a limit of 10% LFL in the helicopter operating areas.

4.3.7 Dual lamp/filament type fittings should be installed to allow for single failures where problems of access occur for the replacement of unserviceable light fittings.

4.3.8 Installation/vessel emergency power supply design should include the landing area lighting. Any failures or outages should be reported immediately to the helicopter operator. The lighting should be fed from an Uninterrupted Power Supply (UPS) system.

4.4 Obstacles – Marking and Lighting

4.4.1 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 metres nor more than 6 metres wide. The colour should be chosen to contrast with the background to the maximum extent. Paint colours should conform with the references at paragraph 4.2.8 above.

4.4.2 Obstacles to be marked in these contrasting colours include any lattice tower structures and crane booms which are close to the helideck or the LOS boundary. Similarly, parts of the leg or legs of jack-up units adjacent to the landing area which extend, or can extend, above it should also be marked in the same manner.

4.4.3 Omnidirectional red lights of at least 10 candelas intensity 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 the installation. Objects which are more than 15 metres higher than the landing area should be fitted with intermediate red lights of the same intensity spaced at 10 metre 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 the intermediate red lights, provided that the lights are arranged such that they will illuminate the whole of the structure and not dazzle the helicopter pilot. Such arrangements should be discussed with the BHAB.

4.4.4 An omnidirectional red light of intensity 25 to 200 candelas should be fitted to the highest point of the installation. Where this is not practicable (e.g. on top of flare towers) the light should be fitted as near to the extremity as possible.

4.4.5 In the particular case of jack-up units, it is recommended that when the tops of the legs are the highest points on the installation, they should be fitted with omnidirectional red lights of intensity 25 to 200 candelas. In addition the leg or legs adjacent to the helideck should be fitted with intermediate red lights of at least 10 candelas at 10 metre intervals down to the level of the landing area. Sufficient lights should be fitted to provide omnidirectional visibility. As an alternative the legs may be floodlit providing the helicopter pilot is not dazzled.

4.4.6 Any ancillary structure within 1 kilometre of the landing area, and which is significantly higher than it, should be similarly fitted with red lights.

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

4.4.8 Installation/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 an Uninterrupted Power Supply (UPS) system.

Chapter 5 Helideck Rescue and Fire Fighting Facilities

5.1 Introduction

This Chapter gives guidance regarding provision of equipment; extinguishing media; personnel; training; and emergency procedures for offshore helidecks on installations and vessels. For specific guidance related to NUI's refer to UKOOA's guidelines for Helicopter Operations to Normally Unattended Installations.

5.2 Key Design Characteristics – Principal Agent

A key aspect in the successful design for providing an efficient, integrated helideck rescue and fire fighting facility is a complete understanding of the circumstances in which it may be expected to operate. A helicopter accident, which results in a fuel spillage with wreckage and/or fire and smoke, has the capability to render some of the equipment inventory unusable or preclude the use of some passenger escape routes.

5.2.1 Delivery of fire fighting media to the helideck area at the appropriate application rate must be achieved in the quickest possible time. The Authority strongly recommends that a delay of less than thirty seconds, measured from the time of incident to actual production at the required application rate, should be the objective.

5.2.2 Foam-making equipment must be located so as to ensure the uniform application of foam to any part of the Safe Landing Area (SLA) irrespective of the wind strength/ direction or accident location. In this respect particular consideration should be given to the loss of a foam monitor.

5.2.3 Consideration must be given to the effects of the weather on static equipment. All equipment forming part of the facility should be designed to withstand protracted exposure to the elements or be protected from them. Where protection is the chosen option, it must not prevent the equipment being brought into use quickly and effectively (see paragraph 5.2.2 above). The effects of condensation on stored equipment should be considered.

5.2.4 The minimum capacity of the foam production system will depend on the D-value of the deck, the foam application rate, the discharge rates of installed equipment and the expected duration of application.

5.2.5 The application rate is dependant on the types of foam concentrate in use and the types of foam application equipment selected. For fires involving aviation kerosene, the International Civil Aviation Organization (ICAO) has produced a performance test which assesses and categorises the foam concentrate. Most foam concentrate manufacturers will be able to advise on the performance of their concentrate against this test. The Authority recommends that foam concentrates compatible with seawater and meeting performance level 'B' are used. These foams require a minimum application rate of 5.5 litres per square metre (of SLA) per minute.

Calculation of Application Rate: Example for a D-value 22.2 metre helideck. Application rate = $5.5 \times \pi \times r^2$ ($5.5 \times 3.142 \times 11.1 \times 11.1$) = 2129 litres per minute.

5.2.6 Given the remote location of helidecks the overall capacity of the foam system should exceed that necessary for initial extinction of any fire. Ten minutes discharge capability is generally considered by the UK CAA to be reasonable.

Calculation of minimum operational stocks: Using the 22.2 metre example as shown in paragraph 5.2.5 above. A 1% foam solution discharged over 10 minutes at the minimum application rate will require 2129 x 1% x 10 = 213 litres of foam concentrate. A 3% foam solution discharged over 10 minutes at the minimum application rate will require 2129 x 3% x 10 = 639 litres of foam concentrate.

NOTE: Sufficient reserve foam stocks to allow for replenishment as a result of operation of the system during an incident, or following training or testing will also need to be held.

5.2.7 Low expansion foam concentrates can generally be applied in either aspirated or unaspirated form. It should be recognised that whilst solution applied unaspirated may provide a quick knockdown of any fuel fire, aspiration, i.e. induction of air into the foam solution by monitor or by hand controlled foam branch, gives enhanced protection after extinguishment. Wherever non-aspirated foam equipment is selected during design, additional equipment capable of producing aspirated foam for consolidation should be provided.

5.2.8 Hand controlled hose line(s) capable of applying water in a jet/spray pattern at a minimum of 250litres/min for cooling, or specific firefighting tactics should be provided. Not all fires are capable of being accessed by monitors or on some occasions the use of monitors alone may endanger passengers. Therefore, the provision of hand controlled hose line(s) for the application of foam should also be provided.

5.2.9 If life saving opportunities are to be maximised it is essential that all equipment should be readily available on, or in the immediate vicinity of the helideck whenever helicopter operations are being conducted. All equipment should be located at points having immediate access to the helicopter landing area. The location of the storage facilities should be clearly indicated.

5.3 Use and Maintenance of Foam Equipment

5.3.1 Mixing of different concentrates in the same tank i.e. different either in make or strength is generally unacceptable. Many different strengths of concentrate are on the market. Any decision regarding selection must take account of the design characteristics of the foam system. It is important to ensure that foam containers and tanks are correctly labelled.

5.3.2 Induction equipment ensures that water and foam concentrate are mixed in the correct proportions. Settings of adjustable inductors, if installed, must correspond with strength of concentrate in use.

5.3.3 All parts of the foam production system, including the finished foam, should be tested by a competent person on commisioning and annually thereafter. The tests should assess the performance of the system against original design expectations.

5.4 Complementary Media

While foam is considered the primary means of dealing with fires involving fuel spillages, the wide variety of fire incidents likely to be encountered during helicopter operations – i.e. engine, avionic bays, transmission areas, hydraulics – may require the provision of more than one type of complementary agent. Dry powder, carbon dioxide or halon are generally considered acceptable for this task although halon is now subject to various restrictions under the Montreal Protocol.

5.4.1 The UK CAA recommends the use of dry powder as the primary complementary agent. The minimum capacity should be 45 kg. The dry powder system should have the capacity to deliver the agent anywhere on the SLA at the recommended discharge rate of 1.35–2 kg/sec. Containers of sufficient capacity to allow continuous application of the agent should be provided.

5.4.2 Where the use of a gaseous agent as an additional complementary agent is deemed necessary by the duty holder, regard should be paid to the requirement to deliver this agent to the seat of the fire. Because of the weather conditions prevalent in the UKCS, gaseous media are considered to be less effective than dry powder for most applications.

All offshore helicopters have integral engine fire protection systems (predominantly Halon) and it is therefore considered that provision of foam as the principal agent plus suitable water/foam branch lines plus sufficient levels of dry powder will form the core of the fire extinguishing system.

5.4.3 In the case of NUI's reference can be made to the UKOOA guidelines 'Helicopter Operations to Normally Unattended Installations'. However, serious consideration should be given to the selection and provision of foam as the principal agent.

5.4.4 All applicators are to be fitted with a mechanism which allows them to be hand controlled.

5.4.5 Dry chemical powder should be of the 'foam compatible' type.

5.4.6 The complementary agents should be sited so that they are readily available at all times.

5.4.7 Reserve stocks of complementary media to allow for replenishment as a result of activation of the system during an incident, or following training or testing should be held.

5.5 The Management of Extinguishing Media Stocks

Consignments of extinguishing media should be used in delivery order to prevent deterioration in quality by prolonged storage.

5.5.1 The mixing of different types of foam concentrate may cause serious sludging and possible malfunctioning of foam production systems. Unless evidence to the contrary is available it should be assumed that different types are incompatible. In these circumstances it is essential that the tank(s), pipework and pump (if fitted) are thoroughly cleaned and flushed prior to the new concentrate being introduced.

5.5.2 Consideration should be given to the provision of reserve stocks for use in training, testing and recovery from emergency use.

5.6 Rescue Equipment

In some circumstances, lives may be lost if simple ancillary rescue equipment is not readily available.

5.6.1 The UK CAA strongly recommends the provision of at least the following equipment.

Sizes of equipment are not detailed but should be appropriate for the types of helicopter expected to use the facility.

Table 5.1 Rescue Equipment

Helicopter RFF Category		
	H1/H2	**H3**
Adjustable wrench	1	1
Rescue axe, large (non wedge or aircraft type)	1	1
Cutters, bolt	1	1
Crowbar, large	1	1
Hook, grab or salving	1	1
Hacksaw heavy duty c/w 6 spare blades	1	1
Blanket, fire resistant	1	1
Ladder *	1	1
Pliers, side cutting (tin snips)	1	1
Set of assorted screwdrivers	1	1
Harness knife c/w sheath**	*	*
Gloves, fire resistant**	*	*
Self-contained breathing apparatus (complete)***	2	2
Power cutting tool	–	1

* For access to casualties in an aircraft on its side
** This equipment is required for each helideck crew member
*** Refer to Home Office Technical Bulletin 1/1997

5.6.2 A responsible person should be appointed to ensure that the rescue equipment is checked and maintained regularly.

5.7 Personnel Levels

The facility should have sufficient trained firefighting personnel immediately available whenever aircraft movements are taking place. They should be deployed in such a way as to allow the appropriate firefighting and rescue systems to be operated efficiently and to maximum advantage so that any helideck incident can be managed effectively. The HLO should be readily identifiable to the helicopter crew as the person in charge of helideck operations. The preferred method of identification is a brightly coloured 'HLO' tabard. For guidance on helideck crew composition refer to the UKOOA guidelines on NMI's and NUI's.

5.8 Personal Protective Equipment

All personnel assigned to rescue and firefighting duties should be provided with suitable personal protective equipment to allow them to carry out their duties. The level of PPE should be commensurate with the nature of the hazard and the risk (consideration should be given to the provision of face masks where, as is generally the case, helicopters constructed substantially of composite material are in use).The protective equipment should meet appropriate safety standards and should not in any way restrict the wearer from carrying out his duties.

5.8.1 Sufficient personnel to operate the RFF equipment effectively should be dressed in protective clothing prior to helicopter movements taking place.

5.8.2 The UK CAA recommends that at least two, positive pressure, self-contained breathing apparatus sets complete with ancillary equipment plus two reserve cylinders should be provided. These should be appropriately stored, readily available close to the helideck for fast deployment by the helideck crew.

5.8.3 Respiratory protective equipment enables the wearer to enter and work in an atmosphere which would not otherwise support life. It is therefore essential that it be stored, tested and serviced in such a way that it will ensure that it can be used confidently by personnel. Refer to the manufacturer's instructions and to the Home Office Technical Bulletin 1/1997.

5.8.4 A responsible person(s) should be appointed to ensure that all personal protective equipment is installed, stored, used, checked and maintained in accordance with the manufacturer's instructions.

5.9 Training

If they are to effectively utilise the equipment provided, all personnel assigned to rescue and fire fighting duties on the helideck should be fully trained to carry out their duties. The UK CAA recommends that personnel attend an established helicopter fire fighting course.

In addition, regular training in the use of all RFF equipment, helicopter familiarisation and rescue tactics and techniques should be carried out. Correct selection and use of primary and complementary medias for specific types of incident should form an integeral part of personnel training.

5.10 Emergency Procedures

The installation or vessel emergency procedures manual should specify the actions to be taken in the event of an emergency involving a helicopter on or near the installation or vessel. Exercises designed specifically to test these procedures and the effectiveness of the fire fighting teams should take place at regular intervals.

5.11 Further Advice

Advice is available from UK CAA Aerodrome Standards Department regarding the choice and specification of fire extinguishing agents.

Chapter 6 Helicopter Landing Areas – Miscellaneous Operational Standards

6.1 Landing Area Height Above Water Level

Because of the effects upon aircraft performance in the event of an engine failure (see Chapter 2) the height of the landing area above water level will be taken into account by the BHAB in deciding on any operational limitations to be applied to specific helidecks. Landing area height above water level is to be included in the information supplied to the BHAB for the purpose of authorising the use of the helideck.

6.2 Wind Direction (Vessels)

Because the ability of a vessel to manoeuvre may be helpful in providing an acceptable wind direction in relation to the helideck location, information provided to the BHAB is to include whether the vessel is normally fixed at anchor, single point moored, semi or fully manoeuvrable. The BHAB may specify windspeed and direction requirements and limitations when authorising the use of the helideck.

6.3 Helideck Movement

6.3.1 Although helidecks located amidships are less liable to the extremes of vessel movement experienced at bow or stern locations, a BHAB clearance will be related to the aircraft operator's Operations Manual limitations regarding the movement of the helideck in pitch, roll, heave and heading. It is necessary for details of these motions to be recorded on the vessel prior to, and during, all helicopter movements.

6.3.2 Pitch and Roll reports to helicopters should include values, in degrees, about both axes of the true vertical datum (i.e. relative to the true horizon) and be expressed in relation to the vessel's head. Roll should be expressed in terms of 'left' and 'right'; pitch should be expressed in terms of 'up' and 'down'; heave should be reported in a single figure, being the total heave motion of the helideck rounded up to the nearest metre. Heave is to be taken as the vertical difference between the highest and lowest points of any single cycle of the helideck movement. The parameters reported should be the maximum peak levels recorded during the ten minute period prior to commencement of helicopter deck operations.

The helicopter pilot is concerned, in order to make vital safety decisions, with the amount of 'slope' on, and the rate of movement of, the helideck surface. It is therefore important that the Roll values are only related to the true vertical and do not relate to any 'false' datum (i.e. a 'list') created, for example, by anchor patterns or displacement. There are circumstances in which a pilot can be aided by amplification of the heave measurement by reference to the time period (seconds) in terms of 'peak to peak'.

6.3.3 Reporting Format:

A standard radio message should be passed to the helicopter which contains the information on helideck movement in an unambiguous format. This will, in most cases, be sufficient to enable the helicopter crew to make safety decisions. Should the helicopter crew require other motion information or amplification of the standard message, the crew will request this (for example, yaw and heading information).

Standard report example:

Situation: The maximum vessel movement (over the preceding ten minute period) about the Roll axis is 1° to port and 3° to starboard (i.e. this vessel may have a permanent list of 1° to starboard and is rolling a further 2° either side of this 'false' datum). The maximum vessel movement (over the preceding ten minute period) about the pitch axis is 2° up and 2° down. The total maximum heave (recorded over the preceding ten minute period) is 1.5 metres.

Report: 'Roll 1° left and 3° right; Pitch 2° up and 2° down; heave two metres'.

6.3.4 Current research has indicated that vessel movement is complex in nature and is characterised by a number of parameters, some of which are not presently reported. It is therefore possible that future requirements will contain different measuring and reporting criteria. The Authority is currently carrying out research into the measurement of the motion and acceleration forces of moving helidecks and their impact on the characteristics of helicopter aerodynamics and dynamics whilst on the deck. A CAA Paper will be published in due course. Pending publication, it is considered useful to comment on some of the findings to date:

- It is important to measure helideck movement at the helideck. Very often pitch, roll and heave measurement is taken from a source far removed from the helideck location. If this source should happen to be midships and the helideck is located high up on the bow, the actual movement and acceleration forces at the helideck are likely to be far in excess of the source measurement. Software packages are available to provide helideck location corrected movement data from a source at a different location.
- Future guidance will advocate that deck motion measuring equipment will be placed at (attached to the underside of) the helideck or compensated by software to give helideck location readings.
- The R & D project has already identified commercially available accelerometer packages which can incorporate software which measures the important parameters; produces a pich, roll and heave read out (maximum over preceding 10 minutes); incorporates a prediction based on known weather patterns and vessel motion characteristics that the deck will be safe for ground operations over the following 10 minutes; and provides all this in a single figure Motion Severity Index (MSI) which will have a straight read-across to helicopter operators' Manuals.
- The helicopter companies' Operations Manuals will eventually contain a Limit of Operability, based initially on a generic helicopter which covers the types in current use. It is intended that the given MSI will be easily referenced to the Operator's Limit of Operability thus providing an unambiguous reporting and recording system.
- Software packages reporting an MSI are also capable of measuring the values accurately in pitch, roll and heave.

It has been noted that some moving helidecks reports to pilots are based on visual estimations. This is not an acceptable way of obtaining vital safety information. It is therefore strongly recommended that all moving helidecks are equipped with accelerometer packages and the associated software which will not only enable future conversion to MSI readout but also produce accurate pitch, roll and heave information for present day reporting requirements.

6.4 Aircraft Operational Data – Reporting and Recording

6.4.1 In addition to the data covered by paragraph 6.3 above, it is essential that all installations are provided with means of ascertaining and reporting at any time:

a) the wind speed and direction;

b) the air temperature;

c) the barometric pressure;

d) the visibility, cloud base and cover; and

e) the sea state.

6.4.2 Air temperature and barometric pressure can be measured by conventional instruments. An indication of wind speed and direction will be provided visually to the pilot by the provision of a windsock coloured so as to give maximum contrast with the background. However, for recording purposes, an anemometer positioned in an unrestricted airflow is required. A second anemometer, located at a suitable height and position can give useful information on wind velocity at hover height over the helideck in the event of turbulent or deflected airflows over the deck. Visibility and cloud conditions will normally be assessed by visual observations as will the sea state, although, on some of the larger installations wave crest to trough measuring instruments are available as are cloud base and visibility measuring instruments.

6.4.3 Measuring instruments used to provide the data listed in paragraph 6.4.1 above should be periodically calibrated in accordance with the manufacturer's recommendations in order to provide continuing adequacy of purpose.

6.5 Location in Respect to Other Landing Areas in the Vicinity

6.5.1 Mobile installations and support vessels with helidecks may be positioned adjacent to other installations so that mutual interference/overlap of obstacle protected surfaces occur. Also on some installations there may be more than one helideck which may result in a confliction of obstacle free sectors.

6.5.2 Where there is confliction as mentioned above, within the obstacle free sector out to 1000 metres, simultaneous operation of two helicopter landing areas is not to take place without prior consultation with the BHAB. It is possible, depending upon the distance between landing areas and the operational conditions which may pertain, that simultaneous operation can be permitted but suitable arrangements for notification of helicopter crews and other safety precautions will need to be arranged. In this context, 'Flotels' will be regarded in the same way as any other mobile installation which may cause mutual interference with the parent installation approach and take-off sector. See also Chapter 3 above.

6.6 Control of Crane Movement in the Vicinity of Landing Areas

6.6.1 Cranes can adversely distract pilots' attention during helicopter approach and take-off from the helideck as well as infringe fixed obstacle protected surfaces. Therefore it is essential that when helicopter movements take place (±5 mins) crane work ceases and jibs, 'A' frames, etc. are positioned clear of the obstacle protected surfaces and flight paths.

6.6.2 The Helicopter Landing Officer should be responsible for the control of cranes in preparation for and during helicopter operations.

6.7 **General Precautions**

6.7.1 Whenever a helicopter is stationary on board an offshore installation with its rotors turning, no person shall, except in case of emergency, enter upon or move about the helicopter landing area otherwise than within view of a crew member or the HLO and at a safe distance from its engine exhausts and tail rotor. It may be dangerous to pass close to the front of those helicopters which have a low main rotor profile.

6.7.2 The practical implementation of paragraph 6.7.1 above is best served through consultation with the helicopter operator for a clear understanding of the approach paths approved for personnel and danger areas associated with a rotors-running helicopter. These areas are type-specific but, in general, the approved routes to and from the helicopter are at the 2–4 o'clock and 8–10 o'clock positions. Avoidance of the 12 o'clock (low rotor profile helicopters) and 6 o'clock (tail rotor danger areas) positions must be maintained.

6.7.3 Personnel must not approach the helicopter while the helicopter anti-collision (rotating/flashing) beacons are operating. In the offshore environment, the helideck should be kept clear of all personnel while anti-collision lights are on.

6.8 **Installation/Vessel Helideck Operations Manual and General Requirements**

The maximum helicopter weight and 'D' value for which the deck has been designed and the maximum size and weight of helicopter for which the installation is certified should be included in the Operations Manual. The extent of the obstacle-free area should also be stated and reference made to any helideck operating limitation imposed by helicopter operators as a result of non-compliance. Non-compliances should also be listed.

6.9 **Helicopter Operations Support Equipment**

6.9.1 Provision should be made for equipment needed for use in connection with helicopter operations including:

a) chocks and tie-down strops/ropes (strops are preferable);

b) heavy-duty, calibrated, accurate scales for passenger baggage and freight weighing;

c) a suitable power source for starting helicopters if helicopter shut-down is seen as an operational requirement; and

d) equipment for clearing the helicopter landing area of snow and ice and other contaminants.

6.9.2 Chocks should be compatible with helicopter undercarriage/wheel configurations. Helicopter operating experience offshore has shown that the most effective chock for use on helidecks is the 'NATO sandbag' type. Alternatively, 'rubber triangular' or 'single piece fore and aft' type chocks may be used as long as they are suited to all helicopters likely to operate to the helideck. The 'rubber triangular' chock is generally only effective on decks without nets.

6.9.3 For securing helicopters to the helideck it is recommended that adjustable tie-down strops are used in preference to ropes. Specifications for tie-downs should be agreed with BHAB.

6.9.4 It is essential that aeronautical radios are provided. Approval for this (and for Non-Directional Beacons) is to be sought from the Air Traffic Safety Standards Department at SRG, Gatwick. Northern North Sea radio procedures require two separate radios on two separate frequencies; one for 'Traffic' and one for 'Logistics'. In addition the HLO should have a portable radio tuned to the 'Traffic' frequency for the 'landing clearance' and ‘lifting’ calls; and tuned to ‘Logistics’ for logistic calls. It is recommended that all mobile installations and vessels used in support of oil/gas exploitation operations are equipped with two aeronautical radio sets. Ideally the power supply for the aeronautical radios should be fed from an Uninterrupted Power Supply (UPS) system.

Chapter 7 Helicopter Fuelling Facilities

7.1 General

The contents of this chapter and Chapter 8 are intended as general advice on the requirements necessary for the fuelling of helicopters on offshore installations and vessels. The information has been compiled by UKOOA in consultation with the Offshore Industry. More detailed information, if required, can be obtained from aviation fuel suppliers. Civil Aviation Publications CAP 74 (Aircraft Fuelling: Fire Prevention and Safety Measures) and CAP 434 (Aviation Fuel at Aerodromes) provide additional general information and guidance. It is inevitable that in a document such as this, the reader will be referred to British Standards or alternative guidance and example. The reader should always check that standards and numbers so referenced are current and reflect current best practice.

7.1.1 It should be noted that offshore fuelling systems may vary according to the particular application for which it was designed. Nevertheless the elements of all systems will basically be the same to include:

a) Transit tanks.

b) Storage facilities (see Note).

c) Delivery system.

NOTE: In some systems where built in tanks are not provided transit tanks are acceptable for storage purposes.

7.1.2 Chapter 7 describes the features of a typical offshore fuelling system with additional information on maintenance requirements and procedures. Chapter 8 provides a detailed guide on fuelling procedures. It should be noted that additional guidance on safety measures concerning fuelling of helicopters can be obtained from CAP 74 'Aircraft Fuelling: Fire Prevention and Safety Measures'.

7.1.3 Particularly in the UK, many responsible bodies within the oil and helicopter industries have developed their own maintenance and inspection regimes and cycles. There may, therefore, appear to be anomalies between different source guidance on: filter element replacement periodicity; hose inspection and replacement periodicity; static storage tank inspection periodicity and; bonding lead continuity checks. Alternative, responsible source guidance may be used where the user can satisfy himself that the alternative is adequate for the purpose considering particularly the hostile conditions to which the systems may be subjected and the vital importance of a supply of clean fuel.

7.2 Fuelling System Description

7.2.1 Transit Tanks

7.2.1.1 Transit tanks should be constructed to satisfy the requirements of the Intergovernmental Marine Consultative Organisation (IMCO), meeting the Dangerous Goods Code Type 1 or Type 2 tank. They should also conform with BS 7072 (1989) – Inspection and Repair of Offshore Containers.

7.2.1.2 Tanks may be of stainless steel or mild steel; if the latter, then tanks must be lined with suitable fuel resistant epoxy lining. The tanks must be encased in a robust steel cage with tie-down points and four main lifting eyes. Where possible, stainless steel fasteners, in conjunction with stainless steel fittings, are recommended. The tank frame should incorporate cross-members to provide an integral 'ladder' access to the tank top. When mounted in the transit frame there should be a centre line slope towards a small sump. This slope should be at least 1 in 30, although 1 in 25 is preferred. Tanks should be clearly marked with the tank capacity and the type of fuel contained. The tank's serial number should also be permanently marked on the identification plate. The tank should normally be fitted with the following:

a) **Manhole**. An 18″ manhole to allow physical access to the interior of the tank.

b) **Inspection Hatch**. A 6″ hatch to enable inspection of the low end of the tank contents.

c) **Dipstick Connection**. A suitable captive dipstick to determine the tank contents, preferably of fibreglass material.

d) **Emergency Pressure Relief**. A stainless steel 2½″ pressure/vacuum relief valve fitted with weatherproof anti-flash cowl. The valve settings will depend on the type of tank in use, manufacturers' recommendations should be followed.

e) **Sample Connection**. A stainless steel sample point, fitted at the lowest point of the tank. A foot-valve should be fitted in the sample line, complete with an extension pipe and terminating with a ball valve with captive dust cap. Sample lines must be a minimum of ¾″ diameter and preferably 1″ diameter. In order to allow correct sample jars to be used, the sample point should be designed with sufficient access, space and height to accommodate the standard 4 litre sample jar.

f) **Outlet/Fill Connection**. The outlet/fill connection should be a flanged fitting with a 3″ internal valve terminating to a 2½″ self-sealing coupler complete with dust cap. The tank outlet should be at least 6″ higher than the lowest point of the tank.

g) **Frame**. The tank barrel and frame should be suitably primed and then finished in safety yellow (BS 4800, Type 08E51). Safety yellow is not mandatory but has been generally accepted for helifuel tanks. All component parts e.g. tank, frame etc. must be properly bonded before being painted.

More detailed specification for transit tanks can be obtained on request from UKOOA.

7.2.2 Static Storage Tanks

Where static tanks are provided they should be constructed to suitable standards. Acceptable standards include ASME VIII and BS 5500 Categories I, II and III. The tank should be mounted with a centre line slope to a small sump. This slope should be at least 1 in 30, although 1 in 25 is preferred. The sump should be fitted with a sample line which has both a gate valve and ball valve and should preferably have a captive camlock dustcap on the end to prevent the ingress of dirt or moisture. Sample lines must be a minimum of ¾″ diameter and preferably 1″ diameter. The sample point accessibility should be as described in paragraph 2.1.2 e) above. Static tanks should be fitted with the following:

a) **Manhole**. A 24″ minimum diameter manhole which should normally be hinged to assist easy opening.

b) **Inspection Hatch**. A 6″ sample hatch to allow for a visual inspection of the low end of the tank, or for the taking of samples.

c) **Dipstick**. A suitable captive dipstick to determine the tank contents, designed so that it cannot bottom on the tank indicator and cause scratching, particularly in lined tanks. The dipstick should preferably be of fibreglass material.

d) **Vent**. A free vent, or an emergency pressure relief valve. When a pressure relief valve is fitted, the type and pressure settings should be in accordance with the manufacturer's recommendations.

e) **Outlet/Fill Connection**. Separate outlet and fill connections with the fill point arranged so that there is no free-fall of product at any stage of the tank filling. The outlet should either be by floating suction or from a stack pipe which extends at least 6” above the lowest point of the tank. If a floating suction is embodied then a bonded floating suction check wire pull assembly should be fitted directly to the top of the tank. A floating suction offers several advantages over a stack pipe outlet and is therefore strongly recommended.

f) **Contents Gauge**. A sight glass or preferably a contents gauge.

g) **Automatic Closure Valves**. Automatic quick closure valves to the delivery and suction inlet and outlets. These valves should be capable of operation from both the helideck and from another point which is at a safe distance from the tank.

7.2.2.1 The static storage tank shell must be properly bonded and the entire tank external surface should preferably be finished in safety yellow paint (BS 4800, Type 08E51). Safety yellow is not mandatory but has been generally accepted for helifuel tanks.

7.3 Delivery System

The delivery system to transfer fuel from the storage tank to the aircraft must include the following components:

a) **Pump**. The pump should be an electrically or air driven, centrifugal or positive displacement type with a head and flow rate suited to the particular installation. The pump should be able to deliver up to 50 IGPM under normal flow conditions and to produce 50 psi no flow pressure, i.e. with the delivery nozzle closed. A remote start/stop button must be provided on or immediately close to the helideck and close to the hose storage location. There should also be a pump running warning light which is visible from the helideck.

b) **Filtration Units**. Filter units including microfilters, filter water separators and fuel monitors should be fitted with automatic air eliminators and sized to suit the discharge rate and pressure of the delivery system. Units should be API 1581 approved. Such filters should provide protection down to 1 micron particle size. Filter units must be fitted with a sample line to enable water to be drained from the unit. The sample line should terminate with a ball valve and have a captive dust cap. Sample lines on filter units must be a minimum ½” diameter but, in general, the larger the diameter of the sample line the better. In any event the drain line should match the vessel outlet.

c) **Flow Meter**. The flow meter should be of the positive displacement type and sized to suit the flow rate. The meter should be regularly calibrated in accordance with the manufacturer’s recommendation, normally annually. It is also recommended that the flowmeter includes both a strainer and an air eliminator.

d) **Fuel Monitor**. A fuel monitor should be provided between the flowmeter and delivery hose. This unit is designed to absorb any water still present in the fuel and to cut off the flow of fuel once a certain amount of water has been exceeded. The monitor is described as an Aviation Fuel Filter Monitor with absorbent type elements.

e) **Delivery Hose**. The delivery hose should be an approved semi-conducting type to BS 3158 (1985) type C, Grade 2, 1½” internal bore fitted with reusable safety clamp adaptors; hoses of larger diameter may be required if a higher flow rate is specified. The hose should be stored on a reel suitable for the length and diameter of the hose being used (the minimum bend radius of the hose should be considered). Fuel type markings (black and white) should be applied to the delivery hose.

f) **Bonding Cable**. A suitable bonding cable must be provided and must always be used to earth the helicopter airframe before any refuelling commences. The cable must be bonded to the system pipework at one end, and be fitted with a correct earthing adaptor to attach to the aircraft and a means of quick disconnection at the aircraft end. The electrical resistance between the end connection and the system pipework should not be more than 0.5 ohm.

g) **Fuelling Nozzle**. The fuel delivery to the aircraft may be either by gravity or pressure refuelling. It is beneficial to have the ability to refuel by either means to suit the aircraft type being refuelled:

i) Gravity. – The nozzle should be 1½" spout diameter fitted with 100 mesh strainer. Suitable types include the EMCO G457/045 refuelling nozzle.

ii) Pressure. – For pressure refuelling the coupling should be 2½" with 100 mesh strainer and quick disconnect. A Carter or Avery Hardoll pressure nozzle with regulator and surge control should be used. On low pressure systems the regulator and surge controller may be unnecessary.

iii) Pressure Gravity. – To meet both requirements, a pressure nozzle can be fitted to the hose end. A separate short length of hose fitted with an adaptor (to fit the pressure nozzle) and with the gravity nozzle attached can be used as required. This arrangement gives the flexibility to provide direct pressure refuelling or, with the extension hose attached, a means of providing gravity refuelling. Alternatively a direct crossover adaptor may be used.

7.3.1 The delivery system, including hoses and nozzles should have adequate weather protection to prevent deterioration of hoses and ingress of dust and water into the nozzles.

7.4 Recommended Maintenance Schedules

Different elements of the helifuel refuelling systems require maintenance at different times, ranging from daily checks on the delivery system to annual checks on static storage tanks. The various components of the system given in paragraphs 7.2 and 7.3 are listed with their servicing requirements.

7.4.1 Transit Tanks

All transit tanks should be subject to a 'trip examination' each time the tank is filled and, additionally, they should be checked weekly for condition. The following six-monthly and twelve-monthly inspections should be carried out on all lined carbon steel tanks. However, for stainless steel tanks, the inspections can be combined at twelve-monthly intervals.

a) **Trip Inspection**. Each time the tank is offered for refilling the following items should be checked:

i) Tank Shell – for condition; has shell suffered any damage since its previous filling?

ii) Visual check of filling/discharge point and sample point for condition and leakage, and caps in place.

iii) Visual check of lifting lugs and four-point sling for signs of damage.

iv) Tank top fittings to be checked for condition, caps in place, dirt free and watertight.

v) Check that tank identification, serial number and contents are properly displayed.

vi) Completion of the trip inspection should be signed for on the 'release note' (see Chapter 8, Annex A).

b) **Weekly Inspection**. Each tank whether it is full or empty, onshore or offshore, should be given a weekly check similar to the trip inspection at a) above to ensure that the tank remains serviceable for the purpose. The weekly check should primarily be for damage and leakage. The completion of this check should be signed for on the serviceability report (see Chapter 8, Annex B).

c) **Six-Monthly Inspection**. The six-monthly inspection must be carried out onshore by a specialist organisation. Such a check should include:

i)	Tank identification plate	Check details.
ii)	Tank shell	Visual check for damage.
iii)	Paint condition (external)	Check for deterioration.
iv)	Paint condition (internal)	Check for deterioration, particularly if applicable around seams.
v)	Lining materials (if applicable)	Check for deterioration, lifting, etc. MEK and/or acetone test should be carried out on linings or on any lining repairs.
vi)	Tank fittings (internal)	Check condition.
vii)	Tank fittings (external)	Check condition.
viii)	Access manhole	Check security.
ix)	Pressure relief valve	Check condition, in particular check for leaks.
x)	Dipstick assembly	Check constraint, markings and cover/ cap for security.
xi)	Bursting disc	Check for integrity and cover/cap for security.
xii)	Inspection hatch assembly	Check seal condition and security.
xiii)	Bonding	Measure electrical bonding resistance between transit tank and its shell.
xiv)	General	Examination and test procedures as set out in BS 7072 (1989) Part 6.

d) **Annual Inspection** The annual inspection should include all of the items at c) above, i.e. six-monthly inspection and, in addition, should include the following:

Vacuum relief valve	Check setting, condition and ensure waterproof fit.

e) **Rectification**. It is a legal requirement that transit tanks are re-certified by a Designated Certifying Authority at least every five years with an intermediate check every 2½ years. The date of certification should be stamped on the tank inspection plate.

7.4.2 **Storage Tanks**

Static storage tanks are subject to an annual or biennial inspection depending on the type of tank. If the storage tank is mild steel with a lining then it should be inspected at least once per year, if the tank is stainless steel then a two-year interval between inspections is acceptable. When due for inspection the tank should be drained and vented with the manhole access cover removed. The inspection should include the following:

a)	Cleanliness	Clean tank bottom as required.
b)	Tank internal fittings	Check condition.
c)	Lining material (if applicable)	MEK (Methyl Ethyl Keytone) and/or acetone test (note this check need only be carried out on new or repaired linings).
d)	Paint condition	Check for deterioration particularly around seams.
e)	Access manhole cover	Check seal for condition and refit cover securely. Refill tank.
f)	Floating suction	Check operation and condition.
g)	Valves	Check condition, operation and material.
h)	Sump/drain line	Check condition, operation and material.
i)	Grade identification	Ensure regulation Jet A-1 markings applied and clearly visible.
j)	Contents gauge	Check condition and operation.
k)	Bonding	Measure electrical bonding resistance between tank and system pipework.

7.4.3 **Delivery Systems**

The offshore delivery system should nominally be inspected by the helicopter operator every three months. However the inspection may be carried out by a specialist contractor on behalf of the helicopter operator. No system should exceed four months between successive inspections. In addition the system should be subject to daily, weekly and monthly checks by offshore fuelling personnel to ensure satisfactory fuel quality.

a) **Daily Checks**. The following checks should be carried out each day:

i) Microfilter and/or filter/water separator and/or filter monitor. Drain the fuel from the sump until clear. The sample should be of the correct colour, clear, bright and free from solid matter. The sample must be checked for dissolved water by using a syringe and water detection capsule (see Chapter 8, paragraph 8.2 b).

NOTE: This check includes the decant filter located in the decant line between the transit tanks and static storage tank.

ii) Storage tank. A fuel sample must also be drawn from each compartment of the storage tank (as applicable) and checked for quality as in paragraph i) above.

iii) A sample should also be drawn from the hose end and checked for quality as in paragraph i) above.

iv) These daily checks should be recorded on the 'daily storage checks', see Chapter 8, Annex C.

NOTE: Fuel samples taken in accordance with i) and ii) above should be retained for at least 24 hours to enable them to be analysed in the event of an aircraft accident.

b) **Weekly Checks**. The following checks should be carried out each week (in addition to the daily checks specified above). See Chapter 8, Annex B.

i) Differential pressure gauge. During refuelling the differential pressure gauge reading should be noted and recorded on the filter record sheets, see Chapter 8, Annex D.

ii) Entire system. (Including transit tank checks detailed in paragraph 7.4.2 b)) The system must be checked for leaks and general appearance.

iii) Tank top fittings. Should be checked to see all are in place, clean and watertight.

iv) Inlet and outlet couplings. Check caps are in place.

v) Gauge filters. Filters fitted to fuelling nozzles and fuelling couplings must be inspected and cleaned. If significant quantities of dirt are found, the reason must be established and remedial action taken. During these checks the condition of any seal should be checked for condition and to ensure they are correctly located.

vi) Floating suction. This should be checked for buoyancy.

vii) Aviation delivery hose. The hose should be checked visually whilst subjected to system pump pressure. This particular check should be recorded on the hose inspection record, see Chapter 8, Annex E.

viii) Delivery nozzle. The strainer should be removed and cleaned and replaced as necessary, see v) above, the bonding wire and clip should also be checked for general condition, security and electrical continuity.

ix) Bonding Reel. Check for general condition, security and electrical continuity.

x) Storage Tank. Check buoyancy of floating suction.

xi) The completion of these checks should be recorded on the serviceability report, see Chapter 8, Annex B.

c) **Monthly Checks**. The following additional check should be carried out at monthly intervals and entered on the 'serviceability report':

i) Delivery Hose. Pressure test in accordance with the test procedure and record on 'Hose Inspection' record as exampled at Chapter 8, Annex E.

d) **Three-Monthly Checks**. A three-monthly check is the major inspection of the system and should be carried out by an authorised inspector. The following check of items to be included will depend on the particular installation and is included as a general guide, additional items may be included as appropriate:

i) All filtration units, i.e. decant line, dispenser and monitor filter. Obtain a fuel sample and check for appearance and water presence (see Chapter 8, paragraph 8.2 b) procedure). Note results of sample check on system records. If bad samples are obtained on this three-monthly check it could indicate the presence of bacteriological growth in the separator. If samples are not good proceed as follows:

aa) Open the filter vessel and inspect for surfactants, bacteriological presence, mechanical damage and condition of lining (if applicable). Clean out any sediment and carry out a water test on the water stripper.

ii) Check earth bonding between transit tank and main storage.

iii) Suction fuel hose and coupling

aa) Ensure outer protective cover is present.

bb) Check hose for damage and leakage.

cc) Check end connections for damage and leakage.

dd) Check correct operation of hose coupling.

ee) Check end cap present.

iv) Pump unit

aa) Remove, clean and inspect strainers.

bb) If air driven, then remove air line lubricator, regulator and water separator units, service as required.

v) Hose reel

Ensure reel mechanism operates correctly, grease rewind gears.

vi) Delivery hose

Carry out a visual check of the hose whilst under system pressure. Look for external damage, soft areas, blistering, leakage and any other signs of weakness. Particular attention should be paid to those sections of the hose within about 45 cm (18 ins) of couplings since these sections are especially prone to deterioration.

vii) Delivery coupling/nozzle

aa) Check operation to ensure correct lock off and no leakages.

bb) Remove, clean and visually check cone strainers, replace as necessary.

cc) Check earth bonding wire assemblies and bonding clips and pins. Renew if required.

dd) Ensure pressure fuel coupling has sampling valve assembly and is operational (alternatively samples may be taken from an overwing nozzle fitted to the pressure coupling).

ee) Ensure all dust caps are present and are secured.

NOTE: No lubrication is to be applied to any of the coupling or nozzle parts.

viii) Main earth bonding

aa) On auto rewind, check for correct operation or rewind mechanism, adjust and lubricate as necessary.

bb) Carry out a visual check on earth bonding cable and terminal connections, replace if required.

cc) Check condition of earth bonding strap.

dd) Carry out continuity check.

e) **Six-Monthly Checks**. Six-monthly checks, as for the three-monthly checks, should be carried out only by authorised Fuel Inspectors. The contents of the six-monthly check should include all the elements of the three-monthly checks detailed in paragraph 4.4 d) above and, in addition, should include the following items:

i) All filtration units, i.e. decant line, dispenser and monitor filter

aa) Check operation of the differential pressure gauge. (Renew filter element if the differential pressure limit is exceeded.)

bb) Prime the unit and check the operation of the automatic air eliminator. (If manual type is fitted it is recommended that it is replaced with an automatic type.)

cc) Ensure the unit has the correct fuel grade identification.

dd) Ensure the connecting pipework has the correct fuel grade identification.

ii) Electrical pump unit (if applicable)

aa) All electrical circuits to be checked by a qualified electrician.

bb) Check gearbox oil level is appropriate.

cc) Check coupling between motor and pump for wear and signs of misalignment.

dd) Refer to pump manufacturer's recommended maintenance schedule for additional items.

iii) Air-driven pump system (if available)

aa) Lubricate air motor bearings if necessary.

bb) Check coupling between motor and pump for wear and signs of misalignment.

cc) Refer to pump manufacturer's recommended maintenance schedule for additional items.

iv) Metering unit

aa) Check operation of automatic air eliminator.

bb) Lubricate the meter register head, drive and calibration gears with vaseline only.

cc) Lubricate bearings.

v) Hose reel

aa) Check tension on chain drive and adjust if necessary.

bb) Lubricate the bearings.

vi) Delivery hose

Ensure the correct couplings are attached to the hose.

f) **Annual Checks**. Annual checks must be carried out by an authorised Fuel Inspector. The contents of the annual check includes all the items in both the three-monthly and six-monthly and, in addition, consists of the following items:

i) All filtration units, i.e. decant line, dispenser and monitor filters

aa) Remove and discard existing elements and shrouds. Clean out vessel. Visually check all areas of lining for signs of deterioration.

NOTE: For onshore installations, filter elements need only be replaced on condition or every 3 years.

bb) Carry out MEK test if applicable.

NOTE: This need only be carried out to check for correct curing when lining is new or has been repaired.

cc) Carry out DFT thickness test on vessel interior linings if applicable (again this is only necessary on new or repaired linings).

dd) Apply pin hole detection test if applicable.

ee) Fit new elements and shrouds.

ff) Fit new gasket and seals.

gg) Stencil date filters changed on vessel body.

ii) Delivery hose

Ascertain when hose was fitted, either from system records or from hose markings. Delivery hose must be replaced every two years or earlier if any defects are found which cannot be repaired. Alternatively, the hose will have a ten year life, with six-monthly hydrostatic tests.

iii) Fuel delivery meter

The fuel delivery meter may require calibration; refer to manufacturer's recommendations.

Authorised Fuel Inspectors will normally issue a report following an offshore inspection, whether it be a three-monthly, six-monthly or annual check. These reports should be copied to all offshore helicopter operators for their information.

Chapter 8 Refuelling Procedures

8.1 General

This section includes recommended procedures for the filling of transit tanks, the transfer of fuel from transit tanks to static storage and the refuelling of aircraft from static storage. Civil Aviation Publication CAP 434 ‘Aviation Fuel at Aerodromes’ also gives general advice on fuel storage, handling and quality control.

NOTE: Certain companies arrange 2-day training courses at onshore locations. The courses are intended for offshore staff who are involved with maintaining and operating helicopter fuel systems offshore. Details of the above mentioned courses may be obtained from UKOOA on 0171-589 5255.

8.2 Filling of Transit Tanks

The trip examination should be carried out as specified in Chapter 7, paragraph 7.4.1. The tank should then be dipped to ascertain the quantity of fuel in the tank in order to calculate the volume of fuel required to fill the tank. The following items should then be completed:

a) Draw fuel from transit tank sample line and discard until the samples appear water free.

b) Carry out check for fuel quality in the following manner:

   i) Samples must be drawn at full flush into scrupulously clean, clear glass sample jars (4 litres capacity).

   ii) The fuel should be of the correct colour, visually clear, bright and free from solid matter and dissolved water. (Jet A-1 may vary from colourless to straw colour.)

   iii) Undissolved water will appear as droplets on the sides, or bulk water on the bottom of the sample jar. It will also appear as a cloud or haze.

   iv) Solid matter is usually made up of small amounts of dust, rust, scale etc. suspended in the fuel or settled out on the bottom jar. When testing for dirt, swirl the sample to form a vortex, any dirt present will concentrate at the centre of the vortex making it more readily visible.

   v) Testing for suspended water must be done with a syringe and capsule detector test. Fit a capsule to the syringe and immediately withdraw a 5 ml fuel sample into the syringe. Examine the capsule for any colour change. If there is a distinct colour change the fuel should be rejected. (Capsules must be used within 9 months from the date of manufacture. Tubes or capsules are marked with the relevant expiry date. Note: Capsules must not be re-used.)

NOTE: The use of water-finding paper is no longer recommended.

c) Once satisfied that the fuel is free from water, draw off sufficient fuel to measure its specific gravity with a clean hydrometer. The fuel temperature must also be noted in order to correct the measured specific gravity to a relative density (this is done using a correction graph). The relative density of the fuel sample taken from the transit tank must be compared with that of the previous batch of bulk fuel from which the transit tank was last filled. The relative density of the previous batch of fuel should be taken from the previous release note or from the label from the retained sample. If the difference in relative densities exceeds 0.003 the contents of the transit tank may have been contaminated with some other product and the refilling should not take place.

d) First connect the bonding wire to the transit tank then connect the delivery hose coupling to the transit tank filling point and start the transfer pump to fill the tank. It should be noted that the inspection hatch must be opened prior to filling otherwise the bursting disc could be ruptured. When the meter register head indicates that the required quantity of fuel has been transferred, stop the transfer pump, remove the coupling from the tank and then remove the bonding connection. The dust cap must then be replaced on the filling point. The tank should be dipped to check the tank contents. A further sample should be drawn from the tank once it has been filled. This sample should be labelled with the tank number, the fuel batch number and date of filling and should then be retained safely until the tank is offered again for refilling. This sample will be required as a proof of fuel quality in the event of an aircraft incident where fuel may be considered to be a causal factor.

e) The tank should then be sealed and a release note completed with all the required particulars; special attention should be paid that the correct grade of fuel is included on this release note, e.g. with AL38 as appropriate. A copy of this release note should be secured in the tank document container and a further copy retained for reference. A sample release note is appended at Chapter 8, Annex A.

8.3 **Decanting from Transit Tanks to Static Storage**

Before commencing any transfer of fuel it is necessary to dip the storage tank to ensure that the contents of the transit tank can be accommodated within the intended storage facility. The transit tank must have had sufficient time to settle once positioned correctly for the transfer operation. Tanks with floating suction need at least 1 hour for settling time and tanks without floating suction must be left for a period in hours approximately equal to the tank diameter in feet (a tank 6 feet in diameter should be left to settle for a period of at least 6 hours).

The following procedure should then be followed:

a) Check transit tank seals are still intact.

b) Check transit tank grade marked.

c) Check release note for the following.

i) Correct grade.

ii) Quantity.

iii) Batch number.

iv) Date.

v) Certified free from dirt and water.

vi) Signed by authorised product inspector.

d) Take fuel samples from the transit tank and from the decant filter/water separator and discard until the samples appear water free.

e) Carry out checks for fuel quality as described above in paragraph 8.2 b).

f) If the transit tank sample test is not satisfactory, then draining a quantity of fuel off at full flush and then retesting may produce a satisfactory result.

g) Once a satisfactory test has been obtained the transit tank must next be properly bonded to the system interconnecting pipework and then the transfer hose should be connected to the transit tank discharge point (via a suitable filter, i.e. 5 micron or less).

h) Start the transfer pump (if applicable) and open the valves to start the fuel flow. Once fuel transfer has commenced check the coupling connections for any signs of leakage and continue to monitor the fuel flow whilst transfer is taking place.

i) When sufficient fuel has been transferred shut off the valves and stop the transfer pump.

j) Disconnect the electrical bonding lead and replace any dust caps that were removed at the commencement of the operation.

k) Record fuel quality checks and the transfer of the transit tank contents into the storage tanks and retain the release note on board the installation/vessel. A sample sheet for recording these items is at Chapter 8, Annex F.

8.4 **Aircraft Refuelling**

8.4.1 Always ensure before starting any refuelling that the fuel in the storage tank is properly settled, refer to paragraph 8.3 above for correct settling times.

8.4.2 Before the commencement of any helicopter refuelling, the HLO must be notified. All passengers should normally be disembarked from the helicopter and should be clear of the helideck before refuelling commences (but see j) below). The fire team must be in attendance at all times during any refuelling operation. The following procedure will then apply:

a) When the aircraft captain is ready and it has been ascertained how much fuel is required and that the grade of fuel is correct for the particular aircraft, run out the delivery hose on the helideck to the aircraft refuelling point.

b) Take a fuel sample from the nozzle end or from the water separator drain point (if a pressure refuelling coupling is in use) and carry out a water detection check. For two-pilot operations this should be witnessed by the non-handling pilot, who should be satisfied that the fuel water test is acceptable. During single-pilot operations the water detection capsule should be shown to the pilot after the water detection check.

c) Next attach the main bonding lead to the aircraft earthing point.

d) If pressure refuelling, connect the pressure coupling to the aircraft and remain adjacent to the fuelling point. If gravity refuelling, first connect the secondary bonding lead to bond the refuelling nozzle to the aircraft, open the tank filler and insert the nozzle and prepare to operate the fuel level when cleared to do so.

e) The nominated person in charge of the refuelling should operate the system pump switches and open any necessary valves to start the flow of fuel only when given clearance by the pilot.

f) If any abnormalities are observed during the refuelling, the off switch must immediately be operated. When refuelling is complete, the pump should be shut down and the nozzle handle released.

g) Remove the refuelling nozzle or disconnect the pressure coupling as appropriate and replace the aircraft filler cap. Finally disconnect the secondary bond lead. A further fuel sample should now be taken as in b) above and a fuel water check should again be carried out.

h) Remove the delivery hose from the helideck and carry out a final check that the aircraft filler cap is secure then disconnect the main bonding lead from the aircraft and check that all equipment is clear from the proximity of the aircraft. The hose should be rewound onto its reel or, if left unwound, should be stowed clear of any source of heat or radiation which could damage the hose.

i) Enter the fuel quantity onto the daily refuelling sheet and obtain the pilot's signature for the fuel received. A sample copy of the fuelling daily log check is included at Chapter 8, Annex G.

j) If for safety reasons the aircraft captain has decided that the refuelling should be carried out with passengers embarked, the following additional precautions shall be undertaken:

   i) Constant communications must be maintained between the aircraft captain and the refuelling crew.

   ii) The passengers must be briefed.

   iii) The emergency exits opposite the refuelling point must be unobstructed and ready for use.

   iv) A competent person must be positioned ready to supervise disembarkation in the event of an emergency.

8.4.3 Civil Aviation Publication CAP 74, 'Aircraft Refuelling: Fire Prevention and Safety Measures', offers further general guidance.

8.5 Sample Documentation

A complete set of suitable documents is attached, these should be used to record maintenance checks, transfer of fuel and aircraft refuelling. The sheets are attached as Appendices to this Chapter and consist of:

Annex A	Release Note
Annex B	Weekly and Monthly Serviceability Report
Annex C	Daily Storage Checks
Annex D	Differential Pressure/Throughput Record
Annex E	Hose Inspection and Nozzle Filters Test Record
Annex F	Storage Tank, Checks Before and After Replenishment
Annex G	Fuelling Daily Log Sheet

Chapter 8 Annex A

Offshore Helicopter Refuelling Equipment Release Note for Transit Tank

1 To be Completed by Supplying Organisation

Name of Installation: .... Release Note No.:..........................

Date filled: .... Delivered To: ....

Grade: .... Batch No.: ....

Quantity: .... Transit Tank No.: ....

Tank Trip Inspection Completed (Sig): .... Name: ....

Transit Tank due Next Service: ....

Check and Certificate Re Transit Contents Before Release					
Empty tank checked before filling	Tank filling supervised	Contents checked after filling and Certified:			
		(a) Free from water	(b) Free from dirt	(c) Correct Colour	(d) Tank sealed
Sig.	Sig.	Sig.	Sig.	Sig.	Sig.

Certified that the product detailed hereon conforms to the relevant specification and has been handled in accordance with the supplying organisation's quality control procedures

Sig. of Authorised Signatory:

2 To Be Completed By Receiving Installation

Name Of Installation: ....

Date Transit Tank Received:.....................................

Date Transit Tank Discharged: .... Quantity: ....

Checks Re Transit Contents Before Release			
(a) Free from water	(b) Free from dirt	(c) Correct colour	(d) Tank sealed
Sig.	Sig.	Sig.	Sig.

Certified product detailed hereon checked and decanted into storage/brought into use

Sig. of Authorised Signatory:

NOTE: One copy to be retained at Supplying Installation
One copy to accompany Transit Tank and to be retained at Receiving Installation

Chapter 8 Annex B

Offshore Helicopter Refuelling Equipment Weekly and Monthly Serviceability Report

Name of Installation: .... Month: .... 19....................

Component	Check		Weekly			
			1	2	3	4
Fuelling Equipment including transit tank	1.	Entire system: Free from leaks, general appearance satisfactory.				
	2.	Tank top Fittings: Caps in place, dirt and water tight.				
	3.	Inlet and outlet Couplings: Caps in place.				
Delivery Nozzle	4.	Strainer: remove, clean, replace if necessary.				
	5.	Free from leaks, cap in place.				
	6.	Bonding Lead: Condition, Security, Continuity.				
Quality Control Test Equipment	7.	Following items available: glass jar, syringe and water detector capsules.				
Fire Extinguishers	8.	Required number in position.				
Microfilter and F/Water Sep.	9.	Record pressure drop on 'Differential Pressure Record' (App 'D').				
Bonding Reel	10.	Condition, Security, Continuity.				
Storage Tank	11.	Floating Suction: Buoyancy.				
				Monthly		
Delivery Hose	1.	Pressure test in accordance with 'Test Procedure' and record on 'Hose Inspection' record.(Annexe 'E')				

Authorised signatory initials columns to indicate satisfactory condition
Record Deficiencies and Corrective Action Taken Below or on Reverse

Chapter 8 Annex C

Offshore Helicopter Refuelling Equipment Daily Checks of Fuel Quality

Name of Installation: ....

STORAGE TANK SAMPLES[1]

Date	Tank No.	Grade	P	C	S	Colour and Appearance	Time	Floating Suction Check	Signature

1. Mark * When Storage Tanks Water Checked after heavy rainfall

WATER SEPARATOR AND FILTER/MONITOR

Date	Filter or Separator		Result ('N' or 'Fail')			Time	Signature
	Type	Serial Number	P	C	S		

Symbols: P Presence of free water
C Detector Capsule
S Sediment

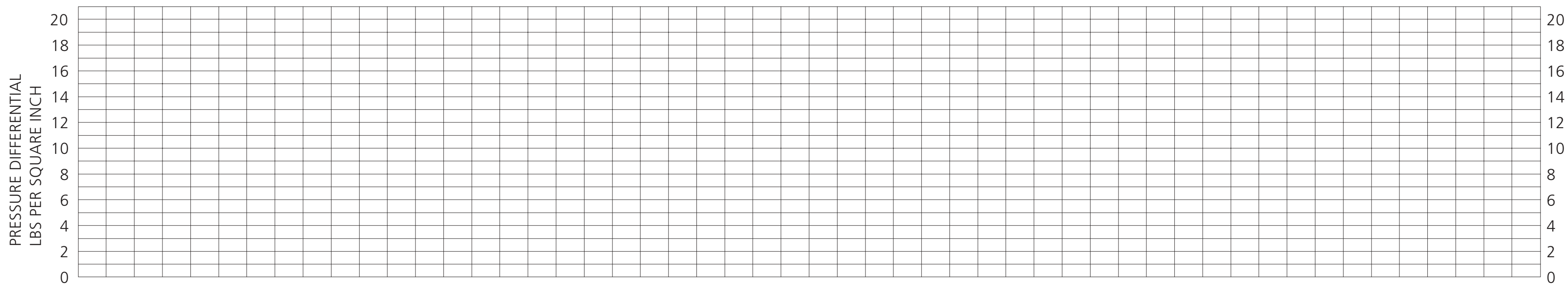
Chapter 8 Annex D

Offshore Helicopter Refuelling Equipment

Microfilter and Filter/Water Separator Differential Pressure and Throughput Record

Installation	Element Type:	Coalescers
Grade of Fuel		Separators
Location of Unit	Date Elements Installed	Coalescers
Filter Model		Separators

Signature																																																			
Date																																																			
Pressure Differential																																																			
Flow Rate																																																			



WEEKLY MAXIMUM PRESSURE DROP GRAPH

Chapter 8 Annex E

Offshore Helicopter Refuelling Equipment Hose Inspection and Nozzle Filters Test Record

Name Of Installation ....

Manufacturer..

Type Of Hose..

Date First Used ....

Date Scrapped..

Hose Identification No................................

Length..

Diameter ....

Location..

Date Tested	Test Carried Out	Item Tested	Result Of Test	Signature

NOTE: Use one page for each hose in service.

Chapter 8 Annex F
Offshore Helicopter Refuelling Equipment
Checks Before and After Replenishment of Storage Tank(s)

Name of Installation: ....

BEFORE REPLENISHMENT (TRANSIT TANK)										AFTER SETTLING (STORAGE TANKS)						
Date	Transfer Note No.	Grade	Tank No.	P	C	S	Colour and Appearance	Time Checked	Signature	Tank	P	C	S	Colour and Appearance	Time and Date Ready for use	Signature

P = Presence of free water
C = Detector Capsule
S = Sediment

Where vertical tanks are installed and fed by consecutive deliveries it will not be necessary to record before and after replenishment checks until the final delivery is made or the tank is required for closure.

Chapter 8 Annex G

Offshore Helicopter Refuelling Equipment – Fuelling Daily Log Sheet

PRODUCT: Jet A-1 D Eng. RD2494/Jet A-1-AL38 D Eng. RD2453 (NB Delete as applicable)

Name of Installation: .... Date Sheet

Aircraft		Helicopter Operator	Hose End Sample Checks		Total Delivered Litres	Signature Of Recipient Pilot	Signature Of Operator	Times	
Type	Registration		Before Fuelling	After Fuelling				Start	Finish

Fuel Checks 'N' Negative TOTAL

Chapter 9 Helicopter Landing Areas on Vessels

9.1 Vessels Supporting Offshore Mineral Workings and Specific Standards for Landing Areas on Merchant Vessels

9.1.1 Helidecks on vessels used in support of the offshore oil and gas industry should be designed to comply with the requirements of the preceding chapters of this publication.

The International Chamber of Shipping (ICS) has published a 'Guide to Helicopter/Ship Operations' which comprehensively describes physical criteria and procedures on ships. It is not intended to reproduce detail from the ICS document which should be referenced in addition to this chapter.

9.1.2 Helicopter landing areas which comply with the criteria and which have been satisfactorily assessed by the BHAB or CAA will be included in the IVLL published by the BHAB. This list will specify the D-value of a helideck; list areas of non-compliance against CAP 437 and; detail specific limitations applied to the helideck. Vessels having ships'-side or midships helidecks or landing areas may be subject to specific limitations due to the lack of obstacle protected surfaces and public transport requirements in terms of performance considerations.

9.1.3 Helicopter landing areas must have an approved D-value equal to or greater than the 'D' dimension of the helicopter intending to land on it.

9.1.4 Helicopter landing areas which cannot be positioned so as to provide a full obstacle-free surface for landing and take-off for specific helicopter types will be assessed by BHAB and appropriate limitations imposed.

9.1.5 It should be noted that helicopter operations to ships with landing areas at the bow or stern may be further limited depending on the ships movement in pitch, roll and heave.

9.2 Amidships Helicopter Landing Areas – Ships Centreline (See Figure 9.1)

General

The following special requirements apply to vessels which can only accommodate a helicopter landing area in an obstructed environment amidships.

9.2.1 Size and Obstacle Environment

The reference value 'D' (overall dimension of helicopter) given at Table 3.1 (Chapter 3) also applies to ships' landing areas referred to in this Chapter. It should also be noted that amidships landing areas are only considered suitable for single main rotor helicopters.

9.2.2 Forward and aft of the centreline landing area shall be two symmetrically located 150° limited obstacle sectors with apexes on the circumference of the 'D' reference circle. Within the area enclosing these two sectors and over the whole of the 'D'

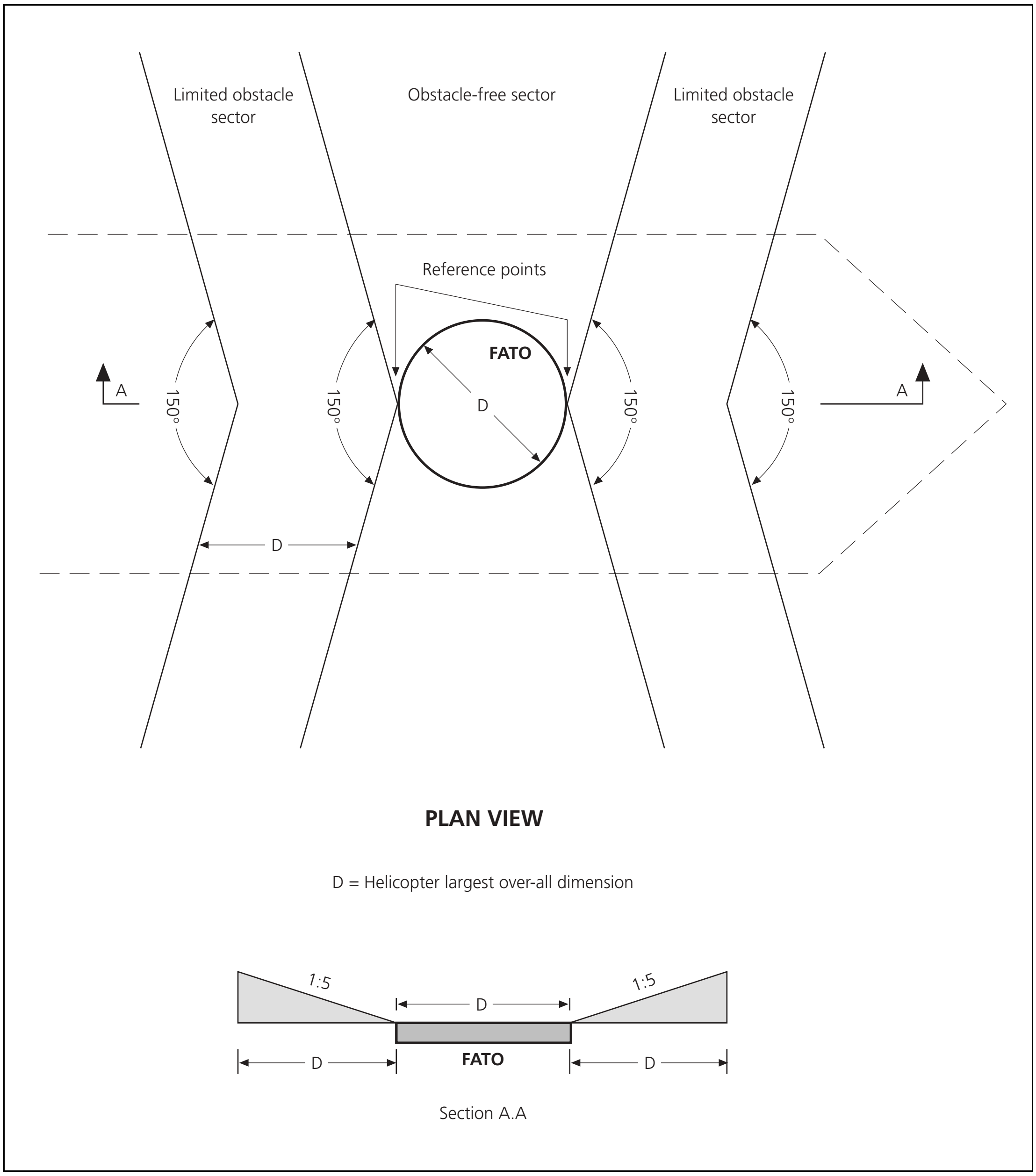


Figure 9.1 Midship Centreline

circle there shall be no obstructions above the level of the landing area except those referred to at Chapter 3, paragraph 3.7.4 which are permitted up to a maximum height of 250 mm above the landing area level.

9.2.3 To provide protection from obstructions adjacent to the landing area, an obstacle protection surface extends both fore and aft of the final approach and take-off area (FATO). This surface extends at a gradient of 1:5 out to a distance of 'D' as shown in Figure 9.1.

9.2.4 Where the requirements for the limited obstacle surface cannot be met but the landing area size (FATO) is acceptable, it may be possible to apply specific operational limitations which will enable helicopters up to a maximum 'D' value of the FATO to operate to the deck. In such cases it will be the Authority's requirement that out of ground effect hover capability is available to the helicopter throughout the landing and take-off manoeuvre.

9.2.5 The structural requirements referred to at Chapter 3 should be considered when providing an amidships landing area on a ship's deck. The provision of a landing area net is a requirement.

9.3 Helicopter Landing Area Marking and Lighting

The basic marking and lighting requirements referred to at Chapter 4 will also apply to all helicopter landing areas on ships except that at amidships areas the aiming circles should always be positioned on the centre of the landing area (FATO).

9.4 Ship's Side Landing Area

9.4.1 Refer to Figure 9.2 for layout and dimensions.

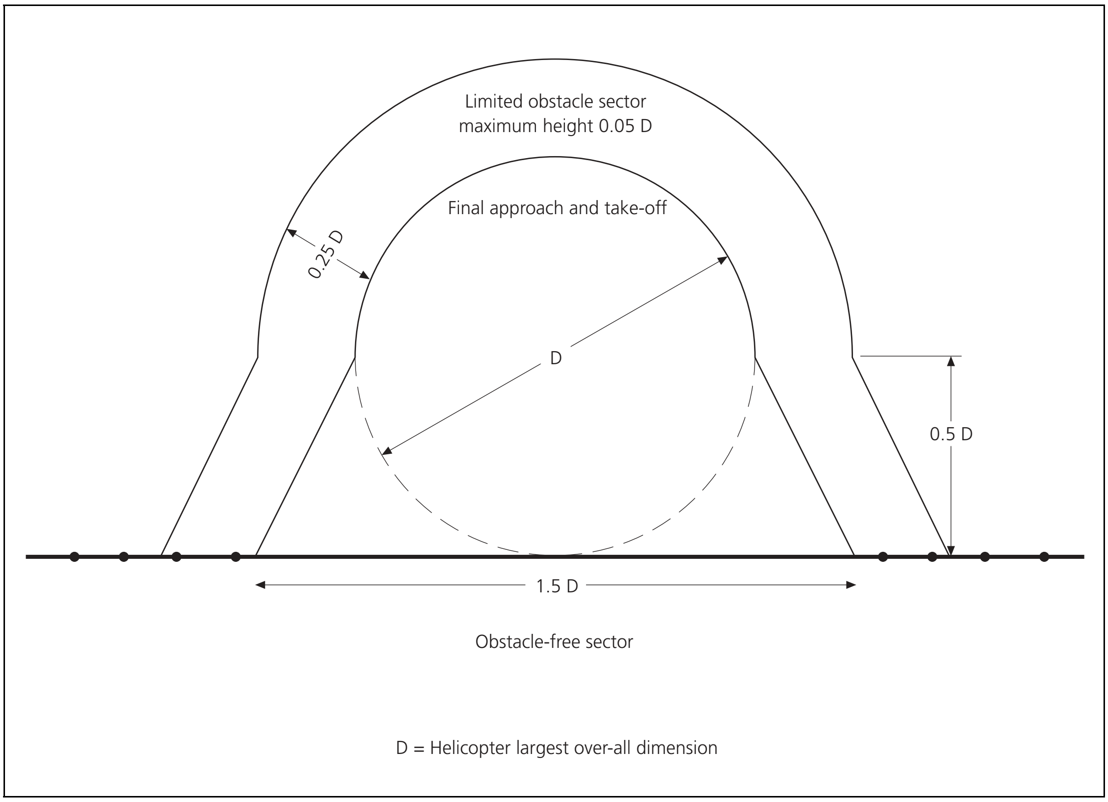


Figure 9.2 Ship's Side: Non-Purpose Built Landing Area

The above areas which consist of an inner 'clear zone' (D-value) and an outer 'manoeuvring zone' should, where possible, be established on the vessel's main deck. The 'manoeuvring zone' which extends beyond the final approach and take-off area (FATO) by 0.25 D for a landing area is intended to provide the helicopter with an additional degree of protection to account for rotor overhang beyond the 'clear zone'.

9.5 Winching Areas

A winching area should provide a 'manoeuvring zone' with a minimum diameter of 2D (twice the overall dimension of the largest helicopter permitted to use the area). Within the 'manoeuvring zone' a 'clear area' should be centred. This clear area should be at least 5 metres in diameter. (See Figure 9.3.)

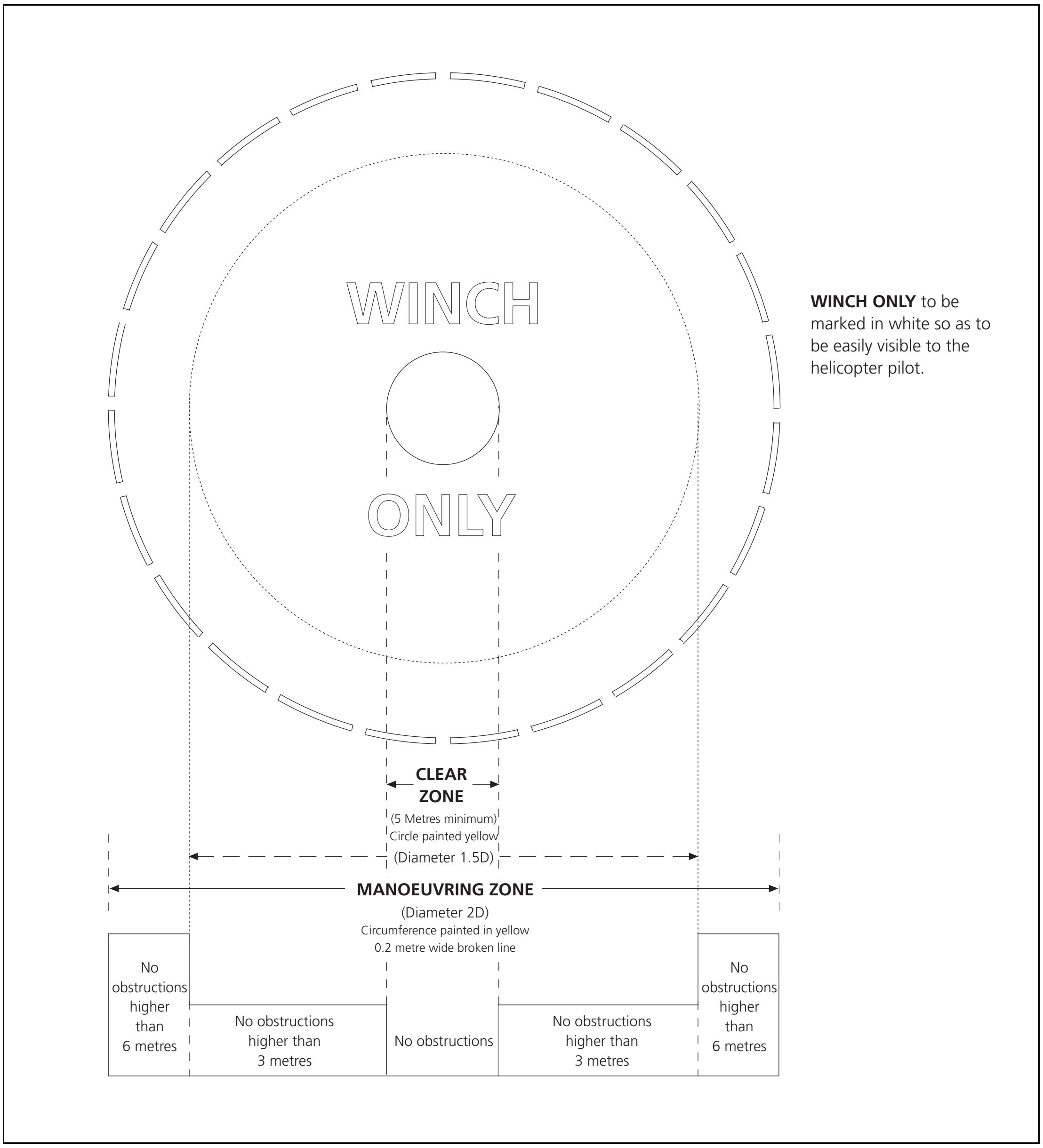


Figure 9.3 Winching Area

9.6 **Obstructions**

9.6.1 To make a landing operation safe it is essential that any part of the ship's side rail within the manoeuvring zone is removed or stowed horizontally.

9.6.2 All aerials, awnings, stanchions and derricks or cranes within the vicinity of the manoeuvring zone should be either lowered or securely stowed.

9.6.3 All dominant obstacles adjacent to the manoeuvring zone should be conspicuously marked.

9.7 **Poop Deck Operations**

Due to the design and nature of a vessel, where it is impossible to provide a main deck landing or winching area it may be acceptable to accommodate a suitable area on the poop deck of the ship. However, if this is the case, the following additional safety factors will have to be considered:

a) air turbulence caused by the superstructure may adversely affect helicopter performance;

b) flue gases may adversely affect the pilot and the performance of the helicopter engines;

c) vessel movement in both pitch and yaw are exaggerated at the stern.

NOTE: To reduce adverse factors mentioned above it is beneficial to position the vessel so that the relative wind is 30° off the port bow.

9.8 Winching Above Accommodation Spaces

Some vessels may only be able to provide winching areas which are situated above accommodation spaces. Due to the constraints of operating above such an area only twin-engined helicopters should be used for such operations and the following procedures adhered to:

a) personnel must be cleared from all spaces immediately below the helicopter operating area and from those spaces where the only means of escape is through the area immediately below the operating area;

b) safe means of access to and escape from the operating area must be provided by at least two independent routes;

c) all doors, ports, skylights etc. in the vicinity of the aircraft operating area must be closed. This also applies to deck levels below the operating area;

d) Fire and rescue parties must be deployed in a ready state but sheltered from the helicopter operating area.

9.9 Night Operations

Figure 9.4 shows an example of the overall lighting required for night helicopter operations. Details of the FATO lighting are given at Chapter 4, paragraph 4.3. Additionally the Ship's Master should ensure that:

a) Floodlights are not directed at an angle which will dazzle the helicopter pilot.

b) Photographic flash equipment is not to be used during the landing and take-off or winching operation.

9.10 Operating Guidance

9.10.1 Landing or Winching

Where practicable, the helicopter should land, rather than winch, because safety is enhanced if the time spent hovering is reduced. Whether the helicopter lands or hovers, the master should be fully aware of, and in agreement with, the pilot's intentions.

9.10.2 Twin and Single-Engined Helicopters

Some states permit offshore operations in single-engined helicopters in accordance with specified rules and criteria. The guidance given in this paragraph (9.10.2) is not relevant for UK operations.

Single-engined helicopters should only be used for transfer to ships on which either a 'full' or 'restricted' landing area is available.

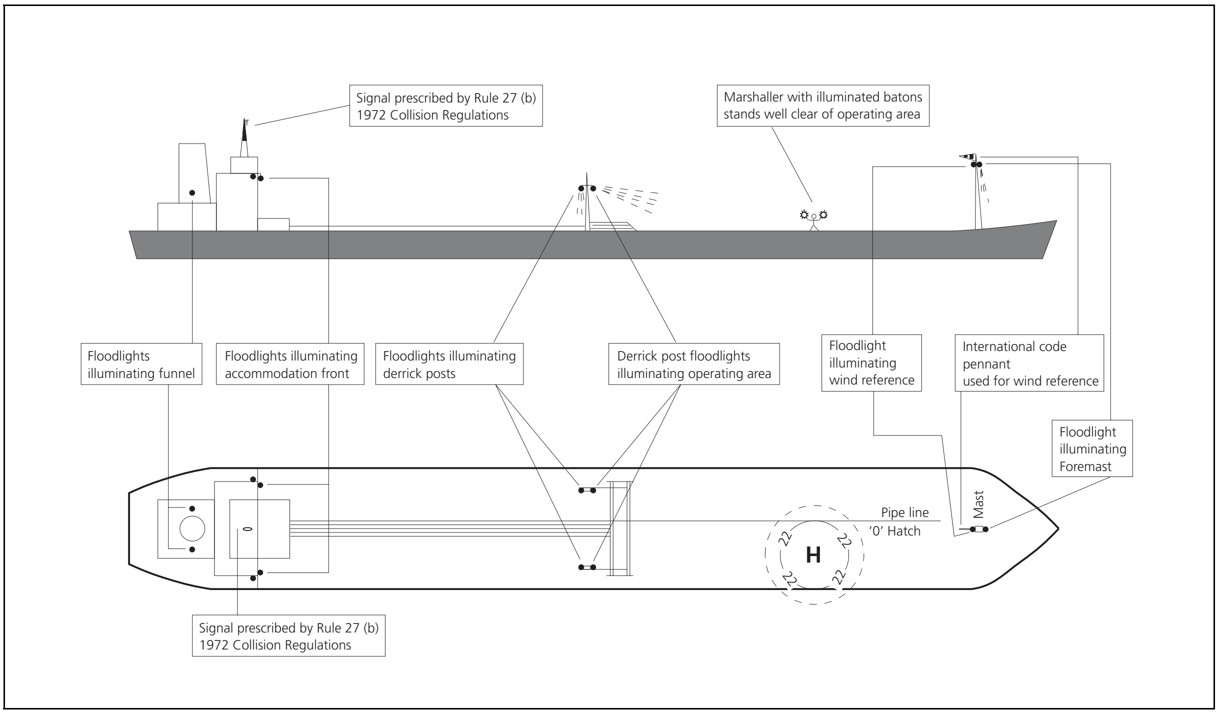


Figure 9.4 Night Operations: Lighting Requirements

At night, single-engined helicopters should only be used to transfer stores. They should not be used to transfer personnel.

Personnel should normally be winched only from multi-engined helicopters with a one-engine-inoperative hover capability.

When helicopter operations are being carried out above winching areas in the vicinity of accommodation spaces, compliance with the requirements of paragraph 9.8 is especially important.

The following Table 9.1 shows the operations which may be conducted with twin-engined and single-engined helicopters respectively, subject to local regulations.

Table 9.1 Twin- and single-engined helicopter operations

	Personnel				Stores			
	Landing		Winching		Landing		Winching	
	Day	Night	Day	Night	Day	Night	Day	Night
Twin Engined	YES	YES	YES*	YES*	YES	YES	YES	YES
Single Engined	YES	NO	NO	NO	YES	YES	NO	NO

* Winching area may be used only if a 'full' or 'restricted' landing area is not available or cannot be used.

9.10.3 **Weather Conditions**

Limiting weather conditions will be in accordance with the requirements of the helicopter operator's 'Operations Manual'. Some vessels may apply lower limits for personnel movement on the helideck.

Chapter 10 Tandem Rotor Helicopter Helidecks

NOTE: For structural load considerations refer to HSE 4th Edition Guidance and Chapter 3, paragraph 3.5 above. There are currently no tandem rotor helicopters operating in UK waters. This chapter is written to provide guidance and an explanation on helidecks marked for tandem rotor helicopters which may appear in UK waters. Ideally such helidecks should be re-marked for single rotor helicopters in accordance with Chapters 3 and 4 above. The criteria listed below is taken from the last edition of CAP 437 and is intended for use only where appropriate.

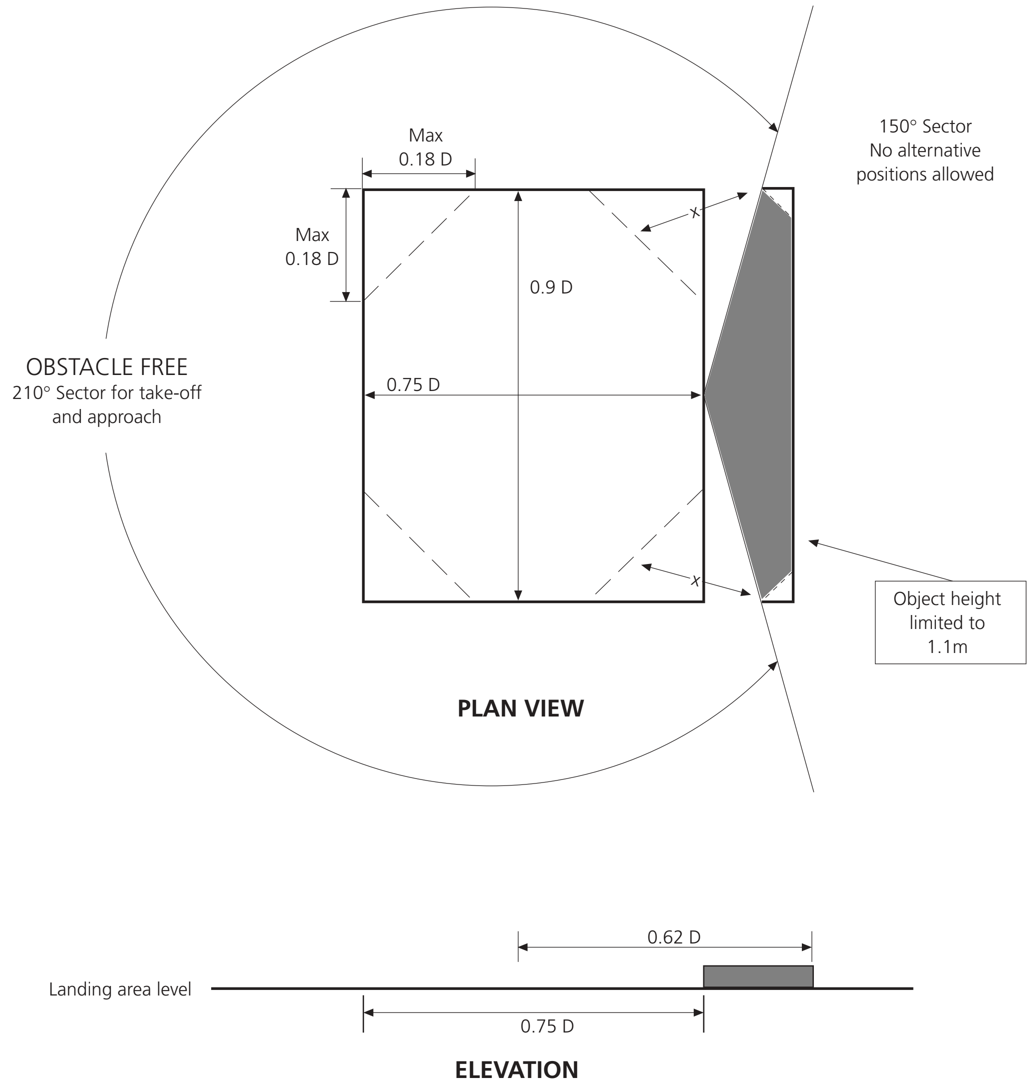
10.1 To allow for omnidirectional landings for any helicopter having tandem main rotors, the area should be sufficiently large to contain a D circle of diameter 0.9 D, where D is the measurement across the rotors in a fore and aft line. If this cannot be met, a landing area rectangle should be provided with a major axis of at least 0.9 D and a minor axis of at least 0.75 D. To allow for omnidirectional landings for any helicopter having tandem main rotors, the area should be sufficiently large to contain a landing area circle of diameter 0.9 D, where D is the measurement across the rotors in a fore and aft line. If this cannot be met, a landing area rectangle should be provided with a major axis of at least 0.9 D and a minor axis of at least 0.75 D, which dimension will allow for bi-directional landings only.

10.1.1 Within this landing rectangle, bi-directional landings will be permitted in the direction of the major axis only. (If necessary for design purposes, any of the corners of this rectangle may be omitted provided that neither of the two sides forming the right angle of any such triangle exceeds 0.18 D in length). (This is illustrated in Figure 10.1.)

10.1.2 From any point on the periphery of the above-mentioned landing area circles, or from the inboard end of the minor axis of the landing area rectangle, an obstacle-free approach and take-off sector should be provided which totally encloses the landing area circle or rectangle and which extends over an arc of at least 210°. Within this sector, and out to a distance of 1000 metres from the periphery of the landing area, only the following items may exceed the height of the landing area, but should not do so by more than 0.25 metres:

- the guttering or slightly raised kerb (associated with the requirements in Chapter 3);
- the lighting required by Chapter 4;
- the outboard edge of the safety net required in Chapter 3;
- the foam monitors;
- those handrails and other items associated with the landing area which are incapable of complete retraction or lowering for helicopter operations.

NOTE: As a general rule, at helidecks where obstacle free sectors are infringed by installations or vessels which are positioned within 1000 metres of the point of origin of the sector, it may be necessary to impose helicopter operating restrictions. (See Chapter 6 for further details.)



NOTES:

1. The D-value relates to the D-value of the largest tandem main rotor helicopter for which the deck is designed.
2. For omnidirection operations by single main rotor (or side by side rotor) helicopters the minimum deck dimension (0.75 D axis) must be equal to or greater than the D-value of the single main rotor (or side by side rotor) helicopter.
3. Distance x = 0.62D–0.375D. The extent of the protected surface in the limited obstacle sector as shown hatched above, is measured from and follows the perimeter of the safe landing area.

Figure 10.1 Obstacle Free Areas
(Tandem Main Rotor Helicopters – Bi-Directional Landings)

10.1.3 The bisector of the 210° obstacle free sector should normally pass through the centre of the landing circle or rectangle. The sector may be 'swung' by up to 15° in the case of omnidirectional landing circles, but not for bi-directional landing rectangles.

10.1.4 For bi-directional landing areas for tandem main rotor helicopters, within the limited obstacle sector, no object shall exceed 1.1 m above helideck level out to a distance of 0.62 D from the centre of the landing rectangle (see Figure 10.1).

10.1.5 For omnidirectional landing areas for tandem main rotor helicopters no objects shall be permitted in the limited obstacle sector within a radius of 0.62 D from the centre of the D circle. Beyond that arc out to an overall distance of 0.83 D objects shall not exceed a height of 0.05 D above helideck level (see Figure 10.2).

10.1.6 The bisector of the 210° obstacle free sector should normally pass through the centre of the safe landing area. The sector may not be 'swung' (as illustrated in Figure 10.3) in the case of bi-directional landing rectangles.

10.2 Omnidirectional Landing Area

The criteria contained in Chapters 3 and 4 should be followed except that the touchdown marking and H should be located in the centre of the D circle. The inner diameter of the touchdown marking should be 0.5 D of the actual helideck D-value but should not exceed 12 metres.

10.3 Bi-directional Rectangular Landing Area

The criteria contained in Chapters 3 and 4 should be followed except that the touchdown marking and H should be located in the centre of the landing area. Where the minor axis of the landing rectangle is greater than 0.75 D, the marking should be located half the nominal 0.75 D distance from the outboard edge of the helideck. The inner diameter of the touchdown marking should be half the 0.9 D value of the helideck but should not exceed 12 metres. Additionally, yellow guidelines, 1 metre wide, from the periphery of the touchdown marking to the edge of the helideck parallel to the long side of the rectangle should be marked. (See Figure 10.3.)

10.4 Loads – Structural Response Factor

Reference should be made to Chapter 3.

Where test data for both front and rear undercarriage has been reviewed, the structural response factor may be modified as follows:

Natural frequency of deck structure	Structural response factor
Between 17 and 25 Hz	1.30
Between 25 and 50 Hz	1.15
Between 50 and 100 Hz	1.10

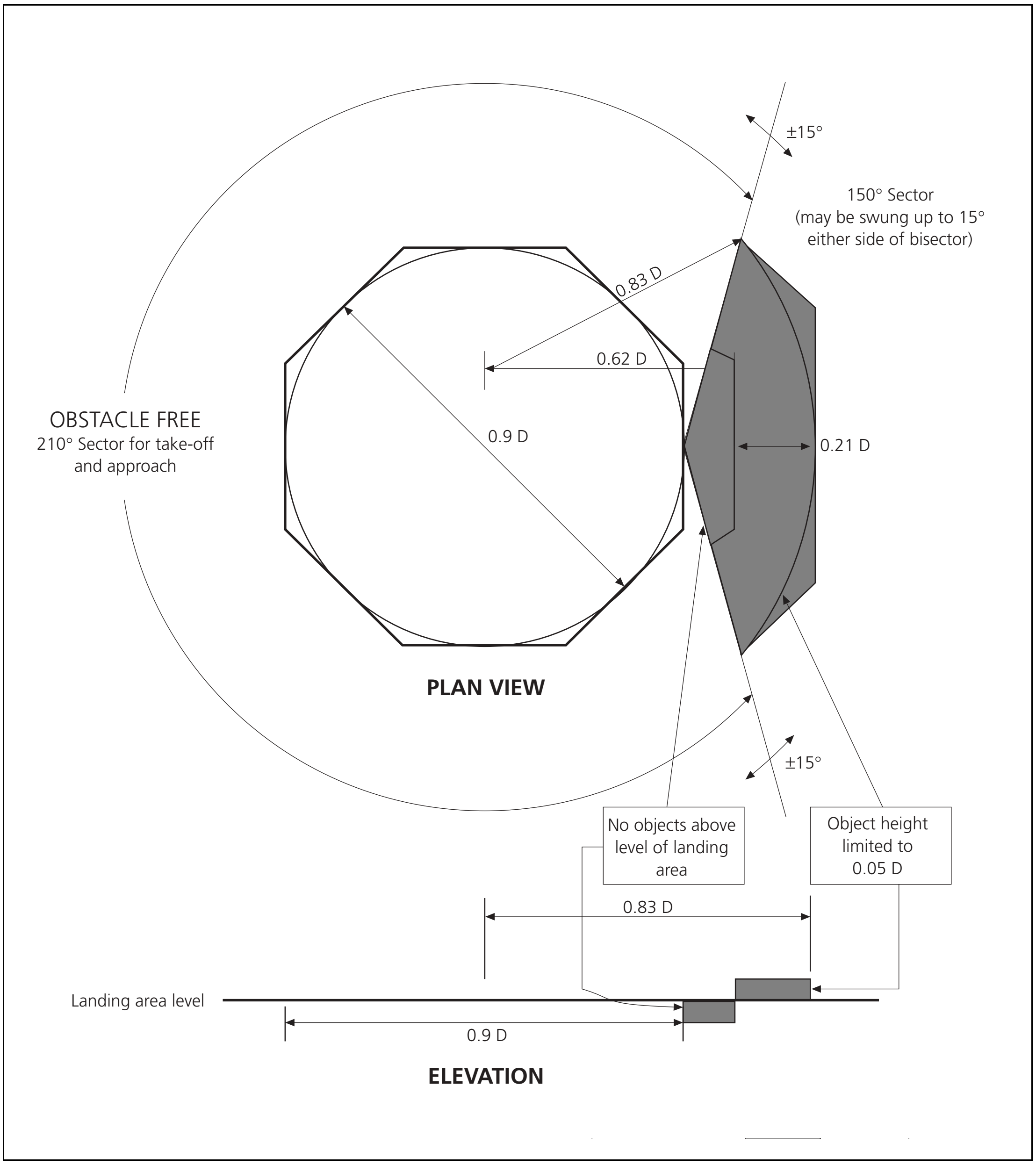


Figure 10.2 Obstacle Free Areas
(Tandem Main Rotor Helicopters – Omnidirectional Landing)

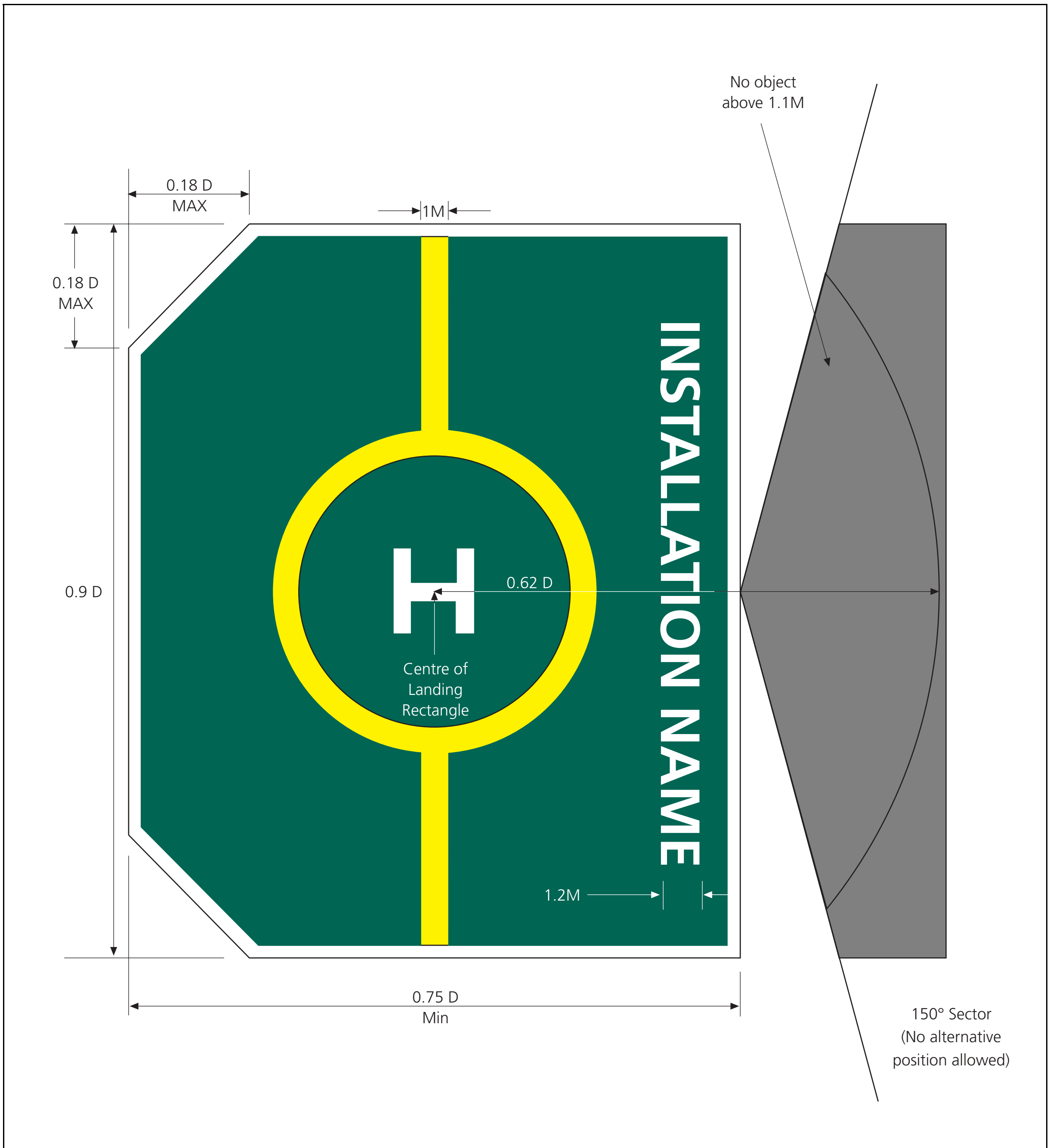


Figure 10.3 Bi-Directional Markings for Tandem Main Rotor Helicopter Operations

NOTES:

1 The D-value relates to the D-value of the largest tandem main rotor helicopter for which the helideck is designed.

2 For omnidirectional operations by single main rotor (or side by side rotor) helicopters the minimum deck dimension (0.75 D axis) must be equal to or greater than the D-value of the largest single rotor (or side by side rotor) helicopter approved to use the deck.

3 Where the minor axis is greater than the minimum 0.75 D, the 'H' should be located ½ of the nominal 0.75 D from the outboard edge of the deck.

Appendix A Checklist

The following checklist indicates in general terms the minimum number of helideck physical characteristics which the Civil Aviation Authority considers should be examined during periodic surveys to confirm that there has been no alteration or deterioration in condition.

a) **Helideck Dimensions:**

i) D-value as measured;

ii) Declared D-value;

iii) Deck shape;

iv) Scale drawings of deck arrangement.

b) **Deck Landing Area Conditions:**

i) Type of surface, condition, friction, contaminant free;

ii) Fuel retention;

iii) Deck landing area net;

iv) Perimeter safety netting;

v) Tie-down points.

c) **Environment:**

i) Turbine and other exhausts;

ii) Hot and cold gas emissions;

iii) Turbulence generators;

iv) Flares;

v) Emergency gas release systems;

vi) Adjacent fixed/mobile/vessel exhausts, gas emissions, flares, and turbulence generators.

d) **Obstacle Protected Surfaces (Minima):**

i) Obstacle free sector (210°);

ii) Limited obstacle sector (150°);

iii) Falling 5:1 gradient;

iv) Note if i) or iii) above are swung from normal axis.

e) **Visual Aids:**

i) Deck surface;

ii) General condition of painted markings;

iii) Location of H;

iv) Aiming circle;

v) Safe Landing Area perimeter line – relationship to Chevron;

vi) D-value marked within perimeter line;

vii) Chevron marking (if reduced the sector is to be marked in degrees);

viii) Certification marking (exact D-value);

ix) Maximum allowable weight marking;

x) Conspicuity of installation name;

xi) Wind indicator;

xii) Perimeter lighting;

xiii) Floodlighting;

xiv) Obstruction lighting;

xv) Marking of dominant obstacles;

xvi) Shield of installation working lights (helideck light pollution).

f) **Fuel System:**

i) Jet A-1 installation;

ii) Hose;

iii) Earthing equipment.

Appendix B Bibliography

References in Chapter 3

1 M E Davies, L R Cole and P G O'Neill. The Nature of Air Flows over Offshore Platforms, NMI Report R14 dated June 1977.

M E Davies, L R Cole and P G O'Neill. Wind Tunnel Investigation of the Temperature Field due to the Hot Exhaust of Power Generation Plants on Offshore Installations, NMI Report R54 dated December 1979.

M E Davies. Wind Tunnel Modelling of the Local Atmospheric Environment of Offshore Platforms. NMI Report R5 dated May 1979.

2 J M Biggs, Introduction to Structural Dynamics, McGraw Hill.

3 R J Mainstone, Structural Tests of an Experimental Helicopter Platform, Building Research Station, Engineering Series 26.

4 R J Steffans, Structural Vibration and Damage, Building Research Establishment Report 1974, HMSO.

5 R J Mainstone, Properties of Materials at High Rates of Straining or Loading, Building Research Station, CP 62/75.

Other References

Guide to Helicopter/Ship Operations, International Chamber of Shipping, Third Edition, May 1989.

Offshore Installations: Guidance on Design, Construction and Certification, Health and Safety Executive, HMSO ISBN 0 11 4106126.

International Civil Aviation Organization

ICAO Doc 9261 AN/903	Heliport Manual
ICAO Doc 9284 AN/905	Technical Instruction for the Safe Transport of Dangerous Goods by Air
ICAO Annex 14 Volume II	Heliports

UK Offshore Operators Association (UKOOA)

UKOOA	Guidance documents on Management of Offshore Helideck Operations on NAIs & NUIs
UKOOA	Guidelines for Helicopter Refuelling Systems

UKOOA publish a very composite range of guidance documents on all aspects of offshore operations. Only the two publications referenced in CAP 437 are shown above. For a full listing of UKOOA guidlines and documents refer to 'Sources' below.

Offshore Petroleum Industry Training Organisation (OPITO)

Helicopter Landing Officers Handbook (OPITO)

Helicopter Refuelling Handbook (OPITO)

Civil Aviation Authority

CAP 74	Aircraft Refuelling: Fire Prevention and Safety Measures
CAP 434	Aviation Fuel at Aerodromes
CAA Paper 98002	Friction Characteristics of Helidecks on Offshore Fixed-Manned Installations.
CAA Paper 98003	Helideck Status Signalling System

Sources

Civil Aviation Publications (CAPs) and Civil Aviation Authority Papers (CAA Papers) are published on the CAA web site at www.caa.co.uk and are available in paper format from Documedia Solutions Ltd, 37 Windsor Street, Cheltenham, Glos, GL52 2DG. Telephone (01242) 283131

ICAO publications are available from Airplan Flight Equipment, 1a Ringway Trading Estate, Shadowmoss Road, Manchester M22 5LH. Telephone 0161 499 0023. The ICAO website address is www.icao.int.

British Standards (BS) may be obtained from Her Majesty's Stationery Office, PO Box 276, Nine Elms Lane, London SW8 5DT. Telephone 020 7211 5656 or from any HMSO. Advice on relevant codes (BS EN & PREN) is available from the CAA at SRG Gatwick.

HSE Publications from HSE Books, PO Box 1999, Sudbury, Suffolk, CO10 6FS. Telephone (01787) 881165.

OPITO Publications from OPITO, Inchbraoch house, South Quay, Ferryden, Montrose, Scotland, DD10 9SL. Telephone (01674) 662500.

UKOOA Publications from UKOOA, 3 Hans Crescent, London, SW1X 0LN. Telephone 020 7589 5255; or, from UKOOA, 9 Albyn Terrace, Aberdeen, AB10 1YP. UKOOA publications can also be viewed on the Internet at:- http\\www.ukooa.co.uk.