



BSI Standards Publication

Cranes — Offshore cranes

Part 1: General-purpose offshore cranes

National foreword

This British Standard is the UK implementation of EN 13852-1:2025. It supersedes BS EN 13852-1:2013, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MHE/3/-/10, Marine cranes.

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

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European foreword

This document (EN 13852-1:2025) has been prepared by Technical Committee CEN/TC 147 “Cranes - Safety”, the secretariat of which is held by SFS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2025, and conflicting national standards shall be withdrawn at the latest by October 2025.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13852-1:2013.

EN 13852-1:2023 includes the following significant technical changes with respect to EN 13852-1:2013:

- a) adjustment of scope;
- b) update of reference standards;
- c) new clause for exchange of information;
- d) new clause for fitness for purpose;
- e) new clause for high risk applications;
- f) new clause for security of automation and control systems;
- g) new clause for environmental footprint;
- h) new clause for safety functions;
- i) revised requirements for strength, stability and fatigue;
- j) revised requirements for control systems;
- k) revised requirements for electrical equipment;
- l) revised requirements for mechanical equipment;
- m) revised requirements for fluid power systems;
- n) revised requirements for safeguarding;
- o) new requirements and new annex for installation interface;
- p) new requirements for user interfaces;
- q) new requirements for fabrication;
- r) revised requirements for lifting of persons;

- s) revised requirements for verification;
- t) revised requirements for information for use;
- u) new annex for installation interface;
- v) new annex for crane assistant functions;
- w) new annex for crane study;
- x) new annex for high risk applications;
- y) new annex for guidance for classification.

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

For relationship with EU Directive(s) / Regulation(s), see informative Annex ZA and 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.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Introduction

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

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organizations, market surveillance, etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- a) machine users/employers (small, medium and large enterprises);
- b) machine users/employees (e.g. trade unions, organizations for people with special needs);
- c) service providers, e.g. for maintenance (small, medium and large enterprises);
- d) consumers (in case of machinery intended for use by consumers).

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 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 a 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 EN 13852-3) and 2D/3D motion compensated cranes;
- g) subsea lifting operations;
- h) lifting operations involving more than one crane;
- i) offshore cranes as part of the emergency preparedness plan for evacuation.

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 dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) 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 1679-1:1998,¹ *Reciprocating internal combustion engines - Safety - Part 1: Compression ignition engines*

EN 1837:2020, *Safety of machinery - Integral lighting of machines*

EN 1838:2024, *Lighting applications - Emergency lighting*

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

EN 12077-2:2024, *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 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 13001-2:2021, *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 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*

¹ As impacted by EN 1679-1:1998+A1:2011.

EN 13001-3-5:2016+A1:2021, *Cranes - General design - Part 3-5: Limit states and proof of competence of forged and cast hooks*

EN 13001-3-6:2018+A1:2021, *Cranes - General design - Part 3-6: Limit states and proof of competence of machinery - Hydraulic cylinders*

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

EN 13557:2024, *Cranes - Controls and control stations*

EN 13586:2020, *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 61800-5-2:2017, *Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional*

EN IEC 60079-0:2018,² *Explosive atmospheres — Part 0: Equipment — General requirements (IEC 60079 0:2017)*

EN IEC 62485-2:2018, *Safety requirements for secondary batteries and battery installations - Part 2: Stationary batteries*

EN 60079-14:2014,³ *Explosive atmospheres — Part 14: Electrical installations design, selection and erection (IEC 60079-14:2013)*

EN ISO 898-1:2013,⁴ *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 3834-1:2021, *Quality requirements for fusion welding of metallic materials - Part 1: Criteria for the selection of the appropriate level of quality requirements (ISO 3834-1:2021)*

EN ISO 3834-2:2021, *Quality requirements for fusion welding of metallic materials - Part 2: Comprehensive quality requirements (ISO 3834-2:2021)*

EN ISO 3834-3:2021, *Quality requirements for fusion welding of metallic materials - Part 3: Standard quality requirements (ISO 3834-3:2021)*

EN ISO 3834-4:2021, *Quality requirements for fusion welding of metallic materials - Part 4: Elementary quality requirements (ISO 3834-4:2021)*

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

² As impacted by EN IEC 60079-0:2018/AC:2020-02.

³ As impacted by N 60079-14:2014/AC:2016

⁴ As impacted by EN ISO 898-1:2013/AC:2013

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 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 15614-12:2021, *Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 12: Spot, seam and projection welding (ISO 15614-12:2021)*

EN ISO 15614-13:2023, *Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 13: Upset (resistance butt) and flash welding (ISO 15614-13:2021)*

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

EN ISO 80079-36:⁵2016, *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" (ISO 80079-37:2016)*

EN 60204-32:2008, *Safety of machinery - Electrical equipment of machines - Part 32: Requirements for hoisting machines*

EN 60529:1991,⁶ *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 61310-1:2008, *Safety of machinery - Indication, marking and actuation - Part 1: Requirements for visual, acoustic and tactile signals*

EN 61310-2:2008, *Safety of machinery - Indication, marking and actuation - Part 2: Requirements for marking*

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

EN 60204-1:2018, *Safety of machinery - Electrical equipment of machines - Part 1: General requirements*

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*

⁵ As impacted by EN ISO 80079-36:2016/AC:2019.

⁶ 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 2631-1:1997,⁷ *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 3864-3:2024, *Graphical symbols — Safety colours and safety signs — Part 3: Design principles for graphical symbols for use in safety signs*

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

ISO 5817:2023, *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 13200:1995, *Cranes — Safety signs and hazard pictorials — General principles*

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*

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

abnormal event

unexpected feedback or lack of feedback, discrepancy, fault or malfunction of a part of a control system, for example sensors, equipment, software and hardware, which may indicate a hazardous situation

⁷ As impacted by ISO 2631-1:1997/Amd 1:2010

3.2

actual hook load

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

3.3

availability

ability to be in a state to perform as required

[SOURCE: EN ISO 14224]

3.4

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

3.5

crane configuration

specific combination of structural members and mechanical components, reeving and similar items assembled, positioned and erected according to manufacturer's instructions and ready for operation

3.6

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.

3.7

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

3.8

drive

power control elements and actuators needed to perform a main motion of the crane

Note 1 to entry: Reference is made key 4 and 5 in Figure I.7

3.9

duplicated component

redundant primary component which prevents the load or boom from being dropped or prevents the crane from unintended motions in the event of single failure in one of the redundant components

Note 1 to entry: An example of a duplicated component is a secondary brake or a duplicated rope.

3.10

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

3.11

emergency operation system

EOS

back-up system for limited operation of the crane in an emergency situation

3.12

emergency shut down

ESD

control actions undertaken to shut down equipment or processes in response to a hazardous situation

[SOURCE: EN ISO 13702:2015]

3.13

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

3.14

folding

motion to fold or unfold a knuckle boom assembly

3.15

general-purpose offshore crane

multipurpose slewing jib type offshore crane

3.16

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

3.17

high risk application

type of application and/or lifting mode (incl. consideration of related crane configurations), where the consequences of failure are exceptionally severe with respect to harm of people or loss of human lives and/or economic, social and environmental aspects and where an increased level of safety is considered necessary

3.18

hoisting

moving the hook in vertical direction

3.19

lifting mode

control or operating mode of the crane which requires specific protective measures, different from other control or operating modes e.g. lifting of loads or lifting of persons; on-board or off-board lift, etc

3.20

lifting of persons

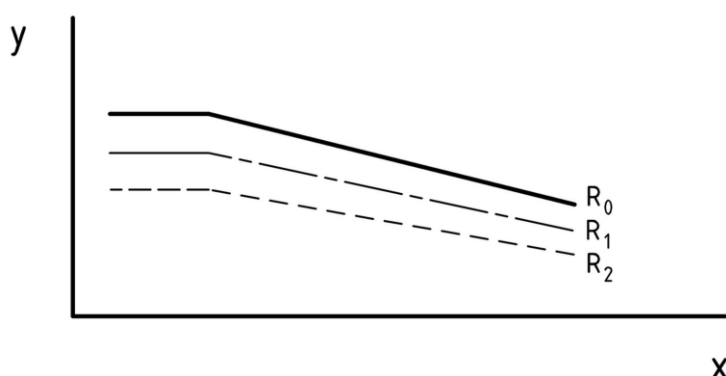
lifting operation where persons are moved by the crane from one location to another, using equipment attached to the crane hook

3.21

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

3.22

luffing

motion where the boom is raised or lowered

3.23

main load path

route along the primary structural components of the offshore crane

Note 1 to entry: Primary structural components along the main load path, e.g. for a rope luffing type crane (see Figure I.1 in Annex I), can be listed as follows: pedestal, slewing bearing, crane frame, boom, a-frame, luffing system (incl. winches), hoisting system (incl. winches), hook or hook block.

3.24**manual overload protection system****MOPS**

system activated 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

3.25**manufacturer**

organisation which designs and fabricates the crane

3.26**motion compensation**

function which automatically, either actively or passively, fully or partly, controls the hook motions to compensate unwanted motions or reduce dynamic impacts

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 not covered by this document.

3.27**motion detection system****MDS**

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

3.28**off-board lift**

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

3.29**offlead load**

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

Note 1 to entry: Reference is made to Figure 2 and Annex J for an illustration of the offlead load.

3.30**offshore crane**

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

3.31**offshore installation**

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

3.32**on-board lift**

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

3.33**overload**

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

3.34

pedestal

structural arrangement with the main purpose to support the crane and transfer the loads from the crane to the offshore installation

3.35

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 pedestal, foundation, slewing bearing, a-frame boom, wire ropes, hooks, etc.

3.36

radius

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

3.37

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

Note 1 to entry: Rated capacity R_0 refers to on-board lifts, R_n refers to off-board lifts and R_p refers to lifting of persons. Rated capacity corresponds to hoist load as defined in EN 13001-2:2021 and Safe Working Load (SWL) as used by ILO conventions.

Note 2 to entry: The operating condition depend on e.g. lifting mode, crane configuration, reeving arrangement, radius, significant wave height, wind, heel/trim of the installation, etc.

3.38

rated capacity limiter

RCL

device or system that automatically protects the crane against overload during on-board lifts, lifting and persons and other high risk application, if applicable

3.39

safe state

state of the machine when safety is achieved

Note 1 to entry: The safe state does not include the restoration of initial equipment failures

[SOURCE: EN IEC 62061:2021, 3.2.68]

3.40

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]

3.41**secondary component**

component that is not a primary component

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

3.42**sidelead load**

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

Note 1 to entry: Reference is made to Figure 2 and Annex J for an illustration of the sidelead load.

3.43**significant damage**

state of loading that represents 80 % of the failure load

3.44**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

3.45**slewing**

motion where the crane is rotating about its vertical axis

3.46**telescoping**

motion where the boom is extended or retracted

3.47**travelling**

motion where the wire rope suspension for hoisting is moved along the boom

3.48**user**

organisation (owner, operator, contractor, buyer) which uses the crane

4 List of significant hazards

Table 1 contains all the significant hazards, hazardous situations and hazardous events, as listed in CEN Guide 414, that have been identified as significant for this type of machinery, and which require action to eliminate or reduce the risk.

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 shall be mitigated by inherent safe design measures, protective measures and/or instructions for use. For selection of a suitable set of crane standards for a given application, reference is also made to Annex A.

Table 1 — List of significant hazards, hazardous situations, hazardous events and their relation to the associated requirements in this document

Group	Significant hazard in accordance with CEN Guide 414, Table 1	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) — by kinetic energy (acceleration, deceleration, moving/rotating elements) — by mechanical strength (break-up)	5.2, 5.5, 5.8, 5.10
1.2	by stored energy, e.g.: — elastic elements (springs)	5.2, 5.6
1.3	Crushing	5.9
1.4	Shearing	5.9
1.5	Cutting or severing	5.9
1.6	Entanglement	5.9
1.7	Drawing-in or trapping	5.9
1.8	Impact	5.9
1.9	Stabbing or puncture	5.9
1.10	Friction or abrasion	5.9
1.11	Injection	5.9
1.12	Slipping, tripping and falling	5.9
1.13	Instability	5.2, 5.8
2	Electrical hazards	
2.1	Touching live parts	5.4
2.2	Parts which have become live under fault conditions	5.4
2.3	Not enough distance to live parts under high voltage	5.4
2.4	Electrostatic phenomena	5.4
2.5	Electromagnetic phenomena	5.4
2.7	Short-circuit	5.4
2.8	Overload	5.1.5, 5.4
2.9	Thermal radiation	5.4
3	Thermal hazards	
3.1	Burn, scald	5.9.14
4	Noise hazards	

Group	Significant hazard in accordance with CEN Guide 414, Table 1	Associated requirements in this standard
4.1	Permanent hearing loss, tinnitus	5.9.9, 5.9.10
5	Vibration hazards	
5.1	Vibrations transmitted to the operator when sitting during operation	5.9.11
5.2	Portable hand-held and/or hand-guided machinery	
5.3	In conjunction with a rigid position (e.g. trauma of the spine, osteo-articular disorder, low-back morbidity)	5.9.2
6	Radiation hazards	
6.1	Low frequency electromagnetic radiation	
6.2	Radio frequency electromagnetic radiation	5.4.11
6.3	Optical radiation (infrared, visible and ultraviolet)	
6.4	Lazer	
6.5	Ionizing radiation source	
7	Material/substance hazards	
7.1	Hazards from contact with inhalation of harmful fluids, gases, mists, fumes and dusts	5.6.3, 5.9.15
7.2	Fire	5.7.17
7.3	Explosion	5.1.6, 5.8.5, 5.8.6
8	Ergonomic hazards	
8.1	Unhealthy postures or excessive effort	5.9
8.2	Inadequate consideration of anatomy	5.9
8.3	Insufficient means for evacuation/emergency exit	5.9
8.4	Inadequate local lighting	5.8, 5.9
8.5	Design or location of indicators and visual displays units	5.3, 5.7, 5.9
8.6	Design, location or identification of control devices	5.3, 5.9
8.7	Flicker, dazzling, shadow, stroboscopic effect	5.9
8.8	Mental overload/underload	5.9
8.9	Human error during operation	5.3, 5.9
8.10	Repetitive activity	
9	Hazards associated with the environment in which the crane is used	
9.1	Lightning	5.8, 5.9
9.2	Moisture	5.1.3, 5.4.4, 5.9
9.3	Pollution	
9.4	Snow, water, wind, temperature	5.1.3, 5.2, 5.3, 5.8

Group	Significant hazard in accordance with CEN Guide 414, Table 1	Associated requirements in this standard
9.5	Exhaust gas/lack of oxygen at workplace	5.1.6
9.6	Dust and fog	
10	Control system hazards	
10.1	Failure/disorder of the control system and control circuits	5.1.10, 5.3, 5.4, 5.6, 5.7
10.2	Restoration of energy supply after an interruption	5.1.10, 5.3, 5.4, 5.7
10.3	Software error	5.1.10, 5.1.8, 5.7, 5.9
10.4	Failure of the power supply	5.1.10, 5.4.8, 5.7
11	Combination of hazards	
11.1	- for example, repetitive activity + effort + high environmental temperature	
11.2	- for example, dismantling of heavy guards + painful effort	
12	Hazards due to: - assembly and installation - setting - cleaning - fault finding - maintenance	
12.1	Maintenance	5.9
12.2	Insufficient means of access during use, setting and maintenance	5.9
12.3	Cleaning inside the machine	5.9
12.4	Being trapped in a machine	5.9
17	Hazards linked to work position on the machine	
17.1	Fall of persons during access to or at/from the work position	5.9
17.2	Fire (lack of extinguishing means)	5.7
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)	5.9
17.4	Insufficient visibility from the work position	5.3, 5.9
17.5	Inadequate seating	5.9

Group	Significant hazard in accordance with CEN Guide 414, Table 1	Associated requirements in this standard
18	Hazards due to operation of the control system	
18.1	Inadequate location of manual controls	5.3, 5.9
18.2	Inadequate design of manual controls and their mode of operation	5.3, 5.9
19	Hazards due to the power source and the transmission of power	
19.1	Engine and batteries	5.1.5, 5.4
19.2	Transmission of power between machines	5.3, 5.4, 5.5, 5.6
19.3	Couplings and towings	5.5
20	Hazards from/to third persons	
20.1	Unauthorized start-up/use	5.1.8, 5.3
20.2	Drift of a part away from its stopping position	5.3, 5.7
20.3	Lack of inadequacy of visual or acoustic warning means	5.7
21	Hazards due to insufficient instruction for the driver/operator	
21.1	Insufficient instruction for the driver/operator	7.1, 7.2
22	Mechanical hazards caused by load falls, collisions, machine tipping	
22.1	Lack of stability	5.2, 5.5, 5.7, 5.8, 5.10
22.2	Uncontrolled loading, overloading, overturning moments exceeded	5.2, 5.7
22.3	Uncontrolled amplitude of movements	5.2, 5.7
22.4	Unexpected/unintended movement of loads	5.2, 5.7
22.5	Inadequate holding devices/accessories	5.5, 5.6
22.6	Collision of more than one machine	5.7
22.7	Access of persons to load support	5.9
22.8	Derailment	5.5
22.9	Insufficient mechanical strength of parts	5.2, 5.5
22.10	Inadequate design of pulleys and drums	5.5
22.11	Inadequate selection of chains, ropes, lifting and accessories and their inadequate integration into the machine	5.5
22.12	Lowering of the load under the control of friction brake	5.7.16
22.13	Abnormal conditions of assembly/use/maintenance	5.9.17
22.14	Effect of load on persons (impact by load or counterweight)	

Group	Significant hazard in accordance with CEN Guide 414, Table 1	Associated requirements in this standard
23	Hazards linked to driver/operator position	
23.1	Insufficient visibility from driver position	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	5.11
27.2	Failing of controls in person carrier (function, priority)	5.3, 5.7, 5.11
27.3	Overspeed of person carrier	5.3, 5.7, 5.11
27.4	Falling of persons from person carrier	5.11

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, documented and mitigated in accordance with EN ISO 12100:2010.

5.1.2 Exchange of information

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

The information to be exchanged should, as a minimum, include the following:

- intended location of the offshore installation, area of operation, metocean data, area lay out, vessel locations, any fixed and moving restrictions for crane operations;
- installation type, including inclinations and motions, if applicable;
- layout of the installation, pedestal location, foundation and elevation, boom rest, if applicable, external lighting and location of control station(s);
- material handling philosophy for the offshore installation;
- crane type, crane configuration, typical geometry and load charts for all lifting modes;
- service life, classification and operational limitations of the crane;

- g) pedestal design, stiffness and possible excitation and oscillation data, in-service and out-of-service interface loads, minimum failure loads based on the failure mode analysis requirements;
- h) interface connections, such as communications, access, electrical power system, batteries, UPS, power needs, power availability and reliability data, power regeneration (if applicable), electrical earthing systems, instrumentation, condition monitoring, utilities;
- i) corrosion protection philosophy, coating systems, surface protection;
- j) ambient temperature range for the operation of the crane, and any sources of vapors, gases, radiation or heat from the installation (e.g. flares, exhaust) that may affect the crane or any of its components;
- k) area classification including installation ignition source control (Emergency Shutdown (ESD), if applicable) and fire prevention/protection philosophy;
- l) security of automation and control systems, requirements to firewalls, cyber security and software access;
- m) identification system for equipment and components of the crane and the installation interface;
- n) typical characteristics and requirements to items intended to be attached to the hook, such as loads, non-fixed load lifting attachments, lifting accessories, baskets, carriers and containers;
- o) if the crane is part of the emergency preparedness plan for rescue operations, the expectations and requirements for availability, reliability and mobilization time of the crane;
- p) if applicable, information about intended lifting of persons and other high risk applications and risk classification;

The offshore crane manufacturer and the user should cooperate to optimize the crane selection and interface with the offshore installation, based on the exchanged information, in order to ensure that the crane is fit for purpose. Further recommendations for a crane study are given in Annex O.

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 and 5.1.1.

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

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.

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 design 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;
- f) power regeneration to the installation, if applied, shall be compatible with the requirements agreed between the manufacturer and the user.

The available power supply shall be sufficient for simultaneous operation of the greater of:

- 1. minimum required hoisting velocity as required by Annex B, Clause B.4.1 and minimum required radial hook velocity at rated capacity as required by Annex B, Clause B.4.2.
- 2. minimum required hoisting velocity as required by Annex B, Clause B.4.1 and minimum required lateral hook velocity at rated capacity as required by Annex B, Clause B.4.2.

Hoisting motions shall always have first priority, but no other motion shall stop fully if operated simultaneously. Reference is made to 5.3.5 with regard to predictable smooth response of the main motions.

In case of power supply failure the crane shall enter a safe state, ref. Annex G.

5.1.6 Hazardous area

Cranes installed in or exposed to hazardous areas shall comply with Annex L. If a shutdown philosophy is applied by the user and adequate compensating measures are applied and implemented in the crane in accordance with G.4, the cabin and electrical rooms, etc., may be classified as safe areas.

Reference is also made to Clause 5.8.5 and 5.8.6.

5.1.7 High risk applications

Offshore cranes designed for high risk applications shall have an increased level of safety which is developed and implemented based on the requirements of the risk assessment ref. Clause 4 and 5.1.1 and the principle of safety integration according to ISO 12100:2010.

For requirements concerning lifting of persons, see 5.1.1.

For guidance concerning high risk applications other than lifting of persons, see Annex P.

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, 5.1.1 and 5.9.20.

The following aspects shall be addressed in particular as a minimum:

- 1) Roles and responsibilities of key personnel and management involved in the operation and maintenance of the crane;
- 2) Policies, procedures, assets, data and software 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;
- ISO/IEC 27001:2022, 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.

NOTE Attention is drawn to ISO/TR 14062:2002, which provides information on the integration of environmental aspects into the product design process and can be used as guidance for application in standardization. For further guidance reference is made to CEN Guide 4:2008, Table 1.

5.1.10 Safety functions

Safety functions are protective measures that can be part of the inherently safe design, safeguarding and complementary protective measures, or measures taken by the user (for example ESD).

The manufacturer shall document a complete list of safety functions in accordance with Clause 7.1.3 based on a specific risk assessment of the control system in accordance with EN ISO 12100:2010 and EN ISO 13849-1:2015.

Safety functions and their SRP/CS shall comply with the required performance levels in accordance with Annex H.

Activation of any safety function shall result in a safe state of the crane, ref. Annex G .

Table 2 specifies minimum safety functions of an offshore crane and the corresponding protective measures of this product standard and shows the relation to safety functions/safety related parameters given by EN ISO 13849-1:2015, Table 8 and 9.

Table 2 — Minimum required safety functions

Safety function description	Clause reference	Title	Safety function/characteristic, ref. EN ISO 13849-1:2015, Tables 8 and 9
Safety functions which stop /restrict motions and dangerous movements by the crane and loads	5.7.7	Motion limiters	Safety-related stop function initiated by a safeguard
	5.7.9	Slack rope limiter	
Safety function which prevents unexpected start up and unexpected movement	5.3.3	Prevention of unexpected start-up	Prevention of unexpected start-up
Safety functions which protect the crane from gross overloads	5.7.8	Rated capacity limiter (RCL)	Isolation and energy dissipation function
	5.7.12	Automatic overload protection (AOPS)	
	5.7.13	Manual overload protection (MOPS)	
Safety function which safeguards the crane against abnormal data in the control system and abnormal motions related to input values	5.7.11	Motion detection system (MDS)	Monitoring of parameterization of safety related input values
Safety function which de-energize the drives and stops all motions	5.7.15	Emergency stop	Emergency stop function

NOTE Table 2 is not exhaustive and does not include a complete list of safety functions for an offshore crane. The risk reduction process as described in EN ISO 12100:2010 and EN ISO 13849-1:2015 might result in an extended list of safety functions compared to Table 2.

Table 3 specifies examples of additional safeguarding and complementary protective measures and is not exhaustive. Manufacturer shall, as a result of the risk assessment, determine if any of these safeguarding and complementary protective measures shall be integrated in the safety functions listed in Table 2 or defined as additional safety functions, fully or partly.

For any additional safety functions, the required performance level PL_r, ref. Annex H, shall be determined and specified as a result of the risk assessment.

Table 3 — Examples of additional safeguarding and complementary protective measures

Safeguarding and complementary protective measures	Clause reference	Title	Safety function/characteristic, ref. EN ISO 13849-1:2015, Tables 8 and 9
Means for operator to control the main motions	5.3.5	Main motion controls	Local control function Hold to run function
	5.3.7	Remote controls (optional)	
Means to ensure that that the crane is working as intended in the different modes of operation	5.3.4	Mode selector	Enabling device function Control modes and mode selection Interaction between different safety related parts of control systems
	5.11.4	Mode selector for the lifting of persons	
Means to enable the crane, load and any carrier to be moved to a safe position if there is a single failure of the power supply or in the control system	5.7.14	Emergency operation system (EOS)	Emergency operation Escape and rescue of trapped persons
Means of monitoring the control system including power system	5.7.3	Control system indicator	Fluctuation, loss and restoration of power resources
Means to warn the operator of abnormal situations	5.7.6	Rated capacity indicator (RCI)	Indicator and alarms
	5.7 and Annex E	Indicators and alarms	

5.2 Strength, stability and fatigue

5.2.1 General principles and requirements

Offshore cranes and their supporting pedestals, boom rests and other structures and components shall conform to the general principles and requirements in EN 13001-1:2015, EN 13001-2:2021, EN 13001-3-1:2012+A2:2018, EN 13001-3-2:2014, EN 13001-3-3:2014, EN 13001-3-4:2018, EN 13001-3-5:2016+A1:2021 and EN 13001-3-6:2018+A1:2021, as applicable, taking into account the additional requirements of this document.

Components not covered by the above mentioned standards, shall conform to EN13135:2013+A1:2018.

5.2.2 Service classification

5.2.2.1 Service life

Offshore cranes shall be designed for a service life of minimum 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 Clause 5.1.2. Reference is made to Annex Q.

5.2.2.3 Replacement and overhaul

Mechanisms and components requiring replacement or overhaul during the service life of the offshore crane shall be specified with criteria for inspection, replacement and overhauls. Reference is made to Clause 7.3.

5.2.3 Loads and load combinations

5.2.3.1 General

Load combinations shall be established and calculated for each lifting mode, rated capacity, crane configuration and working radius that the offshore crane is designed for in accordance with EN 13001-2:2021 and Annex B. 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.

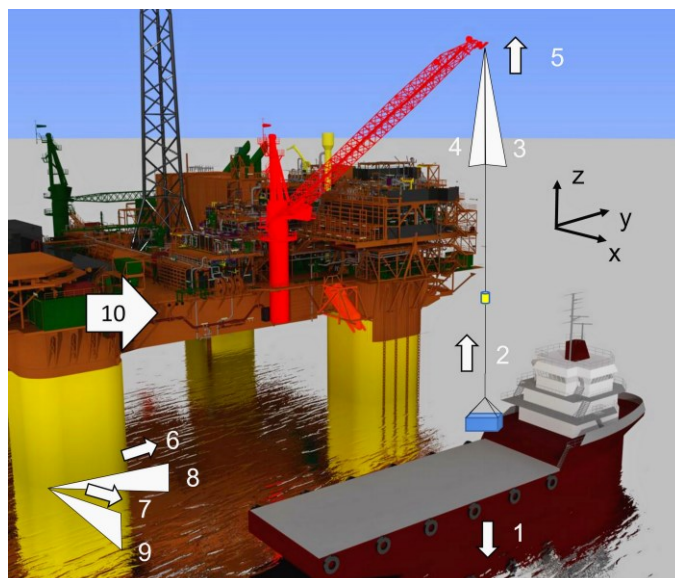
5.2.3.2 In-service loads for on-board lifts

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

5.2.3.3 In-service loads for 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.

A typical off-board lift showing in-service loads, environmental influences, inclinations and motions is illustrated in Figure 2.

**Key**

1	Deck velocity in z-axis	6	Installation surge in y-axis
2	Hoisting velocity in z-axis	7	Installation sway in x axis
3	Offlead angle from z-axis	8	Installation trim angle about x-axis
4	Sidelead angle from z-axis	9	Installation heel angle about y-axis
5	Boom tip velocity in z-axis	10	Wind

Figure 2 — Off-board lift**5.2.3.4 Determination of dynamic factors**

The dynamic factors Φ_2 , Φ_{2min} , Φ_{2C} shall be calculated in accordance with Annex B. Other dynamic factors shall be calculated in accordance with EN 13001-2:2021 as applicable.

5.2.3.5 Out-of-service loads

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

5.2.3.6 Occasional and exceptional loads

The offshore crane including its foundation, boom rest and any parking arrangements, if provided, shall be calculated to withstand the occasional and exceptional loads from the environmental influences as stated in Annex C, and the dynamic coefficients and load combination C as stated in Annex B.

5.2.4 Limit states and proof of competence**5.2.4.1 Steel structures and machinery**

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

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 as per exchange of information, ref. 5.1.2 and EN 13001-2:2021, 4.2.2.1.

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

5.2.4.2 Dynamic safety factor for running and stationary wire ropes

Limit states and proof of competence of wire ropes in reeving systems shall be in accordance with EN 13001-3-2:2014, where the design rope force $F_{Sd,s}$ in EN13001-3-2 Clause 5.2.1 shall be reduced as follows:

$$F_{Sd,s \text{ reduced}} = F_{Sd,s} \cdot f_{Rf} \quad (1)$$

where:

$F_{Sd,s \text{ reduced}}$ design rope force reduced

$F_{Sd,s}$ design rope force in accordance with EN13001-3-2 Clause 5.2.1

f_{Rf} load reference factor for running and stationary rigging in accordance with Table 4

R_x rated capacity R_n , R_0 or R_p for each reeving configuration

Table 4 — Load reference factor for running and stationary wire ropes

Rated capacity of crane R_x (t)	Load reference factor
$R_x \leq 10 \text{ t}$	$f_{Rf} = 1,0$
$10 \text{ t} < R_x \leq 160 \text{ t}$	$f_{Rf} = 1,0 - \frac{R_x - 10 \text{ t}}{600 \text{ t}}$
$R_x > 160 \text{ t}$	$f_{Rf} = 0,75$

5.2.4.3 Static safety factor for running and stationary wire ropes

In addition to the requirement in 5.2.4.2 for running and stationary wire ropes, the minimum static safety factors Z_p and Z_s in Table 5 shall be complied with. The maximum static rope pull L_p shall be determined from dead weight (including the hook block and wire rope) and the actual hook load without dynamic coefficient, wind, offlead/sidelead, trim/heel or other secondary factors. Rope reeving efficiency reduction according to EN 13001-3-2:2022 shall be taken into account for running wire ropes.

The safety factors shall be taken as follows:

$$Z_p \text{ and } Z_s \leq F_u / L_p \quad (2)$$

where:

F_u is the minimum breaking force of the rope as specified by the rope manufacturer

L_p is the maximum static rope pull

Z_p is the static safety factor for running wire ropes

Z_s is the static safety factor for stationary wire ropes

R_x rated capacity R_n , R_0 or R_p for each reeving configuration.

Table 5 — Static safety factors for running and stationary wire ropes

Rated capacity of crane R_x (t)	Running wire ropes	Stationary wire ropes
	Safety factor Z_p	Safety factor Z_s
$R_x \leq 10\text{ t}$	$Z_p = 5,0$	$Z_s = 4,0$
$10\text{ t} < R_x \leq 160\text{ t}$	$Z_p = \frac{10^4}{(8,85 \cdot R_x) + 1910}$	$Z_s = \frac{10^4}{(5,56 \cdot R_x) + 2444}$
$R_x > 160\text{ t}$	$Z_p = 3,0$	$Z_s = 3,0$

5.2.4.4 Bearings

Limit states and proof of competence of bearings shall be in accordance with EN 13001-3-4:2018 with due consideration of Annex B and Annex C.

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+A1:2021 with due consideration of Annex B and Annex C.

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+A1:2021 with due consideration of Annex B and Annex C.

5.2.5 Failure mode analysis

The failure mode analysis shall be carried out in accordance with Annex D.

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 crane configuration based on the limit state and proof of competence of the offshore crane as a whole.

5.2.6.2 Operational limitations

The operational limitations shall be specified for each lifting mode of the offshore crane, based on limit states and proof of competence, performance and other limitations of the control system and the means of safeguarding.

5.2.6.3 Information

The load charts shall be included in the instruction for use.

The load charts shall further be available to the operator at the control station. This can either be as a hardcopy or in an electronic format.

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 5.10.7).

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 5.2.7.1, 5.2.7.2 and 5.2.7.3, be in accordance with EN 13135:2013+A1:2018, EN 13001-3-4:2018 and EN 13001-3-6:2018+A1:2021.

5.2.7.5 Forged hooks

Material for forged hooks shall in addition to the requirements in 5.2.7.1, 5.2.7.2 and 5.2.7.3, be in accordance with EN 13001-3-5:2016+A1:2021.

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 to achieve 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 prevent hydrogen embrittlement.

Materials for slewing bearing fasteners shall be impact toughness tested to achieve an average minimum value of 42 J at $-20\text{ }^{\circ}\text{C}$.

5.3 Control system

5.3.1 General

The control system shall include all means of energizing, starting, stopping, selection of lifting modes, controlling and monitoring the main motions of the crane. The control system also includes power supplies and means of safeguarding, ref. Figure I.7. The control system need not to include the power sources.

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

Components and devices in the control system shall be suitable for their intended use, ref. 5.1.2 and the specified environmental conditions, ref. Annex C.

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 lifting modes, in-service and out-of-service, the control system shall remain in a safe state, and automatically return to a safe state to avoid hazardous situations and any damage to the crane, if any failure or abnormal event occur in the control system, ref. Annex E.

The safe states of each offshore crane shall be determined in accordance with Annex G.

5.3.2 Start and stop functions

Start and stop functions shall be provided to energize and de-energize the crane in accordance with EN 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 any 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.

5.3.4 Lifting mode selector

For all offshore cranes a lifting mode selector shall be provided at the control station or control console. Each lifting mode may cover different crane configurations.

Lifting mode selection shall comply to ISO 12100:2010, 6.2.11.9 and 6.2.11.10 and EN 60204-1:2018, 9.3.4 and 9.3.6.

Lifting mode selection (except between on-board lift and off-board lift) shall be manual and lockable (acknowledged by the operator before it becomes fully effective or by key switch).

Lifting mode selection between load handling and lifting of persons or other high-risk application, shall only be possible without any load in the hook.

Lifting mode selection of emergency operation (EOS) shall be possible from any other lifting mode and independent of any load in the hook.

The selected lifting mode shall be interlocked with the other lifting modes to ensure that only one lifting mode is active at the time. For each lifting mode all assigned safety functions and or specific protective measures shall be enabled.

Lifting modes may include:

- hoist winch selection (where more than one hoist winch is installed);
- load handling including on-board and off-board lifting mode;
- lifting of persons and other high risk applications, if applicable;
- emergency operation (EOS).

The activated mode (including the on-board and off-board lifting mode) shall be continuously displayed at the control station.

Lifting mode selection for load handling shall include an automatic change between on-board and off-board lifting mode. The automatic change between on-board and off-board lifting mode shall be made dependent on the position of the hook in space, regardless of any load in the hook. When the hook is outside the boundaries of the offshore installation and close to the vessel/floating unit with the risk of entanglement, the off-board lift mode shall be active. Otherwise, the on-board lift mode shall be active.

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 EN 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 13001-2:2021.

5.3.6 Inadvertent use

Controls for the main motions shall be protected against inadvertent use in accordance with EN 614-1:2006+A1:2009 and EN 13557:2003+A2:2008. Their desired effect shall only occur by an intentional operation.

This can for example be achieved by the following measures or their combinations:

- 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;
- manual enabling and disabling switch for the controls at the control station;

— timer to deactivate the controls after a period of inactivity.

5.3.7 Remote console (optional)

Remote moveable console(s) may be provided for on-board lifts and maintenance operations such as replacement of wire ropes. The design shall take into account the operational conditions, ref. 5.9.5.

Remote console(s) shall be designed and constructed in accordance with 5.3.5 and 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 selected lifting mode of the crane shall remain available when the remote controls are operated.

The remote console(s) shall be equipped with a stop function actuator in accordance with EN 60204-32:2008, 9.2.7.3.

All essential warnings and alarms resulting from requirements in Annex E shall be presented both visually and audible on the remote console.

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

5.3.8 Minimum hook velocities

The minimum hook velocities for off-board lifts shall be as stated in Annex B. For other lifting modes, the minimum hook velocities shall be sufficient to control and arrest load swing due to wind and installation motions.

5.3.9 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.

For off-board mode, the maximum response time for the main motions shall be as given in Table 4.

Table 4 — Maximum response time

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

5.3.10 Control instrumentation

The control instrumentation shall be in accordance with Annex E.

5.3.11 Location of consoles

The offshore crane shall be equipped with a fixed console in the crane cabin, ref. 5.3.11. In addition, a remote console may be provided in accordance with 5.9.5. The human machine interface of any consoles shall be in accordance with Annex E.

Where a remote console is provided, it shall be possible to locate and operate such that the operator is 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.

5.3.12 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 or common cause failure shall lead to a hazardous situation;
- any failure/fault in the control system shall give an alarm at the control station.

5.3.13 Crane assistant functions

Optional crane assistant functions are described in Annex N.

5.3.13.1 Crane assistant functions

Limit states and proof of competence of wheel/rail contacts shall be in accordance with EN 13001-3:2014 with due consideration of Annex B and Annex C.

5.4 Electrical equipment

5.4.1 General

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

Electrical components and devices shall be suitable for their intended use ref. 5.1.2 and the specified environmental conditions, ref. Annex C.

5.4.2 Isolation of incoming supplies

Offshore cranes normally have several incoming supplies from the offshore installation. Each supply shall be fitted with at least one switch to isolate its feeders. The switches shall cover the functionality described in EN 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 uninterrupted supply or power (e.g. requiring battery power back up of minimum 30 min).

5.4.3 Slipring units

Slip ring units, with main power, emergency power and instrumentation/communication rings, shall be segregated from each other in separate chambers to avoid common cause failure inside the slip ring unit.

5.4.4 Enclosures

Enclosures shall conform to EN 60204-32:2008 and Annex L, as applicable.

5.4.5 Ingress protection

Ingress protection of electrotechnical equipment according to EN 60529:1991 shall as minimum be as follows:

- outdoor, naturally ventilated areas and wash down areas: IP 56;
- other outdoor areas: IP 44;
- remote console sender unit: IP 55;
- dry indoor areas: IP 20.

5.4.6 Cables

Cable selection, arrangement and routing shall be suitable for the environment, including hazardous areas they are subjected to and, mechanical, chemical and thermal influences that may occur.

Cables shall comply with the general requirements given in EN 60204-32:2008 and IEC 61892-4:2019. Installation of cables 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 offshore crane to the external protective earthing system or to the external protective conductor in accordance with the provisions of EN 60204-32:2008, Clause 6.3. Earth fault shall have automatic isolation if the crane distribution system is not an IT earthing 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 an 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 against electric shock by indirect contact

For each circuit or part of the electric equipment, protection against electric shock by indirect contact, shall be provided in accordance with EN 60204-32:2008, subclause 6.3.

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, subclause 6.2.

5.4.10 Hazardous areas

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

5.4.11 Electromagnetic compatibility

Electric and electronic equipment, apparatus and systems, and their assemblies and wiring up shall conform to EN 60204-32:2008.

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.

5.4.12 Variable frequency drives (VFD)

Variable frequency drives (VFDs) shall comply with the requirements in EN 60204-32:2008 and EN 61800-5-2:2017.

5.4.13 Brake resistors

Brake resistors shall be designed to withstand the operating conditions, load actions and the external influences that can occur.

Brake resistors shall be provided with safe means of cooling. Warnings for heat and overpressure detection (if the risk for overpressure is present) of the brake resistors shall be provided at the control station.

5.4.14 Electrical motors

Electrical motors shall comply with requirements in EN 60204-32:2008.

5.4.15 Batteries

Batteries shall comply with 5.4.2 and the requirements in EN 60204-32:2008 and EN IEC 62485-2:2018.

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.

Combustion engines shall be in accordance with EN 1679-1:1998+A1:2011.

Equipment and components shall be suitable for their intended use ref. 5.1.2, Annex B and the specified environmental conditions, ref. Annex C.

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

5.5.2 Hoist and luffing wire rope drives

Hoist and luffing wire rope drives including motors, shafts and drums etc., shall be designed to withstand the operating conditions, load actions and the external influences that can occur, ref. Annex B and Annex C.

5.5.3 Folding and cylinder luffing drives

Folding and cylinder luffing drives shall be designed to withstand the operating conditions, load actions and the external influences that can occur, ref. Annex B and Annex C.

Mechanisms shall be protected against damage where there is a risk of swinging loads.

The boom shall be capable of being lowered from minimum radius, against the in-service design mean wind velocity acting in the most unfavourable direction. For floating units the additional effects stated in C.5 shall also be taken into account.

5.5.4 Slewing drives

Slewing drives, including their cables and connections, shall be designed for an unlimited working range for the slewing motion.

The slewing drive system shall consist of a minimum of two drive units.

Slewing drives shall have means of adjusting backlash on site.

The slewing drive system shall be designed to hold at least 1,3 times the slewing torque caused by the effects of:

- inclination of the installation, see Table C.1;
- mean acceleration of the installation, see C.5.3;
- wind load due to the mean wind velocity $\bar{v}$, see Annex C.4.1 and EN 13001-2:2021, Clause 4.2.3.1.

The above effects shall be considered acting on the mass of the crane and the rated capacity for all radii and load curves. All dynamic factors and partial safety factors shall be set to 1.

5.5.5 Travelling drives

Means shall be provided to prevent the trolley from leaving the track, falling or overturning in the event of a single wheel failure. This shall be achieved by inherent safe design or by the provision of protective devices.

Means of retaining the trolley in position in case of any combination of offlead, sidelead, dynamic loads or sudden release of the load shall be provided.

Tracks shall be fitted with end stops and buffers to prevent trolleys from leaving the tracks.

Trolleys for tracks that may be inclined from horizontal shall be provided with duplicated independent drives or with a secondary suspension capable of holding the trolley in position in case of a failure in the primary drive system.

5.5.6 Telescopic drives

Telescopic booms with telescopic sections shall be such that the sections are prevented from moving out of each other. The extension and the re-entry of the telescopic sections shall always be controlled and carried out in a defined order.

For the requirements for hydraulic cylinders see 5.2.4.6.

5.5.7 Bearings

Bearings for offshore cranes shall be designed, selected and used in accordance with EN 13001-3-4:2018.

Bearings which are part of standard components such as motors and gearboxes, shall be classified and designed in accordance with EN 13001-2:2021.

Slewing bearings inclusive fasteners shall be designed in accordance with EN 13001-3-4:2018. The design of the slewing bearings support structure including stiffness, roundness and flatness, shall be in compliance with the requirements of the slewing bearing manufacturer to provide the specified functionality and lifetime of the slewing bearing.

Slewing bearings, including fasteners shall be suitable for a marine atmosphere and the environmental influences stated in Annex C.

Prestressed bolted connections for fastening of slewing bearings shall conform to ISO 20332:2016.

The ultimate failure load capacity of the slewing bearing assembly, including bearing, fasteners and adjoining flanges, shall be such as to conform to the requirements of Annex D.

Provisions shall be made for replacement of the slewing bearing, for example preparations for the use of a jacking system.

5.5.8 Couplings, splines and gears

Couplings, splines and gears etc. shall be designed to withstand the operating conditions, load actions and the external influences that may occur. When lubricated, means shall be provided for containment and or inspection/maintenance of lubrication as required.

Rack and pinion gears shall be designed, selected and used in accordance with EN 13135:2013+A1:2018.

5.5.9 Brakes

Each powered motion of the offshore cranes (hoisting, slewing, luffing, travelling, folding and telescoping) shall be provided with brake function (s) as applicable to control, stop and prevent unwanted motions in any situation, regardless whether the motion is caused by interruption or fluctuation of the power control itself or by external loads and influences.

Brakes shall be designed in accordance with Annex F.

Single (non-redundant) luffing winches, ref. 5.11.8.1, shall in addition to the normal service brake, be equipped with a mechanically and operationally independent back-up brake, with separate control circuits. The back-up brake should preferably act directly on the winch drum, but a fully independent load path may be considered acceptable.

NOTE For guidance regarding duplication of components, reference is made to Annex P.