

Lifting equipment

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Foreword	5
Introduction	5
1 Scope	7
2 Normative and informative references	7
2.1 Normative references	7
2.2 Informative references	9
3 Terms, definitions and abbreviations	10
3.1 Terms and definitions	10
3.1.1 activation system	10
3.1.23 material handling	11
3.1.25 means of connection	12
3.1.31 release system	12
3.2 Abbreviations	13
4 General safety requirements	14
4.1 Safety	14
4.2 Fitness for use	14
4.3 Reliability and availability	14
4.4 Principle of safety integration	14
4.5 Inherently safe design measures	15
4.6 Safeguarding and complementary protective measures	15
4.7 Information for use	15
4.8 Strength proportion	15
4.9 Maintenance	15
4.10 Quality management system	15
4.11 Risk assessment	16
4.12 Risk reduction	18
4.13 Documentation of risk assessment	18
4.14 Verification	18
4.15 Qualification of new technology	18
5 Common requirements	19
5.1 Suitability	19
5.2 Materials and products	19
5.3 Fire and explosion	19
5.4 Ergonomics	20
5.5 Environmental conditions	22
5.6 Operational loads	23
5.7 Strength and stability – structure and mechanisms	23
5.8 Strength and stability – classification	24
5.9 High risk applications	24
5.10 Power systems	24
5.11 Electro technical equipment	24
5.12 Non-electro technical equipment	24
5.13 Controls, control stations and control systems	24
5.14 Limiting and indicating devices	25
5.15 Emergency systems	25
5.16 Communication	26
5.17 Pneumatics	26
5.18 Hydraulics	26
5.19 Electromagnetic compatibility (EMC)	26
5.20 Exhaust and noise emissions	26
5.21 Utility systems	27
5.22 Fabrication	27
5.23 Installation and assembly	27
5.24 Corrosion protection	27
5.25 Technical construction file	27
Annex A (Normative) Launching and recovery appliances for life saving equipment	29
Annex B (Normative) Material handling principles	69

Annex I (Informative) Selection of elastic pennant – calculation example

76

Foreword

The NORSOK standards are developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for petroleum industry developments and operations. Furthermore, NORSOK standards are, as far as possible, intended to replace oil company specifications and serve as references in the authorities' regulations.

The NORSOK standards are normally based on recognised international standards, adding the provisions deemed necessary to fill the broad needs of the Norwegian petroleum industry. Where relevant, NORSOK standards will be used to provide the Norwegian industry input to the international standardisation process. Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.

The NORSOK standards are developed according to the consensus principle generally applicable for most standards work and according to established procedures defined in NORSOK A-001.

The NORSOK standards are prepared and published with support by The Norwegian Oil Industry Association (OLF), The Federation of Norwegian Industry, Norwegian Shipowners' Association and The Petroleum Safety Authority Norway.

NORSOK standards are administered and published by Standards Norway.

This standard is published in two steps. The final standard is planned to contain the following annexes:

- Annex A: Launching and recovery appliances for life saving equipment
- Annex B: Material handling
- Annex C: Lifting accessories
- Annex D: Drilling hoisting equipment
- Annex E: Lifts
- Annex F: Portable units
- Annex G: Cranes
- Annex H: Foundations and suspensions
- Annex I: Selection of elastic pennant – calculation example

NOTE:

Please observe that this is a preliminary version of edition 2 of this standard. It contains the main part and annex A, B and I. This preliminary version will be withdrawn when the final version of edition 2 is published.

Introduction

The main purpose of this NORSOK standard is to contribute to an acceptable level of safety for humans, the environment and material assets in the petroleum industry by giving technical requirements for lifting equipment.

During development of this NORSOK standard, due consideration has been given to relevant EU Directives, Norwegian regulations, European Standard and International standard, as well as other formal documents of relevance. It should be noted, however, that this NORSOK standard is not a harmonised standard, and it does not contain all the technical and administrative requirements of the applicable regulations and directives, see the foreword.

The expert group responsible for this NORSOK standard has agreed that the main safety philosophy and principal requirements of the standard shall be based on applicable safety and health requirements stated in relevant EU directives, e.g. the Machinery directive (2006/42/EC), ATEX directive (94/9/EC), LVD (2006/95/EC), EMC directive (2004/108/EC), PED (97/23/EC). This applies regardless of type of installation or unit on which lifting equipment is installed. Administrative requirements, however, (e.g. CE marking, declaration of conformity, requirements for EC Type-examination, etc.) do not form part of this NORSOK standard.

The requirements of this NORSOK standard are given in clause 4, clause 5 and in the annexes. The combination of all these requirements forms the technical basis the lifting equipment has to comply with. In case of conflict between similar, but not identical requirements, the requirements of the annexes prevail over the common requirements of clause 5, which in turn prevails over the safety requirements of clause 4. However, this general rule may only be waived if the manufacturer makes use of a recognised solution and documents by means of a risk assessment that said solution gives an equal or better safety level than the conflicting requirement.

1 Scope

This NORSOK standard is valid for lifting equipment on all fixed and floating installations, mobile offshore units, barges and vessels, as well as on land based plants where petroleum activities are performed.

NOTE For the use of lifting equipment, reference is made to NORSOK R-003 and NORSOK R-005.

2 Normative and informative references

The following standards include provisions and guidelines which, through reference in this text, constitute provisions and guidelines of this NORSOK standard. Latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used provided it can be shown that they meet the requirements of the referenced standards.

2.1 Normative references

CEN/TS 13001-3-1,	Cranes – General design – Part 3-1: Limit states and proof of competence of steel structures
CEN/TS 13001-3-2,	Cranes – General design – Part 3-2: Limit states and proof of competence of wire ropes in reeving systems
prCEN/TS 13001-3-3 ¹ ,	Cranes – General design – Part 3-3: Limit states and proof of competence of wheel/rail contacts
FprCEN/TS 13001-3-5 ² ,	Cranes - General design – Part 3-5: Limit states and proof of competence of forged hooks
Directive 97/68/EC,	Directive of the European Parliament and of the Council of 16 December 1997 on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery, amended by Directives 2001/63/EC, 2002/88/EC, 2004/26/EC and 2006/105/EC
DNV Standard for certification of lifting appliances, No. 2.22,	
IEC 61000-6-4,	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards - Emission standard for industrial environments
FEM 1.001, 3 rd edition 1998,	Rules for the design of hoisting appliances
IEC 60034,	Rotating electrical machines
IEC 60204-1,	Safety of machinery – Electrical equipment of machines – Part 1: General requirements
IEC 60204-32,	Safety of machinery – Electrical equipment of machines – Part 32: Requirements for hoisting machines
IEC 60300-3-11,	Dependability management – Part 3-11: Application guide – Reliability centred maintenance
IEC 60529,	Degrees of protection provided by enclosures (IP Code)
IEC 60812,	Analysis techniques for system reliability – Procedure for failure mode and effects analysis (FMEA)
IEC 61000-6-2,	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments
IEC 61892 (all parts),	Mobile and fixed offshore units – Electrical installations – (all parts)
IMO Resolution A.760 (18),	Symbols related to Life Saving Appliances and Arrangements
IMO Resolution MSC.82 (70),	Amendments to Resolution A.760 (18)
ISO 898-1,	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 2631-1,	Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Part 1: General requirements
ISO 3864-1,	Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs in workplaces and public areas

¹ To be published.

² To be published

ISO 3864-2,	Graphical symbols – Safety colours and safety signs – Part 2: Design principles for product safety labels
ISO 3864-3,	Graphical symbols – Safety colours and safety signs – Part 3: Design principles for graphical symbols for use in safety signs
ISO 6309,	Fire protection – Safety signs
ISO 6385,	Ergonomic principles in the design of work systems
ISO 9001,	Quality management systems – Requirements
ISO/TR 11688-1,	Acoustics – Recommended practice for the design of low-noise machinery and equipment – Part 1: Planning
ISO/TR 11688-2,	Acoustics – Recommended practice for the design of low-noise machinery and equipment – Part 2: Introduction to the physics of low-noise design
ISO 12100-1,	Safety of machinery – Basic concepts, general principles for design – Part 1: Basic terminology, methodology
ISO 12100-2,	Safety of machinery – Basic concepts, general principles for design – Part 2: Technical principles
ISO 12482-1,	Cranes – Condition monitoring – Part 1: General
ISO 12944-1,	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 1: General introduction
ISO 13200,	Cranes – Safety signs and hazard pictorials – General principles
ISO 13702,	Petroleum and natural gas industries – Control and mitigation of fires and explosions on offshore production installations – Requirements and guidelines
ISO 13849-1,	Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
ISO 13850,	Safety of machinery – Emergency stop – Principles for design
ISO 13857,	Safety of machinery – Safety distances to prevent hazard zones being reached by upper and lower limbs
ISO/TR 14121-2,	Safety of machinery – Risk assessment – Part 2: Practical guidance and examples of methods
ISO 14121-1,	Safety of machinery – Risk assessment – Part 1: Principles
LSA Code,	IMO SOLAS Life saving appliances (LSA) Code, 2003 Edition
NMD Regulation 4.July 2007	(concerning evacuation and life-saving appliances on mobile offshore units)
No.853,	
NORSOK E-001,	Electrical systems (Edition 5, July 2007)
NORSOK M-501,	Surface preparation and protective coating (Rev. 5. June 2004)
NORSOK N-004,	Design of steel structures (Rev. 2.October 2004)
NORSOK S-001,	Technical safety (Edition 4, February 2008)
NORSOK S-002,	Working environment (Rev. 4. August 2004)
NORSOK Z-007,	Mechanical completion and commissioning (Rev. 2.December 1999)
NORSOK Z-008,	Criticality analysis for maintenance purposes (Rev.2, Nov.2001)
EN 349,	Safety of machinery – Minimum gaps to avoid crushing of parts of the human body
EN 614-1,	Safety of machinery – Ergonomic design principles – Part 1: Terminology and general principles
EN 614-2,	Safety of machinery – Ergonomic design principles – Part 2: Interactions between the design of machinery and work tasks
EN 818-2,	Short link chain for lifting purposes – Safety – Part 2: Medium tolerance chain for chain slings – Grade 8
EN 842,	Safety of machinery – Visual danger signals – General requirements, design and testing
EN 894-1,	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,	Safety of machinery – Ergonomics requirements for the design of displays and control actuators – Part 2: Displays
EN 894-3,	Safety of machinery – Ergonomics requirements for the design of displays and control actuators – Part 3: Control actuators
EN 953,	Safety of machinery – Guards – General requirements for the design and construction of fixed and movable guards
EN 982,	Safety of machinery – Safety requirements for fluid power systems and their components – Hydraulics

EN 983,	Safety of machinery – Safety requirements for fluid power systems and their components – Pneumatics
EN 1037,	Safety of machinery – Prevention of unexpected start-up
EN 1127-1,	Explosive atmospheres – Explosion prevention and protection – Part 1: Basic concepts and methodology
EN 1492-1,	Flat woven webbing slings made of man-made fibres for general purpose use
EN 1492-2,	Roundslings made of man-made fibres for general purpose use
EN 1492-4,	Lifting slings for general service made from natural and man-made fibre ropes
EN 1677-1,	Components for slings – Safety – Part 1: Forged steel components, Grade 8
EN 1677-2,	Components for slings – Safety – Part 2: Forged steel lifting hooks with latch, Grade 8
EN 1677-4,	Components for slings – Safety – Part 4: Links, Grade 8
EN 1679-1,	Reciprocating internal combustion engines – Safety – Part 1: Compression ignition engines
EN 1834-1,	Reciprocating internal combustion engines – Safety requirements for design and construction of engines for use in potentially explosive atmospheres – Part 1: Group II engines for use in flammable gas and vapour atmospheres
EN 1999-1-1,	Eurocode 9: Design of aluminium structures - Part 1-1: General structural rules
EN 12077-2,	Cranes safety – Requirements for health and safety – Part 2: Limiting and indicating devices
EN 12198-2,	Safety of machinery - Assessment and reduction of risks arising from radiation emitted by machinery – Part 2: Radiation emission measurement procedure
EN 12385-1,	Steel wire ropes – Safety – Part 1: General requirements
EN 12385-2,	Steel wire ropes – Safety – Part 2: Definitions, designation and classification
EN 12385-3,	Steel wire ropes – Safety – Part 3: Information for use and maintenance
EN 12385-4,	Steel wire ropes – Safety – Part 4: Stranded ropes for general lifting applications
EN 12644-1,	Cranes – Information for use and testing – Part 1: Instructions
EN 12644-2,	Cranes – Information for use and testing – Part 2: Marking
EN 13001-1,	Cranes – General design – Part 1: General principles and requirements
EN 13001-2,	Cranes – General design – Part 2: Load effects
EN 13135-1,	Cranes – Safety – Design – Requirements for equipment – Part 1: Electrotechnical equipment
EN 13135-2,	Cranes - Equipment – Part 2: Non-electrotechnical equipment
EN 13155,	Cranes – Safety – Non-fixed load lifting attachments
EN 13411-3,	Terminations for steel wire ropes – Safety – Part 3: Ferrules and ferrule-securing
EN 13411-4,	Terminations for steel wire ropes – Safety – Part 4: Metal and resin socketing
EN 13411-5,	Terminations for steel wire ropes – Safety – Part 5: U-bolt wire rope grips
EN 13411-7,	Terminations for steel wire ropes – Safety – Part 7: Symmetric wedge socket
EN 13478,	Safety of machinery - Fire prevention and protection
EN 13557,	Cranes – Controls and control stations
EN 13586,	Cranes – Access

2.2 Informative references

DNV-OS-C501,	DNV Offshore Standard Composite Components
DNV-OS-E303,	Offshore Mooring Fibre Ropes
DNV OS-E406,	Design of free fall lifeboats
DNV OSS-308,	Verification of lifting appliances for the oil and gas industry
DNV-RP-A203,	Qualification Procedures for New Technology
DNV-RP-C203,	Fatigue Design of Offshore Structures
NOKSOK R-003,	Safe use of lifting equipment

NORSOK R-005, Safe use of lifting and transport equipment in onshore petroleum plants

3 Terms, definitions and abbreviations

For the purposes of this NORSOK standard, the following terms, definitions and abbreviations apply.

3.1 Terms and definitions

3.1.1

activation system

interconnected parts necessary for powered or manual opening of the release mechanism, including the power supply and control system or manual control device

3.1.2

agreed

term used when operating conditions or other design parameters are to be specified, and an agreement has to be reached

NOTE The parties of the agreement are the manufacturer of the equipment in question, and the company's technical responsible for operation of the installation in question. The term is used in different contexts, e.g. "unless otherwise agreed", "to be agreed", "as agreed" etc.

3.1.3

availability

availability of an item to be in a state to perform a required function under given conditions at a given instant of time, or in average over a given time interval, assuming that the required external resources are provided

3.1.4

can

verbal form used for statements of possibility and capability, whether material, physical or casual

3.1.5

complex lifting appliances

power driven lifting appliances with high capacity and or high risks

NOTE Complex lifting appliances include, but are not limited to: offshore cranes, BOP cranes, drawworks, launching appliances for lifeboats, tower cranes, mobile cranes etc.

3.1.6

crane

lifting appliance whereby the load can be moved horizontally in one or more directions, in addition to the vertical movement

3.1.7

design temperature

lowest mean daily air temperature for the area of operation, used for the selection of steel grades

3.1.8

extended harm

damage to material assets or the environment in addition to harm (physical injury or damage to health)

3.1.9

fail-safe component

component where the predominant failure mode is known in advance, and which is used such that the effect of such failure is less critical

3.1.10

harm

physical injury or damage to health

3.1.11

inherently safe design measure

protective measure which either eliminates hazards or reduces the risks associated with hazards by changing the design or operating characteristics of the machine without the use of guards or protective devices

3.1.12

installation

facility, plant and other equipment for petroleum activities (excluding ships that transport petroleum in bulk)

NOTE In this NORSOK standard, supply and standby boats are included in the definition of an installation.

Examples of installations include fixed installations, FPSO vessels, rigs, barges, crane barges, service vessels, onshore plants etc.

3.1.13

launching and recovery appliances

lifting appliance for lifesaving equipment

3.1.14

lay down area

deck area for temporary storage of loads and equipment

3.1.15

lifesaving equipment

evacuation equipment and rescue equipment

3.1.16

lifting accessories

components or equipment used between the lifting appliance and the load or on the load to grip it, but which is not an integrated part of the lifting appliance

NOTE The term lifting accessories also cover lifting gear and loose gear.

3.1.17

lifting appliance

machine or device used for vertical movement of a load, with or without horizontal movement

NOTE Include cranes, hoists, drilling hoisting equipment and launching and recovery appliances for life saving equipment, etc.

3.1.18

lifting equipment

common term for lifting appliances and lifting accessories

3.1.19

lifting operation

all administrative and operational activities before, during and after a load is moved and until the lifting equipment is ready for a new load

3.1.20

lifting zone

space between the working area and the maximum lifting height

3.1.21

LSA code

the IMO SOLAS Life saving appliances (LSA) Code, 2003 Edition, adopted by the Maritime Safety Committee (MSC) by resolution MSC.48(66) including the Revised recommendation on testing of life-saving appliances (resolution MSC.81(70)).

3.1.22

main lay down area

deck area for temporary storage of loads and equipment during normal logistics operation of the installation

3.1.23

material handling

vertical and horizontal movement of a load

NOTE Material handling principles include all activities related to handling of goods and materials to and from and internally on the installation in all phases of its lifetime

3.1.24**may**

verbal form used to indicate a course of action permissible within the limits of this NORSOK standard

3.1.25**means of connection**

mechanical parts (e.g. hooks, links, rings, etc.) intended for connection of the life saving equipment to the launching and recovery appliance

NOTE The term "means of connection" covers both those parts which are integral to the life saving equipment and those parts which are integral to the lifting appliance.

3.1.26**offshore crane**

slewing crane used offshore for lifting operations with relative movements between the crane and the loading area

3.1.27**personnel transfer carrier**

basket suspended on cranes used for transfer of personnel between installations and ships

3.1.28**rated capacity (R)**

maximum load that a lifting appliance is designed to lift under specific conditions

NOTE Rated capacity which corresponds to SWL used by International Labour Organisation (ILO).

3.1.29**redundant component**

component or components which continue to perform a failed component's purpose or function without affecting the safe operation

3.1.30**release mechanism**

parts of the means of connection that are moveable for the purpose of disconnecting the life saving equipment from its launching and recovery appliance

3.1.31**release system**

combination of release mechanism and activation system

3.1.32**reliability**

ability of an item to perform a required function under given conditions for a given time interval

3.1.33**reliable component**

component which is capable of withstanding all load conditions, disturbances and stresses, with a low probability of failures or malfunctions

3.1.34**rescue boat**

boat designed to rescue persons in distress and to marshal survival craft.

NOTE Rescue boats are also commonly known as man over board (MOB) boats.

3.1.35**rescue equipment**

rescue boats and personnel transfer carrier

3.1.36**risk**

combination of the probability of occurrence of harm and the severity of that harm

3.1.37**safe working load****SWL**

maximum working load that the lifting equipment is designed to lift under specific conditions

NOTE Safe working load corresponds to the term rated capacity (R) used by many standards.

3.1.38**shall**

verbal form used to indicate requirements strictly to be followed in order to conform to this NORSOK standard and from which no deviation is permitted, unless accepted by all involved parties

3.1.39**should**

verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required

3.1.40**significant wave height**

average height of the highest third of prevailing waves, typically measured over a period of 3 h

3.1.41**test**

specific operation of lifting equipment, with or without a defined load, in order to determine whether the lifting equipment is suitable for use

3.1.42**test load**

specified load that the lifting equipment shall withstand within the manufacturer's specified limits without resulting in permanent deformation or other defects

NOTE Thereby confirming that the design, materials and manufacture comply with specification and statutory requirements.

3.1.43**working area**

vertical projection of all possible load positions

3.1.44**working load limit****WLL**

maximum load that a lifting accessory is designed to lift at a specific configuration

3.2 Abbreviations

ALARP	as low as reasonable practicable
ALS	accident limite state
ATEX	Atmosphères Explosibles
CE	Conformité Européenne
EMC	electromagnetic compatibility
EU	European Union
FAT	factory acceptance test
FMECA	failure mode, effects and criticality analysis
FPSO	floating production, storage and offshore loading
HVAC	heat, ventilation and air conditioning

IMO	International Maritime Organization
LS	life saving
NLS	none life saving
NMD	Norwegian Maritime Directorate
RCM	reliability centered maintenance
SLS	serviceability limit state
SWL	safe working load
UHF	ultra high frequency
ULS	ultimate limit state
VHF	very high frequency
WLL	working load limit

4 General safety requirements

4.1 Safety

Lifting equipment shall be designed, fabricated, tested, installed and maintained in such a way to reduce and minimise risks to humans, the environment and material assets.

All forms of energy including lifting and moving objects, represented or produced by lifting equipment, shall be controlled at any time in a safe manner.

The lifting equipment shall be designed such that no single technical failure results in an unacceptable risk.

4.2 Fitness for use

To minimise the risk of human error during all phases of use, simplicity, comprehensibility, maintainability and recognisability shall be emphasised when designing the lifting equipment.

The selection of type and specification of requirements for lifting equipment shall be based on the specific conditions at the workplace, the work itself, and any risk that may arise during the work.

4.3 Reliability and availability

Lifting equipment shall be designed and constructed using well-proven components and safety principles, to ensure reliability by withstanding

- the operating stresses and loadings,
- the environmental influences,
- other relevant influences.

Lifting equipment shall be designed to ensure high availability and a minimum of “down-time” during the design life. In case of conflict between reliability, availability and/or safety, safety shall always prevail.

4.4 Principle of safety integration

The designer shall aim to eliminate any risk throughout the design lifetime of the lifting equipment, including the phases of transport, assembly, disabling, scrapping and dismantling.

In selecting the most appropriate methods, the manufacturer shall apply the following principles of safety integration in the order given:

1. Eliminate and reduce risks as far as possible by implementation of inherently safe design measures
2. Safeguarding and complementary protection measures in relation to risks that cannot be eliminated
3. Inform the users of the residual risks due to any shortcomings of the protection measures adopted, etc.

The basic terminology, methodology and technical principles are given in ISO 12100-1 and ISO 12100-2.

A documented risk assessment shall be worked out for all lifting appliances. The documentation of risk assessment shall demonstrate that the requirements for performing the risk assessment have been met, and that the results with respect to the acceptance criteria are fulfilled.

The risk assessment principles are given in ISO 14121-1 and ISO/TR 14121-2.

For complex lifting appliances the risk assessment shall be developed using methods on component level, e.g. FMECA as described in IEC 60812.

4.5 Inherently safe design measures

Inherently safe design principles using reliable components shall be applied, see ISO 12100-2, clause 4. Dependent on the result of the risk assessment, fail-safe components or redundant components shall be used.

4.6 Safeguarding and complementary protective measures

Safeguarding and complementary protective measures shall be used to reduce or eliminate risks that can not be avoided or sufficiently limited by inherently safe design measures. Reference is made to ISO 12100-2, clause 5.

4.7 Information for use

Information for use consists of communication links (e.g. text, words, signs, signals, symbols), or diagrams used separately or in a combination to convey information to the user. Information for use shall be supplied to further reduce risks that can not be avoided or sufficiently reduced by inherently safe design measures or safeguarding and complementary protective measures. The information for use shall be an integral part of supply of lifting equipment. Reference is made to ISO 12100-2, clause 6.

4.8 Strength proportion

The strength elements (structural and mechanical) of lifting equipment shall be designed such that the consequences of accidental overloading or unexpected load conditions which causes break down are known and minimised. This requirement does not apply for lifting accessories and portable units.

For cranes and launching appliances for life saving equipment this requirement should be fulfilled by ensuring that the first element to fail is not the foundation or any other element which is essential for the structural integrity of the entire crane or launching appliance.

4.9 Maintenance

Lifting equipment shall be designed and arranged with means for efficient maintenance which ensure that the safe condition can be maintained for the specified design life.

A high level of maintainability shall be ensured, i.e. that the maintenance can easily be performed.

Facilities, including safe access, for maintenance, inspection and testing of essential elements and functions shall be provided.

The maintenance shall be planned with the following priority:

1. Safety
2. Reliability
3. Availability

A maintenance programme shall be provided for all lifting equipment and shall include all important maintenance tasks highlighted and recommended in the risk assessment, see 4.11.

For cranes reference is made to ISO 12482-1 and relevant parts of NORSOK Z-008, as applicable.

If appropriate for complex lifting appliances, the maintenance programme shall be developed on component level, e.g. RCM as described in IEC 60300-3-11.

4.10 Quality management system

The design, manufacturing and installation of lifting equipment shall be performed in accordance with a quality management system. The quality management system shall be in accordance with ISO 9001 or equivalent.

4.11 Risk assessment

4.11.1 General

Risk assessment shall be an integral part of the supply of lifting equipment. This implies that the knowledge and experience of the design, manufacturing, installation, transportation, assembly, dismantling, use, maintenance, incidents, accidents and harm, etc. related to lifting equipment shall be collected and used by the designer in order to assess the risks of lifting equipment during all phases.

Risk assessment shall be an iterative process, and repeated after the application of risk reduction measures until an acceptable level of safety is obtained, see principle of evaluation of risks stated in 4.12.

The risk assessment shall be carried out in accordance with ISO 14121-1.

NOTE ISO 14121-1 gives a more comprehensive description of risk assessment.

The relevant method of analysing hazards and estimating risk shall be selected depending on the lifting equipment characteristics and the type of risks that are dominating. Examples of such methods are described in ISO/TR 14121-2, Annex A.

The risk assessment shall be documented as stated in 4.13 and used as input for the maintenance planning, see 4.4.

4.11.2 Determination of the limits

Determination of the limits of the lifting equipment is the first step in the risk assessment. Determination of the limits of the lifting equipment includes the technical properties and the performance of the lifting equipment, the personnel involved and the environmental constraints at all times.

Determination of limits of the lifting equipment shall include, but not be limited to

- use limits including intended use and foreseeable misuse,
- different modes of operation and operator interventions,
- space limits,
- time limits,
- environmental limits.

4.11.3 Identification of hazards

All hazards, hazardous situations and events shall be systematically identified. The phases shall include, but not be limited to

- construction,
- assembly,
- FAT,
- transport,
- installation,
- commissioning,
- use and foreseeable misuse,
- maintenance and testing,
- repair,
- de-commissioning, dismantling and removal.

Further reference is ISO 14121-1.

4.11.4 Estimation of risks

The risk is the combination of the probability of occurrence of harm and the severity of that harm.

The severity of harm to health can be estimated by taking into account

- a) the severity of injuries or damage:
 - 1) slight;

- 2) serious;
 - 3) fatal.
- b) the extent of harm:
- 1) one person;
 - 2) several persons.

Or, in case of an extended harm of an economic and/or environmental nature:

- a) the severity of the extended harm in terms of cost or environmental damage:
- 1) minor;
 - 2) major;
 - 3) catastrophic.
- b) the extent of the extended harm in terms of cost or environmental damage:
- 1) slight;
 - 2) moderate;
 - 3) extensive.

The probability of occurrence of any harm shall be estimated by taking into account the exposure to a hazard, occurrence of a hazardous event, and the possibilities of avoiding the harm.

The exposure to a hazard is influenced by

- a) need for access to the hazard zone,
- b) time spent in the hazard zone,
- c) number of persons exposed,
- d) frequency of access.

The occurrence of a hazardous event is influenced by

- a) reliability and other statistical data,
- b) incident and accident history,
- c) risk comparison.

The possibilities of avoiding the harm are influenced by

- a) personal skills,
- b) how quickly the hazardous situation is developing,
- c) awareness of risk,
- d) possibility of escape.

4.11.5 Evaluation of risks

Risk evaluation shall be carried out to determine if risk reduction is required. If risk reduction is required, then appropriate risk reduction measures shall be selected and applied in accordance with 4.12, followed by repeated risk assessment. As a part of this iterative process, the designer shall check whether additional hazards are created or other risks are increased, when new measures are applied. If additional hazards do occur, they shall be added to the list of identified hazards, analysed and evaluated.

For standardised lifting equipment which is fully covered by the standards referred to herein, and which fully complies with the requirements stated, without additional hazards, the acceptance criteria in this NORSOK standard apply.

For non-standardised lifting equipment or standardised lifting equipment which partly or fully does not meet the requirements in this NORSOK standard, the remaining risks shall comply with the ALARP principle. The ALARP principle may be described as a reverse burden of proof, i.e. that risk reduction measures shall be implemented, if there is no evidence showing why not. The designer shall implement risk reduction measures unless it can be proven that there is a major inconsistency between cost and benefit.

4.12 Risk reduction

Risk reduction shall comprise all possibilities to reduce the risk, including redesign, design modification, protective measures and information for use.

The designer shall select the most appropriate measure following the three step method below:

- Step 1. Inherently safe design measures
- Step 2. Safeguarding and possible complementary protective measures
- Step 3. Information for use covering residual risks

For reference, see 4.4.

4.13 Documentation of risk assessment

Documentation of risk assessment shall demonstrate that the requirements for performing risk assessment have been met, and that the acceptance criteria are fulfilled.

The documentation shall include description of

- a) the lifting equipment for which the assessment was made (e.g. specifications, limits, intended use) and any relevant assumptions that have been made (e.g. loads, strengths, safety factors),
- b) the hazards and hazardous situations identified and the hazardous events considered in the assessment,
- c) the information on which risk assessment was based:
 - 1) the data used and the sources (e.g. accident histories, experiences gained from risk reduction applied to similar lifting equipment);
 - 2) the uncertainty associated with the data used and its impact on the risk assessment.
- d) the objectives to be achieved by protective measures,
- e) the protective measures implemented to eliminate identified hazards or to reduce risk (e.g. from standards or other requirements),
- f) residual risks associated with the lifting equipment,
- g) the result of the risk assessment,
- h) any forms completed during the assessment such as those given in ISO/TR 14121-2.

4.14 Verification

Lifting equipment shall be subjected to internal verification by the manufacturer to ensure compliance with the requirements. Such internal verification shall be part of the technical construction file, see 5.25.

Before being taken into use, the lifting equipment shall be certified by an enterprise of competence, in accordance with NORSOK R-003 or NORSOK R-005.

Devices for the lifting of persons or of persons and goods involving a hazard of falling from a vertical height of more than 3 m, shall be subject to an involvement by a Notified Body, if the Machinery Directive is applicable.

The need, extent, method and independency of third party verification of the lifting equipment shall be agreed upon, dependent on the criticality of the lifting operations to be performed. DNV-OSS-308 may be used as a reference.

Verification reports shall form part of the final documentation and made available to the end user.

4.15 Qualification of new technology

The solutions described in this NORSOK standard are generally accepted as qualified at the time of publication of this NORSOK standard. Other solutions may also be applied, provided they are sufficiently qualified in accordance with recognised methods. The procedures and principles in DNV-RP-A203 may be used for qualification of new technology.

5 Common requirements

5.1 Suitability

5.1.1 General

At the time of contract for the delivery of lifting equipment, parameters essential to ensuring that the lifting appliance is suitable and fit for use shall be agreed upon. Such design parameters shall include, but not be limited to

- location of installation,
- type of installation,
- area of installation, arrangement and lay-out,
- environment, including temperatures, radiation, wind and other weather conditions, if relevant,
- criticality of the loads to be lifted, and the importance of the lifting operation,
- rated capacity,
- classification (utilization) (see also 5.8),
- design life,
- noise and emissions,
- operational limitations,
- anti collision system,
- fire and gas shut down philosophy,
- automatic shut down criteria,
- other relevant health, safety and environment requirements.

5.1.2 Lifting of personnel

Lifting equipment for the lifting of personnel shall be designed and equipped to minimise the risk for the personnel.

The structural and mechanical capacity of lifting equipment for the lifting of personnel shall be designed with a higher value risk coefficient, see 5.9 and the relevant annexes.

Lifting appliances for the lifting of personnel shall be equipped with additional safety features, see 5.9, 5.15 and the relevant annexes.

5.1.3 Mechanical interference

Lifting appliances shall be arranged and located with the aim not to interfere with other machinery or equipment.

Warning signals and anti-collision systems shall be provided on lifting appliances where mechanical interference with other machinery or equipment represents an unacceptable risk. If so, such equipment shall be specified by customer.

5.2 Materials and products

Materials and products used to construct lifting equipment, or products contained or created during the use of lifting equipment, shall not cause harm. The use of toxic or harmful liquids and substances shall be minimised.

5.3 Fire and explosion

5.3.1 Fire prevention and protection

Fire prevention and protection of lifting appliances shall be in accordance with NORSOK S-001 and EN 13478.

All equipment, electrical and non-electrical, installed and used in hazardous areas, shall comply with ATEX requirements (see EN 1127-1 as relevant of the hazardous area classification), i.e. Zone 0, Zone 1 or Zone 2.

Fire prevention and protection shall be marked in accordance with ISO 6309.

5.3.2 Hazardous areas

Lifting equipment shall be compatible with the classification of the area in which it is installed and used.

Electrotechnical equipment mounted externally (exposed to potential explosive atmosphere) on lifting appliances located in non-hazardous areas, shall as a minimum be classified for use in hazardous area Zone 2, see NORSOK S-002. Crane boom movements may require Zone 1 equipment.

Area classification shall be in accordance with IEC 61892 (all parts).

5.3.3 HVAC

HVAC in enclosed spaces of lifting appliances shall be in accordance with NORSOK S-001 and NORSOK S-002, if applicable.

5.3.4 Fire and gas detection

Complex lifting appliances shall be equipped with fire and gas detection in accordance with NORSOK S-001 as applicable. Requirements additional to NORSOK S-001 shall be specified by customer.

5.3.5 Fire and gas alarms

Lifting appliances with control cabins shall be equipped with fire and gas alarms from the installation which enable the operator to terminate any lifting operations and bring the crane and the load to a safe position before activating a manual shut down. Reference is made to ISO 13702.

5.3.6 Shut-down system

Lifting appliances which represent a hazard if operated in an explosive atmosphere, shall be equipped with an automatic shut-down system which is activated upon confirmed gas detection in the crane ventilation system or in the combustion air inlet, without delay, see NORSOK S-001.

Lifting appliances for life saving appliances and for the lifting of personnel may be specially considered.

5.4 Ergonomics

5.4.1 General

Lifting equipment shall be designed in accordance with ergonomic principles in accordance with EN 614-1 and EN 614-2. In addition, ISO 6385 shall be used for guidance. Relevant requirements in NORSOK S-002 shall be complied with.

5.4.2 Operator position

Control stations for lifting appliances shall be designed and constructed to avoid any risk related to the health and safety of the operator, and such that the operator can safely supervise and control the lifting operations. Design of displays and control actuators shall be in accordance with EN 894-1, EN 894-2 and EN 894-3.

5.4.3 Escape and access

Lifting appliances shall be equipped with access and escape routes for personnel in accordance with EN 13586.

Lifting appliances shall be designed for safe access for operation, inspection and maintenance in accordance with NORSOK S-002.

Ladders, where there is a risk of falling, shall have self closing gates.

Offshore cranes for daily operation shall be equipped with a main access route and a separate alternative escape route between the entrance to the cabin/machinery house and the deck of the installation. The main access route shall have stairway ladders between different levels and be designed for the transport of supplies and spares, and in an emergency to facilitate transport of a stretcher, smokediving and firefighting equipment.

5.4.4 Marking

Lifting equipment shall be marked with identification number (tag. no.) and SWL/WLL).

Cranes shall have additional marking in accordance with EN 12644-2.

Safety colours and safety signs of lifting equipment shall be in accordance with ISO 3864-1, ISO 3864-2, ISO 3864-3 and ISO 13200.

5.4.5 Illumination

A main electric lighting system shall provide illumination of every part of the lifting appliances normally accessible to operators and maintenance personnel, taking its supply from the main source of electrical power.

An emergency lighting system shall provide illumination of the working area of every part of the lifting appliance normally accessible to operators and maintenance personnel, taking its supply from the emergency source of electrical power. Upon loss of the main power source, all emergency lighting shall automatically be supplied from the emergency source of power to ensure safe emergency operation and emergency escape.

Aircraft warning lights shall be installed on all lifting appliances representing a risk of obstruction for aircrafts. Illumination of working area shall be in accordance with NORSOK S-002, 5.6

5.4.6 Prevention of unexpected start-up

Powered lifting appliances shall have devices preventing unexpected start-up in accordance with EN 1037.

Lifting appliances with enclosed cabins and/or remote operated control stations, shall be equipped with a switch/device with which the operator can disable the main control levers.

5.4.7 Guards

Lifting appliances shall be equipped with fixed or moveable guards in accordance with EN 953 to protect persons from mechanical, thermal or other hazards as determined by the risk assessment or described in the annexes or references given in the annexes of this NORSOK standard.

5.4.8 Crushing hazard

For both operation and regular maintenance activities, exposed areas of lifting equipment shall be designed with safety zones and distances to prevent personnel being harmed or injured by moving parts. Reference is made to ISO 13857 and EN 349.

5.4.9 Falling objects

Any components fitted externally on lifting equipment and which may be subjected to vibrations or impacts from contact with other objects during operation, shall be analysed with respect to the hazard of falling objects. If such hazard is unacceptable, the components shall be secured with a double physical barrier against detachment.

NOTE An example of such mechanical component with a double physical barrier is a shackle pin secured in a shackle bow using a threaded nut locked by a split pin. Another example is an additional wire strap or a chain that is capable of catching and holding the falling object without damage.

Bolts used in lifting equipment shall normally be secured. Exceptions are bolts which represent no hazard.

The following methods/products are considered to be properly secured:

- controlled pretension to 70 % of yield;
- nut with split-pin through the bolt;
- through metal nuts;
- locking plates.

Other well proven methods and designs may also be used.

5.4.10 Mechanical vibration and shock

Lifting equipment shall be evaluated for mechanical vibration and shock to humans in accordance with NORSOK S-002 and ISO 2631-1.

5.4.11 Handling and transport facilities

Lifting appliances shall be provided with facilities for handling and transport of major components, e.g. motors, gearboxes, pumps, sheaves, etc.

Detachable parts of lifting appliances weighing more than 25 kg shall be shaped to facilitate strapping or be equipped with attachment points, i.e. lifting lugs etc.

Reference is made to Annex B.

5.4.12 Hot surfaces

The temperature of hot surfaces (e.g. exhaust pipes and channels) shall not exceed the ignition temperatures of flammable mediums that can escape upon accidental leaks.

Shields and guards intended to prevent skin contact shall be fitted, if required.

5.5 Environmental conditions

5.5.1 Temperatures

The design temperature for the lifting equipment, shall be agreed upon.

The corresponding minimum and maximum operating temperatures shall be determined by the manufacturer and shall be stated in the instructions for use.

Lifting equipment designed to operate in cold climate where snow and ice may occur, shall be designed for minimum snow and ice accumulation and the instruction for use shall state any operational limitations caused by snow and ice.

5.5.2 Atmosphere

Lifting equipment shall be designed for operation in a marine atmosphere with 100 % relative humidity, unless otherwise agreed.

5.5.3 Radiation

Lifting equipment intended to be used in areas where it may be exposed to heat radiation from flares or burner booms etc., shall be fitted with heat radiation shielding and any operational limitations shall be stated in the instructions for use.

Wire ropes, sheaves etc., which are exposed to heat radiation shall be fitted with facilities for lubrication. Replacement intervals shall be compatible with local radiation levels.

Lifting appliances shall be designed to limit radiation generation in accordance with EN 12198-2.

5.5.4 Wind

Where applicable for lifting appliances, wind loads shall be specified for both in service and out of service. Reference is made to specific requirements given in annexes for the equipment groups.

Where no specific wind loads are specified, the requirements stated in EN 13001-2, 4.2.3.1 and 4.2.4.2, apply.

5.5.5 Waves, sea induced motions and inclinations

Where applicable, lifting equipment shall be designed for dynamic impacts, load offsets and inclinations of the installation (on which the lifting equipment is located), that may occur when such equipment is in or out of service.

Reference is made to requirements in annexes for the equipment groups.

5.6 Operational loads

Lifting equipment shall be designed for the in-service and out-of-service operational loads including the environmentally induced loads that may occur at/on the installation.

The operational limitations shall be stated in the instructions for use and in rated capacity information (e.g. load indicators, load tables, marking etc.) for the equipment.

5.7 Strength and stability – structure and mechanisms

5.7.1 General

The strength and stability of lifting equipment shall be calculated and documented in accordance with recognised international standards and design codes. If design standards are not specifically listed in the annexes, the method described in 5.7.2 to 5.7.6 shall be used.

5.7.2 Principles for proof of competence

Structural and mechanical strength of structural members and their connections, ropes, rope reeving components and load holding devices and other lifting components shall be documented by performing proof calculations in accordance with the principles of the limit state method described in EN 13001-1.

5.7.3 Loads, load actions, load combinations and load effects

Loads shall be selected/calculated, amplified by dynamic coefficients, multiplied by partial safety factors and superimposed into load combinations in accordance with EN 13001-2 in order to decide their resulting load effects in terms of upper and lower extreme values of nominal stresses or inner forces. Load combinations given in the Annexes of this NORSOK standard shall be applied.

5.7.4 Limit states and proof of competence

The following parts of the CEN/TS 13001-3 series shall be used for the selection of limit design stresses/forces and for the proof of static strength, fatigue strength and elastic stability. The technical specifications listed below also apply to the selection of materials:

- CEN/TS 13001-3-1 for structural members and welded, bolted and pinned connections;
- CEN/TS 13001-3-2 for wire ropes in reeving systems;
- prCEN/TS 13001-3-3 ¹⁾ for wheel/rail contact;
- FprCEN/TS 13001-3-5 ¹⁾ for forged hooks.

Bolts of class 12.9 shall not be used in load bearing connections.

For fatigue design of steel structures DNV RP-C203 may be used as a supplement.

5.7.5 Mechanisms

Mechanisms are devices needed to start or stop a relative motion between two rigid parts of the lifting appliance, between the lifting appliance and its foundation, or between the lifting appliance and the lifted load. Thus motors, brakes, transmission systems and similar components are defined as mechanisms.

Strength of components that form parts of mechanisms shall be proved for loads defined in FEM 1.001, booklet 2, 2.5, applying the allowable stress method for the load combinations referenced in clause 5.7.3 of this standard. All partial safety factors shall be set to 1,0 for this purpose. If relevant (e.g. for lifting persons), the risk factor referenced in 5.9 shall be applied.

Components of mechanisms shall be checked for adequate safety against failure due to fracture, crippling, fatigue and excessive wear in accordance with FEM 1.001, booklet 4, 4.1.

Requirements given in EN 13135-2 shall also apply for certain components in mechanisms.

¹⁾ To be published.

¹⁾ To be published.

5.7.6 Brakes

Unless otherwise stated in this NORSOK standard, brakes for hoisting mechanisms, travel mechanisms and winch driven luffing mechanisms shall, in addition to the requirements of EN 13135-2, comply with the design requirements given in FEM 1.001, booklet 7, 7.5.3.

5.8 Strength and stability – classification

The service condition should be specified according to EN 13001-1 by the following classification:

- Working cycles Classification of U
- Average displacement Classification of D
- Load spectrum Classification of Q
- Number of accelerations Classification of P

5.9 High risk applications

Lifting equipment for high risk operations such as the lifting of persons shall be designed using the risk coefficient stated in EN 13001-2 and safety measures as listed in EN 13135-2, 5.12.3.

As a general rule, the risk coefficient for lifting of persons by using lifting appliances shall be taken as $\gamma_n = 1,5$.

Other requirements for the high risk applications are stated in the annexes.

5.10 Power systems

5.10.1 Electrical installations

Electrical powered lifting appliances shall be provided with relevant power supplies from the installation in accordance with NORSOK E-001.

Electrical installations of lifting appliances shall be in accordance with IEC 61892 (all parts).

5.10.2 Electrical motors

Electrical motors installed in lifting appliances shall be in accordance with applicable parts of IEC 60034.

5.10.3 Combustion engines

Combustion engines installed in lifting appliances shall be in accordance with EN 1679-1 and EN 1834-1.

Arrangement and exhaust of combustion engines shall be in accordance with the applicable area classification, see 5.3.

5.11 Electro technical equipment

Electro technical equipment of lifting equipment shall be in accordance with EN 13135-1, IEC 60204-1 and IEC 60204-32.

Minimum requirements for protection against water ingress and dust penetration to enclosures shall be as follows:

- For indoor located equipment: Grade IP55 according to IEC 60529
- For outdoor located equipment: Grade IP66 according to IEC 60529

5.12 Non-electro technical equipment

Non-electro technical equipment of lifting equipment shall be in accordance with EN 13135-2.

5.13 Controls, control stations and control systems

Controls and control stations including any cableless controls, if relevant, shall be in accordance with EN 13557.

Control systems shall, as a general rule, be designed so that a fault in the control systems does not lead to a hazardous situation. Safety principles in IEC 60204-32 shall be applied.

Safety related parts of control systems for complex lifting appliances shall be in accordance with ISO 13849-1. Unless otherwise stated in this NORSOK standard or references made in the annexes, the required performance levels (PLr) for safety related parts of control systems shall be in accordance with Table 1. For definition of symbols, see ISO 13849-1.

Table 1 — Safety functions – required performance levels

Safety functions(hazard of malfunction)				
	Severity	Frequency/time of exposure	Possibility of avoiding the hazard	PLr
Emergency stop	S2	F1	P2	d
Limiters	S2	F1	P1	c

If the lifting appliance has safety related parts in control systems and safety functions not detailed in this NORSOK standard, the manufacturer shall determine the required performance level in accordance with ISO 13849-1, and demonstrate that the required performance level is achieved.

Programmable electronic systems shall follow the principles of ISO 17894.

5.14 Limiting and indicating devices

Limiting and indicating devices on lifting appliances shall be in accordance with EN 12077-2.

Visual danger signals shall be in accordance with EN 842.

5.15 Emergency systems

5.15.1 Emergency stop

Power operated lifting appliances shall be equipped with an emergency stop in accordance with ISO 13850.

5.15.2 Emergency lowering system

Power operated lifting appliances for suspended loads shall be equipped with an emergency lowering system in order to avoid hazard of swinging loads in the event of loss of normal lowering function. This system is not required if an emergency operation system is provided in accordance with 5.15.3.

The emergency lowering system shall enable a controlled lowering of the load upon a power failure, landing the load safely.

The activation switches or handles shall be of hold-to-run type, and shall be clearly and permanently marked. The control station for emergency lowering shall be positioned in a place that gives the operator a clear view of the load and the lifting zone. The system shall be simple to operate and shall be available without undue delay in order to avoid unacceptable risk. A clear and unambiguous operation procedure for the system shall be included in the instructions for use and shall be permanently displayed at the control station.

5.15.3 Emergency operation

Offshore cranes on floating installations and lifting appliances for the lifting of persons shall be equipped with an emergency operation system. The system shall be able to move the load in any direction, in case of a main power failure or a control system failure, utilising a secondary independent power supply system and a secondary independent control system.

The system shall be simple to operate and shall be available without undue delay in order to avoid unacceptable risk. Unless specified otherwise in the annexes the minimum hoisting and lowering speeds for SWL shall be 10 % of the minimum required speeds. Only one function may be operated at a time.

The control devices shall be of hold-to-run type, and shall be clearly and permanently marked. A separate emergency stop shall be provided for the emergency operation system.

A clear and unambiguous operation procedure for the system shall be included in the instructions for use and shall be permanently displayed at the control station.

Specific requirements applicable to different types of lifting appliances are given in the relevant annexes.

5.16 Communication

5.16.1 Telephone

Cranes and lifting appliances with an enclosed control station shall be fitted with a permanently installed telephone communication system.

5.16.2 UHF/VHF radio

Lifting appliances with an enclosed control station shall be fitted with permanently installed UHF and VHF radio facilities. It shall be possible for the crane driver to send/receive messages without removing the hands from the main control levers.

5.16.3 Loudspeaker/alarm horn

Lifting appliances with an enclosed control station shall be fitted with permanently installed loudspeaker or alarm horn that can be operated by the crane driver without removing the hands from the main control levers.

5.17 Pneumatics

Pneumatic systems and components of lifting equipment shall be in accordance with EN 983.

5.18 Hydraulics

Hydraulic systems and components shall be in accordance with EN 982.

Pressure testing of each part of the system is specified in EN 982, 6.2. In addition, an extended hydrostatic pressure test of the assembled routing system (pipes, hoses and interconnection fittings) shall be carried out. The test pressure shall be 1,5 times the maximum working pressure, limited to 70 bar above the maximum working pressure.

The test pressure holding time shall be minimum 15 min and the oil temperature shall be minimum 7 °C.

5.19 Electromagnetic compatibility (EMC)

5.19.1 EMC immunity

EMC immunity of lifting appliances shall be in accordance with IEC 61000-6-2.

5.19.2 EMC emission

EMC emission of lifting appliances shall be in accordance with IEC 61000-6-4.

5.20 Exhaust and noise emissions

Lifting appliances shall be designed for minimum noise emission according to ISO/TR 11688-1 and ISO/TR 11688-2. The A-weighted emission sound pressure level at the operator position with windows and doors closed and the HVAC turned on, if applicable, shall be less than 80 dB(A).

Exhaust from combustion engines used in lifting appliances shall not exceed the allowable emission limits given in Directive 97/68/EC as amended by Directive 2002/88/EC and Directive 2004/26/EC.

5.21 Utility systems

5.21.1 Sight

Lifting appliances which have an enclosed control station shall have permanent means for window cleaning operated from inside the control station. In addition access means shall be provided for replacement of windshield wipers and manual cleaning of the windows from the outside.

5.21.2 Ventilation

Indoor climate of lifting appliances shall be in accordance with NORSOK S-002, 5.7.

5.21.3 Utility supplies

Lifting appliances shall have permanent arrangements for utility supplies (e.g. water, fuel, service air and electrical connections), as applicable. Details to be agreed upon.

Lifting appliances containing fuel, oil, grease etc. which represent a hazard to the environment, shall have permanent arrangements for enclosed drainage to tank.

5.22 Fabrication

Lifting appliances shall be fabricated in accordance with DNV Standard for certification of lifting appliances No. 2.22, Ch.2, Section 2 Materials and fabrication. This include e.g.

- material selection,
- material certificates,
- material quality,
- welding,
- forming (hot or cold),
- inspection and testing.

5.23 Installation and assembly

Lifting appliances shall be installed and assembled in accordance with DNV Standard for certification of lifting appliances No. 2.22, Ch.2, Section 2 Materials and fabrication, and relevant parts of NORSOK Z-007.

5.24 Corrosion protection

5.24.1 General

In selecting of materials and combination of materials used in lifting equipment, due consideration shall be given to environmental conditions with regards to risk of corrosion.

5.24.2 Surface preparation and protective coating

Surface preparation and protective coating shall be in accordance with NORSOK M-501 and/or ISO 12944-1.

5.24.3 Bolting

Corrosion resistant steel shall be used for external bolting of 10 mm diameter and smaller.

Larger bolts shall normally be hot-dip galvanised low alloy steel. If other qualities are used, special corrosion protection measures shall be applied, e.g. protected cups grease filled.

Bolt assemblies that are essential to mechanical safety, shall be in accordance with ISO 898-1 and DNV Standard for certification of lifting appliances, No.2.22, Ch.2, Sec. 2, C200 and D400.

5.25 Technical construction file

5.25.1 General

A technical construction file shall be compiled by the manufacturer of lifting equipment.

The technical construction file shall address all requirements of this NORSOK standard, as applicable.

The technical construction file shall be prepared and presented in such detail that a third party is able to perform a verification of the product according to the requirements of this NORSOK standard, without supplementary information.

5.25.2 Content

The technical file shall contain, as a minimum,

- unique identification details of the lifting equipment,
- design specification including design parameters,
- risk assessments including resulting risk reduction measures and residual risk level,
- applicable requirements for the lifting appliance,
- standards and codes used,
- technical information, such as drawings, diagrams, calculations, test reports etc.,
- fabrication documentation, e.g. material certificates, fabrication procedures, welding documentation etc.,
- verification reports,
- formal statements, declarations and certificates,
- instructions for use, including inspection and maintenance instructions, including wear and tear tolerances, non destructive examination (NDE) programmes, if applicable.

5.25.3 Instruction for use

The instruction for use shall be made available to the end user.

The instruction for use of lifting appliances shall be in accordance with EN 12644-1.

The instruction for use of lifting accessories shall be in accordance with EN 13155, 7.1.

The maintenance instructions shall include a maintenance programme in accordance with 4.9.

The maintenance instructions shall include information on training of operators and maintenance personnel.

In the case of complex lifting appliances, the information on training of operators and maintenance personnel shall take into account the local conditions on/at the installation and its location.

Annex A

(Normative)

Launching and recovery appliances for life saving equipment

A.1 General (Group E)

A.1.1 Introduction

Some of the requirements given in this annex may require new and unproven technology. Unproven technical solutions shall be qualified in accordance with 4.1.15.

This annex contains technical requirements concerning lifting and lowering facilities of launching and recovery appliances for life saving equipment. This annex also covers suspension and hang-off points for lifesaving equipment and means of connection and release systems that are integral part of the life saving equipment.

Reference is also made to NORSOK S-001 and NORSOK S-002.

This annex does not cover outfitting and other technical facilities that are not related to launching, hang-off or recovery of the life saving equipment. For such equipment, reference is made to national and international regulations and equipment specific standards, e.g. DNV-OS-E406 for free fall lifeboats.

The supplier shall ensure that interfaces regarding operational and technical aspects between launching and recovery appliances, the installation and the lifesaving equipment are in compliance with this NORSOK standard.

The structural strength of launching and recovery appliances for lifesaving equipment shall comply with the requirements of this NORSOK standard. Dynamic coefficients and risk coefficients shall be applied in accordance with A.1.4, A.1.5 and A.1.6.

Launching and recovery appliances shall be in accordance with NMD Regulation 4 July 2007 No. 853 concerning evacuation and life-saving appliances on mobile offshore units, section 8. In addition, other specific sections from said NMD Regulations as referred to in this Annex, apply. Certain requirements from the LSA Code become applicable through references in the said NMD Regulation. In case of conflicting requirements in this NORSOK standard and said NMD Regulation, the following applies:

- the most stringent requirements for structural and mechanical strength apply;
- otherwise the requirements of this NORSOK standard apply.

For lifting accessories used in launching and recovery appliances for life saving equipment, reference is also made to Annex C.

For cranes used as launching and recovery appliances for life saving equipment, reference is also made to Annex G.

The requirement for efficient hand gear for recovery of lifeboats and rescue boats given in the LSA code, section 6.1.2.6, is not comprised by this NORSOK standard.

A.1.2 Group overview

Table A.1 lists the groups of launching and recovery appliances covered by this Annex.

Table A.1 – Groups of launching and recovery appliances

Launching and recovery appliances for life saving equipment							
	Groups						
	Evacuation equipment					Rescue equipment	
	E.1 Free fall lifeboats	E.2 Lifeboats launched by falls and a winch	E.3 Escape chutes	E.4 Rafts	E.5 Escape lines	E.6 Rescue boats	E.7 Personnel transfer carriers

A.1.3 Structural and mechanical strength, proof of competence

Structural and mechanical strength of launching and recovery appliances for life saving equipment, their structural members, machinery, ropes, rope reeving components and means of connection shall be documented by performing proof calculations in accordance with the principles of the limit state method as described in 5.7.

Structural and mechanical strength of the means of connection which are integral parts of the life saving equipment and their anchorage to the life saving equipment shall be documented in the same way.

The proof of competence shall be performed for the ULS and the ALS.

A.1.4 Loads and operational limitations**A.1.4.1 Operational limitations**

Launching and recovery appliances shall be designed to be installed, maintained, tested and used within the limitations described by the following sets of conditions:

- NLS condition;
- LS condition.

The NLS condition is applicable for operation during installation and maintenance.

The LS condition is applicable for operation during a real life saving situation, i.e. evacuation or rescue.

The conditions are defined by

- environmental conditions in terms of max wind speed and max significant wave height,
- operational situations as sidelead and offlead,
- max static angle of heel for the installation in the damaged stability condition.

The NLS and LS conditions are defined in Table A.2.

The design temperature T_D shall be taken as -20 °C, unless otherwise agreed.

It is the responsibility of the supplier of the life saving equipment to ensure and document that safe operation can be achieved in the specified operational conditions.

Table A.2 – NLS and LS conditions

Equipment group	NLS condition			LS condition		
	Maximum wind speed ^a	Maximum significant wave height, H _s	Maximum offlead/ sidelead angle in any direction	Maximum wind speed ^a	Maximum significant wave height, H _s	Maximum angle of heel in any direction ^b
	(m/s)	(m)	(°)	(m/s)	(m)	(°)
E.1	10	1,0	10	36	16	17
E.2	10	1,0	10	36	16	17
E.3	10	1,0	10	36	16	17
E.4	10	1,0	10	36	16	17
E.5	15	N/A	10	36	N/A	17
E.6	10	3,0	10	17	6,0	17
E.7	10	2,0	10	36	16	17

^a Mean wind velocity, $v_m(z)$ at 10 m height above sea (10 min), see EN 13001-2, 4.2.3.1. Mean wind velocity shall be recalculated into 3 s gust winds at the actual height of the launching appliance above sea level.

Example: 17 m/s (10 min) corresponds to ~25 m/s (3 s gust wind).

^b The angle of heel for the damaged host facility shall be set to 17° unless other host facility specific values are known.

A.1.4.2 Rated capacity

Unless otherwise stated in the subsequent clauses of this Annex, the rated capacity for launching and recovery appliances shall be taken as the gross mass of a fully equipped life saving equipment when boarded with its full complements of persons, i.e. crew and passengers.

For the purpose of calculating the rated capacity of launching and recovery appliances, the weight of each person in the life saving equipment (e.g. life boat, rescue boat) shall be set to 90 kg.

A.1.4.3 Loads and load combinations

Structural and mechanical strength of launching and recovery appliances shall be proved for loads and load combinations. The following tables shall be used instead of Table 10 in EN 13001-2:

- Group E.1: Tables A.3 and Table A.4
- Group E.2: Table A.5
- Group E.6: Table A.9

Loads for the ULS shall be determined, based on the NLS and LS conditions.

Loads for the ALS shall be determined, based on extreme wind conditions, extreme wave conditions or earthquake. Extreme wind and wave conditions are conditions with mean wind velocity (10 min at 10 m height above sea) or wave height corresponding to 10 000 year return period. Extreme weather conditions are to be determined for the particular installation in accordance with NORSOK N-002.

ULS loads are to be determined for load combinations A, B and C with partial safety factors (γ_p) as defined in EN 13001-2.

ALS loads are complementary to the requirements in EN 13001-2. The ALS loads are entered into load combinations C2 and C8 in the above mentioned tables, with partial safety factors set to $\gamma_p = 1,0$

Table A.3 – Load combinations for Group E.1 – Launching appliances for free fall lifeboats
Lifeboat in stowed position and launched by primary means of launching

Categories of loads	Loads		Reference		Load combinations A				Load combinations B				Load combinations C					
			EN 13001-2	NORSOK R-002	Partial safety factors γ_p	A1	A2	A4	Partial safety factors γ_p	B1	B2	B4	B5	Partial safety factors γ_p	C2	C3	C7	C8
Regular	Gravitation acceleration, Impacts	Mass of the launching appliance	4.2.2.1	-	*)	1	Φ_1	-	*)	1	Φ_1	-	-	*)	1	1	1	1
		Mass of the hoist load (NOTE 1)	4.2.2.2	-	1,34	1	Φ_3	-	1,22	1	Φ_3	-	-	1,1	1	-	1	1
		Masses of launching appliance and hoist load travelling on uneven surface	4.2.2.3	-	1,22	-	-	Φ_4	1,16	-	-	Φ_4	Φ_4	-	-	-	-	-
	Acceleration from drives other than hoist drive	Masses of the launching appliance and hoist load	4.2.2.4	-	1,34	-	-	Φ_5	1,22			Φ_5	-	-	-	-	-	-
	Displacements		4.2.2.5	-	**)	1	1	1	**)	1	1	1	1	**)	1	1	1	1
Occasional	Environmental actions	Wind loads	4.2.3.1	Table A.2	-	-	-	-	1,22	1	1	1	1	1,16	-	1	-	-
		Snow and ice loads	4.2.3.2	-	-	-	-	-	1,22	1	1	1	1	-	-	-	-	-
		Temperature variations	4.2.3.3	-	-	-	-	-	1,16	1	1	1	1	1,05	1	-	-	-
	Skewing		4.2.3.4	-	-	-	-	-	1,16	-	-	-	1	-	-	-	-	-
Exceptional	Extreme wind – stowed position		4.2.4.2	A.1.4.3	-	-	-	-	-	-	-	-	-	1,0	1	-	-	-
	Static test load		-	A.1.14	-	-	-	-	-	-	-	-	-	1,1	-	1	-	-
	Test load for release mechanism		-	A.1.5.5	-	-	-	-	-	-	-	-	-	1,1	-	-	Φ_5 (NOTE 2)	-
	Excitation of the foundation (NOTE 3)		4.2.4.8	A.1.4.3	-	-	-	-	-	-	-	-	-	1,0	-	-	-	1
Risk coefficient, γ_n			4.3.2	5.9	-	1,5			-	1,5			-	1,0				

*) See EN 13001-2, Table 7

**) See EN 13001-2, 4.3.5

NOTE 1 Mass of the hoist load shall be taken as rated capacity from A.2.3 for load combinations A1, A2, A4, B2, B2, B4 and B5. For load combination C2, the mass of hoist load may be taken as mass of empty lifeboat. For load combination C7, the mass of hoist load shall be taken as the test load for release mechanism.

NOTE 2 $\Phi_5 = \Phi_{2,C7} - 1$.

NOTE 3 Accelerations resulting from earthquake or extreme wave with wave height corresponding to 10 000 year return period, whichever gives the highest accelerations, must be applied to both mass of the hoist load and mass of the launching appliance in all degrees of freedom for the particular installation.

Key

- A1: ULS: Suspended lifeboat with no wind or other environmental loads. This load combination shall be applied for lifeboat in stowed position suspended from each mechanism, i.e. primary means of launching, secondary means of launching, means of retrieval and hang-off relief arrangement. . For skidding arrangements, this load combination shall also be applied in the most unfavourable position at the skidding track during launching.
- A2: ULS: Sudden release of load (drop of lifeboat) as result of activating the release function of the primary means of launching. $\Phi_3 = -1,0$ to be applied for calculating the peak reaction load effects in the main structure caused by drop of lifeboat.
- A4: ULS: Travelling on an uneven surface or track with no wind or other environmental loads, if part of the launching sequence for primary means of launching.
- B1: ULS: Lifeboat in stowed position suspended from primary means of launching in the LS condition. For skidding arrangements, this load combination shall also be applied in the most unfavourable position at the skidding track during launching. For means of retrieval, secondary means of launching and hang-off relief arrangement, this load combination shall be applied for stowed position in the NLS condition.
- B2: ULS: Sudden release of load (drop of lifeboat) as result of activating the release function of the primary means of launching in the LS condition. $\Phi_3 = -1,0$ to be applied for calculating the peak reaction load effects in the main structure caused by drop of lifeboat.
- B4: ULS: Travelling on an uneven surface or track in the LS condition, if part of the launching sequence for primary means of launching.
- B5: ULS: Travelling on an uneven surface and skewing in the LS condition, if part of the launching sequence for primary means of launching.
- C2: ALS: Lifeboat in the stowed position suspended in primary means of launching in combination with loads from extreme wind conditions corresponding to wind speed with 10000 year return period.
- C3: ULS: Static overload testing in NLS conditions with test load of 2,2 times the rated load for the particular mechanism (see A.2.3), i.e. primary means of launching and hang-off relief arrangement.
- C7: ULS: Dynamic impact in hang-off relief arrangement in case of testing the function of release mechanism for primary or secondary means of launching by dropping the lifeboat into the hang-off relief arrangement.
- C8: ALS: Lifeboat in the stowed position suspended in primary means of launching in combination with loads due to external excitation of the foundation.

**Table A.4 – Load combinations for Group E.1 – Launching appliances for free fall lifeboats
Lowering by secondary means of launching and hoisting by means of retrieval**

Categories of loads	Loads		Reference		Load combinations A			Load combinations B			Load combinations C		
			EN 13001-2	NORSOK R-002	Partial safety factors	A1	A3	Partial safety factors	B1	B3	Partial safety factors	C3	C6
					γ_D			γ_D			γ_D		
Regular	Gravitation acceleration, Impacts	Mass of the launching appliance	4.2.2.1	-	*)	Φ_1	1	*)	Φ_1	1	*)	Φ_1	1
		Mass of the hoist load (NOTE 1)	-	A.1.5.3	1,34	Φ_2	1	1,22	Φ_2	1	1,1	-	1
	Inertia forces due to acceleration from hoist drives		4.2.2.4	-	1,34	-	Φ_5	1,22	-	Φ_5	-	-	-
	Displacements		4.2.2.5	-	**)	1	1	**)	1	1	**)	1	1
Occasional	Environmental actions	Wind loads	4.2.3.1	Table A.2	-	-	-	1,22	1	1	1,16	1	-
		Snow and ice loads	4.2.3.2	-	-	-	-	1,22	1	1	-	-	-
		Temperature variations	4.2.3.3	-	-	-	-	1,16	1	1	-	-	-
Exceptional	Dynamic test load		4.2.4.3	A.1.14	-	-	-	-	-	-	1,1	Φ_6 (NOTE 2)	-
	Mass of the hoist load (NOTE 1) during emergency braking.			A.1.5.4	-	-	-	-	-	-	1,1	-	Φ_5 (NOTE 4)
Risk coefficient, γ_n (NOTE 3)			4.3.2	5.9	-	1,5		-	1,5		-	1,0	1,5

*) See EN 13001-2, Table 7

**) See EN 13001-2, 4.3.5

NOTE 1 Mass of the hoist load shall be taken as rated capacity from A.2.3 for load combinations A1, A3, B1 and B3. For load combination C6, mass of the hoist load shall be taken as the test load of 1,1 times the rated capacity.

NOTE 2 For the dynamic load test, coefficient Φ_6 is a function of $\Phi_{2,A1}$.

NOTE 3 The risk coefficient of 1,5 is only applicable if lifting or lowering persons is part of the intended use, see A.2.4.2.1 and A.2.4.3, and when performing proof of competence with rated capacity for lifting persons, see A.2.3. When performing proof of competence with rated capacity (without persons), the risk coefficient may be set to 1,0.

NOTE 4 $\Phi_5 = \Phi_{2,C6} - 1$

Key

- A1: ULS: Pick-up of lifeboat from sea with means of retrieval in NLS conditions without environmental actions from wind, snow/ice or temperature variations. The effect of waves shall be taken into account.
- A3: ULS: Acceleration of hanging lifeboat at start of descent or start of hoisting in NLS conditions without environmental actions from wind, snow/ice or temperature variations.
- B1: ULS: Pick-up of lifeboat from sea in NLS conditions in combination with environmental actions.
- B3: ULS: Acceleration of hanging lifeboat at start of descent or start of hoisting in NLS conditions with environmental actions from wind, snow/ice and temperature variations.
- C3: ULS: Dynamic overload testing in NLS conditions with a test load equal to 1,1 times the rated capacity for the particular mechanism (see A.2.3).
- C6: ULS: Secondary means of launching with a test load equal to 1,1 times the rated capacity (with and without persons, see A.2.3) in combination with loads caused by emergency braking during lowering at full speed.

Table A.5 – Load combinations for Group E.2 – Launching appliances for lifeboats launched by falls and a winch

Categories of loads	Loads		Reference		Load combinations A				Load combinations B			Load combinations C							
			EN 13001-2	NORSOK R-002	Partial safety factors γ_p	A1	A11	A3	Partial safety factors γ_p	B1	B3	Partial safety factors γ_p	C1	C2	C3		C6	C7	C8
Regular	Gravitation acceleration, Impacts	Mass of the launching appliance	4.2.2.1	-	*)	Φ_1	1	1	*)	Φ_1	1	*)	Φ_1	1	Φ_1	1	1	1	
		Mass of the hoist load (NOTE 1)	-	A.1.5.3	1,34	Φ_2	1	1	1,22	Φ_2	1	1,1	-	1	-	1	1	1	
	Inertia forces due to acceleration from hoist drives		4.2.2.4	-	1,34	-	-	Φ_5	1,22	-	Φ_5	-	-	-	-	-	-	-	
	Displacements		4.2.2.5		**)	1	1	1	**)	1	1	**)	1	1	1	1	1	1	
Occasional	Environmental actions	Wind loads	4.2.3.1	Table A.2	-	-	-	-	1,22	1	1	1,16	-	-	1	-	-	-	
		Snow and ice loads	4.2.3.2	-	-	-	-	-	1,22	1	1	-	-	-	-	-	-	-	
		Temperature variations	4.2.3.3	-	-	-	-	-	1,16	1	1	1,05	-	1	-	-	-	-	
Exceptional	Re-entry during lowering	Mass of the hoist load (NOTE 1)	-	A.1.5.3	-	-	-	-	-	-	-	1,1	Φ_2	-	-	-	-	-	
	Extreme wind – stowed position		4.2.4.2	A.1.4.3	-	-	-	-	-	-	-	1,0	-	1	-	-	-	-	
	Test loads		4.2.4.3	A.1.14	-	-	-	-	-	-	-	1,1	-	-	Φ_6 (NOTE 2)	-	-	-	
	Mass of the hoist load (NOTE 1) during emergency braking.		-	A.1.5.4	-	-	-	-	-	-	-	1,1	-	-	-	Φ_5 (NOTE 5)	-	-	
	Test load for release mechanism			A.1.5.5	-	-	-	-	-	-	-	1,1	-	-	-	-	Φ_5 (NOTE 3)	-	
	Excitation of the foundation (NOTE 4)		4.2.4.8	A.1.4.3	-	-	-	-	-	-	-	1,0	-	-	-	-	-	1	
Risk coefficient, γ_n			4.3.2	5.9	-	1,5			-	1,5		-	1,0	1,0	1,0	1,5		1,0	1,0

*) See EN 13001-2, Table 7

**) See EN 13001-2, 4.3.5

NOTE 1 Mass of the hoist load is to be taken as the rated capacity as defined in A.1.4.2 for load combinations A1, A3, B1, B3 and C1. For load combination A11, the mass of hoist load may be taken as the mass of empty lifeboat with crew of 3 persons. For load combinations C2 and C8, the mass of hoist load may be taken as mass of empty lifeboat. For load combinations C3, C6 and C7, the mass of the hoist load shall be taken as the test load of 1,1 times the rated capacity as defined in A.1.4.2.

NOTE 2 For the dynamic load test, coefficient Φ_6 is a function of $\Phi_{2,A1}$. For static load test, $\Phi_6 = 1,0$

NOTE 3 $\Phi_5 = \Phi_{2,C7} - 1$.

NOTE 4 Accelerations resulting from earthquake or extreme wave with wave height corresponding to 10 000 year return period, whichever gives the highest accelerations, must be applied to both

mass of the hoist load and mass of the launching appliance in all degrees of freedom for the particular installation.

NOTE 5 $\Phi_5 = \Phi_{2,C6} - 1$

Key

- A1: ULS: Pick-up of lifeboat from sea in NLS conditions without environmental actions from wind, snow/ice or temperature variations. The effect of waves shall be taken into account
- A11: ULS: Lifeboat suspended from hang-off relief arrangement.
- A3: ULS: Acceleration of hanging lifeboat at start of descent or start of hoisting in NLS conditions without environmental actions from wind, snow/ice or temperature variations.
- B1: ULS: Pick-up of lifeboat from sea in NLS conditions in combination with environmental actions.
- B3: ULS: Acceleration of hanging lifeboat at start of descent or start of hoisting in NLS conditions with environmental actions
- C1: ULS: Re-entry during launching in LS conditions.
- C2: ALS: Lifeboat in the stowed position ready for launching in combination with loads from extreme wind conditions corresponding to wind speed with 10000 year return period.
- C3: ULS: Static and dynamic load testing in NLS conditions.
- C6: ULS: Launching appliance with a test load equal to 1,1 times the rated capacity (ref. A.1.4.2) in combination with loads caused by emergency braking during lowering at full speed in mode for maintenance and installation.
- C7: ULS: Dynamic impact in hang-off relief arrangement in case of testing the function of release mechanism by dropping the lifeboat into the hang-off relief arrangement.
- C8: ALS: Launching appliance with hoist load in combination with loads due to external excitation of the foundation

At the time of publication of this NORSOK standard, hoisting/lowering is the only motion of a typical launching and recovery appliance for lifeboats launched by falls and a winch. Table A.5 summarises the load combinations to be analysed for such appliances. A more detailed analysis of load combinations is needed for launching and recovery appliances with other movements. For such appliances, reference is made to EN 13001-2, Table 10.

Table A.6 Group E.3

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Table A.7 Group E.4

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Table A.8 Group E.5

TO BE DEVELOPED

Table A.9 – Load combinations for Group E.6 – Launching appliances for rescue boats

Categories of loads	Loads		Reference		Load combinations A				Load combinations B			Load combinations C					
			EN 13001-2	NORSOK R-002	Partial safety factors	A1	A11	A3	Partial safety factors	B1	B3	Partial safety factors	C1	C 2	C3	C6	C8
Regular	Gravitation acceleration, Impacts	Mass of the launching appliance	4.2.2.1	-	γ_D *)	Φ_1	1	1	γ_D *)	Φ_1	1	γ_D *)	Φ_1	1	Φ_1	1	1
		Mass of the hoist load (NOTE 1)	-	A.1.5.3	1,34	Φ_2	1	1	1,22	Φ_2	1	1,1	-	1	-	1	1
	Inertia forces due to acceleration from hoist drives		4.2.2.4	-	1,34	-	-	Φ_5	1,22	-	Φ_5	-	-	-	-	-	-
	Displacements		4.2.2.5		**)	1	1	1	**)	1	1	**)	1	1	1	1	1
	Occasional	Environmental actions	Wind loads	4.2.3.1	Table A.2	-	-	-	-	1,22	1	1	1,16	-	-	1	-
Snow and ice loads			4.2.3.2	-	-	-	-	-	1,22	1	1	-	-	-	-	-	-
Temperature variations			4.2.3.3	-	-	-	-	-	1,16	1	1	1,05	-	1	-	-	-
Exceptional	Re-entry during hoisting	Mass of the hoist load (NOTE 1)	-	A.1.5.3	-	-	-	-	-	-	-	1,1	Φ_2	-	-	-	-
	Extreme wind – stowed position		4.2.4.2	A.1.4.3	-	-	-	-	-	-	-	1,0	-	1	-	-	-
	Test loads		4.2.4.3	A1.15	-	-	-	-	-	-	-	1,1	-	-	Φ_6 (NOTE 2)	-	-
	Mass of the hoist load (NOTE 1) during emergency braking.		-	A.1.5.4	-	-	-	-	-	-	-	1,1	-	-	-	Φ_5 (NOTE 4)	-
	Excitation of the foundation (NOTE 3)		4.2.4.8	A.1.4.3	-	-	-	-	-	-	-	1,0	-	-	-	-	1
Risk coefficient, γ_n			4.3.2	5.9	-	1,5			-	1,5		-	1,0	1,0	1,0	1,5	1,0

*) See NS-EN 13001-2, Table 7

**) See EN 13001-2, 4.3.5

NOTE 1 Mass of the hoist load is to be taken as the rated capacity as defined in A.1.4.2 for load combinations A1, A11, A3, B1, B3 and C1. For load combination C6, mass of the hoist load shall be taken as the test load of 1,1 times the rated capacity. For load combinations C3, mass of the hoist load shall be taken as the test load equal to 2,2 times the rated capacity for static test of the crane/davit structure, 1,5 times the rated capacity for static test of the winch and 1,1 times the rated capacity for dynamic test of the winch. For load combinations C2 and C8, mass of the hoist load may be taken as mass of the empty rescue boat.

NOTE 2 For the dynamic load test, coefficient Φ_6 is a function of $\Phi_{2,A1}$. For static load test, $\Phi_6 = 1,0$

NOTE 3 Accelerations resulting from earthquake or extreme wave with wave height corresponding to 10 000 year return period, whichever gives the highest accelerations, must be applied to both mass of the hoist load and mass of the launching appliance in all degrees of freedom for the particular installation.

NOTE 4 $\Phi_5 = \Phi_{2,C6} - 1$

Key

- A1: ULS: Pick-up of rescue boat from sea in NLS conditions without environmental actions from wind, snow/ice or temperature variations. The effect of waves shall be taken into account.
- A11: ULS: Rescue boat suspended from hang-off relief arrangement.
- A3: ULS: Acceleration of hanging rescue boat at start of descent or start of hoisting in NLS conditions without environmental actions from wind, snow/ice or temperature variations.
- B1: ULS: Pick-up of boat rescue boat from sea in LS conditions in combination with environmental actions.
- B3: ULS: Acceleration of hanging rescue boat at start of descent or start of hoisting in NLS conditions with environmental actions.
- C1: ULS: Re-entry during hoisting in LS conditions.
- C2: ALS: Rescue boat in the stowed position ready for launching in combination with loads from extreme wind conditions corresponding to wind speed with 10 000 year return period.
- C3: ULS: Static and dynamic load testing in NLS conditions.
- C6: ULS: Launching appliance with a test load equal to 1,1 times the rated capacity (see A.1.4.2) in combination with loads caused by emergency braking during lowering at full speed.
- C8: ALS: Launching appliance with hoist load in combination with loads due to external excitation of the foundation.

At the time of publication of this NORSOK standard, hoisting/lowering is the only motion of a typical launching and recovery appliance for rescue boats. Table A.9 summarises the load combinations to be analysed for such appliances. A more detailed analysis of load combinations is needed for launching and recovery appliances with other movements. For such appliances, reference is made to EN 13001-2, Table 10.

Table A.10 Group E.7

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A.1.5 Dynamic effects

A.1.5.1 General

The dynamic effects resulting from inertial effects during acceleration of drives and hoisting and gravity effects are generally given as various dynamic coefficients, Φ_i . All dynamic coefficients shall be calculated in accordance with EN 13001-2, except Φ_2 which shall be calculated in accordance with the requirements of this Annex. Φ_2 may vary for each load combination as described herein.

If necessary, means shall be provided to limit the dynamic coefficient Φ_2 to the following maximum values:

- 2,5 for life saving equipment where personnel is standing;
- 4,0 for life saving equipment where personnel is sitting with seat belts.

For the purpose of limiting the dynamic coefficient Φ_2 , the following means may be applied:

- additional elastic elements to reduce the total system stiffness, e.g. an elastic pennant placed between the hoist medium and means of connection;
- passive shock absorbers forming integral part of the launching appliance, its hoisting machinery or the means of connection (either part of the launching appliance or part of the life saving equipment).

The minimum dynamic coefficient Φ_2 shall be no less than 1,5 in any load combinations.

A.1.5.2 Dynamic coefficient Φ_2 for load combination A1 and B1 (pick-up from sea)

Offshore there will be relative motions between the base of the lifting appliance and the life saving equipment lifted from or lowered to the sea. For calculation of inertial and gravity effects acting on the hoist load at the time of pick-up from sea in load combinations A1 and B1, the dynamic coefficient ($\Phi_{2,A1}$ or $\Phi_{2,B1}$) shall be calculated in accordance with equation (A.1).

A.1.5.3 Dynamic coefficient Φ_2 for load combination C1 (re-entry)

Re-entry implies that the launching appliance is reloaded due to the wave motions if the release mechanism does not open after the life saving equipment has landed on the sea, or during hoisting if hoisting velocity is less than the vertical wave velocity.

The dynamic coefficient $\Phi_{2,C1}$ for re-entry is the ratio between the maximum dynamic force created in hoist rope(s) during re-entry, and the mass of hoist load. Equation (A.1) may be used as a simplified method for calculating $\Phi_{2,C1}$. If the simplified method does not sufficiently limit the dynamic coefficient according to the limit values stated above, the maximum force created in the hoist rope(s) shall be determined by a more detailed study, e.g. calculations, simulations or model tests, taking into account the wave period, the lowering or hoisting speed, the stiffness of the launching and recovery appliance and the moment of inertia of the winch drum.

A.1.5.4 Dynamic coefficient Φ_2 for load combination C6 (emergency cut-out)

The dynamic coefficient $\Phi_{2,C6}$ for the impact on the hoist load occurring when lowering at full speed and activating emergency stop in the upper position, shall be calculated in accordance with equation (A.2).

A.1.5.5 Dynamic coefficient Φ_2 for load combination C7 (test of release mechanism)

If the release mechanism of lifeboats is to be tested when the lifeboat is hanging in the stowed position with hang-off relief arrangement connected, the impact caused by sudden drop into the hang-off relief arrangement shall be taken into account by applying a dynamic coefficient $\Phi_{2,C7}$. The maximum dynamic force in the hang-off relief arrangement shall be established based on an equation for energy conservation from kinetic to potential energy, taking into account the stiffness of the hang-off relief arrangement, the possible drop height and pretension of the hang-off relief arrangement. The dynamic coefficient $\Phi_{2,C7}$ is the ratio between the maximum dynamic force and the weight of the hoist load.

A.1.5.6 Use of shock absorbers

If shock absorbers are needed to limit the dynamic force during any of the above situations, the dynamic coefficient shall be calculated as the ratio between the maximum dynamic force created in hoist rope(s) during the stroke of the absorbing element and the weight of the hoist load.

Launching and recovery appliances with shock absorber

The shock absorber must be calibrated for the actual load range.
The dynamic factor is determined as:

$$\psi = \frac{F_{\max}}{F_0} \quad (\text{A.1})$$

where

F_0 is the static force at hook

$F_{\max}$ is the maximum dynamic force at hook

$F_{\max}$ is calculated from the energy equation, see Figure A.1

$$\frac{1}{2} \cdot m \cdot v_R^2 = \int_{x_0}^{x_{\max}} (F(x) - F_0) dx \quad (\text{A.2})$$

where

$m = F_0/g$ = total mass at hook

v_R is the relative velocity between hook and deck at liftoff

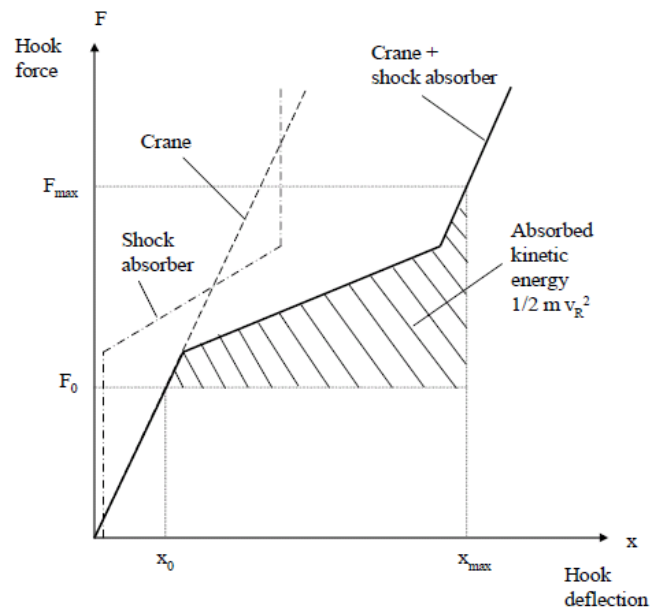
x_0 is the vertical deflection at hook due to static load

$x_{\max}$ is the vertical deflection at hook due to dynamic load

$F(x)$ is the force at hook as a function of the vertical deflection at hook

$F(x_{\max}) = F_{\max}$

Figure A.1 - Effect of shock absorbers



A.1.5.7 Expressions for dynamic coefficient Φ_2

$$\phi_2 = 1 + k_{\Delta} \cdot v_R \cdot \sqrt{\frac{C}{g \cdot R_n}} \quad (\text{A.3})$$

$$\phi_2 = \frac{F_{bra}}{R_n} \quad (\text{A.4})$$

where

- C is the stiffness (in N/m) (weight of hoist load divided by the corresponding hook deflection)
 R_n is the rated capacity (in N) (static weight of the hoist load, i.e the life saving equipment)
 v_R is the relative velocity (in m/s) between the load and hook at the time of pick-up
 g is the gravity acceleration (9,81 m/s²)
 F_{bra} is the maximum rope force (in N) at emergency braking during lowering at full speed in the upper position
 k_{Δ} is a reduction factor depending on the shape of the particular life saving appliance (e.g. rescue boat, life boat, life raft) to be lifted out of the sea water, taking into account that lift off from water gives a gradually increased dynamic load compared to an immediate load lift off from e.g. a boat deck. The value of this factor is to be set to 1,0 by default, unless a lower value has been demonstrated by tests.

v_R shall be calculated as follows:

$$v_R = v_H + \sqrt{v_D^2 + v_C^2} \quad (\text{A.5})$$

where

- v_H is +0,5· v_{Hmax} for pick-up in waves
 v_H is +1,0· v_{Hmax} for re-entry during hoisting
 v_H is -1,0· v_{Hmax} for re-entry during lowering
 v_{Hmax} is the maximum steady state hoisting or lowering velocity (in m/s) for the rated capacity to be lifted or lowered
 v_D is the vertical velocity (in m/s) of the sea surface or deck on which the life saving equipment is located given by equation (A.6)
 v_C is the vertical velocity (in m/s) of the lifting appliance due to wave motions given by expression (A.7)

$$v_D = \frac{K_1 \cdot H_s}{H_s + K_2} \quad (\text{A.6})$$

$$v_C = K_3 \cdot H_s \quad (\text{A.7})$$

where

H_s is the significant wave height for the operational limitation in m

$K_1 = 4,00$ (m/s)

$K_2 = 3,10$ (m)

$K_3 = 0$ for bottom fixed installations (/s)

$K_3 = 0,25$ for semi submersible installations (/s)

$K_3 = 0,50$ for monohull installations (FPSO, etc.) (/s)

The stiffness (C) of the launching and recovery appliance shall be calculated taking into account all elements from the means of connection via the ropes through to the support structure. Elastic pennant, if installed, may also be taken into consideration.

Stiffness may be calculated according to: $C = \frac{R_n}{\sum \Delta L_n}$ (N/m) (A.8)

where

$\sum \Delta L_n$ is the sum of all the contribution to the total hook deflection in m.

For steel wire ropes the elastic deflection may be taken from the following equation:

Elastic deflection of rope [m]:

$$\Delta L_s = \frac{R_n \cdot L_w}{E_w \cdot A_w \cdot 10^3} \quad (\text{m}) \quad (\text{A.9})$$

where

L_w is the rope length in mm

NOTE 1 For recovery (pick-up) operations, the rope length shall be calculated with the means of connection at 1 m above the lowest operational level. For emergency braking, the elevation of the means of connection should be taken to be not lower than 3 m below the upper position.

NOTE 2 Equation (A.9) is based on single fall. For multiple falls, the number of falls must be taken into account.

E_w is the modulus of elasticity as specified by the rope manufacturer for steel wire ropes in N/mm²

Area of rope [mm²]:

$$A_w = \frac{\pi \cdot D_w^2}{4} \cdot C_F \quad (\text{A.10})$$

where

D_w is the nominal rope diameter in mm

C_F is the fill factor of the actual nominal rope construction

A.1.6 Hoisting and lowering velocities

Hoisting and lowering velocities shall be in accordance with Table A.11.

Table A.11 – Hoisting and lowering velocities for launching and recovery appliances

Group		Lowering	Hoisting
NLS condition			
E.1	Sec. means of launching	V_{Hmin}	
	Means of retrieval		V_{Hmin}
E.2		V_{Hmin}	V_{Hmin}
E.6		As for LS condition	As for LS condition
LS condition			
E.1	Sec. means of launching		
	Means of retrieval		
E.2		V_{Hmin} NMD maximum 1,1 m/s	
E.6		V_{Hmin}	V_{Hmin}

where

$$V_{Hmin} = K_0 * \sqrt{V_D^2 + V_C^2} \quad (\text{A.11})$$

$$K_0 = 0,50$$

V_D is given by equation (A.6)

V_C is given by equation (A.7)

A.1.7 Risk coefficient according to EN 13001-2, 4.3.2

For the lifting of personnel all load carrying structure and machinery components including wire ropes, means of connection and their anchorage in the life saving equipment shall be designed with a risk coefficient of

$\gamma_n = 1,5$, in accordance with 5.9.

Exception: Load combination C.1 for group E.2, see Table A.5.

NOTE This requirement addresses the subject of increased mechanical strength during the lifting of persons, see Machinery Directive, Annex I, Clause 6.1.1.

A.1.8 Limit states and proof of competence

A.1.8.1 General

The characteristic resistance (R_k) of material, members, connections and components shall be derived from the subsequent sections or references given in the subsequent sections. The limit design resistance (R_d), in terms of stresses and forces, to be applied for the proof of competence, shall be based on the characteristic resistance and resulting resistance coefficients (γ_R) as described herein or as described in the references given.

In general the limit design resistance is expressed as:

$$R_d = \frac{R_k}{\gamma_R} \quad (\text{A.12})$$

A.1.8.2 Structural members and connections

For launching appliances and load bearing parts of life saving equipment (e.g. anchorage for means of connection), the limit design resistance for structural members and their bolted, pinned and welded connections shall be taken from the following references:

- Steel structures: CEN/TS 13001-3-1, Cranes – General design – Part 3-1
- Aluminium structures: EN 1999-1-1
- Composite structures: DNV-OS-E406 Sec. 6 C

Composite materials shall be selected and documented in accordance with criteria given in Sec. 5 of DNV-OS-E406. Methods described in DNV-OS-C501 may be used to calculate and document their material properties.

Means of connection made from rolled structural steel or aluminium are considered as structural members.

A.1.8.3 Ropes, chains, means of connections and other lifting components

A.1.8.3.1 General

The characteristic resistance (R_k) of ropes, chains, means of connection and other lifting components shall be their breaking force. The design strain (S_d) for these components shall be calculated for all relevant load combinations listed in Table A.3 to Table A.10.

A.1.8.3.2 Steel wire ropes in running reeving systems

Rope length

Steel wire ropes used for launching of life saving equipment to sea shall have a minimum length which takes into account the most unfavourable situation such as inclination of the installation or lowest astronomical tide, wave trough and drift off according to Table A.2.

Strength requirements

The characteristic resistance (R_k) for ropes shall be taken as their breaking force (F_u), taking into account reduction factors resulting from end terminations.

The minimum tensile strength for steel wire ropes shall be 1 770 N/mm², and the maximum tensile strength shall be 1 960 N/mm² according to EN 12385-4.

Wire ropes shall be of rotation resistant construction preferably 35x7 with steel core or 6x36WS IWRC single layer round strand rope according to EN 12385-1, EN 12385-2 and EN 12385-3.

Limit states and proof of competence of ropes in running reeving systems shall be calculated according to CEN/TS 13001-3-2.

Note Friction forces in the reeving system need not be included for the lowering operation where it will function as an additional friction brake. For recovery operation the friction forces shall be included where appropriate.

The design strain (S_d) for ropes is the rope force ($F_{Sd,s}$) resulting from the load actions. The limit design resistance for ropes is the limit design rope force ($F_{Rd,s}$), expressed as

$$F_{Rd,s} = \frac{F_u}{\gamma_{rb}} \quad (\text{A.13})$$

where

$F_{Sd,s}$ is the design rope force according to CEN/TS 13001-3-2, clause 5, as resulting from the load combinations in this NORSOK standard

$F_{Rd,s}$ is the limit design rope force

F_u is the minimum breaking force

as specified by the rope manufacturer, taking into account the reduction caused by the method of end termination

γ_{rb} is the minimum rope resistance factor according to CEN/TS 13001-3-2, 5.4, (minimum 2,0).

The proof of static strength of steel wire ropes shall be as follows:

$$F_{Sd,s} \leq F_{Rd,s} \quad (\text{A.14})$$

NOTE Proof of fatigue strength in accordance with CEN/TS 13001-3-2, clause 6, is not considered necessary for group E. For these appliances corrosion will normally be the governing replacement criterion.

Bending diameters

The bending diameter ratio (D/d) on rope sheaves and drums shall be minimum 18

Terminations of wire ropes

Terminations of wire ropes shall be in accordance with the following standards:

- Ferrules and ferrule-securing EN 13411-3
- Metal and resin socketing EN 13411-4
- Asymmetric wedge sockets EN 13411-5
- Symmetric wedge sockets EN 13411-7

A.1.8.3.3 Chains, means of connection and other lifting componentsStandardised, metallic components

Standardised components, such as chains, links, forged steel components and forged hooks shall be of grade 8 complying with the following standards:

- Chains: EN 818-2
- Forged steel components: EN 1677-1
- Forged hooks with latch: EN 1677-2
- Links: EN 1677-4

These components shall be selected with a breaking force resulting from the following equations, whichever gives the greatest breaking force:

$$BF \geq M \cdot g \cdot 6 \quad (\text{A.15})$$

$$BF \geq M \cdot g \cdot \phi_2 \cdot \gamma_p \cdot \gamma_n \cdot \gamma_{rb} \quad (\text{A.16})$$

where

BF	is the breaking force (kN)
M	is the mass of hoist load (tonnes) for the particular load combination
g	= 9,81 m/s ² is the gravity constant
Φ_2	is the dynamic factor for the particular load combination
γ_p	is the partial safety factor for the particular load combination
γ_n	= 1,5 is the risk coefficient
γ_{rb}	= 1,8 is the component resistance factor

For hook shaped components made of steel forgings, the proof of competence may alternatively be performed in accordance with FprCEN/TS 13001-3-5 ¹⁾ with the following additional requirement:

Specific resistance coefficient shall be set to $\gamma_{sm} = 1,0$.

Non-standardised, metallic components

Means of connection made from components that are not shaped in accordance with any standardised components, shall have a breaking force equal to that required for standardised components. In addition these components shall be able to withstand a manufacturing proof force (MPF) without permanent deformation. The manufacturing proof force shall be:

$$MPF \geq \frac{BF}{1,6} \quad (\text{A.17})$$

Standardised non-metallic components

Standardised non-metallic components, such as roundslings or slings made from man-made or natural fibre webbings or ropes shall be made in accordance with the following standards:

- Flat woven webbing slings: EN 1492-1
- Roundslings: EN 1492-2
- Slings from fibre ropes: EN 1492-4

Exception: Elastic pennants for rescue boats lifted by offshore cranes, see A.7.4.1.

These components shall be selected with a breaking force resulting from equation (A.16) with resistance factor $\gamma_{rb} = 2,3$.

A.1.8.4 Strength proportions

For launching and recovery appliances of group E.2 and E.6 the requirement in 4.8 shall be documented by calculations, showing that the launching appliance will not be detached from the installation before other load bearing parts have collapsed.

A.1.9 Rated capacity limiter

¹⁾ To be published.

Launching and recovery appliances including winches or boom luffing systems shall be equipped with a rated capacity limiter in accordance with EN 12077-2, 5.2, 5.3 and 5.4. The rated capacity limiter shall not prevent lowering.

A.1.10 Secondary brake

Winches for hoisting, boom luffing systems and skidding arrangements on launching and recovery appliances for life saving equipment for the lifting of personnel shall be equipped with a secondary brake in addition to the brake as required by 5.7.6 (primary brake). The secondary brake shall be able to retard and hold the maximum load without sag if the primary brake fails. The secondary brake shall be designed according to the same requirements given for the primary brake given in 5.7.6, or be based on hydraulic restriction.

Primary and secondary brakes shall be arranged for individual testing.

The secondary brake shall preferably act directly on the winch drum, but a load path fully independent from the primary brake will be considered acceptable.

The secondary brake shall be of a different type and make than the primary brake.

Where hydraulic cylinders are used, two independent cylinders shall be provided for each function such that one cylinder is capable to stop and hold the load, in case of a failure of the other cylinder.

Brakes based on hydraulic restriction (e.g. shut off valves etc.), shall be capable of withstanding shocks due to brake impacts. Fluid loss prevention shall be provided according to EN 982.

Where hydraulic restriction is used as a brake, the following requirements apply:

- a) the hydraulic motor/cylinder shall have a closing valve directly at the high-pressure (load) connection (no pipes or hose connections in between);
- b) the closing valve shall close as a result of pressure loss at the low-pressure connection (inlet connection during lowering). This function shall be accomplished by direct bore or piping between the closing valve and the low-pressure connection;
- c) the hydraulic motor/cylinder shall always be ensured sufficient working fluid, also in the event of power failure, i.e. by gravity feeding).

A.1.11 Secondary independent power and control system

Powered launching and recovery appliances for the lifting or lowering of persons, which are not designed for drop, skid launching or gravity lowering, shall be equipped with a secondary independent power and secondary independent control system. The secondary power system shall not be affected by failures in the primary power system, and the secondary control system shall not be affected by failures in the primary control system.

For such appliances, the secondary independent power and control system shall be operated from the control station and shall be simple to activate and operate.

The secondary independent power system shall have sufficient capacity to hoist and lower the same load as the primary power system. Reduced speed is acceptable, see 5.15.3.

A.1.12 Securing arrangement for training and maintenance

For training and maintenance purposes, when the life saving equipment is not intended to be launched, a fail-safe securing arrangement including an interlock system is to be provided to prevent unintended operation or release.

The securing arrangement may be such that launching is not physically possible when the securing arrangement is in place and that launching is only possible when the securing arrangement is removed.

The securing arrangement including attachments to structure shall be durably marked for identification and for prevention of misuse.

A.1.13 Procedures

Clear and unambiguous procedures shall be provided for

- primary means of launching,
- secondary means of launching,
- maintenance and installation facilities,
- life saving operations (i.e. evacuation or rescue).

Easily understandable operations instruction and permanent sign plates in accordance with EN 12644-2 and IMO Resolution A.760 (18), as amended by IMO resolution MSC.82 (70), shall be posted at the launching station.

A.1.14 Testing

A.1.14.1 General

Launching and recovery appliances together with means of connection and their anchorage in life saving equipment shall undergo testing as specified in this subclause to prove that requirements given in this NORSOK standard, are met.

A.1.14.2 Group E.1 – Free fall lifeboats – Primary means of launching and hang-off

A.1.14.2.1 Prototype tests

A.1.14.2.1.1 Release test, means of connection

The means of connection shall be loaded with a force equal to or greater than 200 % of the rated capacity (see A.2.3) of the primary means of launching. The load may be the lifeboat itself with test loads, or a dummy load connected to the means of connection in a realistic manner. The means of connection and direction of load shall be oriented in the same way as it will be when installed on the host facility without heel or trim. The release mechanism shall be opened by the activation system. The test is considered successful if the load is released and dropped, and if there is no damage on the means of connection or the release system. The test shall be repeated for the most unfavourable heel/trim angles up to 17° in any direction if this is realistic for the final installation.

NOTE If the host facility specific value for angle of heel for the damaged host facility is known, this test may be performed at the host specific angle of heel in stead of 17°. Reference is made to Table A.2.

A.1.14.2.1.2 Tensile test, means of connection

The means of connection shall be subjected to a tensile test to verify that the breaking force is equal to or greater than the breaking force specified in A.1.8.2.3. The direction of the load shall reflect the final installation of the host facility without heel or trim. The load shall be kept stable for at least 2 min. The test is considered successful if there is no failure to the means of connection or release mechanism. In this context the term “failure” means: the means of connection do not disconnect, and release tests with loads equal to empty lifeboat and 110 % of the rated capacity are successfully carried out after the tensile test.

A.1.14.2.1.3 Test of actuator force

The actuator force required to open the release mechanism when the means of connection are loaded with a force equal to 100 % of the rated capacity of the primary means of launching (see A.2.3) shall be measured. The actuator shall then be subjected to a force equal to twice this force. The test is successful if there is no damage to the actuator and if the same actuator is successfully used in the prototype test #4.

A.1.14.2.1.4 Release test, lifeboat arrangement

The lifeboat shall be suspended from the primary means of launching in the launching appliance with loads corresponding to empty lifeboat and 110 % of the rated capacity (see A.2.3) of the primary means of launching with the launching appliance oriented in the upright position, i.e. corresponding to final installation on the host facility without heel or trim. For both loading conditions, the release mechanism shall be opened by the activation system. The test is considered successful if the lifeboat is dropped as intended. The test shall be repeated for both loading conditions with the launching appliance oriented in the most unfavourable heel/trim angles up to 17° in any direction. The actuator subjected to prototype test #3 shall be used for this test.

NOTE If the host facility specific value for angle of heel for the damaged host facility is known, this test may be performed at the host specific angle of heel in stead of 17°. Reference is made to Table A.2.

A.1.14.2.1.5 Function test of activation system for release mechanism, manually operated actuator

The following requirements shall be demonstrated by functional tests:

- the number of strokes required to open the release mechanism and release the lifeboat is within the range given in A.2.4.1.2, for loading conditions corresponding to empty lifeboat and 110 % of the rated capacity (see A.2.3) of the primary means of launching;
- the manual force required to operate the enabling device or the manual operating device does not exceed the value given in A.2.4.1.2, for the same loading conditions;
- it is not possible to open the release mechanism with the actuator when the enabling device is not activated.

A.1.14.2.1.6 Function test of activation system for release mechanism, powered actuator

The following requirements shall be demonstrated by functional tests:

- the energy source provided for the powered operated actuator has sufficient amount of potential energy to open the release mechanism and release the lifeboat in two subsequent trials without recharging between the two releases, for loading conditions corresponding to empty lifeboat and 110 % of the rated capacity (see A.2.3) of the primary means of launching (whichever is the most unfavourable);
- the energy source is capable of producing an actuator force of at least two times the force measured in test #3 above;
- it is not possible to open the release mechanism by operating only one of the control devices;
- each of the two control devices returns to neutral position after activation.

A.1.14.2.1.7 Dynamic overload tests, skidding arrangement or other mechanisms other than hoisting/lowering

With the launching appliance in an upright position, corresponding to no heel or trim of the host installation, a load equal to 110 % of the rated capacity for the primary means of launching shall be suspended from the suspension point of the primary means of launching, resting at the skidding arrangement or other mechanism in a realistic manner simulating load action from the weight of the lifeboat. The skidding arrangement or other mechanism shall move the load from the full inboard position to the full outboard position and back again, using machinery and power source similar to that of the final installation. The test shall be repeated with the launching appliance inclined to 17° in the most unfavourable directions of heel and trim. The same tests shall be performed with a load equal to a fully equipped lifeboat without persons. The tests are considered successful if the launching appliance is able to perform the required motions for both loading conditions, and there is no damage or permanent deformation after the tests.

NOTE If the host facility specific value for angle of heel for the damaged host facility is known, this test may be performed at the host specific angle of heel in stead of 17°. Reference is made to Table A.2.

A.1.14.2.2 Production and installation tests

A.1.14.2.2.1 General

The production and installations tests are intended to be performed on each manufactured lifeboat in combination with its dedicated launching appliance. The most appropriate time for testing, e.g. FAT or testing during/after commissioning at the host facility, may be agreed in each separate project.

A.1.14.2.2.2 Release test, lifeboat arrangement

The lifeboat shall be suspended from the primary means of launching in its dedicated launching appliance with loads corresponding to empty lifeboat and 110 % of the rated capacity (see A.2.3) of the primary means of launching with the launching appliance oriented in the upright position (i.e. corresponding to final installation on the host facility without heel or trim). For both loading conditions, the release mechanism shall be opened by the activation system. The test is considered successful if the lifeboat is released as intended.

The two independent activation systems (as required by A.2.4.1.2) shall be tested separately. For the purpose of this test, the manufacturer may decide if the lifeboat should be dropped into sea or if the drop should be stopped by a fall arrest device purpose made for this test, e.g. the hang-off relief equipment or other device. In order to avoid exposing persons to risk, a purpose built system for remote operation of the activation systems may be utilised.

A.1.14.2.2.3 Function test, release system

The function tests described in A.1.14.2.1.5 and A.1.14.2.1.6 (as applicable) shall be performed.

A.1.14.2.2.4 Means of launch testing by simulation

The means of launch testing by simulation, as required by DNV-OS-E406 Sec. 11 A500, shall be demonstrated in accordance with a prescribed procedure describing (a) realistic functional test(s) to confirm that both the activation system and release mechanism are working properly. For the purpose of this test, the lifeboat shall be suspended in the primary means of launching with loads corresponding to 110 % of the rated capacity (see A.2.3) of the primary means of launching.

A.1.14.2.2.5 Static overload tests

The lifeboat shall be suspended from the primary means of launching in its dedicated launching appliance with loads corresponding to 220 % of the rated capacity (see A.2.3) for the primary means of launching.

The lifeboat shall be suspended from the hang-off relief arrangement in its dedicated launching appliance with loads corresponding to 220 % of the rated capacity (see A.2.3) for the hang-off relief arrangement.

The tests are considered successful if there is no damage or permanent deformation to the main structure, the primary means of launching or the hang-off relief arrangement after the tests.

As an alternative way to perform the above tests, a test load equal to 220 % of the rated capacity may be suspended from the means of connection part of the launching appliance and the hang-off relief arrangement, respectively. A realistic tensile load test shall then be performed on primary means of launching and attachment points in the lifeboat for hang-off suspension.

A.1.14.3 Group E.1 – Free fall lifeboats – Secondary means of launching and means of retrieval**A.1.14.3.1 Prototype tests****A.1.14.3.1.1 Static overload tests, main structure**

A load equal to 220 % of the fully loaded lifeboat shall be suspended from the main structure of the appliance for secondary means of launching and means of retrieval, respectively, without loading the winch. The load shall be applied in the most unfavourable position of the launching appliance or means of retrieval, simulating a realistic load path for the weight of the lifeboat. The tests are considered successful if there is no damage or permanent deformation to the main structure.

A.1.14.3.1.2 Static overload test, winches

A load equal to 150 % of the rated capacity (see A.2.3) of the means of retrieval or secondary means of launching, shall be suspended from the means of connection forming part of the hoist rope of the winch for the means of retrieval and secondary means of launching, respectively. The load shall be applied with the hoist rope at the outermost layer on the winch drum. If the winch is equipped with both primary and secondary brakes for the purpose of lifting/lowering persons, both brakes shall be applied during this load test.

For winches equipped with primary and secondary brakes for the purpose of lifting/lowering persons, the following test shall be performed in addition: a load equal to 150 % of the rated capacity for lifting persons (see A.2.3) shall be suspended from the means of connection forming part of the hoist rope of the winch. The load shall be applied with the hoist rope at the outermost layer on the winch drum. The test shall be applied for the primary brake (with the secondary brake disabled) and the secondary brake (with the primary brake disabled) separately.

The tests are considered successful if the brakes are able to hold the load, either separately or in combination as tested.

A.1.14.3.1.3 Dynamic overload test, winches

A load equal to 110 % of the rated capacity of the secondary means of launching shall be suspended from the means of connection forming part of the hoist rope, when the winch is installed in the main structure. The load shall be lowered at full speed, starting from the uppermost position of the lifeboat. The lowering motion shall be stopped by the most severe method, e.g. sudden application of winch brakes or emergency stop, immediately after the lowering speed has reached its maximum. If the winch is equipped with both primary

and secondary brakes for the purpose of lifting/lowering persons, both brakes shall be applied simultaneously during this load test. The maximum dynamic peak force on the test load, corresponding to F_{bra} in equation (A.2), shall be recorded during the stop. The test is considered successful if both of the following acceptance criteria are met:

- the brakes brings the winch movement to a complete stop;
- the recorded peak force is equal to or less than the force F_{bra} used in equation (A.2) to calculate the dynamic coefficient $\Phi_{2,C6}$ as defined in A.1.5.4 for load combination C6.

For winches equipped with primary and secondary brakes for the purpose of lifting/lowering persons, the following tests shall be performed in addition: a load equal to 110 % of the rated capacity for lifting of persons (see A.2.3) shall be suspended from the means of connection forming part of the hoist rope, when the winch is installed in the main structure. The load shall be lowered at full speed, starting from the uppermost position of the lifeboat. The lowering motion shall be stopped by the most severe method, e.g. sudden application of both winch brakes by emergency stop, immediately after the lowering speed has reached its maximum. The maximum dynamic peak force on the test load, corresponding to F_{bra} in equation (A.2), shall be recorded during the stop. The test is considered successful if the recorded peak force is equal to or less than the force F_{bra} used in equation (A.2) to calculate the dynamic coefficient $\Phi_{2,C6}$ as defined in A.1.5.4 for load combination C6.

The test shall be repeated with the application of each brake separately, i.e:

- stopping by sudden application of primary brake when secondary brake is disabled, and
- stopping by sudden application of secondary brake when primary brake is disabled

These tests are considered successful if both brakes are able to bring the lowering motion to a complete stop.

A.1.14.3.1.4 Tensile test, means of connection

The means of connection shall be subjected to a tensile test to verify that the breaking force is equal to or greater than the breaking force specified in A.1.8.2.3. The direction of the load shall reflect the final installation of the host facility without heel or trim. The load shall be kept stable for at least 2 min. The test is considered successful if there is no failure to the means of connection or release mechanism. In this context the term "failure" means: The means of connection do not break or disconnect, and it is possible to operate the release mechanism as intended after the test.

A.1.14.3.1.5 Release test

A test shall be performed to verify that the release mechanism can not be opened when loaded with a force greater than 10 % of the rated capacity of the means of connection.

A.1.14.3.2 Production and installation tests

A.1.14.3.2.1 General

The production and installations tests are intended to be performed on each manufactured lifeboat in combination with its dedicated launching appliance. The most appropriate time for testing, e.g. FAT or testing during/after commissioning at the host facility, may be agreed in each separate project.

A.1.14.3.2.2 Speed tests

The hoisting and lowering speed of the secondary means of retrieval and secondary means of launching shall be measured when hoisting or lowering a load equal to the rated capacity for the mechanism. The tests are considered successful if the speeds are within the limits described in A.1.6. In case of gravity lowering with two independent constant speed control devices, the lowering speed test shall be performed for each speed control device separately, with the other speed control device disabled or adjusted to a higher speed. Both speed control devices shall be adjusted to correct speed after the test.

A.1.14.3.2.3 Dynamic overload test, mechanisms other than hoisting

With the launching appliance in an upright position, corresponding to no heel or trim of the host installation, the lifeboat with loads corresponding to 110 % of the rated capacity for the secondary means of launching and means of retrieval shall be suspended from the suspension point of the secondary means of launching and means of retrieval. All mechanisms (i.e. skidding, luffing, slewing, telescoping etc), shall be moved in their full operating range in both directions at full speed in sequence, one at a time. If the movement of the

skidding mechanism loaded by the weight of the lifeboat is part of the cycle, the lifeboat shall be supported by the skidding tracks during this test. There shall be at least two stops of each motion during the cycle. The test is considered successful if the launching appliance is able to perform all the required motions, and there is no damage or permanent deformation after the tests.

A.1.14.3.2.4 Dynamic overload test, winches

The tests described in A.1.14.3.1.3 shall be performed.

The tests described in the first paragraph of A.1.14.3.1.3 shall be performed with the suspended lifeboat with loads corresponding to 110 % of the rated capacity for the means of retrieval and secondary means of launching, respectively.

The tests described in A.1.14.3.1.3, second paragraph, may be performed with a test load.

A.1.14.3.2.5 Static overload tests, main structure

The static overload tests described in A.1.14.3.1.1 shall be performed.

A.1.14.3.2.6 Static overload tests, means of connection

A static overload test shall be performed on the means of connection for means of retrieval and secondary means of launching. A test load equal to 200 % of the rated capacity for the means of retrieval and secondary means of launching, respectively, shall be applied with an arrangement for tensile load testing. The tests are considered successful if there is no damage or permanent deformation to the means of connection after the tests.

A.2 Appliances for free fall lifeboats (Group E.1)

A.2.1 General

The requirements in this subclause apply in addition to the requirements in A.1 for launching and recovery appliances of Group E.1. Relevant requirements in DNV-OS-E406 apply in addition to the requirements in this Annex. In case of conflicting requirements between this Annex and DNV-OS-E406, the requirements of this Annex prevail.

The requirements listed in A.2.2.1 to A.2.5 describe an acceptable design. Alternative designs are acceptable if the risk assessment (see 4.11) proves that the alternative design results in an equal or better safety, fitness for use, reliability and availability, than the requirements in this Annex.

The following requirements from NMD Regulation 4 July 2007 No. 853 apply for launching and recovery appliances of free fall lifeboats:

- section 11, 1st paragraph;
- section 11, 3rd paragraph.

A.2.2 Limits of the launching and recovery appliances for free fall lifeboats

A.2.2.1 General

Launching and recovery appliances of Group E.1 consist of the parts and sub-systems in A.2.2.2 to A.2.2.4.

A.2.2.2 Main structure

The main structure of the launching and recovery appliance for free fall lifeboats is the structure that is directly loaded by the weight of the lifeboat when it is suspended from its primary or secondary means of launching, its means of retrieval or its hang-off relief arrangement. This includes foundation for mechanical equipment, e.g. winches, sheaves etc.

A.2.2.3 Primary means of launching

The primary means of launching is the main lifeboat launching system, normally based on gravity free fall or skidding combined with free fall. This includes means of connection, release system and securing arrangement.

A.2.2.4 Secondary means of launching

The secondary means of launching is an alternative lifeboat launching system, normally based on gravity lowering or power lowering by a lifting appliance. This includes a winch and fall system with its machinery and control system as well as means of connection, release mechanism, release system and securing arrangement. The purpose of the secondary means of launching is not to launch the lifeboat in an emergency situation.

A.2.2.5 Means of retrieval

The means of retrieval is a lifting appliance designed for retrieval of the lifeboat from sea to its stowed position on the host facility. The means of retrieval is normally the same mechanism as the secondary means of launching.

A.2.2.6 Hang-off relief arrangement

The hang-off relief arrangement is lifting accessories and means of connection intended for keeping the lifeboat in the stowed position when the lifeboat is disconnected from the primary means of launching, the secondary means of launching and the means of retrieval.

A.2.3 Rated capacity

When performing the proof of competence in accordance with A.1, the rated capacity for the different mechanisms shall be taken as follows:

- primary means of launching: fully loaded lifeboat;
- secondary means of launching: 1,1 x fully loaded lifeboat;
- means of retrieval: 1,1 x fully loaded lifeboat;
- hang-off relief arrangement: 1,1 x fully loaded lifeboat.

When performing proof of competence with the above listed rated capacities, the risk coefficient given in A.1.7 need not be applied.

“Fully loaded lifeboat” means the gross mass of a fully equipped lifeboat when boarded with its full complements of persons (crew and passengers).

Main structure shall be proved for the load effects resulting from applicable loads on all the mechanisms, whichever gives the highest load effects.

If secondary means of launching and means of retrieval is intended to be used with persons inside the lifeboat, the proof of competence shall also be performed with rated capacity for lifting persons. Rated capacity for lifting persons with these mechanisms shall as a minimum be taken as empty (fully equipped) lifeboat with crew of 3 persons. When performing proof of competence with rated capacity for lifting persons, the risk coefficient given in A.1.7 shall be applied.

A.2.4 Functional and safety requirements

A.2.4.1 Primary means of launching

A.2.4.1.1 General

The primary means of launching shall be capable of launching the lifeboat in any possible loading condition, i.e. from empty lifeboat with crew of three persons to the fully loaded lifeboat.

A.2.4.1.2 Release system for the primary means of launching

The release mechanism and activation systems shall comply with the following clauses of DNV-OS-E406 in addition to the requirements of this subclause:

- Sec. 7, C101;
- Sec. 11, A400;
- Sec. 11, A500.

The release mechanism and activation systems shall be capable of operating in all specified environmental conditions, including icing.

The release mechanism shall be designed in such a way that it will not be forced open by the self weight of the lifeboat, i.e. an external force from an actuator shall be necessary to open the release mechanism. The actuator and release mechanism shall be interconnected in the positive mode in accordance with ISO 12100-2, 4.5.

The two independent activation systems for the release mechanism, as required by DNV-OS-E406 Sec. 7, C101, may consist of manually operated or powered actuators.

Manually operated actuators shall have a manual operating device (e.g. hydraulic hand pump or manual jacking system) for each actuator and an enabling device (e.g. hydraulic by-pass valve or mechanical coupling device) placed out of reach for the operator of the manual operating device. The enabling device shall need a continuous manual force to be kept in the "enable" position. The number of required strokes for the manual operating device shall be in the range of 5 to 10. The maximum manual force required to operate the enabling device or the manual operating device shall not exceed 250 N.

Each powered actuator shall have its own source of stored energy and its own control system incorporating two manually operated control devices named "launch", which are required to be activated simultaneously to start moving the release mechanism. The control devices shall be protected against inadvertent operation and shall be placed such that one operator can not activate both control devices simultaneously. The control devices shall return to neutral position when released. The energy sources shall have a capacity of twice the amount of energy needed to open the release mechanism. It shall be possible to visually control the amount of stored energy.

Each actuator shall be designed to produce a force exceeding two times the force required to open the release mechanism with the fully loaded lifeboat.

A.2.4.2 Secondary means of launching

A.2.4.2.1 General

The secondary means of launching shall be capable of launching the lifeboat in any possible loading condition, i.e. from empty lifeboat up to the rated capacity for the mechanism as specified in A.2.3.

NOTE The requirements for secondary means of launching given in this clause are intended for launching devices utilising a winch and falls. Other solutions may also be considered, but at the time of publication of this NORSOK standard no other solutions are considered sufficiently qualified. Other solutions must be qualified in accordance with 4.15.

The requirements given in the subsequent subclauses are given based on the assumption that the secondary means of launching is intended to lower the lifeboat with a crew of three. If lowering the lifeboat with persons inside is not part of the intended use, the requirements in A.2.4.2.2.1 and A.2.4.2.2.3 need not apply.

A.2.4.2.2 Launching mechanism

A.2.4.2.2.1 Constant speed control

In case secondary means of launching is based on gravity lowering by a winch, the lowering speed shall be controlled by two independent constant speed control devices. Each speed control device shall be able to control the lowering motion within the speed limit given in A.1.6.

A.2.4.2.2.2 Winch brakes, primary brakes

Winches shall be equipped with brakes (primary brake) in accordance with 5.7.6.

A.2.4.2.2.3 Winch brakes, secondary brakes

Winches shall also be equipped with secondary brakes in accordance with A.1.10.

A.2.4.2.2.4 Control station

A control station for the secondary means of launching shall be located outside the lifeboat with the following control devices:

- start device to enable power supply to the launching and recovery appliance;
- stop device to disable power supply to the launching and recovery appliance;

- emergency stop for emergency purposes to stop all motions;
- movement control device for starting, stopping and variable speed control of the lowering motion. The movement control device must be of the hold-to-run type, i.e. return to neutral position when released.

The control station for the secondary means of launching shall not influence on the primary means of launching and shall be located so that the operator has a clear view to the life boat in all positions.

A.2.4.2.3 Motion limiter

A motion limiter for the lowering motion shall be installed to prevent ropes from running off the drum or be wound on the drum in the wrong direction when the lifeboat is seaborne. The setting point of the motion limiter shall take into account the most unfavourable situation caused by possible sidelead and offlead, wave trough and the lowest astronomical tide. When the lower motion limit has been reached, at least 2 windings of wire rope shall remain on the winch drum.

A.2.4.2.4 Secondary independent power supply and control system

In case secondary means of launching is based on powered lowering, a secondary independent power supply and control system in accordance with 5.5.13 shall be provided.

A.2.4.2.5 Release system for the secondary means of launching

The release system shall be operated from within the lifeboat and shall require two deliberate actions by the operator. Opening the release mechanism shall only be possible when the means of connection are offloaded.

The release system shall be physically protected against inadvertent use.

The release mechanism shall be designed in such a way that it will not be forced open by the self weight of the lifeboat, i.e. an external force from an actuator shall be necessary to open the release mechanism. The actuator and release mechanism shall be interconnected in the positive mode in accordance with ISO 12100-2, 4.5.

A manually operated actuator shall be provided for opening of the release mechanism of the secondary means of launching.

A.2.4.3 Means of retrieval

A.2.4.3.1 General

The means of retrieval shall be capable of hoisting the rated capacity given in A.2.3 from sea surface to the stowed position.

NOTE The requirements for means of retrieval given in this clause are based on means of retrieval combined with secondary means of launching utilising a winch and falls. Other solutions may also be considered, but at the time of publication of this NORSOK standard, no other solutions are considered sufficiently qualified. Other solutions must be qualified in accordance with 4.15.

The requirements given in the subsequent subclauses are given based on the assumption that the means of retrieval is intended to hoist the lifeboat with a crew of three. If hoisting the lifeboat with persons inside is not part of the intended use, the requirements in A.2.4.3.2.3 need not apply.

A.2.4.3.2 Hoisting mechanism

A.2.4.3.2.1 General

A powered winch shall be provided for hoisting the lifeboat with a minimum speed as given in A.1.6.

A.2.4.3.2.2 Winch brakes, primary brakes

Winches shall be equipped with brakes (primary brake) in accordance with 5.7.6.

A.2.4.3.2.3 Winch brakes, secondary brakes

Winches shall also be equipped with secondary brakes in accordance with A.1.10.

A.2.4.3.2.4 Control station

The control station described in A.2.4.2.2.4 shall also incorporate a movement control device for starting, stopping and variable speed control of the hoisting motion. The movement control device shall be of the hold-to-run type.

A.2.4.3.3 Motion limiter

A motion limiter for the hoisting motion shall be installed to prevent hoisting the lifeboat beyond the stowed position. A backup motion limiter shall be provided to prevent excessive pulling forces in the hoist rope(s) caused by hoisting the lifeboat against an obstruction in the event of failure of the first motion limiter.

A.2.4.3.4 Rated capacity limiter

A rated capacity limiter shall be provided to prevent the means of retrieval from hoisting loads in excess of the rated load.

A.2.4.3.5 Secondary independent power supply and control system

The secondary independent power and control system required by A.2.4.2.4 shall also be provided for the means of retrieval.

A.2.4.3.6 Release system (means of connection)

TO BE DEVELOPED

A.2.4.4 Hang-off relief arrangement

Hang-off relief arrangement is the system required by DNV-OS-E406 sec.7, C102.

The hang-off relief arrangement shall be designed to keep the lifeboat in the stowed position when it is disconnected from the primary and secondary means of launching. Suspension points and means of connection for the hang-off arrangement forming integral parts of the lifeboat shall have easy access so that it is possible to connect without entering the lifeboat. The hang-off relief arrangement shall be designed so that it is not possible to attach any of its components to the wrong suspension points or means of connection.

A.2.4.5 Skidding systems

In addition to the limit states described in A.1.8, the proof of competence shall be performed for the SLS for the skidding tracks. The verification of serviceability limit state shall be based on deflection criteria for the skidding tracks.

Deflection criteria for the skidding tracks shall be established with the aim to obtain the predicted trajectory in air during launching.

The SLS shall be proven for load combinations A1 and B1 in Table A.3.

A.2.5 Marking

Means of retrieval and secondary means of launching shall be clearly marked to advise the user if the lifting or lowering of lifeboat with persons inside is allowed or not. Marking shall be provided in both cases, e.g.:

- “This winch/means of retrieval/secondary means of launching is intended for lifting/lowering the lifeboat with persons inside during installation, maintenance or training. Maximum number of persons is <number of persons>”, or
- Lifting/lowering of persons is NOT ALLOWED with this winch/means of retrieval/secondary means of launching”.

This marking shall be provided at the operator station.

A.3 Appliances for lifeboats launched by falls and a winch (Group E.2)

A.3.1 General

The requirements in this subclause come in addition to the requirements in A.1 for launching and recovery appliances of Group E.2.

The requirements listed in A.3.2 to A.3.8 describe an acceptable design. Alternative designs are acceptable if the risk assessment, see 4.11, proves that the alternative design results in an equal or better safety, fitness for use, reliability and availability, than the requirements in this Annex.

NOTE The requirements in this subclause of Annex A apply to launching appliances for lifeboats with two suspension points, i.e. one fore and one aft, with single fall or multiple falls at each suspension point. Other solutions (e.g. one suspension point) may also be considered, but at the time of publication of this NORSOK standard, such solutions are not considered sufficiently qualified. Other solutions must be qualified in accordance with 4.15.

The following requirements from NMD Regulation 4 July 2007 No. 853 apply for launching and recovery appliances of Group E.2:

- section 11, 1st paragraph;
- section 11, 2nd paragraph, including subclauses a through d, and g through h

A.3.2 Mode selector

Launching and recovery appliances of Group E.2 shall have a control device (mode selector) for manual selection of two distinguished different operational modes, i.e. mode for installation and maintenance, and mode for emergency evacuation. The mode selector shall be protected against unintended use. The mode selector shall be located at the control station outside the lifeboat. Clear indication of the selected mode shall be provided inside the lifeboat and at the control station outside the lifeboat.

The two operational modes shall have separate functional characteristics as described in A.3.3.1 and A.3.4.1, such that the functions of each mode can not influence or affect the other. A summary of the functional characteristics of the two operational modes is given in Table A.12.

Table A.12 - Modes and functional characteristics overview

Launching appliance functional characteristics		Mode for installation and maintenance	Mode for emergency evacuation
During wire rope suspended lifeboat	Start	Yes	"Launch"
	Stop	Yes	No
	Emergency stop	Yes	No
	Power hoisting and power lowering by variable speed control	Yes	No
	Gravity lowering by two independent constant speed controls	No	Yes
	Re-entry overload protection	No	Yes
	Primary brake	Yes	No
	Secondary brake	Yes	No
	Motion limiter up	Yes	No
	Motion limiter down	Yes	No
	Secondary independent power- and control system	Yes	No
	Rated capacity limiter	Yes	No
During seaborne lifeboat	Primary release system	No	Yes
	Back up release system	Yes	Yes

A.3.3 Mode for installation and maintenance

A.3.3.1 General

When the mode selector is in the position for installation and maintenance the requirements in A.3.3.2 to A.3.3.7 applies.

A.3.3.2 Control station

A control station shall be located outside the lifeboat with the following control devices:

- start device to enable power supply to the launching and recovery appliance;
- stop device to disable power supply to the launching and recovery appliance;
- emergency stop for emergency purposes to stop all motions;
- mode selector;
- indication of selected mode;
- movement control devices for hoisting and lowering and, if applicable, any other movements. All movement control devices shall be of the hold-to-run type, i.e. return to neutral position when released. All movements shall have variable speed control.

The control station must be located so that the operator has a clear view to the life boat during all movements.

A.3.3.3 Winch brakes

Primary and secondary brakes shall be operative as described in 5.7.6 and A.1.10.

A.3.3.4 Motion limiters

Motion limiters for the upper and lower position of the lifeboat shall be installed and automatically prevent further hoisting or lowering at these positions and activate the brakes. The motion limiter for the upper position shall stop the movement at the level for boarding the lifeboat. A backup motion limiter shall be provided for the upper position to prevent excessive pulling forces in the hoist ropes caused by hoisting the lifeboat against an obstruction in the event of failure of the first motion limiter.

A.3.3.5 Rated capacity limiter

A rated capacity limiter shall be installed to prevent any overload during operation.

A.3.3.6 Backup release system

Operation of the backup release system described in A.3.4.5.2 shall be possible in the mode for installation and maintenance.

A.3.3.7 Secondary independent power and control system

In case of unintended stops as result of power failure or failure in the control system, secondary independent power and control systems in accordance with 5.5.13 shall be available in mode for installation and maintenance.

A.3.4 Mode for emergency evacuation**A.3.4.1 General**

When the mode selector is in the position for emergency evacuation the following applies:

Before any movement of the lifeboat can be initiated the securing arrangement in A.1.12 need to be removed.

A.3.4.2 Launch devices

The emergency evacuation shall be activated from within the lifeboat by the simultaneous operation of two control devices named "launch". The "launch" devices shall be placed such that one operator can not activate both control devices simultaneously. The control devices must return to neutral position when released. Activation of the "launch" devices shall initiate the lowering motion. The "launch" devices shall be protected against inadvertent operation. A duplicate "launch" device may also be arranged outside the lifeboat for remote operation for test purposes only.

A.3.4.3 Lowering mechanism and speed control

The lowering motion shall only depend on gravity or stored mechanical energy. Once the lowering motion has started it shall continue regardless of any crew intervention until the lifeboat is seaborne.

The lowering speed shall be controlled by two independent constant speed control devices. Each speed control device shall be able to control the lowering motion within the speed limit given in A.1.6.

A.3.4.4 Disabled safety features

No other safety features shall be operational during the descent, except for those ensuring the release mechanism to be secured.

A.3.4.5 Release system

Once the lifeboat is seaborne and at least one of the wire rope suspensions is offloaded, the release mechanisms for both the wire rope suspensions shall be opened automatically by the primary activation system.

A.3.4.6 Release mechanism

The release mechanism shall be designed in such a way that it will not be forced open by the self weight of the lifeboat, i.e. an external force from an actuator shall be necessary to open the release mechanism. The actuator and release mechanism shall be interconnected in the positive mode in accordance with ISO 12100-2, 4.5.

Dynamics caused by initiation of the emergency evacuation from installation deck elevation or oscillation during the descent (boat acceleration) shall not cause the release mechanism to open unintentionally.

The release mechanisms connecting the wire rope falls to the lifeboat, shall operate at all rope fleet angles between -45 degrees to +45 degrees from vertical in all horizontal directions and up to 180 degrees rope twist either way when the boat is seaborne.

A.3.4.7 Activation systems

A.3.4.7.1 General

The release system shall have two independent activation systems for opening the release mechanisms, i.e. primary activation system and backup activation system. Both activation systems shall be designed to open the release mechanisms under the load of a fully loaded life boat.

A.3.4.7.2. Primary activation system

The primary activation system consists of the following parts:

- a power source (i.e. stored potential energy) for each release mechanism;
- an actuator for each release mechanism;
- a control system incorporating a detection system for detection of
 - seaborne lifeboat,
 - one of the suspension points is offloaded.

When the conditions for release (seaborne lifeboat and one offloaded suspension point) are detected, the control system shall initiate movement of the actuators to open both release mechanisms simultaneously.

The primary activation system shall be disabled until the conditions for release are detected.

The control system of the primary activation system shall have a required performance level (PLr) equal to or better than "d" in accordance with ISO 13849-1.

A.3.4.7.3 Backup activation system

For the event of malfunctioning of the primary activation system, a manually operated backup activation system for opening both release mechanisms simultaneously shall be provided. The backup release system shall be available for both operational modes.

The activation system for the backup release system shall be operated from within the boat and shall require two deliberate actions by the operator.

Operation of the backup activation system shall only be possible when the lifeboat is seaborne.

The backup activation system shall be physically protected against inadvertent use.

A.3.4.8 Re-entry overload protection

Unless the manufacturer can demonstrate by calculations, simulations or model tests that the dynamic coefficient, $\Phi_{2.C1}$, is within the limit described in A.1.5, the launching appliance or the lifeboat shall be arranged with a protective device or system to limit the dynamic coefficient, $\Phi_{2.C1}$, as specified.

A.4 Appliances for escape chutes (Group E.3)

TO BE DEVELOPED

A.5 Appliances for rafts (Group E.4)

TO BE DEVELOPED

A.6 Appliances for escape lines (Group E.5)

TO BE DEVELOPED

A.7 Appliances for rescue boats (Group E.6)

A.7.1 General

Launching and recovery of rescue boats may be performed by general purpose offshore cranes or dedicated rescue boat cranes or davits especially designed for such operations.

This clause applies to dedicated rescue boat cranes or davits especially designed for such operations. Reference is made to Annex G for general purpose offshore cranes intended for lifting rescue boats.

This clause also applies to the means of connection that form integral parts of the rescue boat, including their release mechanisms, release systems and anchorage to the hull.

NOTE The requirements in this clause of Annex A apply to launching appliances for lifeboats with one suspension point, with single fall or multiple falls. Other solutions (e.g. multiple suspension points) may also be considered, but at the time of publication of this NORSOK standard, such solutions are not considered sufficiently qualified. Other solutions must be qualified in accordance with 4.15.

The requirements in this clause apply in addition to the requirements in A.1.

The launching and recovery appliances shall be able to operate a fully loaded rescue boat in all positions.

Launching and recovery appliances for rescue boats shall provide a minimum horizontal clearance from the rescue boat to any fixed structure of 8 m for non-ship installations.

The following requirements from NMD Regulation 4 July 2007 No. 853 apply for launching and recovery appliances for rescue boats:

- section 11, 1st paragraph;
- section 11, 4th paragraph, including sub clauses a) through d)

The following requirements from NMD Regulations July 2007 No. 853 apply for means of connection and release systems that form integral part of the rescue boat:

- section 9, 2nd paragraph, including subclauses c and d

A.7.2 Functional and safety requirements for the launching and recovery appliances

TO BE DEVELOPED

A.7.3 Means of connection, release mechanism and systems

The requirements herein apply to both the launching/recovery appliance and the rescue boat.

A.7.4 Elastic pennant for lifting rescue boat with offshore crane

A.7.4.1 General

When lifting a rescue boat (group E.6) with offshore crane, an elastic pennant shall be utilised in order to limit the dynamic impact acting on the load bearing structural parts of the boat and the personnel on board.

The elastic pennant shall be selected and dedicated for the particular rescue boat to be lifted.

The elastic pennant shall consist of a single legged sling made from 8-strand plaited construction man made fibre rope in accordance with EN 1492-4.

NOTE Other rope constructions may also be considered, but at the time of publication of this NORSOK standard, this is the most commonly used rope construction for this purpose and other constructions are not considered sufficiently qualified. Other rope constructions must be qualified in accordance with 4.15.

The sling shall have spliced eyes with thimbles and permanent fittings in both ends. Consideration shall be given to the weight of end-connections and risk of entanglement and harm to personnel operating the equipment.

Links, rings etc used as means of connection in the lower end of the pennant shall be designed such that incorrect attachment and snagging hazards are avoided.

A.7.4.2 Working load limit (WLL)

The working load limit, WLL_{R002A} (tonnes), for an elastic pennant including its end fittings shall be equal to or greater than the gross mass of the fully equipped rescue boat with its full complement of persons.

NOTE The WLL for elastic pennants for rescue boats is labelled with the index "R002A" in order to distinguish it from lifting slings for general service.

A.7.4.3 Safety factors

Ropes for elastic pennants shall be selected with the specified minimum breaking load, MBL (tonnes) and static spring rate in order to satisfy the following requirements for static and dynamic safety factors:

Static safety factor, SF_{Stat} , is the ratio between the 90 % of MBL and WLL:

$$SF_{Stat} = \frac{90\%MBL}{WLL_{R002A} \cdot g} \quad (A.18)$$

where

MBL is the specified minimum breaking load (in kN) for the fibre rope used in the elastic pennant
 $g = 9,81 \text{ m/s}^2$ is the acceleration of gravity.

Ropes for elastic pennants shall be selected with MBL giving a static safety factor not less than 10.

Dynamic safety factor, SF_{Dyn} , is a minimum required safety factor based on dynamic factor, partial safety factor, risk coefficient and rope resistance factor as follows:

$$SF_{Dyn} = \phi \cdot \gamma_p \cdot \gamma_n \cdot \gamma_{rb} \quad (A.19)$$

where

γ_p is the partial safety factor

$\gamma_p = 1,34$ for load combination A

$\gamma_p = 1,1$ for load combination C

$\gamma_n = 1,5$ is the risk coefficient as described in 5.9

$\gamma_{rb} = 2,3$ is the rope resistance factor for fibre ropes

$\phi = 1 + \frac{V_R}{g} \sqrt{\frac{K_s}{WLL_{R002A}}}$ is the dynamic factor for pickup of rescue boat from sea

$V_R = 0,5 \times V_{WLL} + \sqrt{V_D^2 + V_C^2}$ is the relative velocity (in m/s) between rescue boat and hook at pick-up

where

V_{WLL} (m/s) is the maximum steady state hoisting velocity the crane is able to lift the rescue boat

V_D (m/s) is given by expression (A.4) in A.1.5.6

V_C (m/s) is given by expression (A.5) in A.1.5.6

K_s is the static spring rate (in kN/m) for the elastic pennant

NOTE The dynamic factor, ϕ , is only dependent on the characteristics of the fibre rope used in the elastic pennant, in addition to the relative velocity and WLL. For the purpose of calculating the dynamic factor, the crane is assumed to be indefinitely stiff.

The dynamic factor, ϕ , and the dynamic safety factor, SF_{Dyn} , shall be calculated for load combinations (LC) A and C, where

LCA is pick-up of rescue boat from sea in the NLS condition

LCC is pick-up of rescue boat from sea in the LS condition

It is assumed that the offshore crane is designed with sufficient hoisting/lowering velocity to avoid re-entry in the LS condition.

The dynamic safety factor, SF_{Dyn} , shall not exceed the static safety factor, SF_{Stat} , in any load combination.

The dynamic factor, ϕ , shall not exceed 2,5 for LCA and 3,0 for LCC.

NOTE Increasing the static safety factor contributes to increased operational risk when handling the elastic pennant in rough seas due to heavier equipment and larger dimensions. A higher static safety factor also gives less elasticity, i.e. increases the dynamic factor. Keeping the static safety factor as low as possible is therefore desirable, although not less than 10.

A.7.4.4 Static spring rate

Static spring rate and static stiffness is defined as follows:

Spring rate, K: The ratio of change in tension (force) to change in length: $K = \Delta F / \Delta L$ (kN/m)

Stiffness, S: The non-dimensional form of spring rate, given as ratio of change in tension ΔF to minimum breaking load (MBL) divided by the ratio of stretch to original length:
 $S = (\Delta F / MBL) / (\Delta L / L_0)$

Static spring rate, K_s : Spring rate during subsequent loading less than or up to highest previously applied load (kN/m)

Static stiffness, S_s : Stiffness during subsequent loading less than or up to highest previously applied load.

Reference is also made to definitions, terminology and explanations of change in length behaviour of fibre ropes given in DNV-OS-E303, Sec.4, and Appendix A.

The static spring rate is determined from the dimensionless static stiffness as follows:

$$K_s = S_s \times MBL / L_0 \quad (A.20)$$

The static stiffness of the fibre rope used in the elastic pennant shall be based on a rope that has been pre-loaded to 25 % of MBL.

For the purpose of simplified calculations, the static spring rate may be based on a linear curve crossing the static spring rate at 20 % of MBL.

For the purpose of calculating the static spring rate, length of the pennant shall taken as length between splices.

A.7.4.5 Testing

Test requirements given in EN 1492-4 shall apply with the following additional requirements:

The manufacturer of elastic pennants shall perform type tests in accordance with EN 1492-4, 6.3, on each nominal rope size

NOTE This requirement is complementary to the requirement for general purpose slings, for which representative type test are performed for groups of sizes

Prototype tests of the fibre rope shall be performed on each nominal rope size to determine the static stiffness (S_s – kN/m) for the fibre rope that has been pre-loaded to 25 % of MBL.

The manufacturing test specified in EN 1492-4, 6.5, shall be performed on at least one sample of elastic pennant made from the same rope drum.

A.7.4.6 Marking

In addition to the marking specified in EN 1492-4, clause 7, the sling shall be labelled "R-002A Elastic pennant". The label shall also be marked with the maximum steady state hoisting velocity (m/s) for which the elastic pennant is intended to lift the rescue boat.

A.7.4.7 Certificate

The manufacturer's certificate for the elastic pennant shall be labelled "R-002A Elastic pennant" in addition to the information required in EN 1492-4, clause 8.

The certificate shall state the maximum steady state hoisting velocity (in m/s) for which the elastic pennant is intended to lift the rescue boat.

The certificate shall identify the rescue boat which the elastic pennant is intended to lift.

A.7.4.8 Calculation example

An informative example of how to select diameter and length of the elastic pennant is given in Annex I.

A.7.5 Instructions for use of elastic pennants

Elastic pennants shall be accompanied with instructions for use as specified in Annex A and Annex C (as appropriate) of EN 1492-4. In addition the following instructions shall be stated:

- this elastic pennant is intended for lifting and lowering the rescue boat as stated in the certificate only. Any other use of the elastic pennant is prohibited;
- this elastic pennant shall only be used to lift the rescue boat in a straight lift. No choking is allowed;
- this elastic pennant is intended for use in training operations in wave conditions up to and including 3 m significant wave height. It is also intended for real rescue operations in wave conditions up to and including 6 m significant wave height;
- a thorough examination shall be performed after each training operation;
- the elastic pennant shall be replaced immediately if it has been used in rescue operations in wave conditions exceeding 3 m significant wave height;
- the elastic pennant shall be replaced every second year, regardless of condition as determined by visual examination.
-

A.7.6 Load bearing parts of rescue boats

A.7.6.1 General

The proof of competence shall be carried out in accordance with A.1.3, A.1.7 and A.1.8 for means of connection and their anchorage points which are integral part of the rescue boat.

A.7.6.2 Load combinations

For the purpose of proof calculations, the mass of hoist load shall be taken as the weight of the fully equipped rescue boat with its full complement of persons (crew and passengers).

The following load combinations shall be applied to rescue boats:

Load combination A:

Pick-up from sea in the NLS condition.

- Dynamic factor: $\Phi_2 = 2,5$
- Partial safety factor: $\gamma_p = 1,34$

- Risk coefficient: $\gamma_n = 1,5$

Load combination C:

Pick-up from sea in the LS condition.

- Dynamic factor: $\Phi_2 = 3,0$
- Partial safety factor: $\gamma_p = 1,1$
- Risk coefficient: $\gamma_n = 1,5$

A.7.7 Instructions for use of offshore cranes

The crane shall be equipped with a detailed instruction for rescue boat operations. The instruction shall be summarised in a procedure for training and emergency operations. The procedure shall be included in the emergency preparedness plan for the installation.

The procedure for rescue boat operations shall include, but not be limited to

- authority and responsibility for involved personnel,
- planning and precautions,
- announcement routines,
- crane information,
- rescue boat information,
- any equipment to be used,
- manning and personnel qualifications,
- personnel safety equipment,
- communication equipment and procedure,
- operational limitations, including dynamic load charts which describe the option for deliberate exceeding the suppliers recommendation during emergency operations.

A dynamic load chart shall be calculated for the actual rescue boat that is to be lifted.

The dynamic load chart shall clearly state the conditions upon which it is based and, if relevant, the type and specification of the elastic fibre rope sling that is to be used.

The dynamic load chart shall differentiate between training operations and emergency operations.

NOTE In an emergency where the offshore crane is to be used for handling the rescue boat, it is to be noted that this operation has to be authorised by the installation management in each case. In an emergency situation the operational risks as well as the technical risks for the rescue team have to be balanced against the actual conditions and the probability of a successful rescue operation.

A.7.8 Instructions for use of dedicated rescue boat cranes or davits

The rescue boat crane or davit shall be equipped with a detailed instruction for rescue boat operations. The instruction shall be summarised in a procedure for training and emergency operations. The procedure shall be included in the emergency preparedness plan for the installation.

The procedure for rescue boat operations shall include but not be limited to

- authority and responsibility for involved personnel,
- planning and precautions,
- announcement routines,
- crane/davit information,
- setting of personnel lift mode,
- rescue boat information,
- any equipment to be used,
- manning and personnel qualifications,
- personnel safety equipment,
- communication equipment and procedure,
- operational limitations, including dynamic load charts which describe the option for deliberate exceeding the suppliers recommendation during emergency operations.

A dynamic load chart shall be calculated for the actual rescue boat that is to be lifted. The calculation shall take into account the applicable damping effect of an elastic sling, motion compensator or shock absorber.

The dynamic load chart shall clearly differentiate between training operations and emergency operations.

NOTE In an emergency where the crane or davit is to be used for handling the rescue boat, this operation has to be authorised by the installation management in each case. In such situations the operational risks as well as the technical risks for the rescue team, have to be balanced against the actual conditions and the probability of a successful rescue operation.

A.8 Personnel transfer carriers (Group E.7)

TO BE DEVELOPED

Annex B

(Normative)

Material handling principles

B.1 Concept principles

Material handling principles cover all activities related to handling of goods and materials to and from and on the installation in all phases of its lifetime.

The installation shall be designed to ensure that the number of lifting operations is minimized, and with sufficient lay-down, storage areas and transportation routes for safe and efficient operation of the installation. Due consideration shall be given to the different phases of use of the installation, including all operations, regular maintenance, shutdowns for major overhaul and simultaneous operations.

All transportation routes shall be planned without any obstructions and thresholds. Transportation routes shall be dimensioned for the weight and size of equipment that will be transported to and from the area.

Operators of lifting appliances shall have a clear view of load and handling areas in regular use.

When designing areas for maintenance, the safest lifting equipment and lifting concepts shall take preference. Concepts for material handling that are impervious to weather conditions, shall take preference.

In order to avoid unnecessary shut down of process systems in the operation period, the installation shall be designed with safe lifting and transport routes for all equipment that has to be dismantled regularly for service, testing and control, see B.3.3.

Priorities of preference for lifting equipment are as follows:

- a) Forklift trucks/personnel and goods lifts/lorries with cranes/mobile cranes.
- b) Permanent crane/lifting foundations.
- c) Temporary/other mobile lifting equipment.
- d) Rigging equipment.

Due consideration shall be given to the effect of motions on floating installations, vibrations from other equipment. In addition, the environment shall be considered, in areas where material handling equipment is used and stored.

The criticality and economic importance of the load (special process equipment), shall be reflected when selecting lifting and transport equipment to handle the load, e.g. additional lifting and braking systems and emergency lowering facilities, see 4.11.4 and 5.1.1.

Bulk hose transfer stations on offshore installations shall be designed with hoses on power driven hose reels or similar solution, preferably with an automatic connection system on the supply vessel.

B.2 General requirements

Projects for development of new installations shall establish the following documents:

- general material handling philosophy in accordance with B.5;
- offshore crane study in accordance with B.6, if relevant;
- material handling plan in accordance with B.7.

The project shall ensure that necessary documentation from suppliers is incorporated into the documents.

Modification projects shall update existing philosophies, studies and plans, if relevant.

If the installation consists of more than one deck elevation, and is permanently manned, it shall be equipped with a sufficient number of personnel and goods lifts. The size and capacity of these lifts shall be adjusted to

the size/weight of the largest/heaviest items to be transported by the lift, but the minimum capacity shall be 1 500 kg. The goods lift shall give access to the main transportation routes at all deck levels. Good access to main workshop/stores shall be given priority.

Lifting of equipment of more than 25 kg shall be done by means of mechanical lifting.

If lifting or transporting of loads weighing more than 25 kg is required, there shall be enough space for the use of lifting and transportation gear.

Permanent arrangements (e.g. monorails, lifting lugs) shall be installed for material handling of equipment/objects > 200 kg and which require regular maintenance, if it not reachable for a fork lift truck or other movable lifting appliances.

Minimum requirements for material handling of equipment is given in Table B.1.

Table B.1 – Requirements for material handling

Weight	Maintenance interval		
	Yearly	2 years to 5 years	> 5 years
25 to 200 kg	A	B	C
200 kg to 3 tonnes	A	B	B
> 3 tonnes	A	A	A
Key A: Permanently installed lifting arrangements, e.g. monorails/pad eyes. B: A description (material handling plan) for material handling of equipment with use of temporary lifting equipment. The plan shall include documentation of structural capacity of all lifting points of more than 200 kg. C: No requirements for documentation of material handling.			

Lifting equipment intended for infrequent use, but exposed to wind, rain, snow or sea spray, shall be designed for easy and safe dismantling, re-installation and storage in warehouse.

Permanently installed lifting equipment, which are exposed to wind, rain, snow or sea spray, shall be designed with extra protection against corrosion, and preferably be parked/stored in a weather protected garage.

When installing lifting equipment near flares, burners and exhaust outlets on the installations, due consideration shall be given to the effects of thermal exposure on the lifting equipment during the lifetime of the installation, e.g. on sensitive electric components, non-metallic materials, steel wire ropes, ventilation of cabin, oil temperature etc.

Offshore cranes

The offshore cranes shall be located in places which give the best combination of crane coverage and a clear view of the handling areas and supply vessels from the operator cabins.

The offshore cranes shall cover the deck area and lay down/storage and handling areas including the entire pipe deck (installations with drilling or work-over facilities only). For offshore installations with more than one offshore crane, common lay down areas that are reachable by two offshore cranes, shall be provided. On floating installations, lay down areas close to the crane pedestals shall be avoided.

The offshore cranes shall have the outreach necessary to avoid offlead in conjunction with handling of loading hoses to/from supply vessels.

The offshore cranes, including crane hooks, shall not be planned used as hang-off points for other material handling equipment.

Offshore crane boom rests shall be provided.

A dedicated area with access for maintenance (e.g. replacement of crane hooks and steel wire ropes), with an arrangement for storage of main load and whip line hooks, shall be provided. The need for a separate working platform for this purpose shall be considered.

A device for load testing of the main cranes should be installed in the deck structure, if specified by the crane manufacturer.

B.3 Working areas

B.3.1 General

Main lay down areas for regular material handling shall be clearly visible from the control station of the lifting appliances that handles loads to and from such areas.

Remotely operated lifting operations where no personnel are exposed to suspended loads when the load is automatically connected and disconnected, can be performed when supervised (observed) by a camera.

The working areas shall be designed to withstand the loads that will be placed in the area. Working areas and lay down areas shall normally be located in a safe zone and provided with heavy-duty barriers to prevent damage to adjacent equipment.

On floating installations, attachment points for sea fastening of cargo shall be provided.

Lifting appliances and their working areas shall be located so as to minimise the risk of load handling, impacts and dropped object damage to systems and structures.

Information regarding the extension and weight capacities of working and lay-down areas shall be available to the operator of the crane in use.

Lay down areas shall be designed such that the signaller and slinger easily can escape to a safe position.

On offshore installations, hose loading stations and rescue boat shall be visible from the offshore crane cabins if the rescue boat is to be launched by offshore crane.

Walls close to working areas and lay down areas should as far as possible have clean surfaces without obstructions, e.g. flood lights, cable trays, piping, etc.

B.3.2 Bumpers

Suitable bumpers for impact protection against horizontal and vertical loads shall be provided where necessary in the working and lay down areas where lifting equipment is used. The impact protection shall have a flexible design to absorb the energy induced by the lifting appliances and their loads without being permanently damaged, and shall facilitate means for personnel escape in danger zones. Bumpers shall preferably be made of vertical elements facing the load handling area to prevent loads from snagging the bumper.

Suitable bumpers for swinging loads shall be provided for protection of escape routes, lighting fixtures, instrumentation, piping and other equipment near the working and storage areas. On floating installations, working and lay down areas shall be equipped with reinforced impact protection, designed to take up the loads induced by the installation's motions and the motions induced by the lifting appliances.

B.3.3 Lifting zones

The term "dropped object" in this subclause means the full load or parts of the load falling as a consequence of a mechanical or system failure.

Within the defined lifting zones, equipment, piping containing hydrocarbons, flammable or toxic gas/liquids and high voltage and cables shall be protected against dropped objects.

All areas within the working area of lifting appliances shall be evaluated and classified according to the consequences of dropped objects, and this shall be reflected in the lifting restriction charts for the installation, see B.5.

Red areas	Areas where the consequence of dropped object is unacceptable to the installation or to personnel, and lifting is not permitted. Typical examples are unprotected process equipment areas, areas with personnel and areas with critical components or equipment without dropped object protection or protecting structures.
Yellow areas	Areas where the consequence of dropped objects is serious for the installation and for personnel. A risk assessment shall be performed, and lifting shall be according to strict procedures only. Typical examples are process equipment areas and normally manned areas protected against dropped objects.
Green areas	Areas planned and laid out for routine lifting operations. No restriction for routine lifts.

Predefined lifting zones should be defined as green areas. Areas where lifting will be performed, shall as a minimum be defined as yellow or green. All yellow areas shall have predefined lifting restrictions according to the loads expected to be handled in or above the area.

The working areas and dropped object protection devices shall be checked for impact from dropped objects according to the accidental limit state defined in NORSOK N-004. The impact loads for design of the deck area and protection devices shall be selected in accordance with relevant weight, size and drop height expected for the specific location.

Lifting operations in red areas (e.g. over well equipment) can be allowed if the lifting equipment is constructed for lifting operations, where the severity of possible harm or extended harm, is high. As a minimum, the following requirements shall be complied with:

- lifting appliances shall be fitted with two independent hoisting mechanisms with independent control systems;
- each of the hoisting mechanism shall be able to handle the load independently of the other;
- performance levels shall be higher than normal load handling levels.

For such lifting operations, a risk assessment has to be carried out in addition to the above requirements.

B.3.4 Shafts/hatches

Vertical handling of loads in shafts should preferably be by use of personnel and goods lift.

Shafts that will be used for lifting operations shall be designed in such a way that loads cannot get trapped or stuck.

Hatches that are opened and closed frequently should be hinged. Hatches shall be designed with a dedicated system for closing/opening and be arranged for securing in open position.

B.3.5 Lifting operations between installation and vessel

Unprotected critical equipment that can be damaged by falling loads (e.g. risers, pipelines, cables, subsea wellheads and equipment) shall not be installed in areas on and by the side of installations intended for loading and unloading of vessels. There shall be no drain or liquid outlets in the area that can harm the vessel or persons on board. There shall be no exhaust outlets in the area that can harm lifting appliance or lifting wire and reduce the view of the vessel. The installation shall be designed without obstructions that reduce the view of the vessel from the lifting appliance.

B.3.6 Transportation routes

Primarily, transportation of equipment on the installation shall be done by machine driven vehicles (e.g. forklift trucks on offshore installations, lorries at onshore installations) or manually operated trolleys.

The main transportation routes on an offshore installation should be designed for forklift trucks with a minimum capacity of 1 500 kg. To avoid unnecessary use of barriers, main gangways at the installation shall not be crossing under or be placed near the lifting routes of main lay down areas.

The need for protection barriers along transportation routes intended for transportation of large/heavy

equipment, and in locations where forklift trucks are used, shall be evaluated. The protection barriers shall not obstruct access to equipment, valves, etc.

Entrances directly into transportation routes, shall be designed to avoid hazardous situations, such as collisions between personnel, transport equipment, automatic doors etc.

Transportation routes shall be sized to allow transportation of the largest/heaviest item from its location to the lay down area.

Transportation routes shall, where required, be designed for special transportation remedies, such as heavy lifts and/or forklift trucks, air film transporters etc. Transportation routes shall not contain steps or thresholds.

B.4 Material handling in a project

In parallel with the engineering of the installation, the engineering of lifting equipment for maintenance shall be carried out.

The feasibility of the material handling shall preferably be verified and documented by use of 3-D design tools.

Permanent lifting equipment shall preferably be installed and certified early in the construction phase, enabling its use during the rest of the construction phase; hence verifying the suitability and the safety of the lifting equipment.

Facilities, including safe access for maintenance, inspection and testing of essential elements and functions, shall be provided.

B.5 General material handling philosophy – Concept phase

A general philosophy for material handling in the project/module/installation shall be developed and approved by the company early in the concept phase. It shall be revised as the design changes, and finally issued as an as-built version.

The material handling philosophy shall as a minimum describe the following:

- a) main material handling equipment, e.g. main cranes, goods lift, mobile lifting beams, forklift truck, mobile cranes, lorries with cranes etc. including sizes and capacities;
- b) main material handling routes: to and from warehouse, to and from workshops, to and from pipe deck, to and from drill floor, to and from kitchen, to and from supply vessel, to and from quay, to and from gates;
- c) design criteria for all transport routes/roads and parking spaces for mobile cranes, e.g. minimum axle load, free width and free height;
- d) lifting restriction charts for the installation, including philosophy for lifting across process areas;
- e) maximum allowable lifting heights, coverage and restrictions for the main cranes;
- f) lay down and storage areas including function, size and location, also covering lay down/storage areas for and handling of temporary, company provided and hired equipment;
- g) lifting areas, including sketches, which are not visible from the crane cabins;
- h) weather constraints (waves and wind);
- i) definition of largest/heaviest item to be handled per area including description of transportation route and type of handling equipment;
- j) deck load/ground capacities on all areas in the installation. Both loading areas, transport routes and areas between equipment. The deck load/ground capacities shall include allowable evenly distributed load, point loads, drop loads and forklift truck capacities, see also B.3.3;
- k) evaluation of concurrent crane operations on pipe deck – can be verified and documented by 3D design tool;
- l) requirements for dropped object protection;
- m) goods handling to/from helideck;
- n) load categories for monorails, hoists and pad eyes;
- o) requirements for use of rigging equipment and loose lifting equipment at the installation;
- p) material handling through shafts and hatches;
- q) standardization of the lifting equipment, limiting the number of different types of equipment.

B.6 Offshore crane study – Engineering phase

An offshore crane study document, based on the principles of the material handling philosophy, shall be prepared and maintained throughout the engineering phase. The feasibility of the material handling by means of the offshore crane shall be verified and documented by use of 3-D design tools. The document shall as a minimum contain the following elements:

- a) definition of all relevant documents for transmittal to the authorities;
- b) basis for location of offshore cranes and other main cranes;
- c) visibility of lay down areas, and exceptions, if any;
- d) description of handling with offshore cranes to and from the supply vessels and internally on the topsides;
- e) listing of the most common lifting operations including frequency of these;
- f) description of safe lifting routes for the most common lifting operations;
- g) height of crane cabins above the most elevated crane-handling area;
- h) description of maximum allowable lifting heights, coverage and restrictions;
- i) requirements for dropped object protection;
- j) description of crane outfitting related to safety, alarms, communication, lightning, etc.;
- k) description of situations where the crane booms shall be brought to the rest position and the frequency of these;
- l) description of weather constraints (waves and wind);
- m) evaluation of concurrent crane operations on pipe deck;
- n) description of crane operations involving transportation of personnel, e.g. rescue boat, personnel basket, etc.;
- o) description of operational range, safe lifting routes and lay down areas for offshore cranes, if offshore cranes are to be used for transferring loads from one side of the installation to the other;
- p) description of protection against heat radiation from flare, burners and exhaust outlets on crane cabins, crane systems and wires;
- q) plot plan showing:
 - 1) crane locations,
 - 2) offshore crane operation range with and without jib, minimum radius and radius for heaviest lift,
 - 3) maximum allowable lifting heights,
 - 4) maximum weight capacities for lay down areas and transportation ways,
 - 5) lay down areas, including allowable loads (areas not visible from the crane cabin shall be highlighted),
 - 6) hose loading stations,
 - 7) tote tank area,
 - 8) access and transportation ways, including allowable loads,
 - 9) permanent and temporary restriction areas,
 - 10) dropped object protection,
 - 11) crane maintenance platform(s), including location for facilities for re-reeving and replacement of wire rope,
 - 12) storage for crane hooks,
 - 13) crane boom rests,
 - 14) rescue boat.

B.7 Material handling plan

The material handling philosophy, in the final as-built version, shall be included in the material handling plan.

This material handling plan shall identify all equipment that needs to be handled, and describe the method, equipment and the transport route to be used when lifting out the unit, transporting it to its destination, and replacing it. The document shall be part of the operational documentation for the installation.

Equipment of more than 25 kg and that requires regular maintenance according to B.2, Table B.1 or replacement during the design life of the installation, shall be included in the document.

When modifying the installation, the material handling plan shall be revised to reflect any changes made to areas, systems, equipment or lifting/transport facilities.

The material handling plan shall as a minimum contain the following:

- a) description of all material handling equipment, e.g. main cranes, personnel and goods lift, fork lift trucks, trolleys, air film transporters, elephant cranes, A-frames, mobile cranes, lorries with cranes etc. including tag numbers (when required), sizes and capacities;
- b) description of standardized sizes of foundations and suspensions for lifting equipment, as applicable, see Annex H;
- c) requirements for certification and marking of foundations and suspensions;
- d) description of the main material handling philosophy for internal transport on the installation;
- e) description of function, size and location of lay down and storage areas including areas for and handling of temporary, company provided and hired equipment;
- f) description of all items of more than 25 kg to be handled, including identification numbers, location, weight, size, expected maintenance/replacement intervals, type of lifting equipment/arrangement, lifting/handling procedure, transport route etc. In cases where the equipment vendor has incorporated comprehensive handling procedures in the maintenance manual, this can be referred to in the report. The material handling description for such equipment can be simplified by just defining the required lifting/transportation equipment and transport routes;
- g) requirements for transportation routes/roads including width and height in the different areas;
- h) description of goods handling to/from helicopter deck, if applicable;
- i) description of loading hose handling including hose replacement;
- j) description of areas where special protection of equipment is required, e.g. dropped object protection, truck barriers, swinging load protection etc.;
- k) material handling drawings based on equipment arrangement drawings or 3D plots including piping and valves containing the following:
 - 1) all equipment to be handled including lifting lugs, monorails, access ways etc.;
 - 2) table containing all equipment identification numbers to be handled with corresponding identification numbers for the lifting equipment to be used;
 - 3) load capacities for lay down areas and transportation routes/roads.

Annex I (Informative)

Selection of elastic pennant – calculation example

I.1 General

This annex serves as an example of how to select appropriate dimensions for an elastic pennant in accordance with A.7.4.1.

I.2 Input parameters

Mass of fully equipped rescue boat
with full complement of persons: 4 000 kg

Required WLL for elastic pennant: $WLL_{R002A} = 4\,000\text{ kg}$

Hoisting speed: $v_{Hmax} = 2,0\text{ m/s}$

Host facility: Semisub

where

v_{Hmax} is the maximum steady state hoisting speed of which the offshore crane at the host installation is able to lift the weigh of the rescue boat

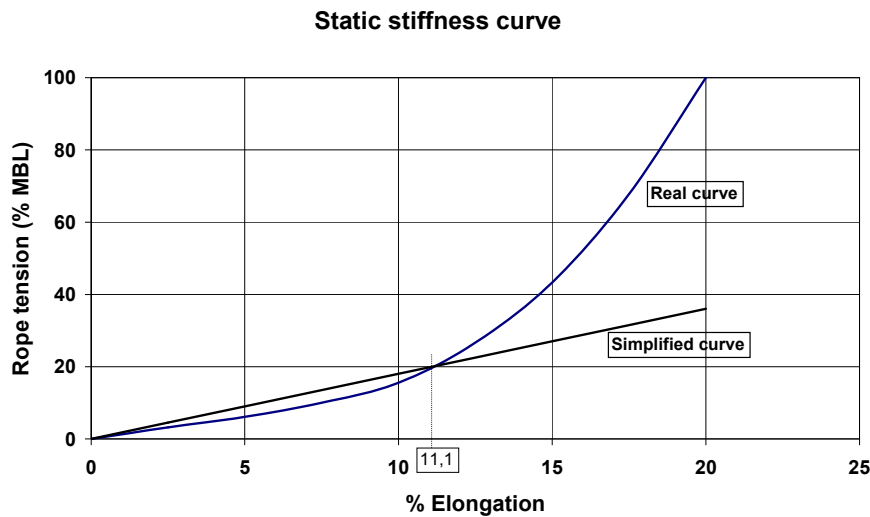
Data for fibre rope, given by rope manufacturer

Rope construction: 8-strand plaited nylon rope

Table for rope diameter vs MBL (minimum braking load):

Diameter (mm)	MBL (kN)
44	350
48	410
52	480
56	550
60	630
64	710
68	790

Curve for static stiffness based on used rope, obtained from tests after pre-loading the rope to $2,5 \times WLL_{R002A}$, is shown in the figure below.



The static stiffness is taken as the gradient of a simplified linear curve crossing the real curve through 20 %MBL.

$$S_s = \frac{20}{11,1} = 1,80 \quad (1.1)$$

Rope diameter:

The rope diameter is selected based on the required minimum breaking load with a minimum static safety factor of 10, taking into account a reduction factor of 10 % for splices:

Required minimum breaking load:

$$MBL_{req} = \frac{10 \cdot 4000 \cdot 9,81}{0,9} = 436000 N = 436 kN \quad (1.2)$$

Necessary rope diameter, from table: 52mm

Actual minimum breaking load selected from rope manufacturers catalogue:

$$MBL_{Act} = 480 kN$$

Actual spring rate:

$$K_s = \frac{MBL_{Act} \cdot S_s}{L} = \frac{480 \cdot 1,80}{L} kN / m \quad (1.3)$$

Minimum rope length:

The velocities applicable for calculation of the dynamic factor, Φ , can be calculated from the input parameters:

Load combination:	LCA	LCC
Sign. wave height, Hs:	3 m	6 m
V_H (m/s)	1,00	1,00
V_D (m/s)	1,97	2,64
V_C (m/s)	0,75	1,50

V_R (m/s)	3,11	4,03
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The dynamic factor, Φ , and the dynamic safety factor, SF_{dyn} , for LCA and LCC can be calculated from the length of the elastic pennant:

Length of elastic pennant L (m)	LCA		LCC	
	Φ	SF_{dyn}	Φ	SF_{dyn}
8	2,64	12,23	3,14	11,90
9	2,55	11,79	3,01	11,44
10	2,47	11,42	2,91	11,05
11	2,40	11,11	2,82	10,71
12	2,34	10,83	2,74	10,42
13	2,29	10,59	2,68	10,16
14	2,24	10,37	2,62	9,92
15	2,20	10,18	2,56	9,72

The minimum required length of the elastic pennant may be plotted against the dynamic factor, Φ , and the dynamic safety factor, SF_{dyn} , as follows:

Based on this plot, it can be shown that the minimum required length is 11,4 m.

