

Cranes — Offshore cranes —

Part 1: General-purpose offshore cranes

The European Standard EN 13852-1:2004 has the status of a
British Standard

ICS 47.020.01; 53.020.20

National foreword

This British Standard is the UK implementation of EN 13852-1:2004, incorporating corrigenda December 2004 and February 2007.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags AC AC. Text altered by CEN corrigendum December 2004 is indicated in the text by AC1 AC1.

The UK participation in its preparation was entrusted by Technical Committee MHE/3, Cranes and derricks, to Subcommittee MHE/3/10, Marine cranes.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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English version

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

Appareils de levage - Appareils de levage offshore - Partie
1: Appareils de levage offshore pour usage général

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

This European Standard was approved by CEN on 24 March 2004.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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Contents

Page

Foreword.....	5
1 Scope	7
2 Normative references	7
3 Terms and definitions	11
4 List of significant hazards	15
5 Safety requirements and/or protective measures	17
5.1 General.....	17
5.2 Structure and mechanisms.....	17
5.2.1 General principles and requirements	17
5.2.2 In service loads	17
5.2.3 Out of service loads	18
5.2.4 Failure mode analysis	18
5.2.5 Load combinations	18
5.3 Equipment and components	18
5.3.1 Electrotechnical equipment.....	18
5.3.2 Non-electrotechnical equipment.....	18
5.3.3 Power requirements	18
5.3.4 Slewing drives.....	19
5.3.5 Slewing bearings	19
5.3.6 Slewing bearing fasteners	19
5.3.7 Winches and brakes	19
5.3.8 Wire rope termination.....	19
5.3.9 Wire rope anchorage	20
5.3.10 Wire ropes	20
5.3.11 Hydraulic cylinders.....	20
5.3.12 Motion compensators	20
5.3.13 Shock absorbers.....	21
5.4 Drive systems.....	21
5.4.1 General.....	21
5.4.2 Pneumatic systems	21
5.4.3 Hydraulic systems	21
5.4.4 Electrical systems.....	21
5.4.5 Heave compensation/rope tensioning systems	21
5.5 Health and Safety.....	22
5.5.1 Control stations - General.....	22
5.5.2 Control cabin	22
5.5.3 Communications.....	23
5.5.4 Noise reduction.....	23
5.5.5 Access	24
5.5.6 Guards	24
5.6 Controls, indicators and limiting devices	24
5.6.1 Controls	24
5.6.2 Indicators.....	25
5.6.3 Limiting devices.....	26
5.7 Protection systems.....	27
5.7.1 Overload and over-moment protection	27
5.8 Lifting of personnel	30
5.8.1 General.....	30
5.8.2 Rated capacity.....	31

5.8.3	Secondary brake.....	31
5.8.4	Cylinders	31
5.8.5	Mode selection for personnel lifting.....	31
5.8.6	Personnel rescue.....	31
6	Verification of the safety requirements and/or protective measures	32
6.1	General	32
6.2	Testing	34
6.2.1	General	34
6.2.2	Function test	35
6.2.3	Installation test	35
6.2.4	Test acceptance criteria.....	36
6.2.5	Test load	36
7	Information for use	37
7.1	Documentation	37
7.2	Operation.....	37
7.2.1	General	37
7.2.2	Checks before starting operation	37
7.2.3	Checks during operation	38
7.2.4	Crane out of service	38
7.2.5	Lifting of personnel (if part of the intended use)	39
7.3	Maintenance	39
7.4	Inspections.....	40
7.5	Marking.....	40
7.5.1	Manufacturer's plate	40
7.5.2	Rated capacity information	40
7.5.3	Components.....	40
Annex A	(informative) Selection of a suitable set of crane standards for a given application.....	41
Annex B	(normative) Determination of factors	42
B.1	Calculation of the dynamic coefficient Φ_n by the simplified method.....	42
B.2	Calculation of dynamic coefficient Φ_n by motion response analysis	43
B.3	Out of plane influences.....	44
B.3.1	General	44
B.3.2	Offlead load	44
B.3.3	Sidelead load	45
B.3.4	Horizontal load combination of the out-of-plane influences	45
B.4	Hook velocity	46
B.4.1	Hoisting velocity.....	46
B.4.2	Horizontal hook velocity	46
B.5	Load combinations.....	46
Annex C	(normative) Environmental influences	49
C.1	General	49
C.2	Wind	49
C.2.1	Mean wind velocities.....	49
C.2.2	Boom stalling	49
C.3	Floating units	50
C.4	Thermal effects	50
C.5	Ice	50
C.6	Stowage.....	51
C.7	Corrosion protection.....	51
Annex D	(normative) Failure mode analysis	52
D.1	General	52
D.2	Failure mode charts	52
Annex E	(normative) Material selection.....	54
E.1	General	54

E.2	Verification of material quality	54
E.3	Forged rings for slewing bearings	54
E.4	Slewing bearing fasteners	55
E.5	Welded structures	56
E.6	Non-welded components	56
Annex F	(informative) Control station instrumentation	58
Annex G	(normative) Wire rope safety factors	59
G.1	General	59
G.2	Static safety factors	59
G.2.1	Running rigging	59
G.2.2	Standing rigging	59
G.3	Dynamic safety factors	59
G.3.1	Running rigging	59
G.3.2	Standing rigging	60
Annex H	(normative) Slewing bearings	61
Annex I	(normative) Requirements for brakes	62
Annex J	(normative) Ranking of safety systems	63
Annex K	(normative) Winches	64
Annex L	(informative) Typical general-purpose offshore cranes and terminology	65
Annex M	(informative) Excursion envelope for offlead and sidelead	70
Annex N	(normative) Noise test code	71
N.1	Introduction	71
N.2	Sound power level determination	71
N.2.1	Basic standard to be used	71
N.2.2	Measurement and calculation procedure	71
N.3	Emission sound pressure level determination	72
N.3.1	Basic standard to be used	72
N.3.2	Crane operator and microphone positions	72
N.3.3	Specifications concerning the crane operating cabin	72
N.3.4	Specification relating to wind speed	72
N.3.5	Measurement and calculation procedure	72
N.4	Operating conditions	73
N.4.1	General	73
N.4.2	Test procedure	73
N.5	Information on measurement uncertainties	75
N.6	Information to be recorded	75
N.7	Information to be reported	75
N.8	Declaration and verification of noise emission values	75
N.9	Noise measurement — Test report	76
Annex O	(normative) Equipment for use in a hazardous area	80
O.1	General	80
O.2	Avoidance or reduction of ignition sources	80
O.3	Electrotechnical equipment	80
O.4	Non-electrotechnical equipment	80
O.5	Electrostatic discharge	80
Annex ZA	(informative) Relationship between this European Standard and the Essential Safety requirements of EU Directive 98/37/EC, amended by Directive 98/79/EC	81

Foreword

This document (EN 13852-1:2004) has been prepared by Technical Committee CEN/TC 147 “Cranes - Safety”, the secretariat of which is held by BSI.

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 November 2004, and conflicting national standards shall be withdrawn at the latest by November 2004.

Annexes A, F, L and M are informative. Annexes B, C, D, E, G, H, I, J, K, N and O are normative.

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 98/37.

For relationship with EU Directive 98/37, see informative annex ZA, which is an integral part of this document.

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

Introduction

This document is a type C standard as stated in EN 1070.

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

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

This document is a harmonized standard to provide one means for general-purpose offshore cranes to conform with the relevant Essential Health and Safety Requirements of the Machinery Directive, as amended.

The standard is one in the series of standards of the CEN/CENELEC work program to produce standards for machine safety. It has been prepared to eliminate or reduce hazards when used in the development design and use of offshore cranes.

This standard is one part of EN 13852. The other part is:

Part 2: Floating Cranes i.e. a crane mounted on a vessel or barge designed for its support and transport, primarily intended for construction/deconstruction operations in a marine environment (This is not a harmonized standard).

1 Scope

This European Standard specifies the requirements for general-purpose offshore cranes including their supporting pedestals or structures.

This standard applies to cranes manufactured after the date of issue of this standard.

This European Standard does not cover:

- a) Fabrication, assembly, dismantling or changing the configuration of the crane;
- b) Lifting accessories, i.e. any item between the hook and the load;
- c) Sub-sea lifting operations;
- d) Design temperature below $-20\text{ }^{\circ}\text{C}$;
- e) Operations at an ambient temperature above $40\text{ }^{\circ}\text{C}$;
- f) Lifting operations involving more than one crane;
- g) Transportation of the crane;
- h) Loads due to earthquake;
- i) Cranes on seagoing vessels, excluded from the scope of the Machinery Directive.

The significant hazards covered by this European Standard are identified in clause 4.

This standard includes requirements for the lifting of personnel.

Where National Authorities permit the use of a general-purpose offshore crane for the lifting of personnel, the crane would at least need to fulfil the requirements of this standard.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 418	<i>Safety of machinery – Emergency stop equipment, functional aspects – Principles for design</i>
EN 457	<i>Safety of machinery - Auditory danger signals - General requirements, design and testing (ISO 7731:1986, modified)</i>
EN 614-1	<i>Safety of machinery – Ergonomic design principles – Part 1: Terminology and general principles</i>

EN 842	<i>Safety of machinery – Visual danger signals – General requirements, design and testing</i>
EN 894-3	<i>Safety of machinery – Ergonomic requirements for the design of displays and control actuators – Part 3: Control actuators</i>
EN 954-1	<i>Safety of machinery – Safety related parts of control systems – Part 1: General principles for design</i>
EN 982	<i>Safety of machinery – Safety requirements for fluid power systems and their components – Hydraulics</i>
EN 983	<i>Safety of machinery – Safety requirements for fluid power systems and their components – Pneumatics</i>
EN 1005-3	<i>Safety of machinery – Human physical performance – Part 3: Recommended force limits for machinery operation</i>
EN 1050	<i>Safety of machinery – Principles for risk assessment</i>
EN 1070:1998	<i>Safety of machinery – Terminology</i>
EN 1127-1:1997	<i>Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology</i>
EN 10025	<i>Hot rolled products of non-alloy structural steel – Technical delivery conditions.</i>
EN 10083-1	<i>Quenched and tempered steels – Part 1: Technical delivery conditions for special steels</i>
EN 10083-2	<i>Quenched and tempered steels – Part 2: Technical delivery conditions for unalloyed quality steels</i>
EN 10113-1	<i>Hot-rolled products in weldable fine grain structural steels – Part 1: General delivery conditions</i>
EN 10113-2	<i>Hot-rolled products in weldable fine grain structural steels – Part 2: Delivery conditions for normalized/normalized rolled steels</i>
EN 10113-3	<i>Hot-rolled products in weldable fine grain structural steels – Part 3: Delivery conditions for the thermo mechanical rolled steels</i>
EN 10137-1	<i>Plates and wide flats made of high yield strength structural steels in the quenched and tempered or precipitation hardened conditions – Part 1: General delivery conditions</i>
EN 10137-2	<i>Plates and wide flats made of high yield strength structural steels in the quenched and tempered or precipitation hardened conditions – Part 2: Delivery conditions for quenched and tempered steels</i>
EN 10204	<i>Metallic products – Types of inspection documents</i>
EN 12077-2	<i>Cranes safety – Requirements for health and safety – Part 2: Limiting and indicating devices</i>
EN 12385-1	<i>Steel wire ropes – Safety – Part 1: General requirements</i>
EN 12385-2	<i>Steel wire ropes – Safety – Part 2: Definitions, designation and classification</i>
prEN 12385-3	<i>Steel wire ropes – Safety – Part 3: Information for use and maintenance</i>

EN 12385-4	<i>Steel wire ropes – Safety – Part 4: Stranded ropes for general lifting applications</i>
EN 12644-1	<i>Cranes – Information for use and testing – Part 1: Instructions</i>
EN 12644-2	<i>Cranes – Information for use and testing – Part 2: Marking</i>
EN 13135-1	<i>Cranes - Safety - Design - Requirements for equipment – Part 1: Electrotechnical equipment</i>
prEN 13135-2	<i>Cranes – Equipment – Part 2: Non-electrotechnical equipment</i>
prEN 13411-3:1999	<i>Terminations for steel wire ropes – Safety – Part 3: Ferrules and ferrule-securing</i>
EN 13411-4	<i>Terminations for steel wire ropes – Safety – Part 4: Metal and resin socketing</i>
EN 13411-6	<i>Terminations for steel wire ropes – Safety – Part 6: Asymmetric wedge socket</i>
prEN 13411-7	<i>Terminations for steel wire ropes – Safety – Part 7: Symmetric wedge socket</i>
EN 13463-1:2001	<i>Non-electrical equipment for potentially explosive atmospheres - Part 1: Basic method and requirements</i>
EN 13557	<i>Cranes – Controls and control stations</i>
prEN 13586	<i>Cranes – Access</i>
prEN 14502-1	<i>Cranes – Equipment for the lifting of persons – Part 1: Suspended baskets</i>
EN 50014	<i>Electrical apparatus for potentially explosive atmospheres – General requirements</i>
EN 50015	<i>Electrical apparatus for potentially explosive atmospheres – Oil immersion «o»</i>
EN 50016	<i>Electrical apparatus for potentially explosive atmospheres – Pressurized apparatus «p»</i>
EN 50017	<i>Electrical apparatus for potentially explosive atmospheres – Powder filling «q»</i>
EN 50018	<i>Electrical apparatus for potentially explosive atmospheres – Flameproof enclosures «d»</i>
EN 50019	<i>Electrical apparatus for potentially explosive atmospheres – Increased safety «e»</i>
EN 50020	<i>Electrical apparatus for potentially explosive atmospheres – Intrinsic safety «i»</i>
EN 50021	<i>Electrical apparatus for potentially explosive atmospheres – Type of protection «n»</i>
EN 50028	<i>Electrical apparatus for potentially explosive atmospheres – Encapsulation «m»</i>
prEN 50039	<i>Electrical apparatus for potentially explosive atmospheres – Intrinsically safe electrical systems 'i' - Group II systems for gas atmospheres</i>
EN 60079-14	<i>Electrical apparatus for explosive gas atmospheres – Part 14: Electrical installations in hazardous areas (other than mines) (IEC 60079-14:1996)</i>
EN 61000-6-2	<i>Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments (IEC 61000-6-2:1999, modified)</i>
EN 61000-6-4	<i>Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments (IEC 61000-6-4:1997, modified)</i>

EN 61310-1	<i>Safety of machinery – Indication, marking and actuation – Part 1: Requirements for visual, auditory and tactile signals (IEC 61310-1:1995)</i>
EN 61310-2	<i>Safety of machinery – Indication, marking and actuation – Part 2: Requirements for marking (IEC 61310-1:1995)</i>
EN 61310-3	<i>Safety of machinery – Indication, marking and actuation – Part 3: Requirements for the location and operation of actuators (IEC 61310-1:1995)</i>
EN ISO 3744:1995	<i>Acoustics – Determination of sound power levels of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane (ISO 3744:1994)</i>
EN ISO 4871	<i>Acoustics – Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)</i>
EN ISO 898-1:1999	<i>Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs (ISO 898-1:1999)</i>
EN ISO 11201	<i>Acoustics – Noise emitted by machinery and equipment – Measurement of emission sound pressure levels at work station and other specified positions – Engineering method in an essentially free field over a reflecting plane (ISO 11201:1995)</i>
EN ISO 11688-1	<i>Acoustics - Recommended practice for the design of low-noise machinery and equipment - Part 1: Planning (ISO/TR 11688-1:1995)</i>
EN ISO 11688-2	<i>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)</i>
EN ISO 12100-2:2003	<i>Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles (ISO 12100-2:2003)</i>
ISO 4308-1	<i>Cranes and lifting appliances – Selection of wire ropes – Part 1: General</i>
ISO 8566-1	<i>Cranes – Cabins – Part 1: General</i>
ISO 9927-1	<i>Cranes – Inspections – Part 1: General</i>
ISO 12478-1	<i>Cranes – Maintenance manual – Part 1: General</i>
ISO 12480-1:1997	<i>Cranes – Safe use – Part 1: General</i>
ISO 12482-1	<i>Cranes – Condition monitoring – Part 1: General</i>
IEC 61131-3	<i>Programmable Controllers – Part 3: Programming languages (IEC 61131-3:2003)</i>
F.E.M. 1.001 Section I,	<i>Heavy Lifting Appliances, 1998 3rd edition revised</i>
	— <i>Booklet 1 Object and scope</i>
	— <i>Booklet 2 Classification and loading on structures and mechanisms</i>
	— <i>Booklet 3 Calculating the stresses in structures</i>
	— <i>Booklet 4 Checking for fatigue and choice of mechanism components, except for wire rope safety factors Z_p, for which annex G of this standard applies</i>

— Booklet 9 Supplements and comments to booklets 1 to 8

NOTE New design standards for cranes are under preparation by CEN for which in due course the references to standards issued by FEM in clause 5 of this standard, will be substituted by the new design standards, i.e. EN 13001-1 and EN 13001-2, etc.

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 1070:1998 and the following apply.

NOTE Definitions are in alphabetical order for the English language version only.

3.1

automatic overload protection system (AOPS)

system that automatically safeguards and protects the crane against the effects of a gross overload during operation by allowing the hook to be pulled away from the crane in downwards direction within specified offlead and sidelead angles, without causing significant damage to the crane, see B.3 and annex M

3.2

active heave compensation system (AHC)

system, which maintains the position of the load using external energy

3.3

actual hook load

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

3.4

active rope tensioning system (ART)

system, which forces the tension of the hoisting rope to a predefined value using external energy

3.5

component

single part or assembly of parts of a crane, which is subjected to load effects (e.g. ropes (stationary or running), traverse beams, pendant bars, sheaves, axles, gears, couplings, brakes, hoists, hydraulic cylinders, shafts, shackles, swivels and pins)

3.5.1

primary component

component which is essential for the safety and structural integrity of the crane

3.5.2

secondary component

any component that is not a primary component

3.6

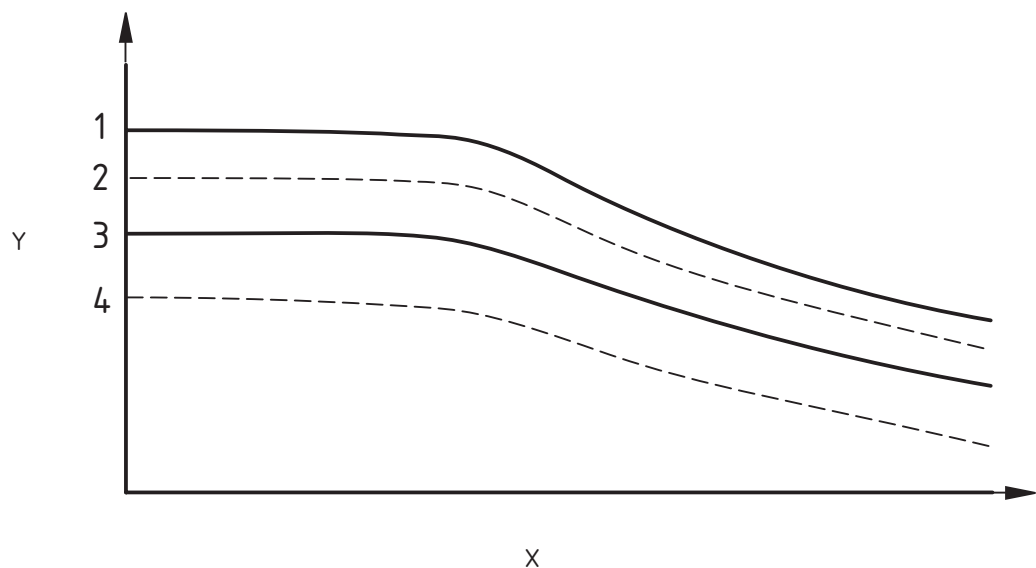
crane stiffness (C)

vertical static force applied at the hook required to produce unit vertical deflection assuming the pedestal support structure to be rigid

3.7

design load

maximum theoretical load ($R_0 \times \Phi_0$) that can be safely lifted by the crane at any given radius in the design condition such that the permissible stresses are not exceeded, see Figure 1



$R_0 \times \Phi_0 \geq R_n \times \Phi_n + \text{"Loss"}$ (1)

Key

X	radius
Y	load
1	design load $R_0 \times \Phi_0$
2	operational load $R_n \times \Phi_n$
3	platform lift R_0
4	sea lift R_n
"Loss"	effects due to environmental conditions and out of-plane influences

Figure 1 – Design load

3.8
design moment

maximum moment caused by the design load multiplied by radius

3.9
design temperature (T_d)

reference temperature for the area in which the crane is to be installed, used as a criterion for the selection of materials. The design temperature shall be taken as the lowest mean daily air temperature with an annual probability of exceedance of 10^{-2}

3.10**dynamic coefficient (ϕ_n)**

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

3.11**folding system**

mechanical system, which causes the knuckle boom assembly to be folded or unfolded

3.12**general-purpose offshore crane**

slewing crane mounted on an offshore installation, for which the duties include load handling to and from supply vessels, barges or semi-submersibles

3.13**hazardous area**

area in which a potentially explosive atmosphere (gas and/or dust) can be present

AC2 3.14**load chart**

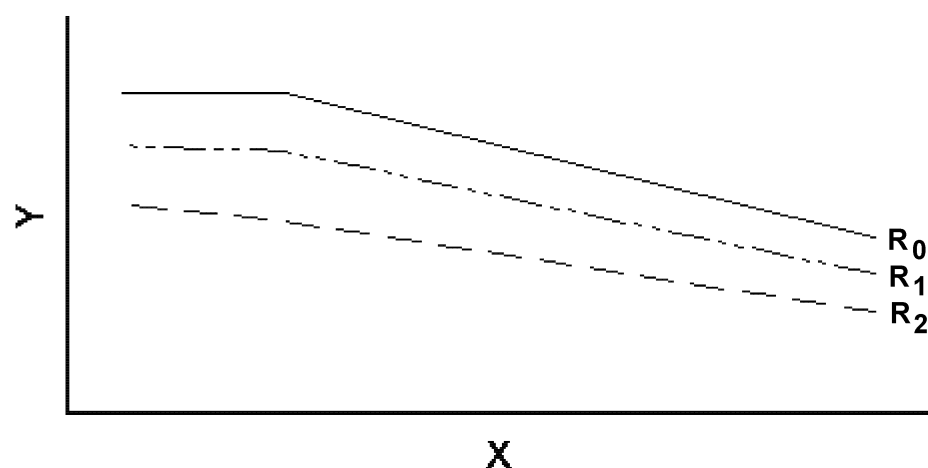
diagram or table showing the rated capacity relative to the radius, environmental conditions, out of plane influences and type of operation. The load chart shall state the in service operational limits of the crane, e.g. wind, heel, trim, ice, AOPS etc

An example is given in Figure 2

Lifting to and from the deck of supply vessels at

3 fall hoist reeving. Maximum 1 degree trim and

2 degrees heel, maximum wind speed 25 m/s.

**Key**

X	radius
Y	rated capacity
R_0	rated capacity for platform lifts
R_1	rated capacity for sea lifts with wave height $H_{1/3} = 1$ m
R_2	rated capacity for sea lifts with wave height $H_{1/3} = 2$ m

Figure 2 – Load chart AC2

3.15

luffing system

mechanical system which causes the boom to be raised or lowered

3.16

manual overload protection system (MOPS)

system, activated by the crane operator, that protects the crane against possible overload by reducing the load carrying capacity and allowing the hook to be pulled away from the crane in any direction

3.17

offlead load

horizontal load at the boom tip caused by the radial displacement of the hook and/or the radial acceleration of the boom tip.

AC₂ 3.18

offshore installation

fixed structure supported by the sea bed or floating unit, supported by buoyancy forces, used for the exploration, production and/or storage of hydrocarbons in a marine environment **AC₂**

3.19

overload

condition where the actual hook load exceeds the design load

3.20

over-moment

condition where the actual hook load multiplied by the radius (at existing inclination and offlead) exceeds the design moment

3.21

passive heave compensation system (PHC)

system, which maintains the position of the load between predefined limits, using stored energy

3.22

passive rope tensioning system (PRT)

system, which maintains the tension of the hoisting rope between predefined values, using stored energy

3.23

sidelead load

horizontal load at the boom tip caused by the lateral displacement of the hook and/or the lateral acceleration of the boom tip

3.24

significant damage

condition that represents 80% of the calculated limit state (see annex D) of the weakest load carrying structural or mechanical component

3.27

AC₂ significant wave height ($H_{1/3}$) **AC₂**

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

3.28

radius

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

3.29**rated capacity (R_0 or R_n)**

actual hook load that the crane is designed to lift for a given operating condition n (e.g. boom configuration, reeving arrangement, offlead/sidelead, heel/trim, radius, wave height etc)

NOTE Rated capacity R_0 equates to SWL as found in ILO conventions

3.30**running rigging**

all wire ropes passing over sheaves or guide rollers, or wound on winches, irrespective of whether or not the ropes are moved under load

3.31**standing rigging**

ropes that are not turned round or wound on to winches (e.g. guided wires, pendants, stays)

4 List of significant hazards

This clause contains all significant hazards, hazardous situations and events, as applicable in the scope of this standard, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce risk.

Table 1 — List of significant hazards and associated requirements

HAZARDS (as listed in EN 1050)		Relevant clause(s) in this standard
Hazards, hazardous situations and hazardous events		
1	Mechanical hazards	
1.1	<i>Generated by machine parts or work pieces caused, e.g., by:</i>	
1.1.5	Inadequacy of mechanical strength	5.2, 5.3.2, 5.3.4, 5.3.5, 5.3.6, 5.3.7, 5.3.8, 5.3.9, 5.3.10, 5.3.11, 5.8.3, 5.8.4
1.2	<i>Accumulation of energy inside the machinery caused, e.g., by:</i>	
1.2.2	Liquids and gases under pressure	5.3.2, 5.3.3, 5.3.11., 5.3.12, 5.3.13, 5.4.2/3, 5.4.5, 5.5.2.4
2	Electrical hazards	5.1, 5.3.1, 5.4.4
3	Thermal hazards	5.2.1, 5.2.2
4	Hazards generated by noise	5.5.4,
8	Hazards generated by neglecting ergonomic principles in machinery design	5.5, 5.5.2, 5.5.2.3, 5.5.5, 5.5.6

HAZARDS (as listed in EN 1050)		Relevant clause(s) in this standard
10	Unexpected start-up, unexpected overrun/overspeed (or any similar malfunction)	5.3.1, 5.3.2, 5.3.3, 5.3.11, 5.3.12, 5.3.13, 5.4.5, 5.5.1, 5.6.1, 5.6.2, 5.6.3
11	Impossibility of stopping the machine in the best possible conditions	5.6.3, 5.7.1
13	Failure of the power supply	5.3.3, 5.6.2.5, 5.7.1.3, 5.7.1.4,
14	Failure of the control circuit	5.3.1, 5.4.1/2/3/4/5, 5.5.2.5, 5.6.1, 5.6.2, 5.6.3, 5.7.1.6, 5.8.5
16	Break-up during operation	5.2.4, 5.3.4, 5.7.1.4, 5.8.6,
17	Falling or ejected objects	5.5.2.
18	Loss of stability/overturning of machinery	5.2, 5.3.4, 5.3.5, 5.3.6, 5.8.2, 5.3.11, 5.6.2/3
Additional hazards, hazardous situations and hazardous events due to lifting		
27	Mechanical hazards and hazardous events	
27.1	<i>from load falls, collisions, machine tipping caused by :</i>	
27.1.2	uncontrolled loading – overloading – overturning moments exceeded	5.6.2.2
27.1.3	uncontrolled amplitude of movements	5.6.2, 5.4.5, 5.7.1
27.1.4	unexpected/unintended movement of loads	5.6.1, 5.4.5
27.4	from insufficient mechanical strength of parts	5.2, 5.3.2
27.5	from inadequate design of pulleys, drums	5.3.2
27.6	from inadequate selection/integration into the machine of chains, ropes, lifting equipment	5.3.2, 5.3.8/9/10
27.7	from lowering of the load by friction brake	5.7.1.4
27.8	from abnormal conditions of assembly/testing/use/ maintenance	5.5.3, 5.5.5, 6 and 7
29	<i>Hazards generated by neglecting ergonomic principles:</i>	
29.1	insufficient visibility from the driving position	5.5.2.1/2, 5.5.3
34-37	Hazards due to the lifting or moving of personnel	5.8, 7.1.1.5

5 Safety requirements and/or protective measures

5.1 General

General-purpose offshore cranes shall comply with the safety requirements and/or protective measures of this clause.

The crane shall be designed according to the principles of EN ISO 12100-2 for relevant hazards, which are not dealt with by this document (e.g. sharp edges).

NOTE This specific risk assessment is part of the general risk assessment relating to the hazards not covered by this C standard.

In addition, if the crane or parts of the crane shall operate in hazardous area, it shall be designed according to the principles of explosion protection for relevant hazards, as stated in annex O.

5.2 Structure and mechanisms

5.2.1 General principles and requirements

The crane and pedestal shall be in accordance with the normative annexes of this standard and the following:

F.E.M. 1.001 Section I, Heavy Lifting Appliances, 1998 3rd edition revised

- Booklet 1 Object and scope
- Booklet 2 Classification and loading on structures and mechanisms
- Booklet 3 Calculating the stresses in structures
- Booklet 4 Checking for fatigue and choice of mechanism components, except for wire rope safety factors Z_p , for which annex G of this standard applies
- Booklet 9 Supplements and comments to booklets 1 to 8

The design loads for structure and machinery components shall be established in accordance with annex B and C by using the design calculation method as stated in the FEM. However for sea lifts, the product of the duty factor γ_m and the dynamic coefficient ψ as defined in FEM shall not be less than 1,3. In this standard the symbol Φ equates to ψ .

Rope drives shall comply with ISO 4308-1.

AC2 Text deleted AC2

The general principles and requirements shall also be considered for the maintenance, taking into account the environmental conditions prevailing on offshore installations.

Materials shall be selected in accordance with annex E.

5.2.2 In service loads

Vertical loads are to be multiplied by the dynamic coefficient determined in accordance with B.1 and B.2. Offlead and sidelead loads, and the inclination of the crane base on floating installations, shall be taken into consideration in the design load as stated in B.3.

The crane shall be provided with, a load chart, see **AC2** 3.14 **AC2**. The load chart shall be displayed at the control station. The information from the load chart shall be programmed into the rated capacity indicator as described in 5.6.2.2.

The crane shall withstand the environmental influences in annex C.

5.2.3 Out of service loads

The crane shall withstand the environmental influences in annex C.

5.2.4 Failure mode analysis

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

5.2.5 Load combinations

Load combinations shall be in accordance with B.5.

5.3 Equipment and components

5.3.1 Electrotechnical equipment

Electrotechnical equipment shall be in accordance with EN 13135-1.

Safety related parts of control systems shall comply with the specified categories of performance as given by EN 954-1, minimum category 2.

Electrotechnical equipment operating in a hazardous area shall be in accordance with EN 60079-14 and annex O.

Enclosures for electrotechnical equipment operating in a hazardous area shall be in accordance with EN 50014, EN 50015, EN 50016, EN 50017, EN 50018, EN 50019 and EN 50020

Programming languages in Programming Logic Controllers shall comply with IEC 61131-3.

5.3.2 Non-electrotechnical equipment

Non-electrotechnical equipment shall in addition to the requirements of this standard, be in accordance with F.E.M. Rules Booklet 4, 5.2 and prEN 13135-2. The latter has first priority in case of conflict.

Safety related parts of control systems shall comply with the specified categories of performance as given by EN 954-1, minimum category 2.

5.3.3 Power requirements

The crane prime mover shall be such that the full power demands of any loading and speed combinations associated with the various motions are compatible with the operations that the crane is designed for, such that:

- a) A diesel engine shall not stall;
- b) A diesel engine shall not over-speed;
- c) An electric motor shall not overheat;
- d) The supply energy is sufficient (if power is supplied from an external source off the crane).

If the crane does not have enough power for full speed to all motions at maximum load simultaneously, the speeds shall be reduced either automatically or manually according to rules of priority clearly stated in the operating manuals. Hoisting motion shall always have first priority.

The installed power shall not be less than the highest of the required power for:

- 1) Full hoisting speed and 50 % luffing speed, or
- 2) Full hoisting speed and 50 % slewing speed.

5.3.4 Slewing drives

Slewing drives system shall be designed to hold at least 1,3 times the static design slewing torque, caused by effects of wind, sidelead and crane base inclination.

The system shall consist of a minimum of two independent drive units, unless the failure of the slewing drive will not cause uncontrolled movement of the crane.

The slewing brakes shall comply with annex I.

5.3.5 Slewing bearings

Slewing bearings shall be in accordance with annex E and H.

5.3.6 Slewing bearing fasteners

The fasteners attaching the fixed ring to the pedestal structure shall be equally spaced over the 360° mounting circumference of the bearing.

For the connection between revolving ring and crane, unequal fastener spacing may be used if the integrity of the bolted connection can be verified by structural analysis including fatigue consideration or empirical data from prototype testing.

The distance between the centres of two fasteners shall not in general exceed $6d$, where d is the nominal diameter of the bolt.

The mating surface shall be steel to steel without surface levelling compound. The flatness of the mating surfaces shall be within the tolerances specified by the slewing bearing manufacturer.

Slewing ring fasteners shall be in accordance with AC_2 annex E AC_2 .

5.3.7 Winches and brakes

Winches shall be in accordance with annex K.

Brakes shall be in accordance with annex I.

5.3.8 Wire rope termination

Wire rope termination shall be one of the following three types only and shall be in accordance with prEN 13135-2 and the following:

- a) Wedge socket in accordance with EN 13411-6 or prEN 13411-7;
- b) Spelter socket in accordance with EN 13411-4;
- c) Ferrule secured-eyes (with thimble only) in accordance with prEN 13411-3.

Socketing of wire ropes shall be carried out according to AC2 *text deleted* AC2 the socket's manufacturer instructions.

On running single line where hooking/snatching may occur, end termination with adequate shape as shown in prEN 13411-3:1999, A.2 or similar, shall be used.

5.3.9 Wire rope anchorage

Wire rope anchorage shall be in accordance with prEN 13135-2, except for the following

All wire rope anchorages, including those at the hook, boom head, integral shackle, etc., which are exposed to motions or impacts shall have double means of locking in order to avoid inadvertent loosening and detachment during operation.

AC2 The break out load of the anchorage to the winch drum(s) shall not be less than the required minimum wire rope breaking force minus the frictional effect of three turns of rope. AC2

Where nuts, bolts, screws, etc. are used for fixing the wire ropes, the prescribed torque is to be durably and clearly visibly marked in the immediate vicinity.

5.3.10 Wire ropes

Wire ropes shall comply with EN 12385-1, EN 12385-2, EN 12385-4 and prEN 12385-3.

Uncoated or bright surface finish shall not be used, unless documented maintenance procedures are provided to ensure that the corrosion protection is guaranteed throughout the specified lifetime.

The required minimum wire rope breaking force shall be determined by the maximum static and dynamic rope pull multiplied by the safety factor Z_p given in annex G. The efficiency of the applicable wire rope termination shall comply with an EN- or ISO standard or be documented by test certificate/report covering the actual wire rope being used. If the efficiency of the end termination is below 80 %, the loss shall be compensated for up to minimum 80 % efficiency.

The maximum static rope pull shall be determined from dead weight (including the hook block) and the actual hook load without dynamic coefficient, wind, offlead/sidelead, trim/heel or other secondary factors. The effects of sheave friction shall also be taken into consideration.

The maximum dynamic rope pull shall be determined from dead weight (including the hook block) and the actual hook load including dynamic coefficient, wind, offlead/sidelead and trim/heel.

5.3.11 Hydraulic cylinders

Hydraulic cylinders used as primary components shall be designed based on the maximum pressures and dynamic forces acting in service and out of service.

Where hydraulic cylinders are used for luffing, folding or telescoping, they shall be fitted with a device, which will hold the boom in position in the event of loss of hydraulic power pressure to the cylinder or hose/pipe burst, e.g. automatic closing hydraulic brake valves, pilot operated non-return valves (protective valves). This device shall be placed inside or directly connected to the cylinder i.e. no intermediate piping or hoses shall be used.

5.3.12 Motion compensators

Where an active or passive motion compensator system(s) is installed, it shall be in accordance with EN 954-1 minimum category 2 and automatic in operation. Failure in operation shall be displayed at the control station.

5.3.13 Shock absorbers

Where a shock absorber is installed, it shall be automatic in operation. It shall be so designed that any failure of the shock absorbing function does not result in a catastrophic loss of the load.

5.4 Drive systems

5.4.1 General

All main functions, e.g. hoisting, slewing, luffing, shall respond to the controls such that minimum required speed is obtained from stand still within 2 s from full activation of the control lever.

The control system shall be such that interference fields (EMC) e.g. radio and telecommunications, electrical or electronic transmission of the controls, do not cause unintended movements or other hazardous actions of the crane. Electric and electronic equipment, apparatus and systems are permitted only when they conform to EN 61000-6-2 and EN 61000-6-4. All items of equipment shall be assembled and wired up in accordance with the instructions of the suppliers, to comply with the relevant EMC standards. When in particular cases specific measures are required to achieve sufficient immunity or emission values, the manufacturers of the crane shall take those measures for all cranes for which the same situation could apply.

As a minimum, safety related parts of control systems shall comply with category 2 of EN 954-1.

The controls of the main functions, hoisting, slewing, luffing, folding and telescoping, shall provide predictable smooth motions proportional to the position of the control levers and with insignificant hysteresis and zero band.

Control systems including multiple speed selection either manual or automatic, shall always return to their safest condition with regard to stabilising the crane and the load, if any error occurs in the control system.

5.4.2 Pneumatic systems

Pneumatic systems shall comply with prEN 13135-2 and EN 983. Pneumatic elements and components shall only be contained in a controlled environment. Air filters and dryers shall be installed in environmentally controlled areas to limit contamination acceptable to component.

5.4.3 Hydraulic systems

Hydraulic systems shall comply with prEN 13135-2 and EN 982. For vented reservoirs, air breathers shall be provided and arranged to ensure the filtered air entering the reservoir is to a cleanliness level compatible with the system requirements, taking into consideration the environmental conditions in which the system is installed.

5.4.4 Electrical systems

Electrical systems shall comply with EN 13135-1. For operational temperatures below 0 °C and above 40 °C special considerations apply.

Local thermal effects, such as the thermal influence of flares etc., shall be taken into account when determining the applicable ambient temperature of the electrical system.

5.4.5 Heave compensation/rope tensioning systems

Where installed, heave compensation/tension systems shall be facilitated in order to ease and simplify the lifting operations. The system(s) shall be of the following types:

- a) Active heave compensation system (AHC);

- b) Passive heave compensation system (PHC);
- c) Active rope tensioning system (ART);
- d) Passive rope tensioning system (PRT).

An active rope tensioning system (ART) shall, when activated and the control lever for hoisting is in the position for full hoisting, provide a tension in the hoisting wire rope to a set point value, both in downward and upward ship motion.

The activation of any rope tensioning system shall only be possible when the hoisting system is unloaded.

Activation of the heave compensation system(s) shall be protected against inadvertent use.

The activation switch for heave compensation/rope tensioning systems shall be clearly and durably marked in accordance with a), b), c) or d) of this sub clause.

When the system(s) is/are deactivated, the crane shall smoothly return to normal operation.

5.5 Health and Safety

5.5.1 Control stations - General

The control station shall include all controls, instruments, indicators, signals, load charts and alarms that are necessary for safe operation of the crane. In addition, the control station shall be in accordance with EN 13557.

5.5.2 Control cabin

5.5.2.1 General

A cabin shall be provided in order to contain the control station and a working environment for the crane operator. The cabin shall comply with ISO 8566-1, unless this is in conflict with EN 13557 and the following requirements:

- a) It shall be weatherproof to suit a marine environment;
- b) It shall be equipped with a second seat in addition to the operator's seat;
- c) Every window shall be provided with low noise wind-shield wipers and high pressure spray nozzles to ensure clear view;
- d) It shall be provided with sufficient external access and to allow for safe wind-shield wiper exchange and window cleaning;
- e) It shall have an ergonomic design in accordance with EN 614-1.

Where a full view of the loading area is not possible from the control station, CCTV shall be provided, preferably in the boom tip, to enable the operator to survey the crane motions, lifting accessories, load motions, loading areas etc. Where a monitor is installed, it shall be located in a way that facilitates easy viewing from the operator's position, without obstructing the normal view.

5.5.2.2 Windows

Windows shall be provided to give aerial vision of the load and the operation area of the crane at any position of the load from minimum to maximum radius. In addition roof windows, side windows and floor windows shall be provided.

The minimum view angles from the operator position shall be as follows:

- a) Side view: $\pm 100^\circ$, with operator movement while seated;
- b) Vertical plane: the operator shall be able to see the load and boom in all their positions.

Windows shall be of laminated glass.

As a minimum the cabin roof including windows shall be able to withstand the impact of a steel ball weighing 7 kg, falling from a height of 2 m, without plastic deformations exceeding 50 mm.

The front window shall extend down to the floor with vertical protection bars, which shall give minimum obstruction to the crane operator's view.

Floor windows shall be protected by a grating, which shall be arranged not to obstruct a free view to the operation area.

5.5.2.3 Crane operator's seat

Where provided, the crane operator's seat shall be of an ergonomic design with a padded seat and adjustable arm support. The seat shall be fully adjustable i.e. height, forwards/backwards and backrest angle. Arm supports shall be easy to remove. The seat shall have an easily attachable headrest, which shall give full support in the reclined position.

5.5.2.4 Cabin interior

The cabin shall be provided with means of defrosting and demisting the windows.

The cabin shall have the means to provide a comfortable working environment for the crane operator. The system shall be able to keep an adjustable inside temperature within the range of 15 °C to 25 °C for external operational temperatures, which are specified for the crane.

Where pressurized hoses, pipes and cables are located in the cabin they shall be protected against mechanical damage, and such that personnel are protected from the effects of hose rupture, leakages, etc

5.5.2.5 Cabin instrumentation

The instrumentation shall be located in accordance with EN 13557. See also annex F.

The cabin shall be provided with fire, smoke and gas alarms from detectors in the machinery house and air intakes.

5.5.3 Communications

Communication equipment shall be provided to enable the crane operator to communicate with the platform and the supply vessels and other units involved in the lifting operations. The crane operator shall be able to operate the radio communication system without moving his hands from the main control levers.

5.5.4 Noise reduction

5.5.4.1 Noise reduction at source by design

The main noise sources to be found in a general-purpose offshore crane are:

- a) Engines used for the crane functions;
- b) Winches, gears and transmissions;

- c) Hydraulic and pneumatic components and circuits;
- d) Brakes and other mechanical components;
- e) Heave compensation and rope tensioning systems.

The following measures shall be used to reduce noise at source of general-purpose offshore cranes:

- f) Selection of low-noise hydraulic and mechanical components;
- g) Use of anti vibration systems to reduce structure borne sound;
- h) Encasement of noise-radiating parts;
- i) Appropriate adjustment of operating speeds.

NOTE 1 This list is not exhaustive and alternative measures for noise reduction with identical or greater effectiveness can be used.

NOTE 2 The criterion for assessing the effectiveness of these measures is the actual noise emission values from the machine and not the nature of the reduction measures themselves.

EN ISO 11688-1 and EN ISO 11688-2 shall be referred to for general guidance on the design of low-noise machinery.

The crane shall be designed such that the A-weighted emission sound pressure level at the operator position at the control station, with windows and doors closed and ventilation on, measured according to annex N, shall be less than 80 dB(A), as measured i.e. excluding uncertainties as described in N.5. and N.8.

5.5.4.2 Noise reduction by information

Recommendations for further noise reduction during use shall be given in the instruction manual, see clause 7.

5.5.5 Access

Means of access for operation and/or maintenance shall conform to prEN 13586.

5.5.6 Guards

The crane shall incorporate guards in accordance with EN 12077-2.

5.6 Controls, indicators and limiting devices

5.6.1 Controls

Controls shall meet the requirements of the following standards with regard to the addressed items:

EN 614-1, EN 894-3, EN 1005-3, EN 13557 and EN 61310-1, 2 and 3.

For the application of EN 614-1, EN 894-3, EN 1005-3, EN 13557 and EN 61310-1, EN 61310-2 and EN 61310-3, the manufacturer shall carry out an adequate risk assessment for the requirements thereof where choice is necessary.

NOTE This specific risk assessment is part of the general risk assessment relating to the hazards not covered by this C standard.