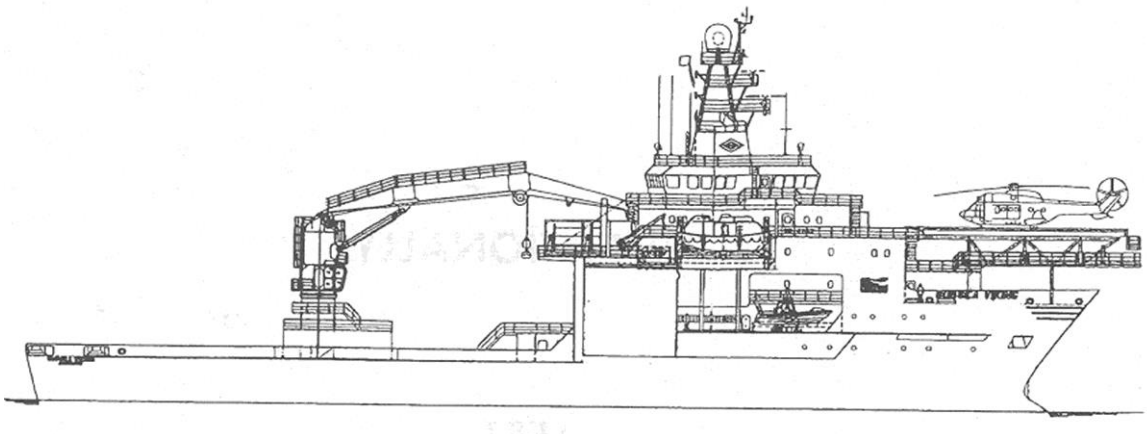
Standard Measuring Equipment
for
Helideck Monitoring System (HMS)
and
Weather Data

(HCA, UK CAA, Bristow Group, Babcock International, CHC, NHV)



Contents

1 Purpose and Intentions

The purpose of this document is to ensure adequacy and uniformity of readings/registration of helideck movement and weather conditions.

This standard represents an agreement between Bristow Group, Babcock International Group, CHC Group and NHV, and shall apply to all Moving Helidecks operating in European waters.

Further intentions are to establish National and International standards based on the contents of this document.

2 Principles

Basic reference is made to:

- Norwegian Requirements published in BSL D 5-1.8.2.
- UK standards for offshore helicopter landing areas published in CAP 437.

The HMS system shall accurately process and integrate information from sensors for helideck movement, wind and other meteorological data, which shall be located in optimum positions in order to provide the required information relating to the helideck.

The measuring equipment shall provide sufficient information to the operator to complete all applicable weather sections of the standard offshore weather/helideck report, provided to the helicopter operators.

All information shall be numerically displayed in relevant locations on the vessel or installation for easy communication with helicopters in flight and the helicopter land base operations. The system shall facilitate transmittal of electronic data to the helicopter land base operation.

3 Definitions

Moving Helideck:

a helideck mounted on a floating unit such as a Vessel, Floating Production Unit, Semi-Submersible Rig or floating Jack Up Rig and other helidecks shall be considered to be an unstable/moving landing area if the pitch or roll exceeds 1 degree either side of the vertical and if the vertical movement of the helideck exceeds 0.4 metres/second.

Helideck Pitch:

is the angle between the absolute horizon and the plane of the helideck measured along the longitudinal axis of the vessel.

Helideck Roll:

is the angle between the absolute horizon and the plane of the helideck measured along the lateral axis of the vessel.

Helideck Inclination:

is the largest angle between the absolute horizon and the plane of the helideck.

Significant Heave Rate (SHR):

is the average of the one-third highest values of instantaneous heave rate recorded during the previous 20-minute monitoring period. This can more conveniently be calculated by:

Significant Heave Rate m/sec = 2 x rms (Root Mean Square) of the instantaneous heave rate.

$$RMS_{hr} := \sqrt{\frac{1}{20min}\left(\int_{t-20min}^{t} hr(t)^2\,dt\right)}$$

Measure of Motion Severity (MMS):

is the instantaneous value of the ratio of the total acceleration in the plane of the helideck divided by the component of the total acceleration normal to the helideck.

Motion Severity Index (MSI):

is the maximum value of MMS expected during the next 20 minutes.

Wind Severity Index (WSI):

is the 10-minute mean free stream wind speed, corrected to correspond to the height of the main rotor of a helicopter landed on the helideck. An average main rotor height of 4 metres above the helideck surface is to be assumed.

Relative Wind Direction (RWD):

is the 2-minute mean free stream wind direction relative to the longitudinal axis of a helicopter landed on the helideck.

4 Measurements

4.1 Accuracy of Measurements

The monitoring system (including related sensors) shall be checked and verified for accuracy and correct operation in accordance with the manufacturer's procedures following installation - see Section 8.3. A verification report shall be provided to both the owner of the installation, the helicopter operator(s) and the Helideck Certification Agency.

The accuracy of the system shall be checked and verified whenever deemed necessary, as required by the manufacturer's procedures or every 2 years, whichever the sooner. A verification report shall be issued and distributed after each periodic control.

The accuracy of the data produced by the Helideck Monitoring System concerning motion shall be:

- Pitch / Roll / Inclination: <± 0.1° RMS (Root Mean Square) in the range 0 to 3.5°,
- Heave Rate: < ± 0.1 m/s RMS (Root Mean Square) in the range 0 to 1.3 m/s,
- Helideck Accelerations (MSI): < ± 0.01 m/s^2 RMS (Root Mean Square) in the range 0 to 0.2 m/s^2.
- Wind Speed: Under 10 kts: +/-1kt, over 10kts: 10%,
- Wind direction (relative to magnetic North) overall accuracy of better than +/-10deg for wind speeds over 2kts. This will depend not only on the measurement accuracy of the wind sensor, but also on the accuracy of the orientation of the wind sensor relative to the vessel, and the accuracy of the vessel heading measurement relative to magnetic North.

NOTE: For the purposes of calculating the MMS, the accelerometer package need not be exactly aligned with the vessel's longitudinal (x) and lateral (y) axes; this is because the signals from these components are combined into a single resultant acceleration in the plane of the helideck. However, it is crucial that the vertical acceleration is measured in the direction normal to the helideck, and that the alignment is within 0.1 degree. The sign of the axes chosen (whether z is positive downwards or upwards) is not important since the absolute value is used in the calculation of the MMS.

The accuracy concerning meteorological data other than wind speed and direction shall be in compliance with CAP 437 Standards for offshore helicopter landing areas and CAP 746 Requirements for meteorological observations at aerodromes published by the UK Civil Aviation Authority or equivalent national standards.

4.2 Helideck Motion Parameters

General:

Displays of the relevant values (see below) of all motion parameters relating to the last 20 minutes shall be provided. These shall be updated ('displayed') at least once per minute using data from a moving 20-minute sampling 'window'. In addition, graphical presentations of the displayed data covering the last 3 hours of these data shall be provided to assist the determination of trends. Displayed values should be used for comparison to the helicopter landing limits detailed in Section 7, and should be rounded as described below, consistent with their expected accuracy.

Helideck Pitch:

The equipment shall be capable of measuring helideck pitch in degrees up and down from zero, with zero being the absolute horizontal level. In maritime terms maximum pitch consists of trim + pitch. The values to be displayed and reported are the

maximum pitch up and maximum pitch down occurring during the previous 20-minute period, rounded to one decimal point.

Helideck Roll:

The equipment shall be capable of measuring helideck roll in degrees right/starboard and left/port, with zero being the absolute horizontal level. In maritime terms maximum roll consists of list + roll. The values to be displayed and reported are the maximum roll right/starboard and maximum roll left/port occurring during the previous 20-minute period, rounded to one decimal point.

Maximum Helideck Inclination:

The equipment shall be capable of measuring the maximum helideck inclination in degrees to the absolute horizon. The value to be displayed and reported is the maximum occurring during the previous 20-minute period, rounded to one decimal point.

Significant Heave Rate (SHR):

The equipment shall be capable of measuring the rate of vertical movement of the helideck in metres per second. The value to be displayed and reported is 2 x the rms of the instantaneous heave rate measured during the previous 20 minutes, rounded to one decimal point.

In order to avoid frequent changes to the status light when the SHR is close to the limit, the helideck status in terms of SHR shall be determined as follows:

- The helideck operational status (based on SHR) becomes red if:
  - the SHR is equal to or greater than the heave rate limit, and
  - all of the displayed SHR records in the previous 2 minutes are also equal to or greater than the heave rate limit (or equivalently, the minimum SHR in the previous 2 minutes is equal to or greater than the limit).
- Once the helideck status is red, it becomes green again only if:
  - the SHR falls below the heave rate limit, and
  - the mean of the displayed SHR values in the previous 10 minutes are below the heave rate limit.

Measure of Motion Severity (MMS):

The equipment shall be capable of measuring the instantaneous accelerations (gravitational and inertial) in the plane of the helideck and normal to the surface of the helideck. The equipment shall calculate the MMS from these measurements using the following formula:

$$MMS = \frac{\sqrt{a_x^2 + a_y^2}}{|a_z|}$$

where: a_x is the total surge acceleration, in the plane of the helideck
a_y is the total sway acceleration, in the plane of the helideck
a_z is the total acceleration normal to the helideck

Motion Severity Index (MSI):

The equipment shall be capable of calculating the MSI. The MSI is defined as the maximum value of MMS occurring during the previous 20 minutes.

For display and reporting purposes, for the calculation of the MSI the MMS is to be converted to the form of a dynamic slope in degrees, and then multiplied by 10 and rounded to the nearest whole number, to avoid confusion with pitch, roll and inclination values. Hence:

$$MMS_{MSI} = 10 \times \tan^{-1} (MMS_{measured})$$

Note: $\tan^{-1}$ expressed in degrees, not radians.

and:

$$MSI = MMS_{MSImax} (t - 20 \text{ min}, t) \times R$$

Note: 'R' is a constant ≥ 1. It has been determined that this shall initially be set to R = 1, however it is recommended that systems incorporate a facility to enable authorised persons to update the value of R.

4.3 Wind Data

General:

Met observation data is usually provided in two forms:

- a local Met report (provided to pilots at take off and landing, representative of conditions along the runway or at an offshore installation), and
- an official METAR (an observation that is representative of the whole aerodrome).

In the UK these reports are essentially the same for most weather parameters but, for surface wind data, the local report contains the 2-minute mean speed and direction with the direction in degrees Magnetic, and the METAR contains a 10 minute mean speed and direction with the direction given in degrees True.

With the introduction of the relative wind monitoring function, the anemometer used as the source for HMS wind data shall either be located away from the helideck (where it will likely be affected by rotor down wash), or the HMS shall switch to such an anemometer before the helicopter touches down.

Wind Speed:

Wind speed shall be displayed and reported in knots, rounded to the nearest whole number. Displayed wind speed shall be configurable to show the 2-minute mean wind speed with gusts, and 10-minute mean wind speed with gusts. Gusts shall be calculated and displayed as the maximum of the 3 second averages of the wind speed (2min or 10min) samples.

Wind Severity Index (WSI):

The equipment shall be capable of calculating the WSI. The WSI is defined as the 10-minute mean wind speed measured in knots. For the purposes of calculating the WSI, the wind speed shall be adjusted to the height of the main rotor of a helicopter landed on the helideck using a power law approximation of a marine atmospheric boundary layer as follows:

$$\mathrm{WSI}(t) = \mathrm{mean}_{\,t-10\,\mathrm{min}}(U_{\mathrm{meas}}) \cdot \left(\frac{H_d + 4\mathrm{m}}{H_{\mathrm{meas}}} \right)^{0.13}$$

where: H_d is the helideck height in metres
U_{meas} corresponds to the measured wind speed at a height H_{meas}

To avoid confusion between the WSI and the wind speed used by helicopter pilots (which includes gusts), the WSI shall be displayed as a percentage of the maximum limiting WSI_{max} (i.e. the value of the WSI where the limit line intersects the axis at MSI=0) for the helicopter type selected. Hence:

Displayed WSI% = WSI(t) / WSI(max) x 100%

and this should be rounded to the nearest whole number.

Wind Direction:

Wind direction shall be reported in degrees relative to magnetic North (from, as a three-digit number, North=360). Displayed wind direction shall have the options to show the 2-minute mean wind direction and 10-minute mean wind direction.

Relative Wind Direction (RWD):

The equipment shall be capable of calculating the RWD for presentation on the ‘On-Deck’ display on entry of the helicopter’s heading following touchdown.

The RWD shall be calculated from the vessel heading, the helicopter heading after touchdown (communicated by the pilot to the Radio Operator), and the 2-minute mean wind direction; all of these input parameters should be referenced to magnetic North as a three-digit number, North=360.

Note: Vessel and helicopter headings are TO and wind direction FROM.
The RWD is an angle difference, not a 360deg bearing, and therefore should be calculated as +/-180deg relative to zero. It should be displayed as a positive number (rounded to the nearest degree) and with the sign represented by “Right” (positive) or “Left” (negative).

4.4 Other Weather Data

Weather data other than wind data shall be in compliance with CAP 437 Standards for offshore helicopter landing areas and CAP 746 Requirements for meteorological observations at aerodromes published by the UK Civil Aviation Authority or equivalent national standards.

4.5 Heading of Helideck/Vessel

The heading of the helideck and the vessel shall be stated in degrees relative to magnetic North as a three-digit number, using the same convention as for the helicopter heading.

5 Displays and Indicators

These requirements define the information and selections that must be presented to the system operator via the displays. Although there is no reason to adopt any particular style or layout for the display, there are advantages to maintaining as much standardisation as possible between systems produced by different suppliers. It is therefore strongly recommended that the displays presented in this specification be followed as closely as possible unless there are compelling reasons to do otherwise.

Since the HMS operates in two distinct modes, 'pre-landing' and 'on-deck', two separate displays are required. It is recommended that the example displays below are followed as far as possible in terms of layout, grouping of information, labelling, colour and presentation of numerical and graphical information.

5.1 Specific Design Requirements for the 'Pre-Landing' Mode Display(s)

The figures at the end of this section present the preferred displays for the system in 'pre-landing' mode. The information presented on this display shall be updated at least at 1-minute intervals.

a) Vessel name, location coordinates, and Helideck Category (consistent with the helideck's certification, as discussed later in Section 6.1) shall be displayed at the top of the display. Date and time (UTC), and software version and helicopter landing limits designation (see Section 7) should also be clearly displayed

b) User 'inputs' to be grouped and positioned prominently towards the top of the display shall include: Helicopter Type and Category, Day/Night, Helideck Category. 'Drop-down' selection boxes are the preferred method for these data inputs.

c) The Helideck Landing Status is the overarching parameter governing the pilot's 'land/do not land' decision. It shall be presented at the top of the display as a 'traffic light' with red, amber and blue lights from top to bottom. The Helideck Landing Status will also be relayed to physical repeater lights on the helideck (see Section 5.3 below).

   The Helideck Motion Status is defined as follows:

- Blue status (steady burning): safe to land based on pitch/roll/'processed' SHR/inclination and MSI/WSI limits.
- Amber status (steady burning): MSI/WSI limit only exceedance (consider using modified operating procedures).
- Red status (steady burning): do not land (pitch, roll, 'processed' SHR or inclination out of limits).

Note: Amber MSI/WSI limit exceedances alert the flight and helideck crew to the potentially marginal helideck motion conditions and the need to consider mitigating action. Operations may only be lost during Amber Status if the flight and/or helideck crew are unable to take mitigating action or do not judge the mitigating actions to be sufficient for the prevailing conditions.

d) The historical trend of the helideck motion status shall be available for selection when required and shall provide a graphical representation of the status clearly on a horizontal scale of time for the last 20 minutes (or 3 hours, consistent with the current requirements for the graphical representation of displayed Pitch/Roll/Heave Rate and Inclination historical trends). When selected, the trend graph shall be positioned close to the motion status 'traffic light'.

e) An MSI/WSI graph is required. It shall display the limit lines and the extent of the amber zone and shall show the trend of values in the previous 20mins (or 3 hours). The numerical MSI and WSI values (updated every minute) will also be shown. The MSI/WSI graph shall be grouped with the helideck motion status 'traffic light' and trend graph. Note that the WSI% value should be displayed and reported rather than the WSI value.

f) 'Reported Values' are required and shall include the standard values reported by the Radio Operator (RO) to the helicopter pilot prior to landing (as defined in CAP437). The values shall be arranged from top to bottom or left to right in the order in which they are reported, namely: Pitch (Up/Down), Roll (Right/Left), Heave Rate and Inclination.

g) Limits shall be clearly displayed adjacent to the associated reported values. Where limits are exceeded, this shall be clearly identified and highlighted visually e.g. red coloured text used to indicate the value(s) exceeding the defined limits.

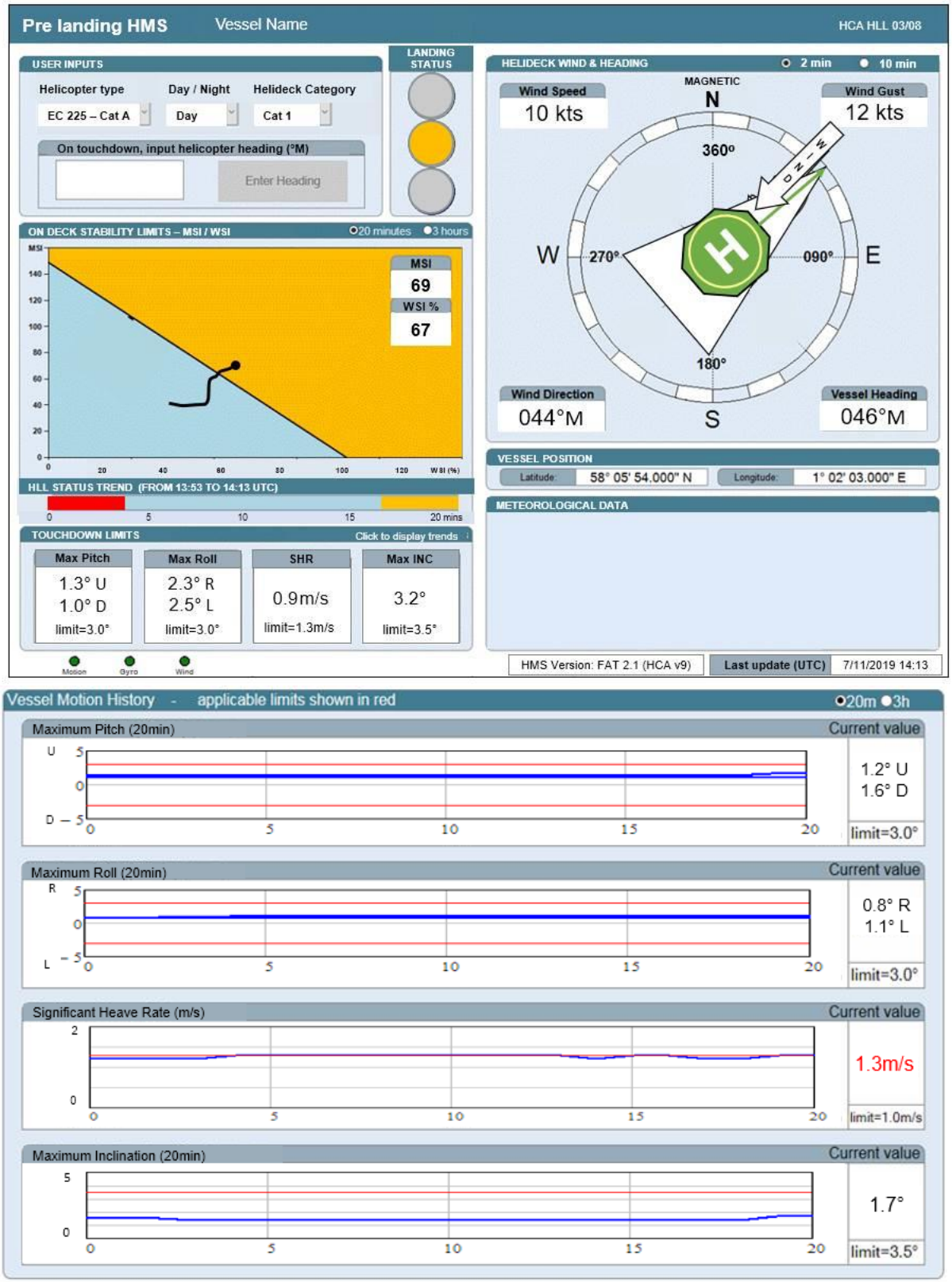
h) Graphical representations of deck motion parameter trends (Pitch, Roll, Heave Rate and Inclination) are required for the last 20 minutes (or 3 hours). These shall be grouped together and time axes shall be aligned to enable an easy comparison with each other and the deck motion status 'traffic light' trend. Graphical trend data shall be grouped together with their associated reported values.

i) Heave period and max heave are no longer required. 'Max heave rate' (previously calculated using the so called 'Norwegian Method') is now described as 'Heave Rate' (and will display Significant Heave Rate (SHR) values).

j) ‘Helideck Wind and Heading Data’ is required and shall include a compass rose which shall display:
   - ‘Magnetic North’, and corresponding compass directions as well as degrees. The compass shall be clearly marked to show segments of 10 degrees.
   - Wind Direction Vector shown as an arrow and clearly labelled.
   - The vessel depicted schematically in a manner that clearly identifies the bow or other reference direction (e.g. as an isosceles triangle or plan view of the actual vessel), centrally located and clearly showing the vessel heading on the compass.
   - The helideck depicted as an icon consistent with the design requirements for helidecks on vessels specified by CAP437 – dark green background with a white perimeter and a white ‘H’ within a yellow circle. This supports consistency and familiarity with existing system designs on offshore vessels.
   - The helideck icon shall be positioned centrally within the vessel icon, and centrally within the compass.
   - ‘Wind and Heading Data’ shall also include a numerical presentation of Wind Speed and Wind Direction values. Wind speed shall be presented as a two-digit number, wind direction shall be displayed as a 3-digit number, i.e. 001 to 360^{o}. The display shall allow toggling between 2-minute or 10-minute mean values, and shall clearly identify what wind speed/direction averaging is being displayed. By default, the displayed values should be 2-minute averages.

k) ‘Meteorological data’ specified by CAP 437 and CAP 746 (or equivalent national standards) may be presented (optional) and be grouped together, with the exception of wind speed and direction data which shall be grouped with Wind and Heading Data.

l) A data entry field shall be provided for the helicopter heading reported by the pilot after touchdown and shall be clearly identified as a mandatory action. The helicopter heading must be entered into the system immediately after touchdown, i.e. as 001 to 360, relative to magnetic North. It shall not be possible to switch to the ‘on-deck’ mode unless and until a valid helicopter heading is entered into the system. The system shall automatically switch to the ‘on-deck’ mode once the helicopter heading has been entered on the ‘pre-landing’ display.



'Pre-Landing' Mode Displays[1]

[1] Note that this example does not show the correct subdivision of the wind directions in segments of 10 degrees

5.2 Specific Design Requirements of the On-Deck Display

The figure at the end of this section presents a preferred display for the system in 'on-deck' mode. The information presented on this display shall be updated at least at 1-minute intervals.

a) As with the pre-landing display, the Vessel name, location coordinates, and Helideck Category (consistent with the helideck's certification, as discussed later in Section 6.1) shall be displayed at the top of the display. Date and time (UTC), and software version and HLL limits designation should also be clearly displayed.

b) The helicopter heading (reported by the pilot, relative to magnetic north) is primary information and therefore shall be positioned at the top left-hand corner of the wind and heading data section of the display. This information shall be editable in case of incorrect input. The display should provide a record of the helicopter heading at the time of landing and, if applicable, any heading correction and corresponding time stamp.

c) Information pertaining to 'RWD criteria' is required and shall be grouped towards the top of the 'on-deck' display:

- 'RWD Status' – to be arranged as a 'traffic light' with red, amber and blue lights from top to bottom. Location and arrangement to be consistent with 'pre-landing' helideck motion status 'traffic light' to promote familiarity with the system layout, and to be clearly labelled as 'RWD Status' (instead of 'Helideck Motion Status' in the 'pre-landing' display).

  The RWD Status is defined as follows:

  - Blue status (slow flash): relative wind direction within limits.
  - Amber status (fast flash): impending relative wind limit exceedance (investigate cause and identify appropriate mitigating action required).
  - Red status (fast flash): relative wind limit exceeded (take appropriate mitigating action).

  Changes in RWD status constitute an alarm; they shall be clearly shown and annunciated in a way that would help attract the attention of the RO. An audible alarm may also be added. The RWD Status will also be relayed to physical repeater lights on the helideck (see Section 5.3 below).

- Numerical values for RWD and 2-minute averaged wind speed.
- RWD/Wind Speed limits graph which shall show the limits lines, the extent of the corresponding (flashing) amber and red zones, and the trace of the RWD/wind speed data points since touchdown. This will be displayed near the RWD status 'traffic light'.

d) 'Change Since Touchdown' data/information is required and shall include:

- RWD status trend – a graphical presentation of the RWD status over time since touchdown. The trend data shall be colour coded in accordance with the RWD status (red, amber, blue).
- Δ Vessel Heading – a graphical representation of the change in vessel heading over time since touchdown (using the same convention as for the

RWD and showing the relative change as Right (+)/Left (-)). If there is a change greater than ±10deg, this shall be clearly identifiable. The example display below presents the Δ Vessel Heading as a line chart to clearly identify deviation from the touchdown value.

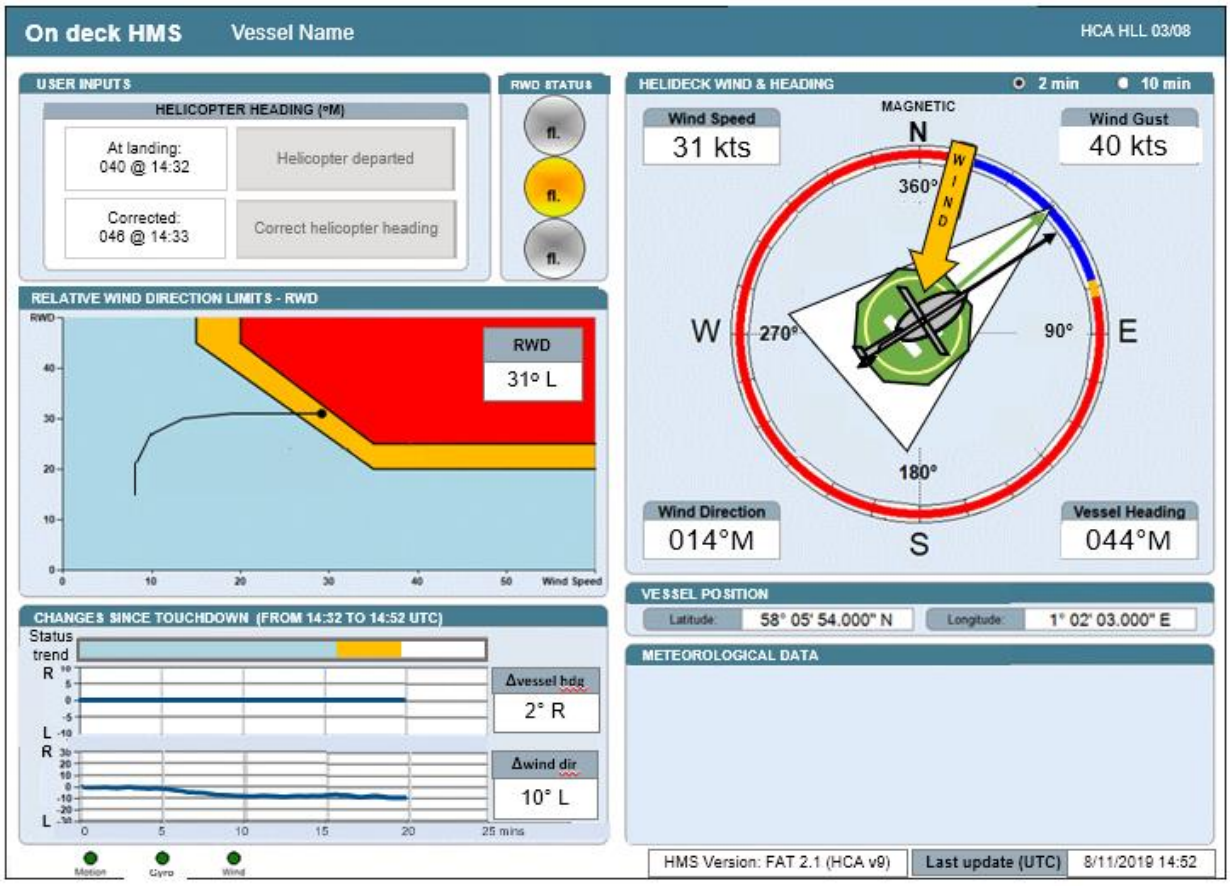
- Δ Wind Direction – a graphical representation of the change in wind direction over time since touchdown (showing the relative change as Right (+)/Left (-)). If there is a change greater than ±30deg, this shall be clearly identifiable. The example display in the figure below presents the Δ Wind Direction trend as a line chart to clearly identify deviation from the touchdown value.

Grouping of information in this manner shall enable the RO to assess if either of the vessel heading or wind direction change is more than expected and assist identification of the cause of any RWD limit exceedance.

Should the vessel heading or wind direction change significantly after touchdown, and exceed the limits specified in Section 7.2, this shall be clearly identified. It is recommended that the y-axis scale is bounded (limits of +/-10deg for the change in vessel heading, and +/-30deg for the wind direction) to assist the interpretation of the trends. When any of the trends exceeds these limits, it is proposed that the time segment when an exceedance has occurred is clearly marked to attract attention, e.g. using 'reverse video' flashing.

e) 'Wind and Heading Data' is required, consistent with the 'pre-landing' display. The compass rose shall be consistent with the corresponding 'pre-landing' presentation, and also include a graphical representation of the helicopter, showing its heading and the width of the RWD blue and amber sectors, allowing a direct visual comparison with the wind direction vector. The wind direction vector shall also be coloured according to the RWD status, to reinforce the meaning of the RWD status. The display shall allow toggling between 2-minute or 10-minute mean values and shall clearly identify what wind speed/direction averaging is being displayed. By default, the displayed values should be 2-minute averages.

f) The meteorological data (optional) shall be presented in the same manner as with the pre-landing display.



On-Deck Display[2]

5.3 Repeater Lights

A repeater light system indicating the helideck operational status shall be installed to provide information directly to the helideck crew and helicopter flight crew. The operational status annunciated by the repeater lights shall be identical to that presented on the system 'Pre-Landing' and 'On-Deck' displays and shall comprise blue, amber and red lights. The lights are to be extinguished if the HMS is unserviceable.

A detailed specification for the repeater lights is presented in Attachment 1.

5.4 HMS Serviceability

The HMS shall monitor the status of all sensor inputs and shall react to sensor failures as follows:

a) The HMS shall display the status of all sensors and provide a warning message if any of the sensors are inoperative.

b) If pitch, roll, inclination, heave rate, or any of the inputs required for the calculation of the MSI or RWD function are inoperative/ unserviceable then the

[2] Note that this example does not show the correct subdivision of the wind directions in segments of 10 degrees

helideck repeater lights shall be switched off and the traffic light display shall be blank.

c) If any of the other parameters (e.g. met information) are inoperative/ unserviceable then the helideck repeater lights and the traffic light display shall operate normally.

At least one helideck repeater light directly visible to either member of the flight crew with the helicopter landed on the helideck shall be operative for the HMS to be considered serviceable.

6 Classification of Helidecks and Helicopters

6.1 Helidecks

There is no official classification method available for this purpose. The proposed classification contains three categories based on the actual floating unit's size, configuration and motion characteristics. Limitations are defined by helideck pitch, roll and inclination and by helideck heave rate. A prime requirement is that the installation has measuring and monitoring equipment installed, and functional, in accordance with this document. Operations to those installations which either do not have the appropriate measuring or monitoring equipment installed, or whose equipment is inoperative, are limited to stable deck conditions, i.e. ≤1° Pitch & Roll and 0.4m/s SHR. Stable deck conditions may be established using an inclinometer mounted on the bridge of the vessel for Pitch and Roll, and by visual estimation of the heave rate (heave amplitude divided by half of the heave period) for SHR.

The category will be entered on the individual vessel/rig information plate in the North Sea Airway Manual or rig plate and the Company Helideck Limitation List (HLL).

Category 1: Semi-submersibles including floating jack ups and all large vessels including FPSOs and tankers.

Category 2: Small vessels, e.g. DSVs and seismic vessels, with a helideck that offers good visual cues. This would normally be a stern or midships deck offering a view of the structure of the vessel through at least 90° (assuming the vessel is steaming more or less into wind).

Category 3: Small vessels with poor visual cues, such as a bow deck or a deck mounted above the bridge superstructure with the landing direction facing forwards (bow deck) or abeam (high deck).

NOTE:
Small vessels will be categorized 2 or 3 on inspection by the HCA and their helideck certificate and associated Jeppesen or equivalent data will reflect this (except that small vessels with midships decks will always be Category 2).

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6.2 Helicopters

Helicopters are classified as either Category A or Category B based on an assessment of their handling characteristics in relation to the landing (touchdown); on deck stability is addressed via the MSI/WSI/RWD limits.

Aircraft Category A:
Comprises helicopters in the AS332 series, EC225, S61 and S92, AW189.

Aircraft Category B:
Comprises helicopters in the AS365 series, EC135, EC155, S76 series, B212/B412, AW139, H175, AW169, H145.

> *NOTE: This does not constitute a helideck approval for a specific helicopter type on a specific helideck*.

7 Operational Limitations

7.1 Landing Limits

The maximum values of helideck pitch, roll, inclination and SHR permitted for landing are defined in the table below.

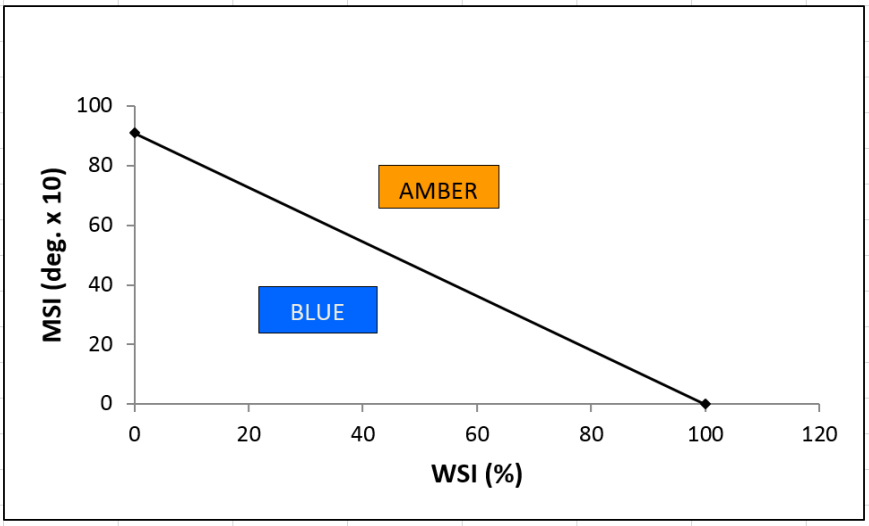
AIRCRAFT CATEGORY	DAY / NIGHT	HELIDECK CATEGORY								
		1			2			3		
		P/R	INC	SHR	P/R	INC	SHR	P/R	INC	SHR
A	DAY	±3	3.5	1.3	±2	2.5	1.0	±2	2.5	1.0
	Night Semi-Subs	±3	3.5	1.0	Not Applicable			Not Applicable		
	Night Other vessels	±2	2.5	1.0	±2	2.5	0.5	±1*	1.5*	0.5*
B	DAY	±4	4.5	1.3	±3	3.5	1.0	±3	3.5	1.0
	Night Semi-Subs	±4	4.5	1.3	Not Applicable			Not Applicable		
	Night Other vessels	±3	3.5	1.0	±2	2.5	0.5	±1.5*	2.0*	0.5*

* Night operations to Category 3 vessels are not permitted in UK waters.

Key:
P/R = Pitch and Roll (deg); **INC** = Helideck inclination (deg); **SHR** = Significant Heave Rate (m/s); **H/A** = Heave Amplitude (m).

For tanker mooring buoys (whose deck movement is measured by inclination rather than pitch and roll) the inclination limits are ±2° by day and ±1° by night regardless of aircraft category.

In addition to the above red ‘do not land’ limits, the amber MSI/WSI ‘caution’ detailed in the plot below shall be applied prior to touchdown.



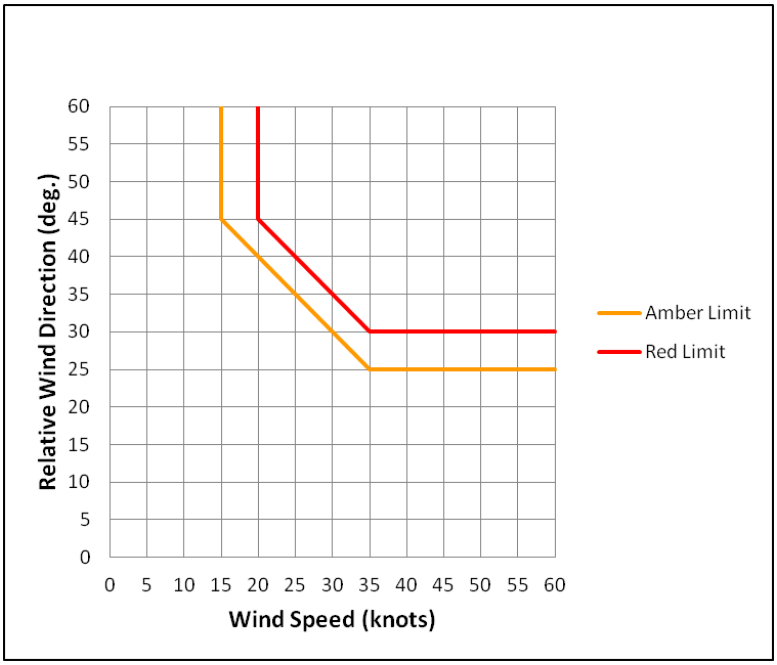
NOTE 1: The coordinates of the line are (91, 0), (0, 100), where a WSI of 100% corresponds to the maximum WSI for the helicopter type selected or the generic maximum WSI limit of 43 knots if no helicopter type is selected.

NOTE 2: The MSI/WSI limit defined above is a generic limit to be applied to all helicopter types for which helicopter manufacturer validated MSI/WSI limits are not available, i.e. the HMS shall default to the above limit. The HMS shall include provision for the addition and selection of helicopter type-specific limits by authorised personnel.

NOTE 3: The colour blue is used to denote the 'helideck safe' condition to avoid confusion with the green helideck perimeter lights.

7.2 On-Deck Limits

Following touchdown, the RWD amber 'caution' and red 'warning' limits detailed in the plot below shall be applied.



8 Miscellaneous Requirements

8.1 Data Transmission and Storage

The information presented on the pre- and post-landing displays shall be relayed to helicopter operators for flight planning and auditing purposes. It is recommended that an internet-based 'live' display is used (ideally refreshed at a rate of about once a minute); alternatively, as a minimum requirement, pre-landing display data may be sent by email to the helicopter operators in sufficient time prior to the helicopter's departure.

> *Note: Use of flashing symbology for highlighting any information accessed pre-departure from onshore (e.g. parameter exceedances) shall be avoided due to the potential for strobe effects with internet transmission.*

For quality auditing purposes, at least 30 days' worth of processed instantaneous measurements and pre- and post-landing display records (displayed values) shall be stored and made available to helicopter operators. It is recommended that these files contain all the HMS parameters included in the verification testing, see Section 8.3 below. This ensures that all relevant information is captured, using consistent and clear conventions.

8.2 Training

Vessel operators shall ensure that all staff using the system are adequately trained and competent in the role and task. This shall include the operation of the HMS, the interpretation of the HMS displays, and the procedures to be employed during helicopter movements.

8.3 Certification and Maintenance

The HMS shall be tested by the HMS provider (HP), overseen by an appropriately qualified Independent Competent Person (ICP) to confirm compliance with this standard. The appropriate National Aviation Authority (NAA) and/or HCA will provide guidelines on the requirements for the verification/certification process, setting out the responsibilities of both the HP and the ICP. The guidelines will include certain 'mandated' elements/tests that the HP testing procedure shall include and that the ICP will independently check. These shall be common in scope and level of detail for all HPs and HMS products and shall cover:

- the detailed calculation from the raw data of the HCA limiting parameters of R, P, INC, HR, MSI/WSI, RWD,
- the correct display on the GUI of all HMS parameters to include display layout,
- checks that the latest limits are correctly implemented in the HMS software, and
- checks of other helideck site-specific data in the HMS.

The certification of the generic HMS and oversight of individual installations, including maintenance, will be performed by HCA. The independent verification/certification process shall comprise the following main stages:

a) Factory Acceptance Test (FAT) planning:

The HP prepares a generic FAT procedure during the design stage. The ICP reviews the HP's generic FAT procedure and checks that it is compatible with the verification requirements of the NAA/HCA. The FAT procedure should include a section for mandated verification tests.

b) FAT testing of the generic product:

The HP performs the FAT testing of the generic product. The ICP witnesses the testing and checks that the data provided by the HP demonstrate compliance with the HMS standard, including NAA/HCA guidelines and mandated tests on independent verification. The HP and ICP submit the appropriate documentation to HCA for review. Following satisfactory completion of this process, the HMS generic product will be considered to have been 'approved'.

Note: This stage shall be re-visited when i) the manufacturer changes the design of the generic HMS product sufficiently to require a revision of the generic FAT procedure, or when ii) NAA/HCA advise that any of the mandatory testing procedures has changed significantly, e.g. as part of a major update of the specification.

c) Site-specific functional testing and Implementation audit:

For site-specific functional testing and auditing purposes, an appropriately trained helideck inspector may assume the functions of an ICP. The ICP checks that for each HMS installed on a moving helideck:

- An FAT has been carried out prior to dispatch from the HP and that the FAT complies with NAA guidelines – if the FAT procedure is the same as that of an approved generic product, the scope of the FAT checking will be focused on the site-specific elements only e.g. site-specific sensor voting logic or functionality.
- An SAT (Site Acceptance Test) has been carried out, to test the correct installation of the system in-situ.
- After both the FAT and SAT are complete, the ICP checks that:
  - The operational HMS limits and other parameters set in the HMS software at each site are correct and are up-to-date, consistent with the values set by the NAA/HCA.
  - Other site-specific information is correctly set in the HMS (e.g. wind sensor voting algorithms, wind sensor elevations above the helideck).
  - There is evidence of correct sensor installation (e.g. MRU deck alignment and calibration, wind sensor siting, see additional guidance section below).
  - There are provisions for historical HMS data for the site to be kept (for a period of at least 30 days) and that these can be accessed easily by the helicopter operators for audit purposes (e.g. processed HMS data accessed via the internet, preferably via a similar interface as that used for the HMS GUI). Detailed (raw measurement data) is to be kept by the

HP and made available on request to NAA/HCA/AAIB if needed for an incident investigation.

- There is planning in place for the HP to provide HMS training to ROs/HLOs at each site. This is to complement the MetOffice training already provided to ROs for the purpose of compiling meteorological CAP437 reporting data.

The ICP submits a report for each individual HMS installation to HCA. The status of the HMS will be recorded in the Helideck Information Plate.

d) In-service maintenance audits:

For each HMS installed, audits are carried out by the ICP/ HCA every two years (ideally aligned with the helideck certification cycle) to check that:

- There is evidence that the sensors are maintained and verified regularly.
- Historical data for the site are kept and can be accessed easily for audit purposes.
- Records exist to prove that user training has been provided to ROs/HLOs at each site.
- User feedback is taken into account and issues are resolved promptly.

Any issues or concerns about the correct functioning of the HMS product are reported back to the HP and NAA/HCA, and improvements to the HMS standard/testing procedure are proposed as necessary.

Additional guidance will be provided in due course by the NAA/HCA to cover the detail of:

- The mandated verification tests for the HCA limiting parameters (current and MSI/WSI/RWD), and the format of input and output files for the timeseries tests
- Standards for MRU alignment / calibration, and wind sensor calibration / voting.
- Standards for sensor maintenance and verification.

9 Attachment 1: Specification for Helideck Monitoring System Repeater Lights

9.1 Application

With reference to Chapter 6 of CAP 437 – Standards for Offshore Helicopter Landing Areas (8th Edition and later), a repeater light system indicating the helideck operational status is required to provide information directly to the helideck crew and helicopter flight crew. The operational status annunciated by the repeater lights shall be identical to that displayed on the Helideck Monitoring System (HMS) display and shall comprise blue, amber and red lights.

The HMS determines the helideck operational status according to the following criteria:

Before landing:

- Blue status (steady burning): safe to land based on pitch/roll/'processed' SHR/inclination and MSI/WSI limits.
- Amber status (steady burning): MSI/WSI limit only exceedance (consider using modified operating procedures).
- Red status (steady burning): do not land (pitch, roll, 'processed' SHR or inclination out of limits).

Note: Amber MSI/WSI limit exceedances alert the flight and helideck crew to the potentially marginal helideck motion conditions and the need to consider mitigating action. Operations may be lost if the flight and/or helideck crew are unable to take mitigating action or do not judge the mitigating actions to be sufficient for the prevailing conditions.

After landing:

- Blue status (slow flash): relative wind direction within limits.
- Amber status (fast flash): impending relative wind limit exceedance (investigate cause and identify appropriate mitigating action required).
- Red status (fast flash): relative wind limit exceeded (take appropriate mitigating action).

Note: For flash rates see Section 9.3 d) below.

The lights are extinguished if the HMS is inoperative.

The repeater light system may comprise sets of individual blue, amber and red lights or single light units each capable of displaying all three colours. The HMS shall provide a 3-input signal to the repeater light system to indicate the status to be displayed as detailed in the table below.

Additional, alternative means of signalling the status to be displayed (e.g. serial data bus) may be provided. However, the three input signal interface shall always be available (either provided as a standard facility or available as an option) in order to

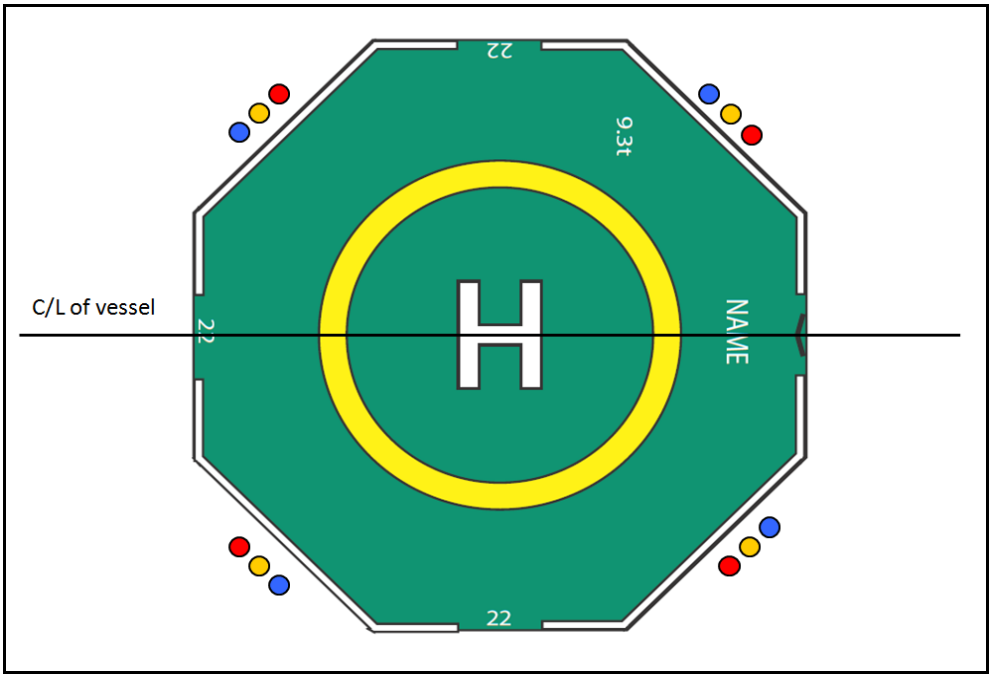
maximise interoperability between HMS and lighting systems provided by different manufacturers.

HMS Signal (24 vdc or volt free)			Repeater Light Mode	
Input #1	Input #2	Input #3	Colour	Mode
0	0	0	OFF	N/A
0	1	0	BLUE	Steady burning
1	0	0	AMBER	Steady burning
1	1	0	RED	Steady burning
0	0	1	OFF	N/A
0	1	1	BLUE	Slow flash
1	0	1	AMBER	Fast flash
1	1	1	RED	Fast flash

9.2 Operational Requirements

Location:

A sufficient number of lights shall be provided to ensure that the flight crew will be able to easily see at least one light/set of lights regardless of the orientation of the helicopter on the helideck. This is expected to require at least four lights or sets of lights arranged in a cross oriented 45deg to the bisector of the Obstacle Free Sector (OFS) as illustrated below.



Performance:

Prior to landing the lights are operated in steady burning mode only and shall be detectable at a range of at least 500 m and conspicuous at a range of at least 400 m in a meteorological visibility of 1400 m in daylight ($E_t = 10^{-3.5}$) and at night ($E_t = 10^{-6.1}$).

After landing the lights are operated in flashing mode only and will be viewed at close range (approx. 5 m). The maximum and minimum intensities for day time operation are therefore halved for the flashing mode to avoid dazzling the pilot. When landed on the helideck, the lowest elevation of the pilot's eyes relative to the light is assumed to be 20°, i.e. a minimum pilot eye height of 1.85 m and a maximum range from the lights of 5 m.

> Note 1: Lights with small apertures will result in higher luminance and will be more likely to cause glare; care shall be taken in designing the light to avoid excessive luminance.
>
> Note 2: During the approach, the height of the helicopter above the helideck is assumed to be 40 to 50 ft at 100 m and around 150 ft at 200 m. This implies that, as an absolute minimum, the main beam of the lights shall cover elevations between 7° and 13°.

Day/Night Operation:

Operations to moving helidecks can take place in daylight and at night. Light intensities for both day time and night operations are therefore specified. During night time operations, the light unit intensity shall be controlled by a photocell as operation of the light at the daylight setting at night is very likely to dazzle the pilot. The photocell needs to be shielded from direct sunlight in order to correctly measure ambient light, particularly during sunset and sunrise when the sun is low in the sky.

The light shall transition from the daylight setting to the night time setting when the ambient illuminance falls below 500 lux and shall switch before it reaches 50 lux. The light shall transition from the night time setting to the daylight setting when the ambient illuminance rises above 50 lux and before it reaches 500 lux. The transition from one setting to another shall be accomplished smoothly (linear transition to within ±10%) without any noticeable step changes.

Serviceability:

As noted in Section 5.4 above, at least one helideck repeater light directly visible to at least one member of the flight crew with the helicopter landed on the helideck shall be operative for the repeater light system to be considered serviceable.

9.3 Characteristics

The following characteristics shall apply for both steady burning and flashing modes of the HMS repeater lights. All intensities shall be measured in accordance with the test procedures for helideck status lights contained in Appendix B of CAA Paper 2008/01. The modified-Allard method (see Appendix C of CAA Paper 2008/01) shall be used for calculation of the effective intensity.

a) The effective intensity as a function of elevation shall be as detailed in the table and figures below.

b) The effective intensity specified in the table shall apply to all angles of azimuth.

c) The colours of the HMS repeater lights shall be as defined in ICAO Annex 14 Vol.1 Appendix 1.

d) In flashing mode the maximum duty cycle shall be 50% ±1%, and:

- the blue light shall flash at a rate of 30 flashes per minute (i.e. 0.5 Hz), ±1%,
- the amber and red lights shall flash at a rate of 60 flashes per minute (i.e. 1.0 Hz), ±1%.

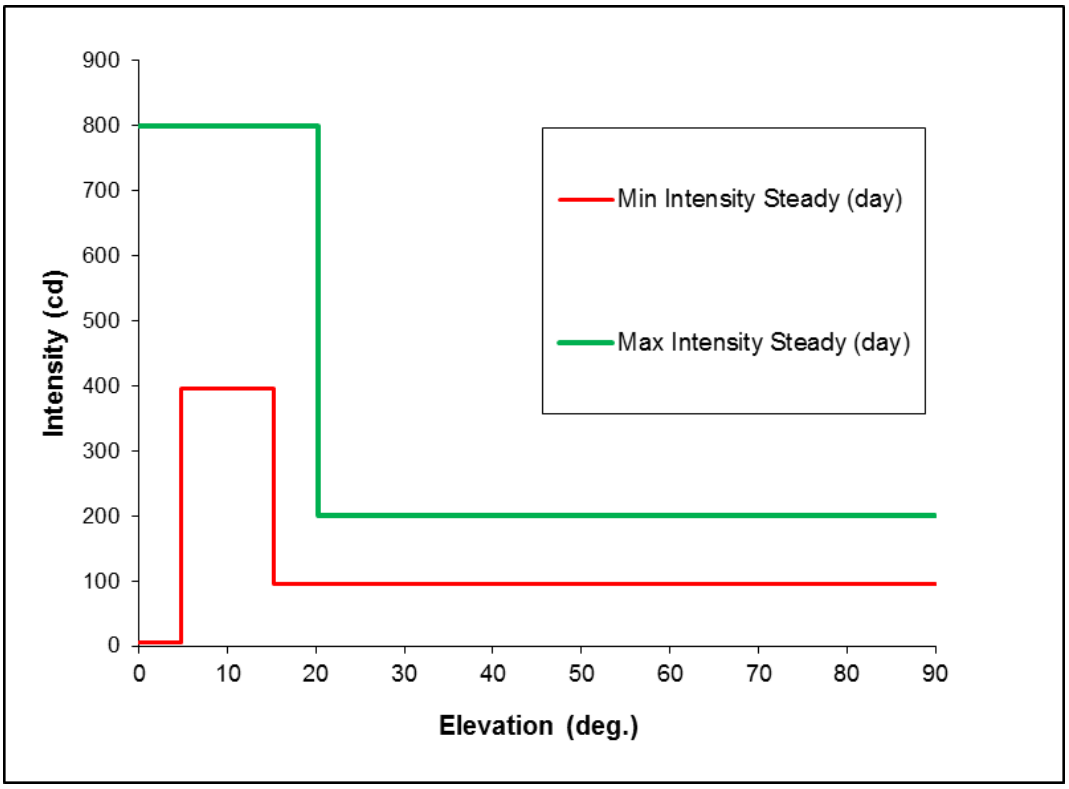
e) In order to prevent erroneous information being presented to the helicopter flight crew:

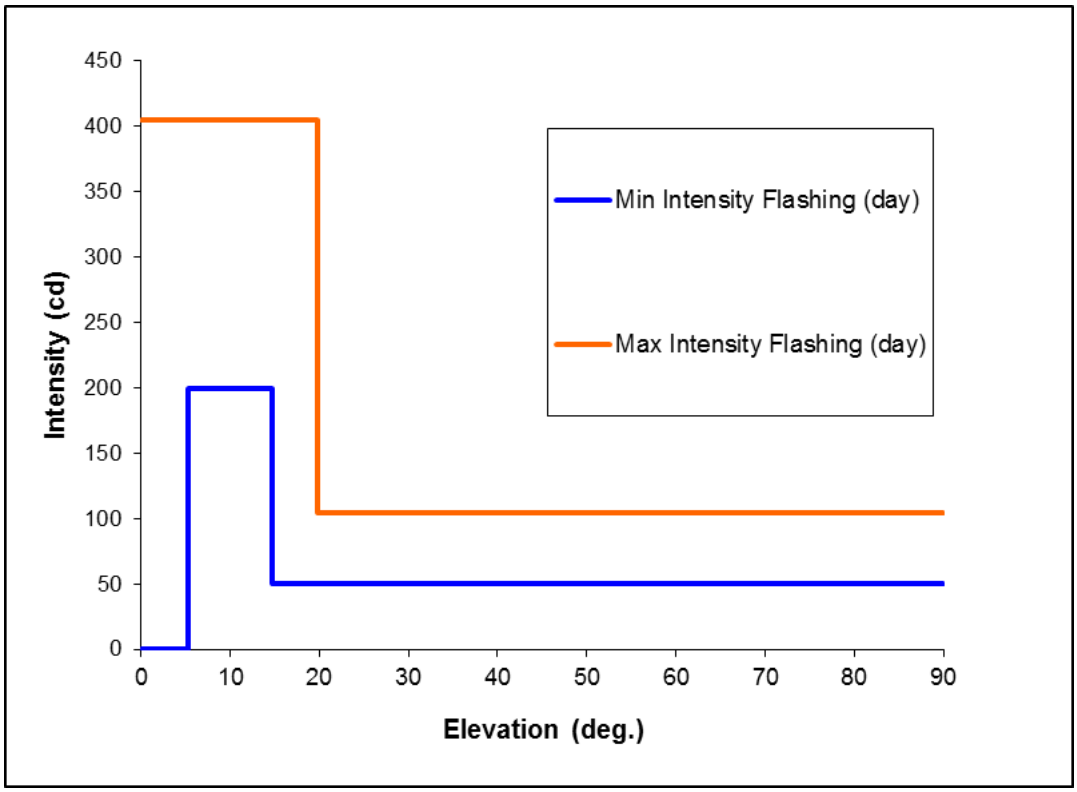
- Any failure detected by the HMS which could result in the output of an incorrect helideck motion status shall result in all the lights being extinguished.
- Any failure detected by an individual repeater light shall result in that light being extinguished.

f) The light shall be tested by an independent test house. The optical department of the test house shall be accredited to the version of EN ISO/IEC 17025 current at the time of testing.

Note: Although not an aviation requirement, the system and its constituent components shall also comply with all regulations relevant to the installation.

Vertical beam characteristics for HMS repeater lights					
Day/ Night	Steady/ Flashing	Min Intensity (cd)		Max Intensity (cd)	
		5° to 15°	>15° to 90°	0° to 20°	>20° to 90°
Day	Steady	400	100	800	200
	Flashing	200	50	400	100
Night	Steady	30	10	60	60
	Flashing	30	10	60	60


900
800
700
600
500
400
300
200
100
0
Intensity (cd)
0
10
20
30
40
50
60
70
80
90
Elevation (deg.)
Min Intensity Steady (day)
Max Intensity Steady (day)


450
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Intensity (cd)
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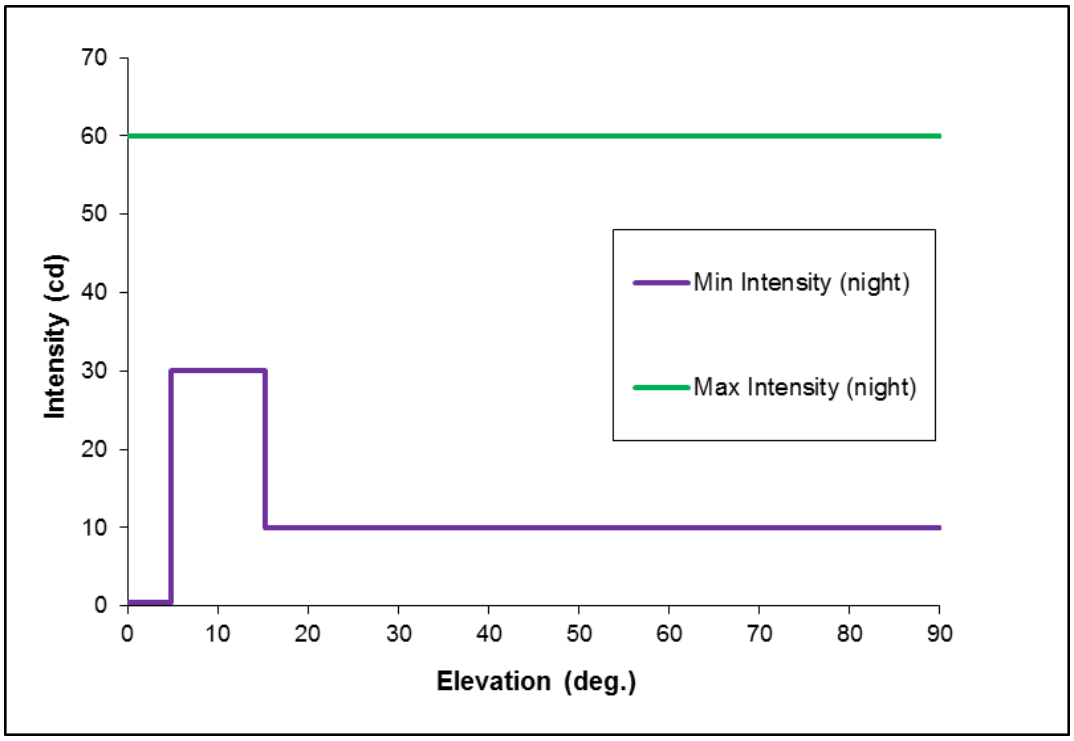
Elevation (deg.)
Min Intensity Flashing (day)
Max Intensity Flashing (day)


70
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Intensity (cd)
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60
70
80
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Elevation (deg.)
Min Intensity (night)
Max Intensity (night)