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Helicopter decks on offshore installations

Helikopter dekk på offshore installasjoner

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Foreword

NORSOK C-004:2019 was adopted as NORSOK Standard 2019-10-24.

NORSOK C-004:2019 supersedes NORSOK C-004 Edition 2, May 2013.

NORSOK is an acronym for the competitive position of the Norwegian continental shelf and comprise petroleum industry standards in Norway. The collaboration initiative in 1993 between the authorities and the petroleum industry initiated the development of NORSOK standards.

Reducing the project execution time and developing and operating cost for petroleum installations on the Norwegian shelf was the target.

The intention for the Petroleum industry is to develop and use standards providing good technical and cost effective solutions to ensure that the petroleum resources are exploited and managed in the best possible way by the industry and the authorities. The industry will actively contribute to the development and use of international standards in the global market.

The NORSOK standards shall:

- bridge the gap based on experiences from the Norwegian continental shelf where the international standards are unsatisfactorily;
- replace oil company specifications where possible;
- be available as references for the authorities' regulations;
- be cost effective; and
- promote the Norwegian sector as an attractive area for investments and activities.

Developing new NORSOK standards and regular maintenance of existing standards shall contribute to maintain the competitiveness both nationally and internationally for the Norwegian petroleum industry.

The NORSOK standards are developed by experts from the Norwegian petroleum industry and approved according to the consensus principles as laid down by the guidelines given in NORSOK A-001 N directive.

The NORSOK standards are owned by the Norwegian Oil and Gas Association, the Federation of Norwegian Industries and the Norwegian Shipowners' Association. They are managed and published by Standards Norway.

Annex A is normative, Annex B is informative.

Main changes from second edition to third edition are in summary:

- new Annex A (normative) Structural design requirements;
- new Annex B (informative) "Method 3" - Utilizing Computational Fluid Dynamics (CFD) for determination of acceptable risk level for offshore helicopter flight operation with respect to hot gas emission from turbine exhausts outlets;
- inclusion of operational experience feedback from recent projects, i.e. Structural and Materials;
- alignment with latest version of "BSL D 5-1" - Regulations for Civil Aviation;
- general formatting and reformulation of text.

NOTE Annex B was available as a support document to NORSOK C-004, Edition 2, and could be downloaded from the web page. The method is included as informative text in this edition.

Introduction

This standard has been written and revised by NORSOK committee EG C Architect.

This NORSOK standard is based on practical experience accumulated from helicopter operations on the Norwegian continental shelf. A primary goal of this standard is to set the framework for maximising flight safety and regularity on offshore helidecks.

The bibliography lists standards, norms, laws, regulations and other literature that may be relevant to the use of this document.

Normative text contains the requirements of the standard. Informative text is only guidance to the reader. All text in foreword, introduction and notes is informative text. Note to entries in section 3 and annexes to the document may be either normative or informative.

Helicopter decks on offshore installations

1 Scope

This NORSOK standard defines the basic requirements for design, arrangement and engineering of helicopter decks on offshore installations in the petroleum industry. This NORSOK standard covers fixed type installations, normally unmanned installations, floating installations, production, drilling and storage vessels.

2 Normative references

The following referenced documents contain text which fully or in part is part of the requirements in the document. For dated references, only the edition cited applies. For undated references, the latest edition of the cited document applies (including amendments).

NORSOK C-002, *Architectural components and equipment*

NORSOK M-101, *Structural steel fabrication*

NORSOK M-102, *Structural aluminium fabrication*

NORSOK M-501, *Surface preparation and protective coating*

NORSOK N-001, *Integrity of offshore structure*

NORSOK N-003:2017, *Actions and action effects*

NORSOK N-004, *Design of steel structures*

NORSOK S-001, *Technical safety*

NORSOK S-002, *Working environment*

NS-EN 1090-3, *Execution of steel structures and aluminium structures — Part 3: Technical requirements for aluminium structures*

NS-EN 1999 all parts, *Eurocode 9 Design of aluminium structures*

NS-EN ISO 19901-8; *Petroleum and natural gas industries – Specific requirements for offshore structures — Part 8: Marine soil investigation*

ICAO, *International Standards and Recommended Practices Annex 14, Volume II Heliports*

DNVGL-OS-E401, *Helicopter decks*

DNVGL-RP-C203, *Fatigue design of offshore steel structures*

DNVGL-RP-C205:2017, *Environmental conditions and environmental loads*

3 Terms and definitions

3.1

shall (requirement)

expression in the content of a document conveying objectively verifiable criteria to be fulfilled and from which no deviation is permitted if compliance with the document is to be claimed

Note 1 to entry: Requirements are expressed using the verbal forms specified in ISO/IEC Directives, Part 2 clause 7.2 Table 3.

3.2

should (recommendation)

expression in the content of a document conveying a suggested possible choice or course of action deemed to be particularly suitable without necessarily mentioning or excluding others

Note 1 to entry: Recommendations are expressed using the verbal forms specified in ISO/IEC Directives, Part 2 clause 7.3 Table 4.

Note 2 to entry: In the negative form, a recommendation is the expression that a suggested possible choice or course of action is not preferred but it is not prohibited.

3.3

may (permission)

expression in the content of a document conveying consent or liberty (or opportunity) to do something

Note 1 to entry: Permissions are expressed using the verbal forms specified in ISO/IEC Directives Part 2 clause 7.4 Table 5.

3.4

can (possibility and capability)

1: expression in the content of a document conveying expected or conceivable material, physical or causal outcome.

2: expression in the content of a document conveying the ability, fitness, or quality necessary to do or achieve a specified thing

Note 1 to entry: Possibility and capability is expressed using the verbal forms specified in ISO/IEC Directives, Part 2 clause 7.5 Table 6.

3.5

5:1 gradient

an obstacle free sector (3.14) intended to provide obstacle free air space in front of and below the helideck

3.6

de-icing

remove snow, ice and frost (from a surface)

3.7

D_H-value

the diameter of the helideck measured inside the perimeter circle when all requirements are complied with

3.8

D-value

the largest overall dimension of the helicopter with both rotors turning

Note 1 to entry: Normally measured from the most forward position of the main rotor blade plane to the most rearward position of the tail rotor blade plane, (or fuselage when relevant)

3.9

HLO

helicopter landing officer

the person in charge of the daily supervision of the helideck

3.10

helideck

dedicated helicopter landing area on offshore installations

3.11

helideck pancake

helideck upper deck structure plus transverse support beams,

Note 1 to entry: Norwegian term is "Dekksflak"

3.12

helideck circle

a hypothetical circle, circumscribing the landing area of the helideck with a diameter equal to the deck's D_H -value (3.7)

3.13

LOS

limited obstacle sector

a 150° sector where obstacles are permitted within certain height limitations and distances

3.14

obstacle free sector

a 210° safe approach and take-off sector for helicopters with an unobstructed flight path above the helideck plane to a safe calculated distance, normally 500 m

3.15

perimeter line

300 mm wide white painted line surrounding the helideck (3.10), where the outside edge marks the border of the safe landing area as defined by the helideck's D_H -value (3.7)

3.16

helideck size

number inscribed in the perimeter line (3.15) at three positions with an angular spacing of 90°, marking the D_H -value (3.7) of the helideck (3.10) rounded to the nearest whole number

3.17

run-off

an extension from the helideck to form a suitable area outside the LOS (3.13) to park a (unserviceable) helicopter

3.18

parking area

a dedicated area suited for planned helicopter ground operations

3.19

TD circle

touchdown circle

yellow inner circle marking the pilots' aiming point for a safe landing of the undercarriage within the landing area

Note 1 to entry: Correct touchdown allows for safe access, cargo handling and other required services on the helideck

3.20

helideck structural sub-assemblies

connectivity illustrated in figure:

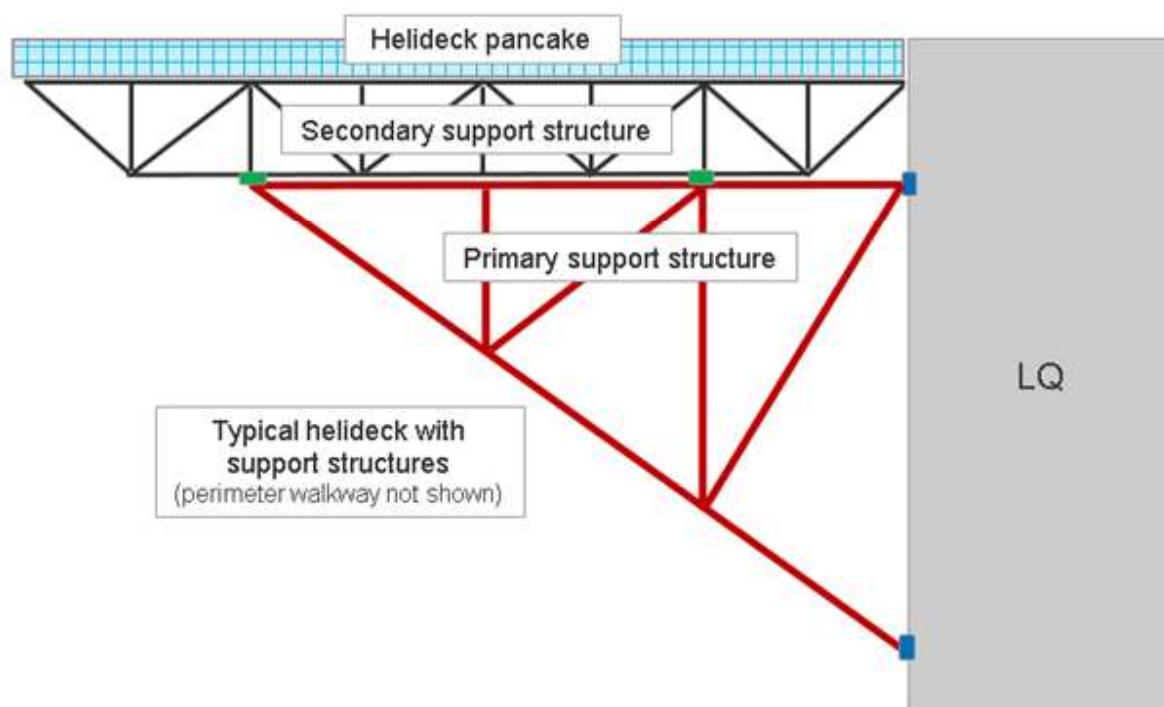


Figure 1 — Helideck structural sub-assemblies illustrated schematically

3.21

air gap

clear opening to underlying structure

3.22

passive fire suppression

recessed and integrated drainage system for safe collection and discharge of water and any dispersed fuel on the surface.

Note 1 to entry: The inlet openings shall provide effective drainage of liquids in a safe and controlled manner. The collector channels in the "pancake" subsurface structure shall be designed to limit the access of air, to the extent that any helifuel kerosene fire will extinguish by itself due to oxygen deprivation.

Note 2 to entry: The flame extinguishing design shall be verified by testing.

4 Abbreviations

For this document, the following abbreviations apply.

BSL	Bestemmelser for sivil luftfart (Regulations for civil aviation)
CFD	computational fluid dynamics
DAHR	dual agent hose reel
DIFFS	deck integrated firefighting system
FMS	foam monitor system
FPSO	floating production storage offloading
FSU	floating storage unit
HLO	helicopter landing officer
HTCC	helicopter traffic control centre
LED	light emitting diode
LOS	limited obstacle sector
LQ	living quarters
MTOM	maximum take-off mass
OFS	obstacle free sector
TD Circle	touchdown circle
TGM	temperature gradient matrix
WHRU	waste heat recovery unit

5 General requirements

The provisions set forth in this NORSOK standard shall be complied with in all phases of planning, construction and operation of the helideck.

The helideck design and location shall be seen as an integrated part of the overall offshore installation design and layout arrangement. There are several elements on, and around, an offshore installation that may severely affect safe helicopter operations, unless appropriate measures are taken to avoid, control or reduce any potential hazards. The design approach shall be based on a rational, analytical evaluation and decision-making process to achieve the very best compromise when conflicting requirements occur.

The design process shall run in parallel with other design activities on the installation. The objective is to achieve a functional and safe helideck with safe approach and departure sectors that will facilitate high flight regularity under most operational conditions. Any potential flight limitation shall either be resolved or registered as a limitation in "helideck information sheet".

NOTE Poorly designed helidecks may cause serious helicopter operational restrictions with significant commercial and operational penalties.

6 Environmental effects

6.1 Introduction

The immediate environment surrounding offshore installations may affect helicopter operations in various ways. Such conditions are typically:

- poor visibility (day and night);
- unfavourable wind directions;
- structure induced turbulence;
- thermal effects and turbulence caused by gas turbine exhausts, flares and diesel engine emissions;
- unburned hydrocarbon gas emissions from cold flaring;
- emissions from emergency blow down systems;
- helideck motion caused by ocean waves;
- poor visual points of references/visual cues;
- obstacles adjacent to the helideck.

Several conditions may occur at the same time. These conditions shall be evaluated. Cause and effect shall be examined. Necessary actions shall be taken to provide optimal operational conditions at the helideck. An in-depth understanding of these phenomena and their potential impact is a key factor for a successful helideck design.

The environmental effects shall be correlated with the performance and the sensitivity of the relevant helicopter types to be used on the offshore installation.

The design shall take into account any impact caused by neighbouring installation(s).

6.2 Wind analysis for helicopter operations

CFD analyses or wind tunnel tests shall be performed to describe the air flow and hot gas dispersion close to the helideck. A suitable model of the installation shall be built, where relevant environmental effects shall be simulated and evaluated for various combinations of wind speeds and wind directions.

The analysed wind speeds and directions shall be based on the layout of the helideck, structures or subjects in the vicinity of the helideck and wind rose on the field or for the installation. The turbulence level shall be evaluated in way of using velocity fluctuations u' , v' and w .

Anisotropic turbulence models shall be used for the CFD analyses.

Mapping and visualisation of the wind velocity field shall be provided in the form of plots of velocity magnitude, vertical velocity component and vertical velocity fluctuations above the helideck. Vertical velocity fluctuations to be presented are 1,75 m/s and 2,4 m/s. Operational experience indicates that velocity fluctuation of 1,75 m/s will generate noticeable turbulence. This criterion should therefore normally not be exceeded. Flight limitations are likely at values exceeding 2,4 m/s. Refer to Annex B.

The findings shall be correlated with practical experience data, historic wind data, and relevant information from the helicopter operator. Conclusions and recommendations shall verify and document that the helideck has been given an optimal location on the installation in question. Any possible problems or restrictions regarding helicopter operations shall be highlighted, to enable necessary corrective actions.

Similarly, CFD analyses or wind tunnel tests shall be performed when modifications on existing installations may affect flight performance on the helideck.

The volume of air space to be considered shall comprise the immediate air space surrounding the offshore installation that may induce unfavourable operational conditions at the helideck, and in the helicopter approach and departure sector. The helicopter landing and take-off committal points shall be deemed to be up to 20 m above the helideck.

CFD analyses or wind tunnel tests shall be performed to describe the air flow and hot gas dispersion close to the helideck. Simulations shall be based on a representative model of the installation. Relevant environmental effects shall be simulated and evaluated for various conditions. The findings shall be correlated with practical experience data, historic wind data, and relevant information from the helicopter operator. Conclusions and recommendations shall verify and document that the helideck has been given an optimal location on the installation in question. Any possible problems or restrictions regarding helicopter operations shall be highlighted, to enable necessary corrective actions.

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6.3 Wind

The helideck shall be located and arranged to favour the 210° obstacle-free approach and take-off sector with regards to prevailing wind.

A windsock shall be provided to indicate the wind conditions on the helideck, direction and speed, by locating it in an area of negligible turbulence. It shall be clearly visible to the pilots in the flight approach sector and from the take-off position on the helideck, day and night.

NOTE More than one windsock may be required in order to comply with this requirement.

6.4 Structure induced turbulence

Strong turbulent air flow should be avoided within the operational environment of the helicopter since it may adversely affect the performance and handling.

NOTE 1 Structure induced turbulence is created by wind hitting buildings, structures and equipment, and is in most cases predictable.

NOTE 2 Turbulence around an offshore installation is a major risk factor for helicopter operations and presents a considerable workload on the pilots.

NOTE 3 Typical sources of structure induced turbulence are tall solid buildings and structures, plated derricks, cranes, exhaust stacks, etc. Such elements may cause severe turbulent airflow downwind and may for certain wind directions pose a hazard to helicopter operations. Open or relatively porous structures may reduce this effect considerably and should be encouraged whenever possible.

Structure induced turbulence shall be carefully assessed and documented through CFD analyses or wind tunnel tests. Findings that may endanger helicopter operations, or cause operational restrictions, shall be rectified through necessary design modifications. The objective is to eliminate significant structure induced turbulence at the helideck, and in the helicopter approach and take-off sector.

Lay-down decks in the vicinity of the helideck should be avoided, since bulky containers and tall items placed temporarily on the deck may cause unexpected turbulence.

When adding new modules to an existing offshore installation, new turbulence analysis should be performed.

Cantilevered helidecks, supported by an open frame structure, shall be placed level with a roof top or deck when feasible. This will enable flush access to the LQ entrance, parking area, or hangar, and result in minimal disturbed airflow underneath and above the helideck.

An air gap shall be provided beneath the landing area, when the helideck is placed above a building or solid structure. The height of the air gap should be in the range of 2 m to 5 m, or more, depending on the given situation. Placement of the landing area directly on a roof or deck is unacceptable.

6.5 Hot-air flow

Adequate risk reducing measures shall be taken at the design stage to minimize negative effects from hot air flows from turbine generators, diesel engines, flaring etc., which may severely affect helicopter operations.

Hot air flow, combined with a sudden change in air temperature, may have the following two major effects on the helicopter performance:

- possible momentary stalling of helicopter engines due to sudden air density changes through the turbine compressors;
- significant reduction in helicopter lift capacity.

These effects can be controlled by either proper design, which should be the main priority, or by operational measures that may involve certain helicopter flight limitations. The risk varies with helicopter type, and the risk level increases with large temperature gradients in the flight path. In view of this, the following 3 methods should be assessed:

Method 1 is a conservative, deterministic approach that should be used when designing a new installation. The method is based on CFD analysis and implies that the free airspace above the helideck should not be exposed to temperature increase of more than 2 °C (iso-contour from CFD). The free airspace is defined as a height above the helideck corresponding to approximately 10 m plus wheels-to-rotor height plus one rotor diameter. This method will normally require a minimum exhaust stack height of 30-32 m based on experience data but should be verified in each case. When several stacks are required the design shall allow for optimal location and alignment to minimize gas plume exposure over the helideck. In difficult cases cooling of the exhaust gas may be considered by use of a reliable waste heat recovery system, or similar, based on a total assessment. In situations where this method is deemed impossible, unpractical or noncompliant, methods 2 and 3 should be considered. These methods utilize a risk based approach.

Method 2 is a CFD risk based approach and methodology that has been developed in close corporation with the offshore helicopter operators. The method identifies the temperature gradient levels in the airspace above the helideck with predefined measures reflecting different risk levels. Details of the method is described in Annex B "Utilizing Computational Fluid Dynamics (CFD) for determination of acceptable risk level for offshore helicopter flight operation with respect to hot gas emission from turbine exhaust outlets".

Method 3 is an approach based on method 2 and is pre-processed for conservative gas turbine configurations. The outcome of this process indicates minimum exhaust stacks heights for different gas turbine configurations as shown in Figure 2. The stack height is dependent on both distance to the helideck and gas turbine power. In case of noncompliance, method 3 is recommended. This method is capable of taking into account specific geometrical considerations as well as specific gas turbine configuration.