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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

English Version

Cranes - Offshore cranes - Part 1: General-purpose offshore cranes

Appareils de levage à charge suspendue - Grues off-shore - Partie 1 : Grues off-shore pour usage général

Krane - Offshore-Krane - Teil 1: Offshore-Krane für allgemeine Verwendung

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 147.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 13852-1:2021) has been prepared by Technical Committee CEN/TC 147 “Cranes - Safety”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document supersedes EN 13852-1:2013.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA or ZB, which are integral parts of this document.

This document is one part of EN 13852. The parts are the following ones:

- *Part 1: General-purpose offshore cranes* (the present document);
- *Part 2: Floating cranes*;
- *Part 3: Light offshore cranes*.

This document is a full revision of EN 13852-1:2013.

Introduction

This document is a type C standard as defined in EN ISO 12100:2010.

This document has been prepared to provide one means for general purpose offshore cranes to conform to the essential health and safety requirements of the Machinery Directive.

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document (see Clause 1).

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

1 Scope

This document applies to general purpose offshore cranes including their supporting pedestals and structures.

This document is applicable to general purpose offshore cranes, whose structures are made of steel.

This document provides requirements for all significant hazards, hazardous situations and events relevant to general purpose offshore cranes, for lifting of goods and lifting of persons, when used as intended and under the conditions foreseen by the risk assessment (see Clause 4).

This document is applicable to general purpose offshore cranes, which are manufactured after the date of approval by CEN of this document.

This document is not applicable for:

- a) transportation, assembly, disabling, scrapping, installation or erecting of the crane;
- b) any item attached to the hook, such as loads, non-fixed load lifting attachments, lifting accessories, baskets, carriers and containers;
- c) lifting operations in ambient temperatures below - 20 °C;
- d) lifting operations in ambient temperatures above 45 °C;
- e) accidental loads as result of collisions, earthquakes, explosions, etc., which are not covered by exceptional loads defined in Table B.7;
- f) floating cranes (covered by EN 13852-2), light offshore cranes (covered by FprEN 13852-3) and 2D/3D motion compensated cranes;
- g) subsea lifting operations;
- h) lifting operations involving more than one crane;
- i) emergency rescue operations (except training).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For undated references in the body text, the corresponding dated references in this chapter applies.

EN 614-1:2006+A1:2009, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

EN 614-2:2000+A1:2008, *Safety of machinery — Ergonomic design principles — Part 2: Interactions between the design of machinery and work tasks*

EN 795:2012, *Personal fall protection equipment — Anchor devices*

EN 842:1996+A1:2008, *Safety of machinery — Visual danger signals — General requirements, design and testing*

EN 894-1:1997+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 1: General principles for human interactions with displays and control actuators*

EN 894-2:1997+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 2: Displays*

EN 894-3:2000+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 3: Control actuators*

EN 1127-1:2019, *Explosive atmospheres — Explosion prevention and protection — Part 1: Basic concepts and methodology*

EN 1837:1999+A1:2009, *Safety of machinery — Integral lighting of machines*

EN 1838:2013, *Lighting applications — Emergency lighting*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 12077-2:1998+A1:2008, *Cranes safety — Requirements for health and safety — Part 2: Limiting and indicating devices*

EN 12385-1:2002+A1:2008, *Steel wire ropes — Safety — Part 1: General requirements*

EN 12385-2:2002+A1:2008, *Steel wire ropes — Safety — Part 2: Definitions, designation and classification*

EN 12385-3:2020, *Steel wire ropes — Safety — Part 3: Information for use and maintenance*

EN 12385-4:2002+A1:2008, *Steel wire ropes — Safety — Part 4: Stranded ropes for general lifting applications*

EN 12464-2:2014, *Light and lighting — Lighting of work places — Part 2: Outdoor work places*

EN 12644-1:2001+A1:2008, *Cranes — Information for use and testing — Part 1: Instructions*

EN 12644-2:2000+A1:2008, *Cranes — Information for use and testing — Part 2: Marking*

EN 13001-1:2015, *Cranes — General design — Part 1: General principles and requirements*

EN 13001-2:2014, *Crane safety — General design — Part 2: Load actions*

EN 13001-3-1:2012+A2:2018, *Cranes — General design — Part 3-1: Limit states and proof of competence of steel structure*

EN 13001-3-2:2014, *Cranes — General design — Part 3-2: Limit states and proof of competence of wire ropes in reeving systems*

EN 13001-3-3:2014, *Cranes — General design — Part 3-3: Limit states and proof of competence of wheel/rail contacts*

EN 13001-3-4:2018, *Cranes — General design — Part 3-4: Limit states and proof of competence of machinery bearings*

EN 13001-3-5:2016, *Cranes — General design — Part 3-5: Limit states and proof of competence of forged hooks*

EN 13001-3-6:2018, *Cranes — General design — Part 3-6: Limit states and proof of competence of machinery — Hydraulic cylinders*

prEN 13001-3-7:2019, *Cranes — General design — Part 3-7: Limit states and proof of competence of machinery — Gears and gear boxes*

prEN 13001-3-8:2018, *Cranes — General design — Part 3-8: Limit states and proof competence of machinery — Shafts*

EN 13135:2013+A1:2018, *Cranes — Safety — Design — Requirements for equipment*

EN 13557:2003+A2:2008, *Cranes — Controls and control stations*

EN 13586:2004+A1:2008, *Cranes — Access*

EN ISO 13732-1:2008, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)*

EN ISO 14118:2018, *Safety of machinery — Prevention of unexpected start-up (ISO 14118:2017)*

EN 14502-1:2010, *Cranes — Equipment for the lifting of persons — Part 1: Suspended baskets*

EN IEC 60079-0:2018, *Explosive atmospheres — Part 0: Equipment — General requirements (IEC 60079 0:2017)*

EN 60079-14:2014, *Explosive atmospheres — Part 14: Electrical installations design, selection and erection (IEC 60079-14:2013)*

EN ISO 898-1:2013, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread (ISO 898-1:2013)*

EN ISO 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane (ISO 3744:2010)*

EN ISO 3834-1:2005, *Quality requirements for fusion welding of metallic materials — Part 1: Criteria for the selection of the appropriate level of quality requirements (ISO 3834-1:2005)*

EN ISO 3834-2:2005, *Quality requirements for fusion welding of metallic materials — Part 2: Comprehensive quality requirements (ISO 3834-2:2005)*

EN ISO 3834-3:2005, *Quality requirements for fusion welding of metallic materials — Part 3: Standard quality requirements (ISO 3834-3:2005)*

EN ISO 3834-4:2005, *Quality requirements for fusion welding of metallic materials — Part 4: Elementary quality requirements (ISO 3834-4:2005)*

EN ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components (ISO 4413:2010)*

EN ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components (ISO 4414:2010)*

EN ISO 4871:2009, *Acoustics — Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 7731:2008, *Ergonomics — Danger signals for public and work areas — Auditory danger signals (ISO 7731:2003)*

EN ISO 11201:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections (ISO 11201:2010)*

EN ISO 11688-1:2009, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

EN ISO 11688-2:2000, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 2: Introduction to the physics of low-noise design (ISO/TR 11688-2:1998)*

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 12944-1:2017, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 1: General introduction (ISO 12944-1:2017)*

EN ISO 12944-2:2017, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments (ISO 12944-2:2017)*

EN ISO 12944-3:2017, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 3: Design considerations (ISO 12944-3:2017)*

EN ISO 12944-4:2017, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 4: Types of surface and surface preparation (ISO 12944-4:2017)*

EN ISO 12944-5:2019, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 5: Protective paint systems (ISO 12944-5:2019)*

EN ISO 12944-6:2018, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 6: Laboratory performance test methods (ISO 12944-6:2018)*

EN ISO 12944-7:2017, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 7: Execution and supervision of paint work (ISO 12944-7:2017)*

EN ISO 12944-8:2017, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 8: Development of specifications for new work and maintenance (ISO 12944-8:2017)*

EN ISO 12944-9:2018, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 9: Protective paint systems and laboratory performance test methods for offshore and related structures (ISO 12944-9:2018)*

EN ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2015)*

EN ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design (ISO 13850:2015)*

EN ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2019)*

EN ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards (ISO 14120:2015)*

EN ISO 15614-1:2017, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1:2017, Corrected version 2017-10-01)*

EN ISO 15614-11:2002, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 11: Electron and laser beam welding (ISO 15614-11:2002)*

EN ISO 15614-12:2014, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 12: Spot, seam and projection welding (ISO 15614-12:2014)*

EN ISO 15614-13:2012, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 13: Upset (resistance butt) and flash welding (ISO 15614-13:2012)*

EN ISO 19353:2019, *Safety of machinery — Fire prevention and fire protection (ISO 19353:2019)*

EN ISO 80079-36:2016, *Explosive atmospheres—Part 36: Non-electrical equipment for explosive atmospheres — Basic method and requirements (ISO 80079-36:2016)*

EN ISO 80079-37:2016, *Explosive atmospheres — Part 37: Non-electrical equipment for explosive atmospheres — Non-electrical type of protection constructional safety “c”, control of ignition sources “b”, liquid immersion “k”*

EN 60529:1991,¹ *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 61310-2:2008, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking (IEC 61310-2:2007)*

EN 61310-3:2008, *Safety of machinery — Indication, marking and actuation — Part 3: Requirements for the location and operation of actuators (IEC 61310-3:2007)*

IEC 61892-4:2019, *Mobile and fixed offshore units — Electrical installations — Part 4: Cables*

IEC 61892-6:2019, *Mobile and fixed offshore units — Electrical installations — Part 6: Installation*

ISO 2631-1:1997, *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 1: General requirements*

ISO 3864-1:2011, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

ISO 3864-2:2016, *Graphical symbols — Safety colours and safety signs — Part 2: Design principles for product safety labels*

ISO 3864-3:2012, *Graphical symbols — Safety colours and safety signs — Part 3: Design principles for graphical symbols for use in safety signs*

¹ As impacted by EN 60529:1991/AC:2006-12, EN 60529:1991/A1:2000, EN 60529:1991/A2:2013 and EN 60529:1991/A2:2013/AC:2019-02.

ISO 3864-4:2011, *Graphical symbols — Safety colours and safety signs — Part 4: Colorimetric and photometric properties of safety sign materials*

ISO 5817:2014, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections*

ISO 7010:2019, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

ISO 9927-1:2013, *Cranes — Inspections — Part 1: General*

ISO 12478-1:1997, *Cranes — Maintenance manual — Part 1: General*

ISO 12480-1:1997, *Cranes — Safe use — Part 1: General*

ISO 12482:2014, *Cranes — Monitoring for crane design working period*

ISO 17635:2016, *Non-destructive testing of welds — General rules for metallic materials*

ISO 20332:2016, *Cranes — Proof of competence of steel structures*

ISO 23815-1:2007, *Cranes — Maintenance — Part 1: General*

F.E.M. 1.001 (10.1998), *Rules for the design of hoisting appliances*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

actual hook load

total static weight of the load including any equipment placed between the load and the hook

3.2

automatic overload protection system (AOPS)

system that automatically safeguards and protects the crane against overload during off-board lifts by allowing the hook to be pulled away from the crane, without causing significant damage to the crane

3.3

component

single part or assembly of parts of a crane, which is subjected to load effects

Note 1 to entry: Examples of components are wire ropes, rope sheaves, axles, gears, couplings, brakes, hoists, hydraulic cylinders, shafts, shackles, swivels and pins.

3.4

primary component

component (usually in the main load path) which is essential for the mechanical and structural integrity of the crane

Note 1 to entry: Examples of primary components are boom section, slewing bearing, hoist rope and hook.

3.5

secondary component

component that is not a primary component

Note 1 to entry: Examples of secondary components are walkways and their supports.

3.6

crane stiffness

value representing the rigidity of the crane in terms of a vertical force applied at the hook divided by the resulting vertical deflection at the hook

3.7

dynamic factor (ϕ_{2n})

ratio between the maximum dynamic load at the hook and the actual hook load for any given configuration or operating condition

3.8

emergency operation system (EOS)

back-up system for limited operation of the crane, if the normal system of operation is out-of-service

3.9

folding

motion to fold or unfold a knuckle boom assembly

3.10

general-purpose offshore crane

multipurpose slewing jib type offshore crane

3.11

hazardous area

area in which an explosive gas atmosphere is present or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of the equipment

3.12

hoisting

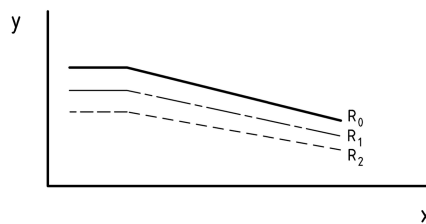
moving the hook in vertical direction

3.13

load chart

diagram or table showing the rated capacity relative to the radius, configuration, environmental conditions, out of plane influences and type of operation

Note 1 to entry: An example is given in Figure 1.

**Key**

- X radius
- Y rated capacity
- R_0 rated capacity for on-board lifts
- R_1 rated capacity for off-board lifts in significant wave height $H_s = 1$ m
- R_2 rated capacity for off-board lifts in significant wave height $H_s = 2$ m

Figure 1 — Load chart**3.14****luffing**

motion where the boom is raised or lowered

3.15**manual overload protection system (MOPS)**

system operated by the crane operator, that protects the crane against possible overload by limiting the hoist wire rope tension to a low value and allowing the hook to be pulled away from the crane during off-board lift

3.16**off-board lift**

lifting operation between the offshore installation and a floating unit where there is a risk of entanglement

3.17**offlead load**

horizontal load at the boom tip caused by the radial displacement of the hook

3.18**offshore crane**

crane mounted on an offshore installation and used for on-board and off-board lifts

3.19**offshore installation**

structure supported by the seabed or floating unit, exposed to an offshore marine environment

3.20**on-board lift**

lifting operation within the boundaries of the offshore installation where the crane is installed

3.21**overload**

condition where the actual hook load exceeds the rated capacity for on-board lift

3.22

pedestal

structural arrangement with the main purpose to support the crane and which is not a structural part of the offshore installation

3.23

lifting of persons

lifting operation where persons are moved by the crane from one location to another, using equipment attached to the crane hook

3.24

radius

horizontal distance between the crane vertical axis of slewing and a vertical line through the hook when there is no offlead or sidelead

3.25

rated capacity (R_0 , R_n or R_p)

maximum actual hook load that the crane is designed to lift for a given operating condition (e.g. lifting mode, configuration, reeving arrangement, heel/trim, radius, significant wave height, wind, etc.)

Note 1 to entry: Rated capacity R_0 refers to on-board lifts, R_n refers to offboard lifts and R_p refers to lifting of persons. Rated capacity corresponds to hoist load as defined in EN 13001-2:2014 and Safe Working Load (SWL) as used by ILO conventions.

3.26

rated capacity limiter (RCL)

device or system that automatically prevents the rated capacity from being exceeded during on-board lifts and lifting of persons

3.27

sidelead load

horizontal load at the boom tip caused by the tangential displacement of the hook

3.28

significant damage

state of loading that represents 80 % of the failure load

3.29

significant wave height (H_s)

average height of the highest one third of the individual wave heights in a short-term constant state of sea, typically 3 h

3.30

telescoping

motion where the boom is extended or retracted

3.31

travelling

motion where the wire rope suspension is moved along the boom

3.32**emergency shut down (ESD)**

safety system on an offshore installation which limits or prevents abnormal events to develop into a major accident

3.33**slewing**

motion where the crane is rotating about its vertical axis

3.34**failure load**

calculated overload at the hook that causes the most probable first loss of the load carrying capacity of a primary component

Note 1 to entry: Examples of failure loads:

- a) result in components exceeding their yield strength, e.g. by forming partly plastic cross-sections;
- b) result in components exceeding their ultimate tensile strength or minimum breaking loads, e.g. wire ropes;
- c) result in immediate buckling of any component;
- d) cause mechanical components to fail to fulfil their primary function, e.g. torque transmitting components.

3.35**user**

organisation (owner, operator, buyer) which owns and utilises the crane

3.36**motion detection system (MDS)**

system that automatically detects and safeguards the main motions of the crane

3.37**emergency load lowering (ELL)**

system activated by the crane operator during out-of-service, to lower the load down to the load supporting deck by the use of gravity

3.38**safety function**

function of the machine whose failure can result in an immediate increase of the risk(s)

[SOURCE: EN ISO 12100:2010, 3.30]

3.39**manufacturer**

organisation which designs and fabricates the crane

3.40**motion compensation**

function which automatically either actively or passively, influences the hook motions to reduce dynamic impacts induced by the environment

Note 1 to entry: Motion compensation in the context of this document is limited to the hoisting motion. Motion compensation for combined motions such as hoisting, slewing, luffing, travelling, folding and telescoping is named 2D/3D motion compensation and is covered by this document.

3.41

lifting mode

automatic or manual configuration of the control system for a specific lifting operation, i.e. selection of no. of falls or hoist winch etc, on-board lift, off-board lift or the lifting of persons

4 List of significant hazards

Table 1 contains all the significant hazards, hazardous situations and events, as far as they are dealt with by this document, identified as significant for this type of machinery, and which require action to eliminate or reduce the risk.

The significant hazards are based upon EN ISO 12100:2010. Also shown are the sub clause references to the safety requirements and/or protective measures in this document.

A risk assessment of each offshore crane design shall be carried out by the manufacturer to check that the hazards identified in Table 1 and any other relevant hazards not identified in Table 1 are dealt with. Any significant hazards identified as a result of the risk assessment in addition to the generic hazards as given in Table 1, shall be taken into consideration.

Table 1 — List of significant hazards, hazardous situations, hazardous events, their relation to the Essential Requirements of the Machinery Directive 2006/42/EC, and associated requirements in this document

Group	Significant hazard in accordance with EN ISO 12100:2010, Table B.1	Directive 2006/42/EC, Annex I	Associated requirements in this standard
1	Mechanical hazards		
1.1	Due to machine parts or workpieces, e.g. — by potential energy (falling objects, height from the ground, gravity)	1.3.3 Risks due to falling or ejected objects	5.2.7, 5.5, 5.8.7, 5.10
	— by kinetic energy (acceleration, deceleration, moving/rotating elements)	1.3.7 Risks related to moving parts	5.2.7, 5.9.13, 5.8, 5.9
	— by mechanical strength (break-up)	1.1.3 Materials and products 1.3.2 Risk of break-up during operation	5.2, 5.4, 5.8, 5.10
1.2	by stored energy, e.g.: — elastic elements (springs)	1.3.9 Risks of uncontrolled movements 1.5.3 Energy supply other than electricity 1.6.3 Isolation of energy sources	5.1.5, 5.6.4

Group	Significant hazard in accordance with EN ISO 12100:2010, Table B.1	Directive 2006/42/EC, Annex I	Associated requirements in this standard
1.3	Crushing	1.3 Protection against mechanical hazards	5.9.13
1.4	Shearing	1.3 Protection against mechanical hazards	5.9.13
1.5	Cutting or severing	1.3.4 Risks due to surfaces, edges or angles	5.9.13, 5.9.14
1.6	Entanglement	1.3 Protection against mechanical hazards	5.9.13, 5.9.14
1.7	Drawing-in or trapping	1.3 Protection against mechanical hazards	5.9.13, 5.9.14
1.8	Impact	1.3 Protection against mechanical hazards	5.9.13, 5.9.14
1.9	Stabbing or puncture	1.3 Protection against mechanical hazards	5.9.13, 5.9.14
1.10	Friction or abrasion	1.3.4 Risks due to surfaces, edges or angles	5.9.14
1.11	Injection	1.3.2 Risk of break-up during operation	5.9.13
1.12	Slipping, tripping and falling	1.5.15 Risk of slipping, tripping or falling	5.9.3
1.13	Instability	1.1.5 Design of machinery to facilitate its handling 1.3.1 Risk of loss of stability	5.2, 5.8
2	Electrical hazards		
2.1	Touching live parts	1.5.1 Electricity supply 1.6.3 Isolation of energy sources	5.4
2.2	Parts which have become live under fault conditions	1.5.1 Electricity supply	5.4

Group	Significant hazard in accordance with EN ISO 12100:2010, Table B.1	Directive 2006/42/EC, Annex I	Associated requirements in this standard
2.3	Not enough distance to live parts under high voltage	1.5.1 Electricity supply 1.6.3 Isolation of energy sources	5.4
2.4	Electrostatic phenomena	1.5.2 Static electricity	5.4
2.5	Electromagnetic phenomena	1.2.1 Safety and reliability of control systems	5.3, 5.4
2.7	Short-circuit	1.5.1 Electricity supply	5.4
2.8	Overload	1.5.1 Electricity supply	5.1.5, 5.4
2.9	Thermal radiation	1.5.1 Electricity supply	5.4
3	Thermal hazards		
3.1	Burn, scald	1.5.5 Extreme temperatures 1.5.6 Fire 1.5.7 Explosion	5.4.10, 5.7.18, 5.9.15
4	Noise hazards		
4.1	Permanent hearing loss, tinnitus	1.5.8 Noise	5.9.10, 5.9.11
6	Radiation hazards		
6.2	Radio frequency electromagnetic radiation	1.5.10 Radiation 1.5.11 External radiation	5.4.11
7	Material/ substance hazards		
7.1	Hazards from contact with inhalation of harmful fluids, gases, mists, fumes and dusts	1.1.3 Materials and products 1.5.13 Emissions of hazardous materials and substances 1.6.5 Cleaning of internal parts	5.9.1
7.2	Fire	1.5.6 Fire	5.7.18
7.3	Explosion	1.5.7 Explosion	5.8.13
8	Ergonomic hazards		
8.1	Unhealthy postures or excessive effort	1.1.5 Design of machinery to facilitate its handling 1.1.6 Ergonomics	5.9.2

Group	Significant hazard in accordance with EN ISO 12100:2010, Table B.1	Directive 2006/42/EC, Annex I	Associated requirements in this standard
8.3	Insufficient means for evacuation/emergency exit	1.1.7 Operating positions	5.9.3
8.4	Inadequate local lighting	1.1.4 Lighting	5.9.9
8.5	Design or location of indicators and visual displays units	1.7.1 Information and warnings on the machinery	5.9.4, 5.9.5, 5.9.20
8.6	Design, location or identification of control devices	1.2.2 Control devices	5.3, 5.9.4
8.9	Human error during operation	1.1.6 Ergonomics 1.2.1 Safety and reliability of control systems Control devices 1.2.5 Selection of control or operating modes 1.5.4 Errors of fitting information	5.3, 5.9.1, 5.9.2
9	Hazards associated with the environment in which the machine is used		
9.1	Lightning	1.5.16 Lightning	5.9.9
9.2	Moisture	1.1.3 Material and products 1.2.1 Safety and reliability of control systems 1.1.7 Operating positions	5.1.3, 5.4.4
9.4	Snow, water, wind, temperature	1.1.3 Material and products 1.2.1 Safety and reliability of control systems 1.1.7 Operating positions	5.1.3, 5.2, 5.3, 5.8
10	Combination of hazards		
10.1	Failure/disorder of the control system and control circuits	1.2.1 Safety and reliability of control systems 1.2.3 Starting 1.2.4 Stopping	5.4, 5.3.2, 5.3.4

Group	Significant hazard in accordance with EN ISO 12100:2010, Table B.1	Directive 2006/42/EC, Annex I	Associated requirements in this standard
		1.2.5 Selection of control or operating modes 1.6.3 Isolation of energy sources	
10.2	Restoration of energy supply after an interruption	1.2.3 Starting 1.2.6 Failure of the power supply	5.3.2, 5.4.8
10.3	Software error	1.2.1 Safety and reliability of control systems	5.7
10.4	Failure of the power supply	1.2.6 Failure of the power supply	5.4.8
12	Hazards due to: — assembly and installation — setting — cleaning — fault-finding — maintenance		
12.1	Maintenance	1.6.1 Machinery maintenance	5.9.17
12.2	Insufficient means of access during use, setting and maintenance	1.6.2 Access to operating positions and servicing points	5.9.3
12.3	Cleaning inside the machine	1.6.4 Operator intervention	5.9.3
12.4	Being trapped in a machine	1.5.14 Risk of being trapped in a machine	5.9.3
17	Hazards linked to work position (including driving station) on the machine		
17.1	Fall of persons during access to or at/from the work position	3.4.5 Means of access 3.4.7 Transmission of power between self-propelled machinery (or tractor) and recipient machinery	5.9.3
17.2	Fire (lack of extinguishing means)	3.5.2 Fire	5.7.18, 5.8.12,

Group	Significant hazard in accordance with EN ISO 12100:2010, Table B.1	Directive 2006/42/EC, Annex I	Associated requirements in this standard
17.3	Mechanical hazards at the work position, such as: — contact with the wheels — rollover and overturning — slipping during access — fall of objects, penetration by objects contact of persons with machine parts or tools (pedestrian controlled machines)	3.2.1 Driving position 3.4.3 Roll-over and tip-over 3.4.5 Means of access 3.4.4 Falling objects 3.3.4 Movement of pedestrian-controlled machinery	5.9.3, 5.8.4, 5.9.4,
17.4	Insufficient visibility from the work position	3.2.1 Driving position	5.9.4
18	Hazards due to the control system		
18.1	Inadequate location of manual controls	3.3.1 Control devices 3.4.5 Means of access	5.3, 5.9.2, 5.9.4
18.2	Inadequate design of manual controls and their mode of operation	3.3.1 Control devices 3.3.3 Travelling function	5.3, 5.9.2, 5.9.4, 5.9.5
19	Hazards due to the power source and the transmission of power		
19.1	Engine and batteries	3.4.2 Moving transmission parts 3.5.1 Batteries	5.1.5
19.2	Transmission of power between machines	3.4.7 Transmission of power between self-propelled machinery (or tractor) and recipient machinery	5.3
21	Hazards due to insufficient instruction for the driver/operator		
21.1	Insufficient instruction for the driver/operator	3.6 Information and Indications	5.7, 5.9.20
22	Mechanical hazards caused by load falls, collisions, machine tipping		
22.1	Lack of stability	4.1.2.1 Risks due to lack of stability	5.2
22.2	Uncontrolled loading, overloading, overturning moments exceeded	4.2.2 Loading control 4.3.3 Lifting machinery 4.4.2 Lifting machinery	5.2, 5.7
22.3	Uncontrolled amplitude of movements	4.1.2.6 a) Control of movements	5.2, 5.7

Group	Significant hazard in accordance with EN ISO 12100:2010, Table B.1	Directive 2006/42/EC, Annex I	Associated requirements in this standard
		4.2.1 Control of movements	
22.4	Unexpected/unintended movement of loads	4.1.2.6 c) Control of movements	5.2, 5.7
22.5	Inadequate holding devices/accessories	4.1.2.6 e) Control of movements 4.4.1 Lifting accessories	5.5
22.9	Insufficient mechanical strength of parts	4.1.2.3 Mechanical strength	5.2, 5.5
22.10	Inadequate design of pulleys and drums	4.1.2.4 Pulleys, drums, wheels, ropes and chains	5.5
22.11	Inadequate selection of chains, ropes, lifting and accessories and their inadequate integration into the machine	Pulleys, drums, wheels, ropes and chains Lifting accessories and their components Chains, ropes and webbing Lifting accessories	5.5
22.12	Lowering of the load under the control of friction brake	4.1.2.6 d) Control of movements	5.7.16
22.13	Abnormal conditions of assembly/use/maintenance	Lifting accessories d) Lifting machinery 4.4.2 e) Lifting machinery	5.9.17
23	Hazards linked to driver/operator position		
23.1	Insufficient visibility from driver position	4.1.2.7 Movements of loads during handling 4.4.2 c) Lifting machinery	5.9.4
<i>Supplementary, for machinery presenting particular hazards due to the lifting of persons</i>			
27	Mechanical hazards		
27.1	Due to: — inadequate mechanical strength — inadequate working coefficients failing of loading control	6.1.1 Mechanical strength 6.1.2 Loading control for machinery moved by power other than human strength	5.11
27.2	Failing of controls in person carrier (function, priority)	6.2 Control devices	5.3, 5.11

Group	Significant hazard in accordance with EN ISO 12100:2010, Table B.1	Directive 2006/42/EC, Annex I	Associated requirements in this standard
27.3	Overspeed of person carrier	6.3.1 Risks due to movements of the carrier 6.4.1 Risks to persons in or on the carrier	5.3, 5.11
27.4	Falling of persons from person carrier	6.3.2 Risk of persons falling from the carrier 6.4.1 Risks to persons in or on the carrier 6.3.3 Risk of objects falling on the carrier	5.11
<i>Hazards not be by eliminated or reduced by inherently safe design measures or safeguarding and/or complementary protective measures</i>			
—	—	1.7 Information	5.1.4

5 Safety requirements and/or protective measures

5.1 General

5.1.1 Design

Offshore cranes shall comply with the safety requirements and protective measures of Clause 5 and shall be subjected to the verification requirements of Clause 6.

Any relevant hazards, which are not dealt with by this standard, shall be assessed and mitigated in accordance with EN ISO 12100.

5.1.2 Exchange of information

All relevant information regarding the interface arrangements, planned use and operating environment of the offshore crane should be exchanged between the manufacturer and the user as recommended in ISO 9374-1:1989 and ISO 9374-4:1989 as relevant.

The information to be exchanged when specifying the technical requirements should include but need not be limited to:

- crane type, configuration, typical geometry and load chart for all modes;
- intended location of the offshore installation, lay out, environmental conditions;
- installation type, including inclinations and motions, if applicable;
- crane location, foundation, boom rest if applicable, external lighting and view from control position(s);
- service life, classification and operational limitations of the crane;

- f) interface connections such as communications, security of automation and control systems, access, electrical power, electrical earthing systems, instrumentation, condition monitoring, utilities, pedestal strength and design, boom rests;
- g) ambient temperature range for the operation of the crane, and any sources of extraordinary heat (e.g. flares, exhaust) or radiation that may affect the crane or any of its components;
- h) any sources of vapours or gases that may affect the crane and its ventilation or any of its components;
- i) area classification including installation ignition source control and fire prevention/protection philosophy of the owner;
- j) characteristics of items attached to the hook, such as loads, non-fixed load lifting attachments, lifting accessories, baskets, carriers and containers;
- k) in-service and out-of-service interface loads on the pedestal with and without factors and coefficients (indicating if these are to be applied in an allowable stress method or limit state method approach) and minimum failure loads based on the Failure Mode Analysis requirements.

The offshore crane manufacturer should assist the offshore installation designer to optimize the crane selection, crane location and specify interface with the installation layout, based on the exchanged information, in order to ensure that the crane is fit for purpose.

Any significant hazard arising from the interface between the crane and the installation, and which is within the scope of supply, ref. Clause 1, shall be addressed in the risk assessment, ref. Clause 4.

An example of a data sheet for the exchange of information is given in Annex M (informative).

5.1.3 Offshore marine environment

Offshore cranes including their structure, machinery and equipment shall be designed suitable and reliable for operation in an offshore marine environment and to resist the environmental influences for the area of operation of the installation according to Annex C (normative).

5.1.4 Fitness for purpose

Based on the exchange of information, ref. 5.1.2, the offshore crane shall be designed and equipped such that it is ready for use and can fulfil its functions safely, taking into account the layout of the offshore installation and the environmental conditions of the area where the crane is operated.

Verification and testing shall be performed or specified in accordance with Clause 6.

Instruction for use shall be specified in accordance with Clause 7.

5.1.5 Power supply

The main power supply, power transmission and power control elements of the offshore crane shall be such that the full power demands of any loading and speed combinations associated with the various motions are compatible with the required operations at the maximum applicable load that the crane is designed for, such that:

- a) a diesel engine shall not stall, overspeed or fall below its nominal speed;
- b) an electric motor shall not stall, overspeed or overheat;
- c) any batteries shall not be overloaded or overheat;
- d) a hydraulic power pack shall not stop/stall or overheat;

e) external power supplies shall not be overloaded or overheat.

The available power shall be sufficient for simultaneous operation of:

- 1) minimum required hoisting velocity at maximum rated capacity and 100 % luffing, telescoping, travelling or folding speed, or
- 2) minimum required hoisting velocity at maximum rated capacity and 50 % luffing, telescoping, travelling or folding speed, and 50 % slewing speed.

Hoisting motions shall always have first priority, but no other motion shall stop fully if operated simultaneously.

5.1.6 Hazardous area

Cranes installed in or exposed to hazardous areas shall comply with Annex L (normative).

5.1.7 High risk application

For high risk applications, the requirements of EN 13135:2013+A1:2018, 5.9, and EN 13001-2:2014, 4.3.2 apply.

NOTE Examples of high-risk applications:

- lifting of loads (or booms) over pressurized or critical equipment;
- lifting of loads that may represent severe consequences if dropped or damaged, e.g. explosives, flammables, dangerous substances or pressurized equipment;
- lifting of persons.

For additional requirements for the lifting of persons, see 5.11 in this document.

5.1.8 Security of automation and control systems

A risk assessment shall be made to ensure that potential threats related to the security of the automation and control system of the crane are identified, addressed and mitigated. See Clause 4.

The following aspects, but not limited to, shall be addressed in particular:

- 1) Roles and responsibilities of key personnel and management involved in the operation and maintenance of the crane;
- 2) Policies, procedures, assets, data and capabilities, which if disrupted, could pose risks to the crane operations and safety; and
- 3) Technical measures to protect against a cyber incident to ensure safety and continuity of operations.

NOTE For further information and requirements see:

- IEC 62443 series of standards, on how to secure information and communication technology aspects of industrial processes;
- EN ISO/IEC 27001:2017, on how to keep information assets secure;
- Baseline Security Recommendations for Internet of Things (IoT) in the context of Critical Information Infrastructures, ENISA, NOVEMBER 2017, on how to ensure security in IoT products and services.

5.1.9 Environmental footprint

The environmental footprint from offshore cranes shall be evaluated and minimized. This includes, but is not limited to:

- use of sustainable and environmental-friendly materials and components;
- fabrication and transportation methods;
- power consumption, for example by selecting more efficient drives;
- regeneration of power;
- emissions to air, such as CO₂ and NO_x;
- noise and vibrations;
- waste and disposables.

5.1.10 Safety functions

Safety functions of control systems include identified parts of control system, 5.2, electrical equipment, 5.4, means of safeguarding, 5.6 and installation interface, 5.8.

NOTE Safety functions are described in EN ISO 13849-1:2015, 5.1.

Table 2 shows the context between safety functions described in EN ISO 13849-1, and safety functions defined in this document.

Safety functions of control systems shall conform to the required performance level in accordance with EN ISO 13849-1:2015 and Annex H (normative) of this document.

Table 2 — Safety functions of an offshore crane

Safety function/safety-related parameter, ref. EN ISO 13849-1:2015, Tables 8 and 9	Safety function of this standard	Safeguarding measures of this standard	Clause reference
Safety-related stop function initiated by a safeguard	Safety functions which safeguards dangerous movements and loads by stopping/restricting the motion	Motion limiters	5.7.7
		Slack rope detector	5.7.9
		Rated capacity limiter (RCL)	5.7.8
Start/restart function Prevention of unexpected startup	Safety functions which energize and de-energize the crane, drives or actuators	Isolation of incoming supplies	5.4.2
		Start and stop functions	5.3.2
		Prevention of unexpected start-up	5.3.3
Local control function Hold to run function	Safety functions which safeguards that the operator is in control of the main motions	Main motion controls	5.3.5
		Remote controls (optional)	5.3.6
Enabling device function		Mode selector	5.3.4

Safety function/safety-related parameter, ref. EN ISO 13849-1:2015, Tables 8 and 9	Safety function of this standard	Safeguarding measures of this standard	Clause reference
Control modes and mode selection	Safety function which safeguards that the crane is working as intended in the different modes of operation	Mode selector for the lifting of persons	5.11.4
Escape and rescue of trapped persons	Safety functions which enables the carrier to be moved to a safe position if there is a single failure of the power supply or in the control system	Emergency operation system (EOS)	5.7.15
Isolation and energy dissipation function	Safety functions which isolate and de-energize the crane and can bring the crane/load to safe position	Emergency shut down (ESD)	5.8.13
		Automatic overload protection (AOPS)	5.7.12
		Manual overload protection MOPS	5.7.13
		Emergency load lowering ELL (optional)	5.7.16
Interaction between different safety related parts of control systems	Safety function which cause intervention between different means of safeguarding	Mode selector	5.3.4
		Mode selector for the lifting of persons	5.11.4
Monitoring of parameterization of safety related input values	Safety function which safeguard the crane against abnormal data in the control system and abnormal motions related to input values	Motion detection system MDS	5.7.11
Emergency stop function	Safety function which de-energize the drives and stops all motions	Emergency stop	5.7.17
Safety related parameters such as speeds, temperature or pressure	Safety function which safeguards the crane against abnormal situations in the control system or in crane	Control system indicator	5.7.3
		Automatic fire detection	5.7.18
Fluctuation, loss and restoration of power resources	Safety function which monitor the power system	Control system indicator	5.7.3
Indicator and alarms		Rated capacity indicator RCI	5.7.6

Safety function/safety-related parameter, ref. EN ISO 13849-1:2015, Tables 8 and 9	Safety function of this standard	Safeguarding measures of this standard	Clause reference
	Safety function which warn the operator of abnormal situations	Indicators and alarms	5.7

5.2 Strength, stability and fatigue

5.2.1 General principles and requirements

Offshore cranes and their supporting pedestals, boom rests and other structures shall conform to the general principles and requirements in EN 13001-1:2015, EN 13001-2:2014, EN 13001-3-1:2015+A2:2018, EN 13001-3-2:2014, EN 13001-3-3:2014, EN 13001-3-4:2018, EN 13001-3-5:2016, EN 13001-3-6:2018, EN 13001-3-7:2019 and prEN 13001-3-8:2018 as applicable.

Strength of components not covered by the EN 13001-1:2015, EN 13001-2:2014, EN 13001-3-1:2015+A2:2018, EN 13001-3-2:2014, EN 13001-3-3:2014, EN 13001-3-4:2018, EN 13001-3-5:2016, EN 13001-3-6:2018, EN 13001-3-7:2019 and prEN 13001-3-8:2018 that form parts of mechanisms shall be proved for loads defined in 2.5 of F.E.M. 1.001:1998, booklet 2, applying the allowable stress method for the load combinations referenced in Annex B (normative) of this document. All partial safety factors shall be set to 1,0 for this purpose.

Components of mechanisms not covered by the EN 13001-1:2015, EN 13001-2:2014, EN 13001-3-1:2015+A2:2018, EN 13001-3-2:2014, EN 13001-3-3:2014, EN 13001-3-4:2018, EN 13001-3-5:2016, EN 13001-3-6:2018, EN 13001-3-7:2019 and prEN 13001-3-8:2018 shall be checked for adequate safety against dynamic load, failure due to fracture, crippling, fatigue and excessive wear in accordance with 4.1 of F.E.M. 1.001:1998, booklet 4.

5.2.2 Service classification

5.2.2.1 Service life

Offshore cranes shall be designed for a service life of 20 years unless otherwise agreed between the manufacturer and the user.

5.2.2.2 Classification

The offshore crane as a whole and its mechanisms shall be classified in accordance with EN 13001-1:2015 based on the information provided according to 5.1.2.

5.2.2.3 Replacement and overhaul

Mechanisms and components requiring replacement and overhaul during the service life of the offshore crane shall be specified with intervals for replacement (Time Between Replacement (TBR)) and overhauls (Time Between Overhaul (TBO)). Reference is made to ISO 12482:2014.

5.2.3 Loads and load combinations

5.2.3.1 General

Load combinations shall be established and calculated for each lifting mode, reeving configuration and working radius that the offshore crane is designed for in accordance with EN 13001-2:2014 and Annex B (normative). In addition, the environmental loads and load actions due to inclinations and motions of the installation which the crane is mounted on shall be taken into consideration in accordance with Annex C (normative).

5.2.3.2 In-service loads for on-board lifts

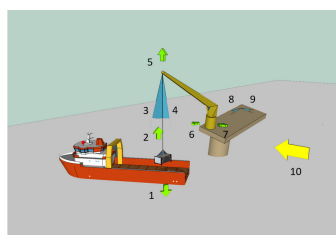
For on-board lifts the load combinations for the load calculation shall be established in accordance with the requirements given in Annex B (normative).

In the absence of a rated capacity for on-board lifts, R_0 shall be taken as the maximum rated capacity for off-board lifts.

5.2.3.3 In-service loads off-board lifts

For off-board lifts the load combinations for the load calculation shall be established in accordance with the requirements given in Annex B (normative).

The main in-service loads and motions for off-board lifts are illustrated in Figure 2.



Key

1	deck velocity	5	boom tip velocity	9	installation heel
2	hoisting velocity	6	installation vertical accelerations	10	wind
3	offlead	7	Installation horizontal accelerations		
4	sidelead	8	installation trim		

Figure 2 — Off-board lifts

5.2.3.4 Determination of dynamic factors

The dynamic factors Φ_2 , Φ_{2min} and Φ_{2C} shall be calculated in accordance with in Annex B (normative). Other dynamic factors shall be calculated in accordance with EN 13001-2:2014 as applicable.

5.2.3.5 Out-of-service loads

The offshore crane including boom rest and any tie-downs if provided, shall be calculated to withstand the out-of-service loads and relative motions between the boom rest and the crane foundation resulting from the environmental influences as stated in Annex C (normative) using the applicable load combinations in in Annex B (normative).

5.2.3.6 Loads due to maintenance

Loads due to maintenance shall be calculated using the applicable load combinations in Annex B (normative).

5.2.3.7 High risk applications

If the offshore crane is designed for high risk applications, ref. 5.1.7, the risk coefficients γ_n as defined in EN 13001-2:2014 shall be used for such operations. In this standard the risk coefficients are separately specified for the rated capacity ($\gamma_{n.RC}$) and the mass of the crane ($\gamma_{n.MC}$).

5.2.4 Limit states and proof of competence

5.2.4.1 Steel structures

Limit states and proof of competence of steel structures shall be in accordance with EN 13001-3-1:2012+A2:2018.

NOTE For structures of slender or very high strength steel design, where nonlinear relations exist between loads and stresses and where significant deformations can be expected, reference is made to EN 13001-3-1:2012+A2:2018, 8.1.

The offshore crane shall be designed to avoid resonance due to load handling and environmental loads and where relevant, loads caused by external excitation of the crane support, shall be taken into account, reference is made EN 13001-2:2014.

5.2.4.2 Wire ropes in reeving systems

Limit states and proof of competence of wire ropes in reeving systems shall be in accordance with EN 13001-3-2:2014, with due consideration of Annex B (normative) and the risk coefficients in 5.2.3.7 and 5.11 in this document.

5.2.4.3 Wheel/rail contacts

Limit states and proof of competence of wheel/rail contacts shall be in accordance with EN 13001-3-3:2014 with due consideration of Annex B (normative) and the risk coefficients in 5.2.3.7 and 5.11 in this document.

5.2.4.4 Machinery

Limit states and proof of competence of machinery shall be in accordance with EN 13001-3-4:2018 with due consideration of Annex B (normative) and the risk coefficients in 5.2.3.7 and 5.11 in this document.

Limit states and proof of competence of machinery such as components and mechanisms shall also be in accordance with EN 13135:2013+A1:2018.

5.2.4.5 Forged hooks

Limit states and proof of competence of forged hooks shall be in accordance with EN 13001-3-5:2016 with due consideration of Annex B (normative) and the risk coefficients in 5.2.3.7 and 5.11 in this document.

5.2.4.6 Hydraulic cylinders

Limit states and proof of competence of hydraulic cylinders shall be in accordance with EN 13001-3-6:2018 with due consideration of Annex B (normative) and the risk coefficients in 5.2.3.7 and 5.11 in this document.

5.2.5 Failure mode analysis

A failure mode analysis shall be carried out in accordance with Annex D (normative).

5.2.6 Load charts

5.2.6.1 General

Load charts shall be calculated for a realistic set of environmental conditions (as agreed between the user and the manufacturer) for each lifting mode and reeving configuration based on the limit state and proof of competence of the offshore crane as a whole.

5.2.6.2 Operational limitations

The load charts shall be presented for each operating mode and specify the in-service operational limitations of the offshore crane, based on limit states and proof of competence, performance and any limitations as set by the safety systems.

5.2.6.3 Information

The load charts shall be included in the instruction for use and be available to the operator at the control station.

The information from the load chart shall be programmed into the rated capacity indicator as described in 5.7.6.

5.2.7 Material selection

5.2.7.1 General

Materials for structural members, bolted and pinned connections shall be in accordance with EN 13001-3-1:2012+A2:2018 which provides a preferred selection of materials.

Selection of materials shall be made upon the following criteria:

- a) strength and ductility at the specified ambient temperature range;
- b) resistance to brittle fracture at the ambient temperature range;
- c) resistance to fatigue loads;
- d) consistency and reliability of material properties;
- e) suitability for fabrication processes (see 5.10);
- f) resistance to corrosion (see 5.10).

5.2.7.2 Impact toughness

The sum of the impact toughness parameter $\sum q_i$, ref. EN 13001-3-1:2012+A2:2018, 4.2.2 and Table 4, shall not be taken less than 9. For requirements to slewing bearings and slewing bearing fasteners, see also 5.2.7.6 and 5.2.7.7.

5.2.7.3 Hydrogen embrittlement

Primary components shall be considered for susceptibility to hydrogen embrittlement due to the corrosive offshore environment.

NOTE A method for the determination of the susceptibility to hydrogen embrittlement/cracking is provided in EN ISO 17642-1:2004, EN ISO 17642-2:2005 and EN ISO 17642-3:2005.

5.2.7.4 Machinery components

Materials for machinery components shall in addition to the requirements in 5.2.7.2 and 5.2.7.3, be in accordance with EN 13135:2013+A1:2018, EN 13001-3-4:2018, EN 13001-3-6:2018, prEN 13001-3-7:2019 and prEN 13001-3-8:2018.

5.2.7.5 Forged hooks

Material for forged hooks shall in addition to the requirements in 5.2.7.2 and 5.2.7.3, be in accordance with EN 13001-3-5:2016.

5.2.7.6 Slewing bearings

Materials for slewing bearings shall be in accordance with EN 13001-3-4:2018 and shall be impact toughness tested at to an average minimum value of 42 J at -20 °C.

Slewing bearing material properties such as chemical composition, mechanical properties, heat treatment, hardening specification and surface finish shall be specified.

5.2.7.7 Slewing bearing fasteners

Fasteners for slewing bearings shall be maximum grade 10.9 and subjected to visual and magnetic particle inspection according to EN ISO 898-1:2013, at least 48 h after completion of the quenching and tempering process.

Fasteners shall have rolled threads, be well greased and sealed against corrosion. Rolling of threads shall be made after heat treatment. If the bolt is surface protected, the treatment shall be such as to preclude hydrogen embrittlement.

Materials for slewing bearing fasteners shall be impact toughness tested at to an average minimum value of 42 J at -20 °C.

5.3 Control system

5.3.1 General

The control system shall include all means of energizing, starting, stopping, selection of operation modes, controlling and monitoring the main motions of the crane. The control system also includes safety functions.

Controls shall conform to the requirements of EN 13557:2003+A2:2008 and IEC 60204-32:2008.

Components and devices in the control system shall be suitable for their intended use and the specified environmental conditions.

The control system shall be such that no single fault or common cause failure, ref. EN ISO 13849-1:2015 (Clause 7), shall result in an uncontrolled movement of the load, parts of the offshore crane or the entire crane.

In all modes, in-service and out-of-service, the control system shall automatically return to a safe state to avoid hazardous situations and damage to the crane, if any failure in the control system occurs.

NOTE A safe state is normally considered to include full stop of all motions, except for the hoist motion in the off-board lift mode, when AOPS or MOPS is activated.

5.3.2 Start and stop functions

Start and stop functions shall be provided to energize and de-energize the crane. Reference is made to IEC 60204-32:2008, 9.2.5.2 and 9.2.5.3.

5.3.3 Prevention of unexpected start-up

Controls shall prevent unexpected start up in accordance with EN ISO 14118:2018.

Where two or more control consoles are provided, means shall be provided so that only one console can be activated at the time. Activation of a second console shall only be possible when the first console is deactivated at its console. An indicator shall illuminate on the console which is activated.

Controls shall be designed or protected so that the desired effect can only occur by an intentional operation.

This can for example be achieved by combinations of the following:

- recessing the actuator (lever, pushbuttons);
- mechanical interlock of the neutral position of the control lever;
- use of a set of actuators requiring sequential or simultaneous actions;
- surrounding the control levers on a panel by a guard rail;
- locating the actuator where it is unlikely to be accidentally knocked;
- manually enabling switch for the controls at the control station.

5.3.4 Mode selector

A mode selector that enables or disables consoles, controls, safety functions or limit the rated capacity or movements of the crane for specific lifting modes shall be arranged as applicable. Such modes may include:

- configuration, no. of falls, hoist winch selection;
- on-board lift mode;
- off-board lift mode;
- remote operation, if applicable;
- mode for lifting of persons, if applicable;
- other modes, as applicable.

Mode selection for different configurations may be manual or automatic. Mode selection between on-board and off-board lift mode shall be automatic. Mode selection for remote operation and the lifting of persons shall be manual and lockable. Manual mode selection shall only be possible when the hook is unloaded.

Only one mode and one control console shall be active at the time. For each specific operational mode, the relevant safety functions and safeguarding measures shall be implemented.

The activated mode shall be displayed at the control station.

Reference is made to Annex G (normative).

5.3.5 Main motion controls

The crane control system shall be designed and constructed in such way that it will respond only to signals from the selected control console, in accordance with EN 13557:2003+A2:2008 and IEC 60204-32:2008, 9.2.7.2.

The direction of movement of the control levers shall be consistent with the offshore crane hook motion. Controls for main motions shall return to the neutral/off position when released.

The controls of the main motions (hoisting, slewing, luffing, travelling, folding and telescoping) shall provide predictable smooth response proportional to the position of the control levers and with insignificant hysteresis and a defined neutral position.

Controls for hoist drives shall be class HD4 in accordance with EN 13001-2:2014.

Controls of the main functions shall be protected against inadvertent use. Reference is made to EN 614-1:2006+A1:2009 and EN 13557:2003+A2:2008.

NOTE A possible solution can be a separate activation switch that has to be manually operated to enable the controls prior to activation and which disables the controls manually by the crane operator after operation followed by automatic deactivation with due delay.

5.3.6 Remote controls (optional)

Remote control may be used for on-board lifts on fixed installations. Remote control may also be used for maintenance operations such as replacement of wire ropes. Operational conditions shall be considered before remote control is used for crane operation.

Remote controls shall be designed and constructed in such way that it will respond only to signals from the intended control unit, in accordance with EN 13557:2003+A2:2008 and EN 60204-32:2008, 9.2.7.2. Any safety functions applicable for the mode of operation of the crane shall remain available when the remote control system is operated.

The remote control shall be equipped with an emergency stop actuator.

All essential warnings and alarms resulting from requirements in Annex E (normative) shall be presented both visually and audible on the remote control panel.

Wireless controls shall not transmit whilst the means to prevent unauthorized use are active and activation of the transmitter is not to initiate crane movement. Operating commands for crane movement shall cease when the crane activation switch is de-energised. Means are to be incorporated to automatically stop all crane movements in case of transmission failure or disturbance within a pre-determined time.

5.3.7 Minimum hook velocities

The minimum hook velocities for the main motion controls shall be as stated in Annex B (normative).

5.3.8 Response time

The response time for the main motions, e.g. hoisting, slewing, luffing, travelling, folding and telescoping shall be taken as the time from when the control lever is activated at standstill until the minimum required hook velocities are achieved in accordance with B.4 is obtained.

For offboard mode, the maximum response time for the main motions shall be as given in Table 3.

Table 3 — Maximum response time

Hoisting	Luffing, travelling, folding, telescoping	Slewing
2 s	3 s	4 s

5.3.9 Control instrumentation

The control instrumentation shall be in accordance with Annex E (normative).

5.3.10 Location of consoles

The offshore crane shall be equipped with a fixed console in the crane cabin. In addition, a wireless remote control console may be provided.

From any position of the control console, the operator shall be able to:

- overview the movements of the crane;
- overview the movements of the load;
- avoid motions in blind zones on landing areas;
- avoid hazards related to the lifting operation.

Reference is made to 5.9.5 and 5.8.6 and Annex E (normative).

5.3.11 Motion compensation

Motion compensation in this context include linear motions of the hoisting system. Where active or passive constant tension systems, heave compensators, motion compensators, shock absorbers or similar systems are installed, the following requirements apply:

- activation and deactivation of any system with any particular load shall not lead to a hazardous situation;
- no single failure shall lead to a hazardous situation;
- any failure/fault in the control system shall give an alarm at the control station.

5.3.12 Crane assistant functions

Optional crane assistant are described in Annex N (informative).

5.4 Electrical equipment**5.4.1 General**

Electrical equipment shall conform to IEC 60204-32:2008 and EN 13135:2013+A1:2018.

Electrical components and devices shall be suitable for their intended use and the specified environmental conditions.

5.4.2 Isolation of incoming supplies

Offshore cranes normally have several incoming supplies from its installation. Each supply shall be fitted with at least one switch to isolate its feeders. The switches shall cover the functionality described in IEC 60204-32:2008.

The(se) switch(es) will normally be placed on the installation side and shall isolate the crane from its power supplies and be lockable in the off position.

Each incoming supply shall be clearly marked at the interface connection with a recognizable and unambiguous text explaining where it shall be isolated.

Typical power supplies available:

- **Main source of electrical power.**
Source of electrical power intended to supply all services necessary for maintaining the unit in normal operational and habitable condition.
- **Essential source of electrical power.**
Source of electrical power intended to supply all services necessary for maintaining the unit in normal habitable condition.
- **Emergency source of electrical power.**
Source of electrical power intended to supply the emergency system in the event of failure from the main source of power.
- **Uninterruptible Power Supply (UPS), also called Transitional Source of Power**
Source of electrical power intended to supply parts of emergency system requiring supply from Transitional Source of Power (i.e. requiring battery power back up of minimum 30 min).

5.4.3 Interface connections

Instrument and electrical interface between the crane and the offshore installation can be either:

- slip ring unit;
- drag chain;
- suspended cables;
- etc.

Interface connections shall ensure proper segregation between, power cables, signal and communication cables.

5.4.4 Enclosures

Enclosures shall conform to IEC 60204-32:2008 and Annex L (normative), as applicable.

5.4.5 Ingress protection

Ingress protection of electrotechnical equipment according to IEC 60204-32:2008 shall as minimum be as follows:

- outdoor, naturally ventilated areas and wash down areas: IP 56;
- dry indoor areas: IP 20;
- remote console sender unit: IP 55;

— other areas: IP 44.

5.4.6 Cables

When the design of a cable system and its components are being considered, due account shall be taken of the environment, including hazardous areas, mechanical, chemical and thermal factors.

Cables shall comply with the general requirements given in IEC 60204-32:2008 and IEC 61892-4:2019. Installation in general shall be in accordance with the requirements of IEC 61892-6:2019.

5.4.7 Protective earthing

For each incoming electrical supply, a terminal shall be provided for connection of the hoisting machine to the external protective earthing system or to the external protective conductor in accordance with the provisions of IEC 60204-32:2008. Earth fault shall have automatic isolation if the crane distribution system is not an IT system. The earth fault detection for nonlinear circuits such as rectifiers, VFD loads and DC loads shall be type B.

The crane distribution system shall be fed by two power systems (power distribution and emergency power distribution, ref. Figure 7) in order to continue the operation of the crane if one of the distribution systems is tripped due to a fault. The two independent systems should have IT earthing system in order to operate the unit with an earth fault. Earth faults in the crane shall give an alarm.

5.4.8 Protection by automatic disconnection of supply

The offshore crane and personnel shall be protected by automatic disconnection of the supply in case of a fault in accordance with IEC 60204-32:2008, 6.3.3.

5.4.9 Protection against electric shock by direct contact

For each circuit or part of the electric equipment, protection against electric shock by direct contact, shall be provided by enclosures or insulation of live parts in accordance with EN 60204-32:2008, 6.2.

5.4.10 Hazardous areas

Electrical equipment and installations for hazardous areas shall be provided in accordance with Annex L (normative).

5.4.11 Electromagnetic compatibility

Electric and electronic equipment, apparatus and systems, and their assemblies and wiring up shall conform to IEC 60204-32:2008 or relevant product specific EMC standards.

The control system shall be such that interference fields, Electromagnetic Compatibility (EMC) of equipment, e.g. radio and telecommunications, electrical or electronic transmission of the signals do not cause unintended movements or other hazardous conditions.

5.5 Mechanical equipment

5.5.1 General

Mechanical equipment shall be in accordance with EN 13135:2013+A1:2018.

Mechanical strength of equipment and components shall be in accordance with the relevant parts of EN 13001 series.

Equipment and components shall be suitable for their intended use and the specified environmental conditions.

Mechanical equipment and components shall be accessible and arranged to facilitate inspection, adjustments, maintenance and dismantling for repair.