BRITISH STANDARD

BS EN
14492-1:2006

Cranes — Power driven winches and hoists —

Part 1: Power driven winches

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The European Standard EN 14492-1:2006 has the status of a British Standard

ICS 53.020.20

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British Standards

National foreword

This British Standard is the UK implementation of EN 14492-1:2006.

The UK participation in its preparation was entrusted by Technical Committee MHE/3, Cranes and derricks, to Subcommittee MHE/3/6, Winches, hoists, lifting blocks and accessories.

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

EN 14492-1:2006 is a candidate "harmonized" European Standard and fully takes into account the requirements of the European Commission mandate M/BC/CEN/92/46, Standardization mandate assigned to CEN/CENELEC concerning equipment and protective systems intended for use in potentially explosive atmospheres and M/BC/CEN/91/1, Standardization request to CEN/CENELEC concerning machines presenting hazards due to mobility or load lifting, given under the EU Machinery Directive (98/37/EEC), and intended to lead to CE marking. The date of applicability of EN 14492-1:2006 as a "harmonized" European Standard, i.e. the date after which this standard may be used for CE marking purposes, is subject to an announcement in the *Official Journal of the European Communities*.

EN 14492-1:2006 is the subject of transitional arrangements agreed under the European Commission mandate. The Member States have agreed a nominal transition period for the co-existence of EN 14492-1:2006 and their corresponding national standard(s). It is intended that this period will comprise a nominal nine-month period during which any required changes to national regulations are to be made, followed by a further nominal twelve-month period for the implementation of CE marking. At the end of this co-existence period, the national standard(s) will be withdrawn.

In the UK there are no corresponding national standards.

BSI as a member of CEN is obliged to publish EN 14492-1:2006 as a British Standard. The UK National Committee would like to draw attention that this standard is primarily intended for winching applications where a load is to be dragged on level ground or up an incline.

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

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

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 14492-1

September 2006

ICS 53.020.20

English Version

Cranes - Power driven winches and hoists - Part 1: Power driven winches

Appareils de levage à charge suspendue - Treuils et palans motorisés - Partie 1: Treuils motorisés

Krane - Kraftgetriebene Winden und Hubwerke - Teil 1: Kraftgetriebene Winden

This European Standard was approved by CEN on 19 August 2006.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Foreword

This document (EN 14492-1:2006) has been prepared by Technical Committee CEN/TC 147 "Cranes — Safety", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2007, and conflicting national standards shall be withdrawn at the latest by March 2007.

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

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

For the relationship with other European Standards for cranes, see informative Annex G.

This is the first part of the standard "Cranes — Power driven winches and hoists". The parts of the standard are:

— Part 1: Power driven winches

— Part 2: Power driven hoists

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

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Introduction

This European Standard is a harmonised standard to provide one means for power driven winches to conform to the essential health and safety requirements of the Machinery Directive, as amended.

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

This European Standard is a type C standard as stated in EN 12100-1.

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

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1 Scope

This European Standard is applicable to the design, information for use, maintenance and testing of power driven winches for which the prime mover is an electric motor, hydraulic motor, internal combustion motor or pneumatic motor. They are designed for the lifting and lowering of loads which are suspended on hooks or other load handling devices or for the lifting and lowering of loads on inclined planes or the exclusive pulling of loads on planes which are normally horizontal.

NOTE Within the period of utilization, the place of use of a winch may be variable.

As a rule, a winch is used without any additional transport movement.

This European Standard is applicable to the following types of winch:

a) rope winches;

b) chain winches;

c) belt winches, except steel belts used as hoisting media;

d) traction winches.

These types of winches a) to d) also include the following specific applications:

— vehicle recovery winches;

— winches on boat trailers;

— forestry winches;

— winches for stationary offshore applications;

— winches for drilling applications;

— winches to be used exclusively for the pulling of loads.

NOTE Examples are shown in Annex A.

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This European Standard does not apply to:

— power-driven hoists in accordance with EN 14492-2;

— winches for seagoing vessels and mobile offshore units;

— winches for the lifting of persons;

— NGL building hoists in accordance with EN 14492-2;

— winches for the handling of hot molten masses (risk covered by EN 14492-2).

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

This European Standard does not specify additional requirements for hazards related to the use of winches in explosive atmospheres in underground works.

This document applies to winches manufactured after approval by CEN with a transitional period of 2 years.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 418:1992, *Safety of machinery — Emergency stop equipment, functional aspects — Principles for design*

EN 563:1994, *Safety of machinery — Temperatures of touchable surfaces — Ergonomics data to establish temperature limit values for hot surfaces*

EN 818-1:1996, *Short link chain for lifting purposes — Safety — Part 1: General conditions of acceptance*

EN 818-7:2002, *Short link chain for lifting purposes — Safety — Part 7: Fine tolerance hoist chain, Grade T (Types T, DAT and DT)*

EN 954-1:1996, *Safety of machinery — Safety related parts of control systems — Part 1: General principles for design*

EN 982:1996, *Safety of machinery — Safety requirements for fluid power systems and their components — Hydraulics*

EN 983:1996, *Safety of machinery — Safety requirements for fluid power systems and their components — Pneumatics*

EN 1127-1:1997, *Explosive atmospheres — Explosion prevention and protection — Part 1: Basic concepts and methodology*

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

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

EN 13001-2:2004, *Cranes — General design — Part 2: Load actions*

EN 13411-3:2004, *Terminations for steel wire ropes — Safety — Part 3: Ferrules and ferrule-securing*

EN 13411-4:2002, *Terminations for steel wire ropes — Safety — Part 4: Metal and resin socketing*

EN 13411-6:2004, *Terminations for steel wire ropes — Safety — Part 6: Asymmetric wedge socket*

EN 13411-7:2003, *Terminations for steel wire ropes — Safety — Part 7: Symmetric wedge socket*

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EN 13463-1:2001, *Non-electrical equipment for potentially explosive atmospheres — Part 1: Basic method and requirements*

EN 13463-5:2003, *Non-electrical equipment intended for use in potentially explosive atmospheres — Part 5: Protection by constructional safety "c"*

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

EN 14492-2:2006, *Cranes — Power driven winches and hoists — Part 2: Power driven hoists*

EN 60034-1:2004, *Rotating electrical machines — Part 1: Rating and performance (IEC 60034-1:2004)*

EN 60079-0:2004, *Electrical apparatus for explosive gas atmospheres — Part 0: General requirements (IEC 60079-0:2004)*

EN 60079-7:2003, Electrical apparatus for explosive gas atmospheres — Part 7: Increased safety 'e' (IEC 60079-7:2001)

EN 60204-32:1998, *Safety of machinery — Electrical equipment of machines — Part 32: Requirements for hoisting machines (IEC 60204-32:1998)*

EN 60529:1991, *Degrees of protection provided by enclosures (IP-code)*

EN 61000-6-2:2005, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments (IEC 61000-6-2:2005)*

EN 61000-6-3:2001, *Electromagnetic compatibility (EMC) — Part 6-3: Generic standards; Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3:1996, modified)*

EN 61000-6-4:2001, *Electromagnetic compatibility (EMC) — Part 6-4: Generic standards; Emission standard for industrial environments (IEC 61000-6-4:1997, modified)*

EN ISO 3744:1995, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essential free field over a reflecting plane (ISO 3744:1994)*

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

EN ISO 11201:1995, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Engineering method in an essentially free field over a reflecting plane (ISO 11201:1995)*

EN ISO 11688-1:1998, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

EN ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology (ISO 12100-1:2003)*

EN ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles (ISO 12100-2:2003)*

ISO 606:2004, *Short-pitch transmission precision roller and bush chains, attachments and associated chain sprockets*

ISO 4301-1:1986, *Cranes and lifting appliances — Classification — Part 1: General*

ISO 4308-1:2003, *Cranes and lifting appliances — Selection of wire ropes — Part 1: General*

ISO 12482-1:1995, *Cranes — Condition monitoring — Part 1: General*

FEM 1.001:1998, *Rules for the design of hoisting appliances, booklets 1, 2, 3, 4, 5 and 8*

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FEM 9.901:1991, *Rules for the design of series lifting equipment and cranes equipped with series lifting equipment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2003 and the following apply.

3.1
anchorage
complete device to anchor the hoisting media to a fixed point

3.2
belt drive
system of belts, belt pulleys, belt drums and belt anchorages

3.3
chain drive
system of fine tolerance steel link chains, roller chains, driven and non-driven chain wheels and chain anchorages

3.4
direct control
main power circuit is directly controlled by the hand controlled actuator without additional means between the actuator and the main power circuit

3.5
fleet angle
angle β or $\beta - \alpha$ or $\beta + \alpha$ (see Figure 1)

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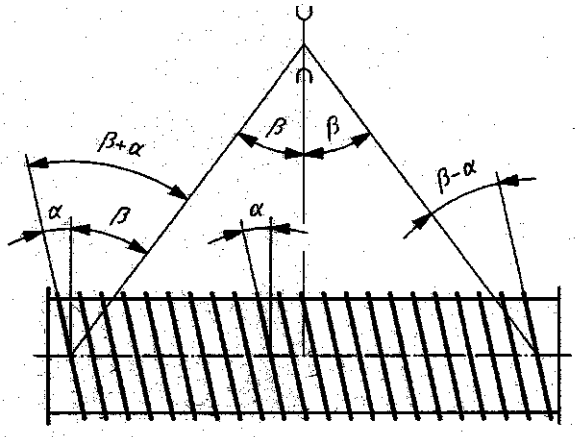

Key

β = fleet angle on the pulley

$\beta - \alpha$ or $\beta + \alpha$ = fleet angle on the drum

α = angle of the grooves on the drum

Figure 1 — Fleet angle

On drums without grooves, the fleet angle is the angle between the rope axis and a line drawn perpendicular to the axis of the drum

3.6
force transmission
two or more connected parts which transmit forces

3.7
forestry winches
rope winches fitted to forestry machines such as pushing tractors and row crop tractors according to ISO 6814 and used on agricultural tractors, e.g. for fitting in a three-point rod assembly, used for pushing works in the forest

3.8
hoist medium or pulling medium
either rope, belt, steel link chain or roller chain that connects the winch to the load

3.9
hydraulic components
elements (e.g. switches, valves, filters) interconnected and forming an operational hydraulic system

3.10
hydraulic overpressure
pressure exceeding the rated pressure or dynamic pressure

3.11
hydraulic systems
definition in ISO 5598 applies

3.12
hydraulic transmission
supply, control and distribution of energy by means of pressurised fluid

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3.13
indirect control
main power circuit is controlled by additional means between the hand controlled actuator and the main power circuit

3.14
lifting/lowering
movement of loads with the level of the load being changed

NOTE Lifting/lowering is the vertical or the vertical and horizontal movement of the loads and all combinations.

3.15
maximum speed
maximum of all speeds in the kind of movement in accordance with the intended purpose (lifting, lowering, pulling)

NOTE For inverter driven winches this speed can occur at the maximum frequency but with a load smaller than the rated capacity of the winch.

3.16
power source
energy to drive the prime mover of a winch e.g.: electrical, hydraulic, pneumatic, or by internal combustion

3.17
pulling
moving of loads on planes which are normally horizontal; in case of the pulling force being removed from the load, caused by stopping or failure of the winch including hoist media, no load movement takes place. For each working cycle, the pulling media needs to be spooled off respectively pulled out

NOTE Pulling is a special case of a load movement with the load movement taking place on a surface, the inclination of which is almost zero or insubstantial.

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3.18
pulling force
force which the winch is designed to pull

3.19
rated capacity
load that the winch is designed to lift; in case of winches with multi-layer winding, this is the value in the top layer of the drum

3.20
rated capacity limiter
device that automatically prevents the winch from handling loads in excess of its rated capacity, taking into account the dynamic effects during normal operational use.

This can be achieved by limiting the force flow (direct acting rated capacity limiter) or by switching off the energy supply to the lifting drive and stopping the lifting movement (indirect acting rated capacity limiter)

3.21
rated lifting speed
linear speed of the load when lifting a load corresponding to the rated capacity of the winch

— in case of electric motors at rated voltage and rated frequency as indicated on the nameplate;

— in case of hydraulic motors at rated flow as indicated on the nameplate;

— in case of pneumatic motors at rated pressure as indicated on the nameplate.

For rope winches, the speed at the lowest rope-layer on the drum

3.22
rated lowering speed
linear speed of the hoist medium when lowering a load corresponding to the rated capacity of the winch

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— in case of electric motors the rated voltage and rated frequency applies;

— in case of hydraulic motors the rated flow applies;

— in case of pneumatic motors the rated pressure applies.

For rope winches, the speed at the lowest rope-layer on the drum

3.23
rated pressure
pressure in hydraulic or pneumatic systems at which the component is intended to operate for a number of repetitions sufficient to assure adequate service life

3.24
rated pulling speed
linear speed of the load when pulling under the effect of a load corresponding to the pulling force of the winch

— in case of electric motors, the rated voltage and rated frequency applies;

— in case of hydraulic motors, the rated flow applies;

— in case of pneumatic motors, the rated pressure applies

3.25
rope anchorage
arrangement comprising the parts which connect the rope termination to the major load bearing structure, e.g. pins, bolts, compensating levers, tension rods

NOTE This does not include the rope fastening on the rope drum.

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3.26
rope drive
system of ropes running on rope drums or traction sheaves and over rope sheaves, and rope attachment parts

3.27
rope end termination
arrangement that has direct contact with the rope in order to allow its connection to e.g. rope anchorage and hook

3.28
rope fastening on the rope drum
all parts with which the rope is fastened on the rope drum

3.29
stall torque (of an a.c. motor)
maximum steady-state asynchrony torque which the motor develops without an abrupt drop in speed, when the motor is supplied at the rated voltage and frequency

3.30
vehicle recovery winches
winches fitted e.g. onto a service car. They are used for loading or pulling an inoperative vehicle onto the service car, or for partly lifting an inoperative vehicle. Also, they may be used for unloading or pulling off an inoperative vehicle.

Vehicle recovery winches may also be directly fitted to a vehicle and used for self-recovery and/or recovery of another vehicle

3.31
winches
machines designed for the lifting and lowering of loads which are suspended on hooks or other load handling devices, or for the moving (pulling and lowering) of loads on inclined planes, or the exclusive pulling of loads on

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planes which are normally horizontal. They use ropes, chains or belts wound in one or more layers onto a drum, or ropes in traction sheave drives

NOTE Examples are given in Annex A.

3.32
winch load
m_W
load including all the masses of a load equal to the rated capacity of the winch, the hoist medium and the fixed load lifting attachments, e.g. hooks, grabs, magnets, lifting beams, vacuum lifters

3.33
winches on boat trailers
rope winches or belt winches fitted to boat trailers and used to lower the boat from the trailer into the water, or to pull the boat out of the water onto the trailer

3.34
working coefficient for ropes, chains and belts
minimum breaking force divided by the static force which corresponds either to the pulling force or to the rated capacity

4 List of significant hazards

Table 1 shows a list of significant hazardous situations and hazardous events that could result in risks to persons during normal use and foreseeable misuse. It also contains the relevant clauses in this European Standard that are necessary to reduce or eliminate the risks associated with those hazards.

The significant hazards are based upon EN 1050.

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Table 1 — List of significant hazards and associated requirements

	Hazards	Relevant clause(s) in this European Standard
1	**Mechanical hazards due to:**	
	— machine parts or workpieces, e.g.:	5.1
	a) shape;	n.a.
	b) relative location;	5.1
	c) mass and stability (potential energy of elements which may move under the effect of gravity);	5.1, 5.2, 5.3, 5.4, 5.5, 5.7, 5.9, 5.15.4, 5.15.5, 5.15.6, 5.16.5, 5.16.6, 5.16.7, 5.17.4, 5.17.5, 5.17.6
	d) mass and velocity (kinetic energy of elements in controlled or uncontrolled motion);	
	e) inadequacy of mechanical strength	
	— accumulation of energy inside the machinery, e.g.:	5.4
	f) elastic elements (springs);	5.10, 5.11
	g) liquids and gases under pressure;	5.11.4.3
	— the effect of vacuum	
1.1	Crushing hazard	5.1, 5.7.2, 5.7.4
1.2	Shearing hazard	5.1
1.3	Cutting or severing hazard	5.1, 5.8.3, 5.16.9
1.4	Entanglement hazard	5.1, 5.7.2, 5.7.4, 5.8.3
1.5	Drawing-in or trapping hazard	5.1, 5.7.2, 5.7.4, 5.8.3
1.6	Impact hazard	5.1, 5.8.2, 5.16.9
1.7	Stabbing or puncture hazard	5.1
1.8	Friction or abrasion hazard	5.1, 5.7.2, 5.7.4, 5.7.9, 5.8.1
1.9	High pressure fluid injection or ejection hazard	5.11.4.2, 5.11.5, 5.11.6.3
2	**Electrical hazards due to:**	
2.1	contact of persons with live parts (direct contact)	5.2.1, 5.12, 5.12.4
2.2	contact of persons with parts which have become live under faulty conditions (indirect contact)	5.2.1, 5.12, 5.12.4
2.3	approach to live parts under high voltage	5.12.1
2.4	electrostatic phenomena	5.12
2.5	thermal radiation or other phenomena such as the projection of molten particles and chemical effects from short circuits, overloads etc.	5.12
3	**Thermal hazards, resulting in:**	
3.1	burns, scalds and other injuries by a possible contact of persons with objects or materials with an extreme high or low temperature, by flames or explosions and also by the radiation of heat sources	5.1, 5.11.6.5, 5.11.6.6, 5.14
3.2	damage to health by hot or cold working environment	n.a.
4	**Hazards generated by noise, resulting in:**	
4.1	hearing loss (deafness), other physiological disorders (e.g. loss of balance, loss of awareness)	5.13, 7.2, Annex F
4.2	interference with speech communication, acoustic signals etc.	5.13, 7.2, Annex F

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Table 1 (*continued*)

	Hazards	Relevant clause(s) in this European Standard
5	**Hazards generated by vibration due to:**	
5.1	use of hand-held machines resulting in a variety of neurological and vascular disorders	n.a.
5.2	whole body vibration, particularly when combined with poor postures	n.a.
6	**Hazards generated by radiation due to:**	
6.1	low frequency, radio frequency radiation, micro waves	n.a.
6.2	infrared, visible and ultraviolet light	n.a.
6.3	X and gamma rays	n.a.
6.4	alpha, beta rays, electron or ion beams; neutrons	n.a.
6.5	lasers	n.a.
7	**Hazards generated by materials and substances (and their constituent elements) processed or used by the machinery due to:**	
7.1	hazards from contact with or inhalation of harmful fluids, gases, mists, fumes, and dusts	5.11.2
7.2	fire or explosion hazard	5.11.6.5, 5.11.6.6, 5.14, Annex B, Annex C
7.3	biological or microbiological (viral or bacterial) hazards	n.a.
8	**Hazards generated by neglecting ergonomic principles in machinery design as, e.g. hazards from:**	
8.1	unhealthy postures of excessive effort	5.2.1
8.2	inadequate consideration of hand-arm or foot-leg anatomy	n.a.
8.3	neglected use of personal protection equipment	n.a.
8.4	inadequate local lighting	7
8.5	mental overload and under-load, stress	n.a.
8.6	human error, human behaviour	5.2.1
8.7	inadequate design, location or identification of manual controls	5.2.1, 5.12
8.8	inadequate design or location of visual display units	5.2.1, 5.12
9	**Combination of hazards**	n.a.
10	**Unexpected start-up, unexpected overrun/overspeed (or any similar malfunction) from:**	
10.1	failure/disorder of the control system	5.2.1, 5.2.3, 5.2.5, 5.4, 5.10.3, 5.10.4, 5.10.5.1, 5.11.6.1, 5.11.6.2, 5.12.4, 5.12.7, 5.12.8.2
10.2	restoration of energy supply after an interruption	5.2.1, 5.2.3, 5.10.5.1, 5.12
10.3	external influences on electrical equipment	5.12.3, 5.13
10.4	other external influences (gravity, wind etc.)	5.4
10.5	errors in the software	5.2.5, 5.12
10.6	errors made by the operator (due to mismatch of machinery with human characteristics and abilities, see 8.6)	n.a.
11	**Impossibility of stopping the machine in the best possible conditions**	5.2.1, 5.2.3, 5.10.5.1, 5.10.5.2, 5.11.6.1, 5.12.4, 5.12.7

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Table 1 (*continued*)

	Hazards	Relevant clause(s) in this European Standard
12	**Variations in the rotational speed of tools**	n.a.
13	**Failure of the power supply**	5.4, 5.10.2.2, 5.11.6.2, 5.12, 5.12.8.2, 5.15.7
14	**Failure of the control circuit**	5.2.1, 5.2.3, 5.2.5, 5.4, 5.10.3, 5.10.5.1, 5.11.5, 5.11.6.1, 5.12, 5.12.7, 5.12.8.2
15	**Errors of fitting**	5.1, 5.7.6, 7
16	**Break-up during operation**	5.1, 5.4, 5.5, 5.7.8, 5.8.4, 5.9.2
17	**Falling or ejected objects or fluids**	5.11.6.3
18	**Loss of stability/overturning of machinery**	n.a.
19	**Slip, trip and fall of persons** (related to machinery)	n.a.
Additional hazards, hazardous situations and hazardous events due to mobility		
20	**Relating to the travelling function:**	
20.1	movement when starting the engine	n.a.
20.2	movement without a driver at the driving position	n.a.
20.3	movement without all parts in a safe position	n.a.
20.4	excessive speed of pedestrian controlled machinery	n.a.
20.5	excessive oscillations when moving	n.a.
20.6	insufficient ability of machinery to be slowed down, stopped and immobilised	n.a.
21	**Linked to the work position (including driving station) on the machine due to:**	
21.1	fall of persons during access to (or at/from) the work position	n.a.
21.2	exhaust gases/lack of oxygen at the work position	n.a.
21.3	fire (flammability of the cab, lack of extinguishing means)	n.a.
21.4	mechanical hazards at the work position: a) contact with the wheels; b) rollover; c) fall of objects, penetration by objects; d) break-up of parts rotating at high speed; e) contact of persons with machine parts or tools (pedestrian controlled machines)	n.a.
21.5	insufficient visibility from the work positions	n.a.
21.6	inadequate lighting	n.a.
21.7	inadequate seating	n.a.
21.8	noise at the work position	5.13, 7.2, Annex F
21.9	vibration at the work position	n.a.
21.10	insufficient means for evacuation/Emergency exit	n.a.
22	**Due to the control system:**	
22.1	inadequate location of manual controls	5.2.1, 5.12

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Table 1 (*continued*)

	Hazards	Relevant clause(s) in this European Standard
22.2	inadequate design of manual controls and their mode of operation	5.2.1, 5.10.3, 5.10.4, 5.11.5, 5.11.6.1, 5.12
23	**From handling the machine (lack of stability)**	5.1
24	**Due to the power source and to the transmission of power:**	
24.1	hazards from the engine and the batteries	n.a.
24.2	hazards from transmission of power between machines	n.a.
24.3	hazards from coupling and towing	n.a.
25	**From/to third persons due to:**	
25.1	unauthorised start-up/use	5.2.1
25.2	drift of a part away from its stopping position	5.2.4
25.3	lack or inadequacy of visual or acoustic warning means	n.a.
26	**Insufficient instructions for the driver/operator**	7
Additional hazards, hazardous situations and hazardous events due to lifting		
27	**Mechanical hazards and hazardous events:**	
27.1	from load falls, collisions, machine tipping caused by:	
27.1.1	lack of stability	5.1
27.1.2	uncontrolled loading – overloading – overturning moments exceeded	5.2.2, 5.11.3
27.1.3	uncontrolled amplitude of movements	5.2.1, 5.2.4, 5.4, 5.12.8.2
27.1.4	unexpected/unintended movement of loads	5.2.1, 5.2.2, 5.4, 5.10.2.2, 5.11.3, 5.11.6.2, 5.12.8.2, 5.15.4, 5.16.3, 5.17.4
27.1.5	inadequate holding devices/accessories	5.1, 5.6, 5.7.6, 5.7.8, 5.8.4, 5.9.4, 5.9.5, 5.16.7, 5.16.8
27.1.6	collision of more than one machine	n.a.
27.2	from access of persons to load support	n.a.
27.3	from derailment	n.a.
27.4	from insufficient mechanical strength of parts	5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.11.4.1, 5.11.4.2, 5.15.2, 5.15.6, 5.15.7, 5.16.5, 5.16.7, 5.16.8, 5.17.6
27.5	from inadequate design of pulleys, drums	5.7.1, 5.7.2, 5.7.4, 5.7.5, 5.7.6, 5.9.1, 5.9.3, 5.9.4, 5.16.6, 5.16.7
27.6	from inadequate selection of chains, ropes, lifting and accessories and their inadequate integration into the machine	5.7, 5.8, 5.9, 5.15.6, 5.16.5, 5.17.6
27.7	from lowering of the load under the control of friction brake	5.4
27.8	from abnormal conditions of assembly/testing/use/maintenance	7
27.9	from the effect of load on persons (impact by load or counterweight)	5.2.1, 7

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Table 1 (*continued*)

	Hazards	Relevant clause(s) in this European Standard
28	**Electrical hazards**	
28.1	from lightning	5.12
29	**Hazards generated by neglecting ergonomic principles**	n.a.
29.1	insufficient visibility from the driving position	7
Additional hazards, hazardous situations and hazardous events due to underground work		
30	**Mechanical hazards and hazardous events due to:**	
30.1	lack of stability of powered roof supports	n.a.
30.2	failing accelerator or brake control of machinery running on rails	n.a.
30.3	failing or lack of deadman's control of machinery running on rails	n.a.
31	**Restricted movement of persons**	n.a.
32	**Fire and explosion**	n.a.
33	**Emission of dust, gases etc.**	n.a.
Additional hazards, hazardous situations and hazardous events due to the lifting or moving of persons		
34	**Mechanical hazards and hazardous events due to:**	
34.1	inadequate mechanical strength - inadequate working coefficients	n.a.
34.2	failing of loading control	n.a.
34.3	failing of controls in person carrier (function, priority)	n.a.
34.4	overspeed of person carrier	n.a.
35	**Falling of person from person carrier**	n.a.
36	**Falling or overturning of person carrier**	n.a.
37	**Human error, human behaviour**	n.a.
n.a.: not applicable		

5 Safety requirements and/or protective measures

5.1 General

Winches shall comply with the safety requirements and or protective measures of this clause. In addition, the winches shall be designed in accordance with the principles of EN ISO 12100-1 and EN ISO 12100-2 for hazards relevant but not significant, which are not dealt with by this document. Winches shall be classified in groups of mechanism in accordance with ISO 4301-1 in accordance with the operational requirements and conditions of application.

Winches shall be designed in accordance with FEM 1.001, booklets 1, 2, 3, 4, 8 and 9 and FEM 9.901.

NOTE For the calculation, EN 13001-1, EN 13001-2, and CEN/TS 13001-3-1 are available. After publication of these documents as harmonized European Standards, CEN/TC 147/WGP 7 will check to see how to update this European Standard and to make reference to these documents.

Winches shall be designed taking into account the static and dynamic forces which may occur at intended use. Forces which occur due to the activation of the rated capacity limiter and the emergency stop device shall be taken

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into account. Accessible parts shall not have sharp edges, sharp angles or protruding parts that can cause injury. This can be achieved by e.g. de-burring, flanging, trimming, sand blasting.

Connections and individual components of winches shall incorporate features so that they cannot self-loosen.

Moving transmission parts (shafts, fans, wheels, gears, belts, couplings) shall be designed, positioned or guarded in order to protect against the risks associated with possible contact of exposed persons during the intended use.

Risk of burn during hoisting operation caused by contact between the operator's skin and hot surfaces of the winch shall be reduced by following the principles of EN 563.

Winches shall be equipped with a device which prevents the load from running back unintentionally. This device shall act automatically and shall be dimensioned so that it is capable of safely absorbing the occurring forces. This requirement is fulfilled e.g. by self-locking drives, automatically acting service brake, automatically engaging gears.

Information for certain applications are given by:

a) Annex B; winches should be in accordance with Annex B when used in explosion hazard areas;

b) Annex C; winches should be in accordance with Annex C when operating in aggressive environments and outdoors;

c) Annex D; winches should be in accordance with Annex D when operating at low temperatures.

5.2 Devices

5.2.1 Control devices

Devices for starting and stopping manually controlled winches shall be fitted with hold-to-run control elements so that the drive energy supply is interrupted when the actuating elements are released.

Actuating elements of control devices shall incorporate features that prevent unintentional operation or not wanted movements of the load. (See EN 13557:2003, 5.2.3.1.2.) Actuating elements of control devices shall incorporate features and be arranged and marked in such a way that their assignments, direction of operation and switching state are unmistakably recognisable.

5.2.2 Rated capacity limiters and indicators

5.2.2.1 General

Winches for lifting and lowering purposes with a rated capacity of 1 000 kg or more and winches for pulling purposes with a pulling force of 10 000 N or more shall be fitted with a rated capacity limiter.

The rated capacity limiter shall be designed to prevent overloading of the winch. It shall also limit the forces transmitted to the supporting structure, which are to be provided by the manufacturer (see 7.2). Overloading means exceeding the designed operating forces.

NOTE A rated capacity limiter may also be incorporated within the supporting structure into which a winch is fitted.

Rated capacity limiters shall be in accordance with EN 12077-2.

Rated capacity limiters shall operate to override the controls of the winch as required in EN 12077-2:1998, 5.4.2.1. This requirement can be fulfilled either by direct acting rated capacity limiter or by indirect acting rated capacity limiter.

As, in the case of winches, the rated capacity and the pulling force do not vary with the position of the load the risk assessment shows that no hazard occurs from the load when the rated capacity limiter was triggered. Winches do therefore not require rated capacity indicators as defined in EN 12077-2.

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5.2.2.2 Setting

5.2.2.2.1 General

The rated capacity limiter shall limit the forces to a level equal to or less than the designed operating forces (as defined in EN 12077-2:1998, 5.4.1.2).

5.2.2.2.2 Direct acting rated capacity limiters

The setting shall be done in such a way that the dynamic overload test, see Clause 6, can be performed without changing the setting of the rated capacity limiter.

NOTE In case of winches with multi-layer winding, the load with which the overload test is to be performed, is different for the innermost and the top layer of the drum.

With this setting, the effective force in the winch medium shall not exceed 160 % of the force of the corresponding layer, resulting from the rated capacity.

With this setting, a load exceeding (ϕ_{DAL} multiplied by a load of the corresponding layer, resulting from the rated capacity) shall not be lifted.

NOTE ϕ_{DAL} see 5.2.2.3.

5.2.2.2.3 Indirect acting rated capacity limiters

The setting shall be such that a load exceeding the rated capacity of the winch or a force exceeding the pulling force multiplied by the triggering-factor shall trigger the limiter. (Load > $\alpha \cdot m_{RC}$ or force > $\alpha \cdot$ pulling force) The triggering-factor shall be less or equal to 1,25 ($\alpha \leq 1{,}25$).

When lifting/lowering a load greater of 125 % than the rated capacity of the winch shall not be lifted over a distance greater than the maximum rated hoisting speed multiplied by 1 s.

NOTE The triggering-factor corresponds to α, 5.2.2.3.3.

5.2.2.3 Maximum force

5.2.2.3.1 General

When lifting/lowering, the maximum force $F_{max,L}$ occurs when the rated capacity limiter operates and the load has not left the ground.

When pulling, the maximum force $F_{max,L}$ occurs when the rated capacity limiter operates and the load has not yet been moved.

For winches with intended use of lifting/lowering, equations 1, 2, 3, 4, 5, 6 and 7 shall be used.

For winches with the intended use of pulling, equations 1a, 2a, 3, 4a, 5a, 6 and 7a shall be used.

The maximum force, which applies to the winch when the rated capacity limiter has operated, shall be calculated by:

$$F_{max,L} = \left(\phi_L \cdot m_i + (m_W - m_i)\right) \cdot g \quad (1)$$

$$F_{max,L} = \phi_L \cdot F_t \quad (1a)$$

where

$F_{max,L}$ is the maximum force [N];

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ϕ_L is the force-limit factor [-];

m_W is the winch load [kg];

m_i is the load that the winch is designed to lift; in case of multi-layer winding, it is the value at the first layer of the drum;

g is the acceleration due to gravity (9,81) [m/s²];

F_t is the force that the winch is designed to pull; in case of multi-layer winding, it is the value at the first layer of the drum.

The force-limit factor ϕ_L depends on the type of limiter:

$\phi_L = \phi_{DAL}$ in case of direct acting limiter (see 5.2.2.3.2);

$\phi_L = \phi_{IAL}$ in case of indirect acting limiter (see 5.2.2.3.3).

The maximum force $F_{max,L}$ shall be assigned for the winch to load combination C 1, Table 10 of EN 13001-2:2004. In this context a calculation shall be carried out to establish whether these effects or the conditions of the load combination C 1 in accordance with Table 3 of EN 13001-2:2004 are significant.

The mass of the hoist medium can be neglected if it is less than 5 % of the rated capacity of the winch plus the mass of the fixed load lifting attachments.

5.2.2.3.2 Direct acting rated capacity limiters

Direct acting rated capacity limiters act directly in the chain of drive elements and limit the transmitted force. Those limiters may be, for example, friction torque limiters, pressure limiting valves etc. Direct acting rated capacity limiters generally have no response delay and require no braking path.

The most frequently used limiters for direct limitation are friction torque limiters, which are set to the force limit:

$$F_{Lim} = \left(\phi_{DAL} \cdot m_i + (m_W - m_i)\right) \cdot g \quad (2)$$

$$F_{Lim} = \phi_{DAL} \cdot F_t \quad (2a)$$

where

F_{Lim} is the force limit [N];

ϕ_{DAL} is the force-limit factor for direct acting rating capacity limiters [-];

m_i is the load that the winch is designed to lift; in case of multi-layer winding it is the value at the first layer of the drum [kg];

m_W is the winch load [kg];

g is the acceleration due to gravity (9,81) [m/s²];

F_t is the force that the winch is designed to pull; in case of multi-layer winding it is the value at the first layer of the drum [N].

For friction torque limiters, the factor ϕ_{DAL} shall be less than or equal to 1,6.

On hydraulically acting rated capacity limiters (e.g. pressure relief valves), the factor ϕ_{DAL} shall be less or equal 1,4. On pneumatically acting rated capacity limiters, the factor ϕ_{DAL} shall be less or equal 1,6.

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For direct acting rated capacity limiters the maximal force $F_{max,\,L}$ as defined in Equation (1) is equal to the force limit F_{Lim} in Equation (2):

$$F_{max,L} = F_{Lim} \tag{3}$$

where

$F_{max,L}$ is the maximum Force [N];

F_{Lim} is the force limit [N].

5.2.2.3.3 Indirect acting rated capacity limiters

Indirect acting rated capacity limiters measure the transmitted force using a sensor and switch off the energy supply for the movement of the load and, if required, apply the brake torque. The force when the limiter starts operating is called the triggering-force. Evaluation of that force and filtering of interference signals require time and act as a switch-off-delay. This delay is called response-time. After the response-time the limiter switches off the energy-supply.

The triggering-force shall be calculated by:

$$F_{trig} = (\alpha \cdot m_i + (m_W - m_i)) \cdot g \tag{4}$$

$$F_{trig} = \alpha \cdot F_t \tag{4a}$$

where

F_{trig} is the triggering-force [N];

α is the triggering-factor [-];

m_i is the load that the winch is designed to lift; in case of multi-layer winding it is the value at the first layer of the drum [kg];

m_W is the winch load [kg];

g is the acceleration due to gravity (9,81) [m/s²];

F_t is the force that the winch is designed to pull; in case of multi-layer winding it is the value at the first layer of the drum [N].

The triggering-factor includes the maximum tolerance of the limiter, resulting from its design and construction.

The factor ϕ_{IAL} for indirect acting rated capacity limiters shall be calculated as follows:

$$\phi_{IAL} = \alpha + \frac{\left(C \cdot v_h \left(\Delta t_{IAL} + \frac{\Delta t_{bt}}{2}\right)\right)}{(m_i \cdot g)} \tag{5}$$

$$\phi_{IAL} = \alpha + \frac{\left(C \cdot v_h \left(\Delta t_{IAL} + \frac{\Delta t_{bt}}{2}\right)\right)}{F_t} \tag{5a}$$

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where

ϕ_{IAL} is the force limit factor for indirect acting rated capacity limiters [-].

v_h is the hoisting speed [m/s]. The appropriate speed shall be selected from Table 2;

m_i is the load that the winch is designed to lift; in case of multi-layer winding it is the value at the first layer of the drum [kg];

C is the rigidity of the winch, hoist medium and the supporting structure [N/m];

Δt_{IAL} is the time lapse after attaining load level $\alpha \times m_{RC}$ to when actual motion braking commences [s];

Δt_{bt} is the motion braking time affected by the combined hoist medium tension and brake torque [s];

g is the acceleration due to gravity (9,81) [m/s²];

F_t is the force that the winch is designed to pull; in case of multi-layer winding it is the value at the first layer of the drum [N].

When the rigidity of the supporting structure is unknown at the winch design stage, it shall be assumed to be rigid.

The rigidity of the hoist medium can be calculated by the following equation:

$$C_{med} = \frac{C_{rm} \cdot n}{l_H} \tag{6}$$

where

C_{med} is the rigidity of the hoist medium [N/m];

C_{rm} is the rigidity per meter of a rope, respectively chain, respectively belt [N];

n is the number of load bearing ropes, chains, belts [-];

l_H is the hook path [m].

For indirect acting rated capacity limiters the maximum force $F_{max,L}$ as defined in Equation (1) is not equal to the triggering-force F_{trig} in Equation (4).

The maximum force $F_{max,L}$, as defined in Equation (1) shall be evaluated by:

$$F_{max,L} = \left(\phi_{IAL} \cdot m_i + (m_W - m_i)\right) \cdot g \tag{7}$$

$$F_{max,L} = \phi_{IAL} \cdot F_t \tag{7a}$$

where

$F_{max,L}$ is the maximum force [N];

ϕ_{IAL} is the force limit factor for indirect acting rated capacity limiters;

m_i is the load that the winch is designed to lift; in case of multi-layer winding it is the value at the first layer of the drum [kg];

m_W is the winch load [kg];

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g is the acceleration due to gravity (9,81) [m/s²];

F_t is the force that the winch is designed to pull; in case of multi-layer winding it is the value at the first layer of the drum [N].

Table 2 — Values for v_h for estimation of ϕ_{IAL}

Hoisting speed	Type of winch drive and its operating method				
	HD 1	HD 2	HD 3	HD 4	HD 5
v_h	$v_{h,r}$	$v_{h,r}$	$v_{h,cs}$	$v_{h,r}$	$v_{h,pc}$

HD 1: winch drive cannot be operated with creep speed;

HD 2: a steady creep speed of the winch drive can be selected by the winch operator;

HD 3: winch drive control system ensures the use of a steady creep speed until the load is lifted from the ground;

HD 4: a stepless variable speed control can be operated by the winch operator;

HD 5: after pre-stressing the hoist medium a step-less variable speed control is provided by the drive control system independent of the winch operator;

$v_{h,r}$: is the rated lifting speed in cases HD 1, HD 2 and HD 4;

$v_{h,cs}$: is the steady lifting creep speed in case of HD 3;

$v_{h,pc}$: is the minimum creep speed in case of HD 5.

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5.2.2.4 Additional requirements for friction torque limiters

Friction torque limiters used as rated capacity limiters shall be such that, when triggered, the torque which can be transmitted over a period of time of 60 s shall not exceed the maximum value specified by the manufacturer, and the lifting force shall be sufficient to hold a load equal to the rated capacity of the winch in the lifting motion and when the motor is at standstill. After this period of time of 60 s, the rated capacity of the winch shall not lower at an average speed of not more than half the rated lowering speed whilst the motor is operated upwards; in this case, this average speed is determined over a distance of at least 3 m.

5.2.3 Emergency stop function

Winches shall be provided with an emergency stop function.

Electrically powered winches shall be in accordance with 5.12.7, pneumatically powered winches shall be in accordance with 5.10.5.1 and hydraulically powered winches shall be in accordance with 5.11.6.1.

5.2.4 Lifting and lowering limiters

5.2.4.1 General

Winches shall be fitted with lifting and lowering limiters in accordance with EN 12077-2:1998, 5.6.1.

NOTE Lifting and lowering limiters include, for example, limit switches, adjustable friction torque limiters, relief valves.

In case of friction torque limiters or pressure relief valves, mechanical end stops shall be provided.

Friction torque limiters used as lifting and lowering limiters shall fulfil the requirements of 5.2.2.4.

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The following prescriptions shall apply in addition to those stated in EN 12077-2.

Electrical limiters shall have a positive opening system.

After operation of a limiter, it shall be ensured that the limiter does not return to its original position until the corresponding restricted area has been left by the actuating part.

The lowering limiter shall ensure that the minimum engagement of the lifting medium is maintained at all times during operation. The lowering limiter shall also stop the motion to prevent unwanted coiling in the reverse direction.

5.2.4.2 Second limiter (= backup limiter) for hoisting

For normal operation a second limiter, as defined in EN 12077-2:1998, 5.6.1.4, is not necessary.

A risk assessment based on the particular application may result in the need of a second limiter for certain motions. This second limiter shall not be approached during normal operation, whereas the first limiter can be approached during normal operation.

NOTE Based upon the risk assessment, a second limiter may be necessary, for example when the hoisting limiter is activated with regularity and this limiter is not designed for regularity.

Following operation of the second limiter, a restart shall only be possible by a reset action, e.g. by using a key-lockable hold-to-run control on the control stand, manual reset button on the winch. The indication of a failure of the first limiter, as required in EN 12077-2:1998, 5.6.1.4, is, that a reset action is necessary, after the second limiter has been triggered.

Following operation of the second limiter, a restart shall only be possible into the opposite direction. Indication and reset action are not necessary, if the second limiter is a friction torque limiter designed to accommodate the movement energy.

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5.2.5 Categories of controls

All safety related parts of controls where existing shall fulfil at least the following categories of EN 954-1:1996:

— control circuits built with electromechanical, hydraulic and pneumatic components: category 1;

— safety related parts of controls which are realised electronically: category 2.

Safety related parts of the control are e.g:

a) control devices see 5.2.1;

b) rated capacity limiters see 5.2.2;

c) emergency stop device see 5.2.3;

d) lifting and lowering limiters see 5.2.4;

e) control devices/controls (pneumatic) see 5.10.3;

f) control units/control systems (pneumatic) see 5.10.4;

g) protective measures (pneumatic) see 5.10.5;

h) control devices/controls (hydraulic) see 5.11.5;

i) protective measures (hydraulic) see 5.11.6;

j) power feed isolating and switching devices see 5.12.4.

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The stop function of cable-less control systems, as mentioned in EN 13557:2003, C.3.1 shall conform to category 3.

In case of winches for the lifting of loads above pipes and tubes where the destruction of those pipes and tubes by a falling load can cause the escape of combustible gases or fluids, all safety related parts of controls which are realised electronically, shall at least fulfil category 3.

5.3 Couplings

Couplings in the force flow for winches, with the exception of friction torque limiters according to 5.2.2.4, shall be constructed in such a way that if there is a failure of plastic parts or rubber parts there is a positive engagement, e.g. by metal parts. There shall be no devices provided between load shaft or hoisting medium and the device preventing the load from running back unintentionally, with which it is possible to interrupt the force flow.

5.4 Brakes for lifting and lowering movements

Winches shall be designed in such a way that movements can be decelerated, the load can be held, and that unintended movements are avoided. In addition the rotating masses, the triggering limit of the rated capacity limiter and the maximum speed, e.g. in the event of a phase failure, shall be taken into account.

Brakes shall engage automatically in the following cases:

when

a) the control device returns to its neutral position;

b) the emergency stop function is activated;

c) the external power supply to the brake is interrupted;

d) the power supply of the corresponding drive (= motor) is interrupted or switched off.

In case of winches with combustion engines this requirement is fulfilled if the winch is constructed in such a way that:

— the load shall not lower in an uncontrolled manner in case of lack of fuel;

— the load shall not drop in case of lack of fuel.

In addition to letters a) to d), in the case of 3-phase motors, brakes shall engage automatically when

e) two phases of the power supply of the corresponding drive (= motor) are interrupted.

NOTE If only one phase fails, see 5.12.8.2.

With spring loaded brakes, brake springs shall be compression springs. They shall be guided. The coils of helical springs shall not intertwine in the event of a wire break, so that the pre-stressing of the spring does not decrease in an inadmissible way.

If the braking-force is supplied by pre-stressed springs, the failure of any spring in the braking system shall not reduce the available braking torque by more than 20 %. This can be achieved, for example:

— by using at least 5 springs;

— if less than 5 helical springs are used, they shall be dimensioned such, that the wire diameter is greater than the distance between the windings in the working condition to prevent screwing in of the two spring parts in the event of a wire break.

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The requirement "... the failure of any spring in the braking system shall not reduce the available braking torque by more than 20 %" is not relevant for holding brakes. Where brakes act solely as holding brakes (also in the case of a fault occurring), the rated capacity of the winch shall be held even if one spring breaks.

Brake linings shall be made of asbestos-free material. It shall be possible to check the wear of the brake linings in those cases, where the service life is shorter than the theoretical period of utilization of the winch.

It shall be possible to check, adjust and replace the brake or the brake linings, when required in the user manual. The connection between brake lining and brake lining holder shall not permit unintentional release.

5.5 Gearbox

Gearboxes shall be dimensioned in accordance with the winch loads and classifications in groups of mechanisms. Dimensioning can be for example in accordance with FEM 9.901 or ISO 6336-5. The type of connection shall not produce any impermissible stresses on the gears.

The gear reducer shall be supported and connected to the driving and driven mechanisms in such a way that no impermissible and uncontrolled stresses or deformations are produced in the gears or bearings.

5.6 Load hooks

Hooks shall be designed in accordance with the state of the art.

NOTE Information is given in Annex E.

Hooks shall be such that the unintentional detachment of the load is prevented. This can be achieved by:

— a safety device or

— the shape of the hook.

Hooks equipped with a safety-latch fulfill these requirements.

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5.7 Rope drive

5.7.1 General

Rope drives with steel wire ropes shall be dimensioned in accordance with ISO 4308-1:2003.

NOTE 1 For the calculation of rope drives, CEN/TS 13001-3-2 is available. After publication of this document as harmonized European Standard, CEN/TC 147/WGP 7 will check to see how to update this European Standard and to make reference to this document.

The fleet angle for grooved drums and rope sheaves should not exceed 4° for all ropes and 2° for rotation-resistant rope.

NOTE 2 This is referring to ISO 4308-1:2003 and also EN 13135-2.

The amount of lateral deflection of ropes from the groove direction of drums and rope pulleys shall be such that the rope lead-off cannot come into contact with the tip of the groove section of the drum.

In case of drums designed for single-layer winding and provided correspondingly with grooves, the rope, which is running off, shall not come into contact with adjacent windings.

In the case of rope sheaves, the amount of deflection shall only be such that the rope cannot come into contact with the edge of the groove section.

5.7.2 Rope drum

It shall not be possible for ropes to run off the side of the rope drums.

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NOTE Suitable measures on drums are for example, flanged drum end plates, frame/housing, or rope guides.

Flanged drum end plates shall protrude beyond the rope wound on the drum at the top layer by at least 1,5 × the nominal rope diameter.

Drums designed for single-layer winding shall be grooved. Grooving shall be smooth and free from surface defects liable to damage the rope. The edges shall be rounded. These grooves should have a radius of (0,525 to 0,56) × nominal rope diameter. The rope groove depth should be between 0,28 and 0,45 of the nominal rope diameter. The groove pitch shall provide sufficient clearance between adjacent rope turns on the drum, taking into account the rope tolerance.

The fixing point of the rope shall be easily accessible for maintenance and replacement of the rope.

Rope run-on points in the normal working position of the operating personnel and in the traffic area shall be guarded to prevent accidental ingress of parts of the human body.

5.7.3 Ropes

Ropes used as carrying elements in rope drives shall be selected for the particular application and be made of suitable materials so that they withstand the stresses resulting from an intended use; they shall be rated for a period of service that exceeds the inspection intervals specified by the manufacturer.

In the case of a load suspended by a single-fall rope drive and not guided, rotation resistant ropes shall be used.

Discard criteria shall be recognisable from the outside. Discard criteria are described in ISO 4309.

Rope ends shall be made in such a way that the rope structure does not become detached.

Ropes manufactured from material other than steel shall only be used if the wear conditions are known and the discard criteria are recognisable, in any case at least the following safety requirements connected to the specific application shall be considered:

— fatigue;

— environment;

— rope structure;

— terminations;

— elasticity and plasticity of the rope;

— rope drum;

— sheaves;

— guides/rope runs;

— fastening;

— anchorage;

— number of layers.

The working coefficient for ropes other than steel shall be a minimum of 7.

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5.7.4 Rope sheaves

Rope sheaves shall be provided with a suitable means of preventing the rope from jumping out of the grooves (e.g. when the rope is slack).

The distance between the edge of the sheave and the protective components shall be less than 0,5 × nominal rope diameter.

If the rope sheave breaks, it shall not be possible for the rope to slip off the sheave shaft.

Rope grooves on rope sheaves should have a groove radius of (0,52 to 0,56) × nominal rope diameter. The opening angle of the rope sheave shall be symmetrical and between 30 and 60 degrees. The depth of the grooves shall not be less than 1,4 × nominal rope diameter.

In the working and traffic area, rope run-on points on bottom blocks shall, as far as technically possible, have features that prevent accidental ingress of parts of the human body.

NOTE Features may be e.g. handles, seizable hand gripping form (beads), covers.

5.7.5 Rope guides/rope runs

Rope drives shall be arranged in such a way that damage to the ropes by contact between them and with fixed and moving structures is prevented.

5.7.6 Rope fastening onto the rope drum

Rope fastening onto the rope drum shall be made in such a way that at least 2,5 × the remaining static force at the fastening device is accommodated when the rated capacity of the winch is applied to the winch taking into account the friction effect of the winding on the drum. The coefficient of friction between wire rope and contact surface shall be assumed to be $\mu = 0,1$.

There shall be at least two rope windings remaining on the drum before the fixing point of the rope.

The fastening elements of the fixing point of the rope shall be selected taking into account the rope and drum contours. The rope shall not be led over edges.

5.7.7 Rope anchorage

Rope anchorage shall be such that bending of the rope and other additional stresses on the wire rope are avoided.

With wire ropes which are not of the rotation resistant type, the rope anchorage shall be made in such a way that it is not possible for the wire rope to twist about its longitudinal axis.

Rope anchorages shall be able to resist 2,5 × the static rope force corresponding either to the pulling force or to the rated capacity of the winch without permanent deformation.

5.7.8 Rope end terminations

The following devices shall be used as rope end terminations:

a) asymmetric wedge socket clevis. This device shall be in accordance with EN 13411-6;

b) symmetric wedge socket clevis. This method of socketing shall be used only for rope diameters up to 8 mm. It shall be in accordance with EN 13411-7;

c) metal and resin socketing. This device shall be in accordance with EN 13411-4;

d) wire rope clamps and clamping in accordance with EN 13411-3.

If not otherwise specified in the above mentioned European Standards, the rope-end terminations shall withstand a force of at least 85 % of the minimum breaking force of the rope without rupture.

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Wire rope grips and rope eyes in conjunction with wire rope grips shall not be used as rope-end terminations.

5.7.9 Traction winches

In case of traction winches, the traction shall be such that both during intended use and during tests according to Clause 6 no slipping or creeping of the rope will occur.

The traction shall be proven, either by calculation or by experiment, for 1,5 × the rated capacity (pulling force) during the intended period of utilisation. Here, wear and tear shall be taken into account, e.g. in case of winches where the traction depends on the state of wear of the groove.

NOTE For traction calculation, see e.g. EN 81-1:1998, Annex M.

Ropes shall not be capable of running off the sides of the traction sheave.

NOTE Appropriate measures on traction sheaves are e.g. hoops or metal protection.

Where traction sheaves are grooved, the grooves shall correspond to the type and diameter of the rope intended to be used together with the winch. The groove surfaces should have a roughness of not more than Ra = 6,3.

V-grooves without undercut groove base profile shall possess dimensional stability. This requirement shall be considered fulfilled if the groove flanks have a hardness of at least 50 HRC.

The undercut groove base profile width B of the traction sheave grooves shall not exceed 0,8 × the rope diameter or, if the rope diameter is less than 8 mm, 0,75 × the rope diameter (see Figure 2).

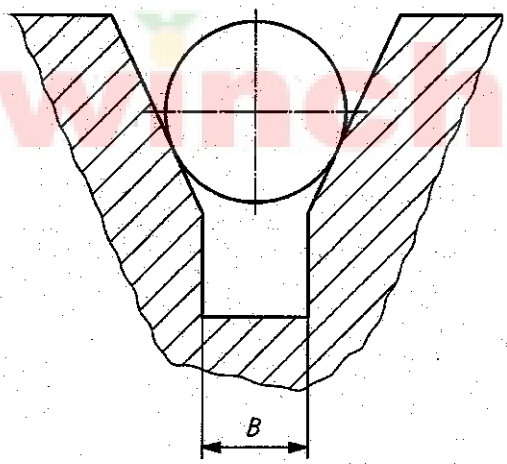

Figure 2 — Undercut groove base profile

5.8 Chain drives

5.8.1 General

Calculations for chain drives with short steel link chains shall be made in accordance with EN 818-1:1996 and EN 818-7:2002.

The components of the chain drive (i.e. chain, chain drive sprockets, chain wheels and chain guides) shall match each other in terms of dimensions and materials. With the manufacturer's planned lubrication, chains shall be ready for discarding due to wear before fatigue rupture.

Chain drive sprockets should be made in one piece; in the case of two-piece chain sprockets, the arrangement of the two halves shall have positive engagement.

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5.8.2 Chains

Short steel link chains shall be in accordance with EN 818-7.

For roller chains identification marks shall be placed at least every 80 links on the chain for traceability-purposes.

The geometry of roller chains shall be in accordance with ISO 606. The working coefficient for roller chains shall be at least 6.

5.8.3 Chain guides

Chain drives shall be provided with a device which ensures that the chain runs properly over chain drive sprockets and chain guide wheels and which prevents the chain from jumping out, twisting and jamming.

In the working and transport zone, chain run-in points (for round steel and roller chains) on chain wheels and sprockets shall incorporate features which prevent manual ingress.

5.8.4 Chain anchorage

Chain anchorage devices shall withstand four times the static chain tensile force at rated capacity of the winch without rupture.

Threaded connections on chain anchorage devices shall be locked to prevent self-loosening. The state of the fastening shall be verifiable.

5.8.5 Securing the chain from running off

The unloaded end of the chain shall be secured against running off the chain sprocket. This safety arrangement shall withstand the forces that occur when the end position is approached.

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5.9 Belt drives

5.9.1 General

The drive shall be such that the belt is subject to uniform loading over its entire width under load conditions.

5.9.2 Belts

Belts used as load-bearing media in winches shall be selected for the particular operating conditions, be made of suitable materials such that they withstand the permissible stresses, and shall be rated for a period of service exceeding that specified by the manufacturer. Discard criteria shall be externally recognisable. A sufficient period of service shall remain between readiness for discarding and rupture.

The materials of the belt shall be such that:

a) environmental influences do not result in premature failure;

b) damage caused by sharp edges or temperature influences do not lead to sudden failure of the belt;

c) contact with the belt does not constitute a danger of injury due to the type of belt.

The working coefficient shall not be less than 5 for belts with a metallic inlay or not less than 7 for belts without metallic inlay.

5.9.3 Belt guide/belt pulleys/belt drum

The ratio of belt sheave and drum diameter to the rated belt thickness shall not be less than 18 ($D/s \geq 18$).

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If a slack belt situation is possible, provisions shall be made to ensure tight winding of the belt. It shall be ensured that the belt is not able to run off the side of the pulley or drum. Rims shall be such that they do not damage the belt which runs against them.

If an inclined pull is possible, measures shall be taken to avoid excessive loading in the edge zones, e.g. moveable suspension of the lifting appliance.

5.9.4 Fastening to the drum

Belt drums shall incorporate features so that the belt can be securely attached to them without damage or bending.

Belt fastening onto the belt drum shall be made in such a way that at least 2,5 times the remaining static force at the fastening device is accommodated when the rated capacity is applied to the winch taking into account the friction effect of the winding on the drum. The specific friction values of the particular materials shall be considered for calculation of the friction torque. It shall be assumed that lubricants are present on the materials.

A minimum of two windings shall always remain on the drum and the belt shall not be capable of being wound onto the drum in the wrong direction.

5.9.5 Belt anchorage

Belt anchorage devices shall withstand four times the static belt tensile force at rated capacity of the winch without destruction of the anchorage and its fastening elements.

Threaded connections on belt anchorage devices shall be locked to prevent self-loosening. The state of the fastening shall be verifiable.

5.10 Pneumatic equipment

5.10.1 General

Pneumatic equipment shall be in accordance with EN 983.

All components and materials of equipment shall be compatible and suitable for the anticipated ambient conditions.

Sufficient air pressure shall be available for all operating modes at any point of the equipment in order to fulfil all functions. A loss in pressure shall not result in hazards.

NOTE Due to the pneumatic drive characteristics, significant differences of lowering and lifting speed may exist.

5.10.2 Energy converters

5.10.2.1 Motors

Motors shall not create additional hazards by heating up nor by icing up.

5.10.2.2 Brakes

Winches using pneumatically released brakes shall be such that unexpected load lowering is prevented.

NOTE This requirement is fulfilled, for example, if the brake releases only, when the motor provides a sufficient moment for holding the load or for controlling the load-movement.

5.10.3 Control devices/controls

Control devices shall be selected so that no pressure and flow disturbances can occur and their level of performance is kept.

Control devices shall be arranged in the control system so that no unintended movements can occur.

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Control devices in control systems shall be selected and arranged in such a way that in the case of a power failure switching positions are automatically reached by spring force bringing the control into a neutral position. For direct-controlled winches this requirement applies only, when the actuators are released.

Controls shall be such, that increasing/decreasing of the actuator-displacement provides increasing/decreasing of the speed of the load.

5.10.4 Control units/control systems

System reaction times as a function of control line lengths shall be reduced to a minimum.

Triggering of machine movements by venting control lines is not permissible.

Control equipment for starting pneumatically operated winches shall automatically return to the neutral position after being released.

Power valves shall have sufficient venting cross sections in their neutral position, to prevent malfunction of the brake.

5.10.5 Protective measures

5.10.5.1 Emergency stop function

The emergency stop function shall conform to EN 418 with the following deviations.

The emergency stop function shall correspond to stop category 0 in accordance with 4.1.5 of EN 418:1992.

The requirement in EN 418:1992, 4.1.12, in accordance with which the resetting of the "Emergency stop" shall not be permitted to initiate restarting does not apply for hand controlled winches in accordance with 5.2.1.

NOTE 1 Restarting following resetting of the "Emergency stop" is excluded owing to the automatically resetting operating elements. No hazard occurs in the particular case of an internal error, since the winch is hand controlled.

In case of indirect control one of the following two requirements shall be fulfilled:

a) the emergency stop function shall interrupt the main air circuit via an additional main air valve, where as this valve shall be designed so that sticking of that valve will not occur, or

b) main valve selection and a unit delivered with the winch providing the required air quality (admissible dust, admissible water content, oil content) to ensure that sticking of the main air valve will not occur.

NOTE 2 Such a unit normally consists of filter, pressure regulator and oiler.

In case of direct control one of the following two requirements shall be fulfilled:

c) the emergency stop function shall interrupt directly the main air circuit, or

d) the actuating elements and the energy switching part of the hand control shall be positively connected. The positive locking shall be designed in a way that the energy switching part can be returned by hand to a stable neutral position.

Pull cord controls can be used, if they fulfil this requirement.

Apart from that, no further emergency stopping devices are required.

5.10.5.2 Pneumatic protection

Disconnection from the pressurised air supply shall not result in load dropping.

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5.10.5.3 Mechanical protection

Moveable elements (e.g. cylinders) shall be arranged and/or covered so that hazards for persons or objects are minimized.

5.10.5.4 Adjustable safety device

Those adjustable safety devices which can cause a hazardous situation, if their pre-set values are modified, shall have means to prevent their readjustment by non-authorised persons. External devices shall have visible means, such as:

a) lead-seals;

b) covers;

c) cups,

which need to be destroyed before a readjustment can take place.

Visible means are not necessary, if special tools specified by the manufacturer of the adjustable safety device shall be used for readjustment.

5.11 Hydraulic equipment

5.11.1 General

Hydraulic equipment shall be in accordance with EN 982.

Hydraulic systems shall be such that only components and auxiliary materials are used which are compatible with each other and ensure correct functioning under the anticipated environmental conditions (temperature, humidity).

5.11.2 Materials and auxiliary materials

Materials used, e.g. metals, elastomeric materials (e.g. pressure liquids, grease, coolant), shall be compatible with each other.

Pressure liquids shall be selected so that under the given operating conditions, leakage and its effects are minimised.

The composition of the liquids shall be so that it is not hazardous to the operating personnel of the winch.

If there is a possibility that the grease used can get into contact with the pressure liquid, it shall be compatible with the pressure liquid.

Elastomeric, polyamid, caoutchouc material is used for static and dynamic seals, flexible and semirigid lines and for coating several components (containers, reservoirs). These materials shall be compatible with the other materials of components and systems and shall withstand the system pressures.

5.11.3 Energy converters

5.11.3.1 Cylinders

The piston and the piston rod shall be connected to each other so that they cannot detach during operation.

Telescopic cylinders with two or more telescopic sections shall be such that the pistons cannot move out of the cylinders.

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The composition of the seals shall be selected so that they are compatible with the chemical composition of the fluid used and shall continuously withstand the given operating temperature, rated pressure and rated speed, without any impermissible leakage or extrusion.

If the strokes of cylinders are limited by mechanical limit stops, these shall be capable of withstanding all operational forces.

5.11.3.2 Motors

For motors whereby internal leakage cannot be avoided, there shall be a device to ensure that the load is not moved due to internal leakage. This requirement can be fulfilled for example by mechanical spring loaded brakes or by self locking gears.

In all circumstances the pressure to the motor shall not be less than 1 bar in order to avoid vacuum in the motor.

5.11.4 Connecting elements and accessories

5.11.4.1 Tubing

Tubing shall be secured so that impermissible additional load (pressure, bending, temperature) does not occur during operation, and wear and corrosion is minimized.

The connection to the energy converters shall be such that the transmission of vibration and noise is minimized.

5.11.4.2 Hoses

Hoses shall be fitted in such a way that no torsional strain occurs during assembling. The bending radius shall not be less than the bending radius specified by the hose manufacturer, and there shall not be contact with obstacles or adjacent components.

In order to avoid the risk of fatigue fracture of hoses, the installation requirements of the hose manufacturer shall be fulfilled.

5.11.4.3 Reservoir

The reservoir shall be equipped with a fluid-level gauge. The reservoir size shall be selected so that the fluid cannot overflow at all operating states.

The reservoir shall be located in the installation so that the necessary inflow into the pump is ensured.

The reservoir size shall be selected so that a sufficient fluid quantity within the permissible temperature range is available at all operating states.

Ventilation of the reservoir shall be provided, in order to avoid impermissible under pressure or over pressure.

5.11.4.4 Cooler/heating

If the permissible upper operating temperature cannot be kept in the circuit by the container, a cooler shall be provided. If the ambient temperature is lower than the lowest operating temperature, the manufacturer shall provide for possibilities by means of which the liquid can be heated up to the required temperature.

NOTE This can be achieved e.g. by warming up the system without load or by fitting a heater.

5.11.4.5 Accumulator

Accumulators are used for storing hydraulic energy, e.g. compressed gas. In this case, liquid and gas shall be separated by means of suitable separated elements. Nitrogen or other inert gases should be used as gas.

It shall be possible to close the accumulator by means of a valve in order to isolate the pressure supply from the installation, if required.

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5.11.4.6 Filters

Filters shall be provided in circuits where contamination continuously occurs.

Filters shall be equipped with a bypass for certain opening pressures, in order to keep the installation working in the case of clogging. An exception is specified in EN 982:1996, 5.3.7 for servo valves and proportional pressure-reducing valves. The flow through the bypass shall be indicated by a signal if the maintenance intervals do not exclude a hazardous condition.

5.11.5 Control devices/controls

Control devices shall be selected so that no pressure and flow disturbances can occur and their level of performance is kept.

Control devices shall be arranged in the control system so that no unwanted functions of the systems (by reaction or similar) can occur.

Control devices in control systems shall be selected and arranged in such a way that in the case of a control power failure switching positions are reached automatically, bringing the installation to a standstill.

Hydraulic cylinders for lifting movements shall be equipped with load holding valves to prevent lowering in the case of a pressure failure. The load holding valves shall be directly connected to the cylinders exclusively using metallic connecting elements. Hydraulic connections between the load holding valve and the cylinder or motor shall consist of steel tubing; flexible hoses shall not be used.

5.11.6 Protective measures

5.11.6.1 Emergency stop function

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The emergency stop function shall conform to EN 418 with the following deviations.

The emergency stop function shall correspond to stop category 0 in accordance with 4.1.5 of EN 418:1992.

The requirement in EN 418:1992, 4.1.12, in accordance with which the resetting of the "Emergency stop" shall not be permitted to initiate restarting does not apply for manually controlled winches in accordance with 5.2.1.

NOTE Restarting following resetting of the "Emergency stop" is excluded owing to the automatically resetting operating elements. No hazard occurs in the particular case of an internal error, since the hoist unit is hand controlled.

In case of indirect control the emergency stop function shall interrupt the main hydraulic circuit via an additional hydraulic valve, which is designed so, that sticking of the piston will not occur.

In case of direct control one of the following two requirements shall be fulfilled:

a) the emergency stop function shall interrupt directly the main hydraulic circuit, or

b) the actuating elements and the energy switching part of the hand control shall be positively connected. The positive locking shall be designed in a way that the energy switching part can be returned by hand to a stable neutral position.

Apart from that, no further emergency stopping devices are required.

5.11.6.2 Hydraulic protection

Hydraulic systems shall be protected against overpressure of the fluid and overspeed of the load. These protective devices shall act on the hydraulic circuits and elements so that the flow rate and pressure are limited to permissible values. In the case of a power failure, all movements shall be stopped.

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5.11.6.3 Mechanical protection

Hydraulic systems shall be arranged and/or covered in such a way that hazards for persons or objects are minimized.

5.11.6.4 Adjustable safety device

Those adjustable safety devices which can cause a hazardous situation, if their pre-set values are modified shall have means to prevent their readjustment by non-authorised persons.

External devices shall have visible means such as;

a) lead-seals;

b) covers;

c) cup,

which need to be destroyed before a readjustment can take place.

Visible means are not necessary, if special tools (i.e. not commercially available) specified by the manufacturer of the adjustable safety device, are necessary for readjustment.

5.11.6.5 Fire

Hydraulic systems shall be such that leaking fluid cannot cause a fire. Devices reaching higher temperatures when being operated (also electrical equipment through sparks or short circuit) shall be thermally separated from devices carrying oil by means of a suitable enclosure, in order to avoid ignition. Under these circumstances flame-retardant hydraulic liquid shall be used.

5.11.6.6 Explosion hazards

Hydraulic systems with chambers or hollows shall be equipped with aeration equipment, in order to prevent an explosion hazard. If hydraulic systems are used in environment with an explosion hazard, only flame-retardant hydraulic liquids shall be used.

5.12 Electrical equipment of winches

5.12.1 General

The electrical equipment of winches shall conform to EN 60204-32 with the following deviations.

5.12.2 Electrical supply

In addition to EN 60204-32:1998, 4.3.1, the following applies:

The winch shall be designed such that it operates reliably in the event of a voltage drop at the winch of up to 5 % between no-load operation and the peak current of the largest motor.

5.12.3 Ambient and operating conditions

5.12.3.1 Electromagnetic compatibility

Winches shall be in accordance with EN 60204-32:1998, 4.4.2.

5.12.3.2 Degree of protection of enclosures for outdoor application

The enclosures for electrical equipment, with exception of the motor, shall have at least a degree of protection IP 55 in accordance with EN 60529.

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The enclosure of the motor shall have a degree of protection of at least IP 54.

A suitable opening may be provided in the base of enclosures so that moisture due to condensation may drain away.

5.12.4 Supply disconnecting (isolating) and switching devices

Remark concerning the application of EN 60204-32:1998, 5.3. The electrical equipment of a winch shall contain devices for the following functions:

a) isolation of the electrical equipment from the mains power supply so that work may be performed without the risk of electric shock or burning;

b) switching-off in the event of emergency switching off or emergency stop.

NOTE The "isolation" function a) may be fulfilled by a crane-supply switch, a crane switch, or, as described in EN 60204-32:1998, 5.3.2, letter d), a plug/socket combination.

The crane-supply switch or crane switch shall meet the requirements of EN 60204-32:1998, 5.3.2 to 5.3.4, for the "Isolation" function.

The "Switching-off" function b) may be fulfilled by a crane switch in accordance with EN 60204-32:1998, 5.3.7.

5.12.5 Overload protection of motors

Winch motors specified in accordance with 5.12.8 require no protective measures in accordance with EN 60204-32:1998, 7.3.

5.12.6 Control circuits and control functions

With regard to 9.2.2 of EN 60204-32:1998, certain control systems (e.g. for converters) may have a short time delay before the supply power is removed, for ensuring that no additional hazard occurs.

5.12.7 Emergency stop function

Winches shall be provided with an emergency stop function in accordance with EN 60204-32.

For cable-less controls see EN 60204-32:1998, 9.2.7.3.

The requirement in EN 60204-32:1998, 9.2.5.4.2, in accordance with which the resetting of the "Emergency stop" shall not be permitted to initiate restarting does not apply for hand controlled winches in accordance with 5.2.1.

NOTE Restarting following resetting of the "Emergency stop" is excluded owing to the automatically resetting operating elements. No hazard occurs in the particular case of an internal error, since the winch unit is hand controlled.

A plug/socket device shall not be considered as emergency stop function.

5.12.8 Electric motors

5.12.8.1 General

Motors shall be selected in accordance with Annex J of EN 14492-2:2006, where applicable, with single-phase motors being excluded.

For single-phase motors the relevant calculation methods shall be used. The selection shall be in accordance with EN 60034-1.

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5.12.8.2 Failure of power supply

Electric winches shall incorporate features so that:

a) the load cannot lower in an uncontrolled manner if a phase should fail;

b) the load cannot drop if a phase should fail.

5.12.8.3 Mechanical limit speed, maximum permissible operating speed

5.12.8.3.1 Winch motors

A motor shall be selected so that the mechanical limit speed will not be reached within the foreseeable braking delay in the event of power loss. A motor for variable speed drive shall be selected so that the mechanical limit speed will not be exceeded in case of switching off by an overspeed protection during lowering with maximum speed and the appropriate load or in case of converter malfunction.

5.12.8.3.2 Three-phase slipring motors

The mechanical limit revolutions shall correspond at least to the values in Table 3 (at 50 Hz):

Table 3 — Limit revolutions for three-phase slipring motors

Synchronous revolutions	min^{-1}	3 000	1 500	1 000	750	600
Mechanical limit revolutions	min^{-1}	4 500	3 000	2 000	1 500	1 200
Recommended mechanical limit revolutions	min^{-1}			2 500	1 875	1 500

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5.12.8.4 Minimum motor stall torque for hoisting motions

5.12.8.4.1 Three phase slipring motors

Stall torques for three-phase slipring motors with contactor control relative to the rated winch motor torques M_n at S3 40 % (see EN 60034-1) shall reach the values given in Table 4:

Table 4 — Stall torques for three-phase slipring motors with contactor control

Frame size (IEC 60072-1) and revolutions	Winch motor stall torque at S3 40 % duty
For frame sizes 100 to 160, at 3 000 min^{-1}, 1 500 min^{-1} and 1 000 min^{-1}	at least $2{,}2 \times M_n$
For frame sizes 180 to 225, at 1 000 min^{-1} and 750 min^{-1}	at least $2{,}2 \times M_n$
For frame sizes 250 to 400, at 600 min^{-1}	at least $2{,}2 \times M_n$
For all other frame sizes and revolutions	at least $2{,}5 \times M_n$

5.12.8.4.2 Other motor types

The minimum motor stall torque shall prevent the fall of the load.

5.12.8.5 Slipring motors

With slipring motors an uncontrolled lowering of the load is possible particularly under the following conditions:

a) intentional or unintentional operation with a reverse current characteristic not matched to the load to be lowered;

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b) operation of the motor with an open rotor or unintentional interruption of the rotor circuit in which case the power supply is not interrupted immediately and therefore the brakes are not applied.

If it is not possible to exclude these possibilities, the winch equipment shall comprise

c) either devices that prevent start-up of the load or stop movement immediately as soon as the possible cause of uncontrolled lowering has been discovered; or

d) devices that stop the hoisting movement before the lowering speed reaches the maximum permissible limit speed specified in 5.12.8.3.2, Table 3.

See also provisions of 7.6 and 9.5 of EN 60204-32:1998.

5.12.9 Electric motion limiters

5.12.9.1 General

Electrical motion limiters shall be realised electromechanically, with a positive-opening function (definition as in 3.46 of EN 60204-32:1998), or they shall possess a comparable safety, for electronic systems at least category 2 of EN 954-1:1996.

5.12.9.2 Second limiter (back-up limiter)

Where for the switching off of a movement a second limiter is provided behind the first one, such a second limiter should have a different circuit from the first one and initiate a category 0 stop function in accordance with 9.2.2 of EN 60204-32:1998.

The requirements of 5.12.9.1 apply only to the second limiter. If an overriding device of the first limiter for test purposes is provided, this shall only be by means of a hold-to-run control device. Second limiters shall not have override facilities.

5.12.10 Temperature

The provision of 4.4.3 of EN 60204-32:1998 shall apply unless otherwise specified between the user and the supplier.

NOTE Beyond the temperature range given in 4.4.3 of EN 60204-32:1998 (0 °C to 40 °C), outdoor-winches may need a wider temperature range, such as – 20 °C to 55° C.

5.13 Reduction of noise by design

5.13.1 General

Noise is a significant hazard where the position of the operator is located in the vicinity of one or more of the noise sources mentioned in 5.13.2 and they have a:

a) high energy level and/or

b) high operating speed.

If noise constitutes a significant hazard, the design shall provide for a low noise level. In this case the recommended practice for the design of low-noise machinery and equipment according with EN ISO 11688-1 shall be taken into consideration.

NOTE EN ISO 11688-2 provides useful information on noise generation mechanisms in machinery.

5.13.2 Main noise sources on winch units

Main noise sources are:

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a) winch mechanisms (motor, gearbox, brake, chain, rope or belt drives);

b) control cabinets;

c) external devices, e.g. motor fans;

d) hydraulic pumps;

e) pneumatic drives.

5.13.3 Measures for noise reduction

Typical measures for noise reduction are:

a) selection of low-noise components;

b) use of flexible securing means which prevent the transmission of structure-borne sound between the components and the structure.

Other measures with identical or increased efficiency may be used.

5.13.4 Protective measures

A typical measure is the use of enclosures reducing noise around components with a high noise emission.

5.13.5 Information on noise

Information on residual risk shall be given to the user, see 7.2.

5.14 Winches for use in a potentially explosive atmosphere

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5.14.1 General

Winches intended for use in potentially explosive atmospheres shall be designed and constructed in accordance with good engineering practice and in conformity with the required categories for group II equipment of EN 13463-1 to ensure avoidance of any ignition sources as detailed in EN 1127-1. To classify the category of the non electrical equipment of the winch, it shall be subjected to an ignition hazard assessment in accordance with 5.2 of EN 13463-1,2001.

The following requirements shall be fulfilled; additional information is given in Annex B.

5.14.2 Electrical equipment of winches

Electrical equipment of winches which are intended for use in Zone 1 shall be at least Category 2 (see EN 1127-1, Annex B) and shall comply with the requirements of EN 60079-0. Where relevant, EN 60079-0 may be supplemented or modified by the following European Standards: EN 50015, EN 60079-2, EN 50017, EN 60079-1, EN 60079-7 and EN 50020, EN 60079-18, prEN 50039, as appropriate.

Electrical equipment of winches which are intended for use in Zone 2 shall be at least Category 3 (see EN 1127-1, Annex B) and shall comply with the requirements of EN 60079-0 and EN 60079-7.

5.14.3 Non-electrical equipment of winches

Non-electrical equipment of winches which are intended for use in a potentially explosive atmosphere shall comply with the requirements of EN 13463-1 and EN 13463-5 and, where relevant, with the selected European Standard for the specific type of ignition protection.

Category 3 equipment for use in zone 2 shall not contain any effective ignition source in normal operation.

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Category 2 equipment for use in zone 1 shall not contain any effective ignition source during foreseeable malfunctions or rare malfunctions.

5.14.4 Electrostatic discharge

Undesirable electrostatic discharges shall be avoided (see 7.4 of EN 13463-1:2001) by earthing and interconnecting all the metallic components of electrical and non-electrical equipment and surrounding metal parts.

NOTE Further information on this topic is given in the CENELEC report R044-001 "Safety of machinery -- Guidance and recommendations for the avoidance of hazards due to static electricity" which is prepared by CLC/TC 44x.

5.15 Additional requirements for vehicle recovery winches and winches on boat trailers

5.15.1 General

The following requirements apply additionally or by way of deviation from the requirements laid down in 5.1 to 5.14, as well as from all annexes.

5.15.2 Rated capacity limiter

Where the risk analysis reveals that there is no hazard of overloading the winch and its supporting structure when using it under the conditions intended by the manufacturer, there is no need to provide a rated capacity limiter. Conditions for this are that the load is prevented from running back and that a failure of the driving motor is excluded.

NOTE A rated capacity limiter is not necessary, if e.g. the limited driving power of the motor prevents overloading of the winch and the supporting structure.

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5.15.3 Motion limiters

Motion limiters are not required.

5.15.4 Freespooling clutches

Where engaging and disengaging clutches are used for the purpose of pulling out the hoist medium, these clutches should not be capable of being engaged and disengaged at a pulling force corresponding to 3 % of the maximum pulling force (resulting from the rated capacity of the winch).

As far as winches with multi-layer winding are concerned, it shall be taken into consideration that, as a rule, the rated capacity decreases with increasing number of rope layers; the lowest value of the rated capacity shall be taken into consideration.

5.15.5 Auxiliary brake

When for freespooling of the hoist medium the winch drive is put into idle mode, devices shall be provided which prevent an uncontrolled unwinding of the hoist medium.

5.15.6 Rope drives

Rope drives shall at least correspond to the conditions of 1) or 2):

1) the working coefficient for the first rope layer shall be at least 2. In this case, the working coefficient shall be determined from the ratio of the minimum breaking force of the rope and the maximum possible pulling force. The maximum possible pulling force results from the maximum motor torque respectively from the maximum force when the rated capacity limiter operates.

   The D/d ratio to the centre of the rope shall be at least:

   — 10 for drums;

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— 11,2 for sheaves;

2) the working coefficient for the first rope layer shall be at least 2.

NOTE The working coefficient is the ratio from the minimum breaking force and the rated tensile force indicated on the nameplate.

The D/d ratio to the centre of the rope shall be at least:

— 11,2 for drum;

— 12,5 for sheaves.

The rated capacity limiter shall ensure that the value of 1,2 times the static rated tensile force is not exceeded.

5.15.7 Electrical supply (battery)

The winch shall be designed in such a way that in case of a voltage drop at the electrical power supply the load is prevented from running back.

5.16 Additional requirements for forestry winches

5.16.1 General

The following requirements apply additionally or by way of deviation from the requirements laid down in 5.1 to 5.14, as well as from all annexes.

5.16.2 Lifting and lowering limiters

The risk analysis may show that either the lifting limiter or the lowering limiter or both are not necessary.

5.16.3 Braking device

If freespooling of the hoist medium is necessary, the braking device may be designed in such a way that it is capable of being arrested in the released position.

Where the load may get caught or jammed during the pushing operation, the winch may be provided with a hold-to-run control device for releasing the brake.

5.16.4 Auxiliary brake

If, for freespooling of the hoist medium, the winch drive is put into idle mode, devices shall be provided which prevent an uncontrolled unwinding of the hoist medium.

5.16.5 Ropes

The working coefficient for the first rope layer on the drum shall be at least 2.

NOTE The working coefficient is the ratio from the minimum breaking force of the rope and the maximum possible pulling force. The maximum possible pulling force results from the maximum motor torque or from the maximum force when the rated capacity limiter is operating, respectively.

5.16.6 Rope drum

Related to the rope axis, the ratio of drum diameter and rope diameter shall be at least 10.

Flanged drum end plates shall protrude beyond the rope wound on the drum at the last layer by at least 2 times the nominal rope diameter.

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5.16.7 Rope fastening onto the rope drum

Where the drum is equipped with a detachable rope fastening, this shall be designed in such a way that it detaches in case of a smaller pulling force resulting from 30 % of the rated capacity, when the rope is wound completely off the drum.

The device shall not detach accidentally when winding the rope off the drum by hand.

5.16.8 Rope end terminations

For forestry winches used for pulling on the ground, the following rope end terminations shall be used:

a) wire rope clamps made of aluminium wrought alloys according to EN 13411-3;

b) Flemish eye with aluminium wire rope clamp according to EN 13411-3.

5.16.9 Mechanical protection

The winch control station shall be located and/or safeguarded in such a way that whiplashing slings and hoist media respectively cannot cause injuries of persons.

5.17 Additional and deviating requirements for winches for pulling purposes

5.17.1 General

For winches for pulling purposes, exclusively the operating condition defined as pulling by 3.17 is considered intended use.

The following requirements apply additionally or by way of deviation from the requirements laid down in 5.1 to 5.14, as well as from all annexes, with the term "rated capacity" being replaced by "pulling force".

5.17.2 Rated capacity limiter

Where the risk analysis shows that the hazard of overloading the winch is not present under the conditions provided by the manufacturer, a rated capacity limiter is not required.

NOTE A rated capacity limiter is not required if e.g. due to the limited driving power of the motor it is not possible to overload the winch by 1,4 times the pulling force and if a failure of the drive motor is excluded.

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5.17.3 Motion limiters

Limiters for the end positions are not required.

NOTE A motion limiter is not required as due to the arrangement of the operating elements, the operator has the possibility to check the winding behaviour of the pulling medium and the pulling medium running into the box without any hindrance.

5.17.4 Free spooling clutch

Where, for the purpose of pulling out by hand the pulling medium, engaging and disengaging clutches are used, these should be secured against unintended operation. This requirement is considered fulfilled if

a) it is not possible to engage or disengage the clutch at a pulling force of more than 3 % of the pulling capacity or

b) if it is possible to secure both engagement positions with positively engaging means.

5.17.5 Auxiliary means for pulling out the pulling medium

If for the purpose of pulling out the pulling medium the drive is disconnected from the drum, devices or elements should be provided which prevent the pulling medium from uncontrolled unwinding.

NOTE For pulling out by hand the pulling medium, devices or elements should exist that have a braking effect on the drum (e.g. pressure roll).

5.17.6 Rope drives

Rope drives shall at least correspond to the conditions of 1) or 2):

1) the working coefficient for the first rope layer shall be at least 2. In this case, the working coefficient shall be determined from the ratio of the minimum breaking force of the rope and the maximum possible pulling force. The maximum possible pulling force results from the maximum force when the rated capacity limiter operates, if fitted, or from the maximum motor torque.

   The D/d ratio to the centre of the rope shall be at least:

   — 16 for drum;

   — 18 for sheaves;

2) the working coefficient for the first rope layer shall be at least 3.

   In this case, the working coefficient shall be determined from the ratio of the minimum breaking force of the rope and the rated pulling force at the middle layer.

   The D/d ratio to the centre of the rope shall be at least:

   — 16 for drum;

   — 18 for sheaves.

   The rated capacity limiter shall ensure that the value of 1,2 times the static rated tensile force is not exceeded.

6 Verification of the safety requirements and/or protective measures

6.1 Winches manufactured in series

Conformity with each safety requirement and/or measure (given in Clause 5) shall be verified by a type verification for the first sample of a series of winches of the same type (column 3 of Table 5) and by an individual verification

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for each winch of the series (column 4 of Table 5). Individual verification is carried out either during manufacture, assembly or commissioning.

6.2 Winches designed individually

Conformity with each safety requirement and/or measure (given in Clause 5) shall be verified for individually designed winches by the method of type verification in Table 5, column 3. Verification is carried out either during manufacturing, assembly or commissioning.

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Table 5 — Methods to be used to verify conformity with the safety requirements and/or measures

Sub-clause number	Requirement	Method of type verification	Method of individual verification
5.1	General	— check of calculation — dynamic test with 1,1 × rated capacity of the winch and static test with 1,25 × rated capacity of the winch to check the mechanical strength and check of calculation — function test, visual inspection	— dynamic test with 1,1 × rated capacity of the winch and static test with 1,25 × rated capacity of the winch to check the mechanical strength
		Testing procedures for verification of classification 1. General For the verification of the classification of a winch, the procedure described in Annex G of EN 14492-2:2006 shall be applied. Here, the requirements for the load in the testing procedure listed in 2. Load shall apply additionally or by way of deviation. 2. Load The whole test shall be carried out with a load condition corresponding to the rated capacity. For winches with multi-layer winding, it is admissible to take a mean of the load condition. From a winding of three rope layers onwards, the test may be carried out with a corresponding load increase in the first rope layer, if the calculation of the rope drum takes into account the multi-layer winding. For winches for pulling purposes, suspended or guided loads may be used	
5.2.1	Control devices	Function test, visual inspection	Function test, visual inspection
5.2.2.1	Rated capacity limiters – General	Test by submitting the winch to an overload condition and checking that the controls have been overridden (see EN 12077-2:1998, Clause 6)	Test by submitting the winch to an overload condition and checking that the controls have been overridden (see EN 12077-2:1998, Clause 6)

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Table 5 (*continued*)

Sub-clause number	Requirement	Method of type verification	Method of individual verification
5.2.2.2	Setting	Test by increasing the load to confirm that the factors ϕ_{DAL} or α of the rated capacity limiter are within the tolerance specified by the manufacturer and are not outside the maximum value in accordance with 5.2.2.2.2 or 5.2.2.2.3 at any speed specified by the manufacturer	Test by increasing the load to confirm that the factors ϕ_{DAL} or α of the rated capacity limiter are within the tolerance specified by the manufacturer and are not outside the maximum value in accordance with 5.2.2.2.2 or 5.2.2.2.3 at any speed specified by the manufacturer
5.2.2.4	Additional requirements for friction torque limiters	Test with rated capacity of the winch to confirm that the friction torque limiter satisfy the requirements after hoisting movement stopped by the housing of the winch	Test with rated capacity of the winch to confirm that the friction torque limiter satisfy the requirements after hoisting movement stopped by the housing of the winch
5.2.3	Emergency stop function	Function test, visual inspection	Function test, visual inspection
5.2.4	Lifting and lowering limiters	Function test	Function test
5.2.5	Categories of controls	Check of design Check of the documentation Function test	Function test
5.3	Couplings	Visual inspection	–
5.4	Brakes for lifting and lowering movements	Dynamic test with 1,1 ×rated capacity of the winch Visual inspection	Dynamic test with 1,1 × rated capacity of the winch Visual inspection
5.5	Gearbox	See 5.1	–
5.6	Load hooks	Visual inspection	Visual inspection
5.7.1	Rope drives – General	Visual inspection Check of calculation	Visual inspection
5.7.2	Rope drum	Visual inspection Measurement	Visual inspection
5.7.3	Ropes	Check of test certificate Visual inspection	Check of test certificate Visual inspection
5.7.4	Rope sheaves	Visual inspection Measurement	Visual inspection

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Table 5 (*continued*)

Sub-clause number	Requirement	Method of type verification	Method of individual verification
5.7.5	Rope guides/rope runs	Visual inspection	Visual inspection
5.7.6	Rope fastening onto the rope drum	Check of calculation Visual inspection	Visual inspection
5.7.7	Rope anchorage	Visual inspection Check of calculation	Visual inspection
5.7.8	Rope end terminations	Visual inspection	Visual inspection
5.7.9	Traction winches	— Check of calculation — visual inspection — check traction by dynamic test with 1,5 × the rated capacity	Visual inspection
5.8.1	Chain drives – General	Check of calculation Visual inspection	Visual inspection
5.8.2	Chains	Check of test certificate Visual inspection	Check of test certificate Visual inspection
5.8.3	Chain guides	Visual inspection	Visual inspection
5.8.4	Chain anchorage	Check of calculation Visual inspection	Visual inspection
5.8.5	Securing the chain from running off	Visual inspection Dynamic test with 1,1 × rated capacity of the winch	Visual inspection
5.9.1	Belt drives – General	Visual inspection	Visual inspection
5.9.2	Belts	Check of test certificate	Check of test certificate
5.9.3	Belt guide/belt pulleys/belt drum	Check of calculation Measurement	–
5.9.4	Fastening to the drum	Visual inspection Check of calculation	Visual inspection

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Table 5 (*continued*)

Sub-clause number	Requirement	Method of type verification	Method of individual verification
5.9.5	Belt anchorage	Visual inspection Check of calculation	Visual inspection
5.10.1	Pneumatic equipment – General Design equipment to conform to EN 983	Check of documentation and calculation, visual inspection	–
	Air pressure	Test that the winch is always able to hold a suspended load equal to the rated capacity of the winch when it is started up at — 90 % — 80 % — 70 % — 60 % of the rated pressure	–
5.10.2.1	Energy transformers –Motors	Function test	–
5.10.2.2	Brakes	Test as in 5.10.1	–
5.10.3	Control devices/controls	Check of the documentation Function test	Function test
5.10.4	Control units/control systems	Check of the documentation Function test Visual inspection	Function test
5.10.5.1	Protective measures – Emergency stop function	Function test, visual inspection	Function test, visual inspection
5.10.5.2	Pneumatic protection	Function test	–
5.10.5.3	Mechanical protection	Function test	Visual inspection
5.10.5.4	Adjustable safety device	Visual inspection	Visual inspection

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Table 5 (*continued*)

Sub-clause number	Requirement	Method of type verification	Method of individual verification
5.11.1	Hydraulic equipment General	Check of the documentation and calculation, visual inspection	Visual inspection
5.11.2	Materials and auxiliary materials	Check of the documentation and calculation Visual inspection	Visual inspection
5.11.3	Energy converters	Dynamic load test with 1,1 × the rated capacity of the winch at maximum permissible hydraulic pressure Function test Visual inspection	Function test Visual inspection
5.11.4	Connecting elements and accessories	Check of the documentation Function test Visual inspection	Visual inspection
5.11.5	Control devices/controls	Check of design Function test	Function test
5.11.6.1	Protective measures – Emergency stop function	Function test Visual inspection	Function test Visual inspection
5.11.6.2	Hydraulic protection	Check of the flow diagram	Function test
5.11.6.3	Mechanical protection	Check of the documentation	Visual inspection
5.11.6.4	Adjustable safety device	Function test	–
5.11.6.5	Fire	Visual inspection	–
5.11.6.6	Explosion hazards	Check of documentation Visual inspection	–

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Table 5 (*continued*)

Sub-clause number	Requirement	Method of type verification	Method of individual verification
5.12.1	Electrical equipment of winches - General	— Visual inspection — Verification that the electrical equipment is in compliance with the technical documentation — Continuity of the protective bonding circuit (see 19.2 of EN 60204-32:1998) — Insulation resistance tests (see 19.3 of EN 60204-32:1998) — Function tests (see 19.4 of EN 60204-32:1998)	— Visual inspection — Continuity of the protective bonding circuit (see 19.2 of EN 60204-32:1998) — insulation resistance tests (see 19.3 of EN 60204-32:1998) — function tests (see 19.4 of EN 60204-32:1998)
5.12.2	Electrical supply	Test: Start-up of the winch motor for the lifting motion with rated capacity of the winch at 0,85 of the rated voltage	–
5.12.3.1	Ambient and operating conditions - Electromagnetic compatibility	Either test: — Immunity to interference in accordance with EN 61000-6-2 — Emissions in accordance with EN 61000-6-4 or to the intended operating environments e.g. EN 61000-6-3 or: — Check of documentation for winches constructed of only EMC-certified electrical and electronic components	Visual inspection EMC conformity declaration
5.12.3.2	Degree of protection of enclosures for outdoor application	EN 60529	EN 60529
5.12.4	Supply disconnecting (isolating) and switching devices	Check of circuit diagrams and selection of the equipment	Visual inspection of the electrical circuit diagrams and equipment of the winch mechanism
5.12.5	Overload protection of motors	Check of the calculation	–
5.12.6	Control circuits and control functions	Check of design Check of the documentation Function test	Function test
5.12.7	Emergency stop function	Function test, visual inspection	Function test see also check for 5.2.3 Visual inspection

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Table 5 (*continued*)

Sub-clause number	Requirement	Method of type verification	Method of individual verification
5.12.8.1	Electric motors General	Check of the calculation	–
5.12.8.2	Failure of power supply	Test with rated capacity of the winch by interrupting a phase	–
5.12.9	Electric motion limiters	Check of documentation Function test	Function test
5.12.10	Temperature	Check of documentation	–
5.13	Reduction of noise by design	Check of documentation Measurements in accordance with Annex F	–
5.14	Winches for use in a potentially explosive atmosphere	Check of calculation	–
5.15.4	Freespooling clutches	Function test	Function test
5.15.5	Auxiliary brake	Function test	Function test
5.15.6	Rope drive	Check of the calculation	–
5.15.7	Electric supply (battery)	Function test	Function test
5.16.3	Braking device	Visual inspection Function test	Visual inspection Function test
5.16.4	Auxiliary brake	Function test	Function test
5.16.5	Ropes	Check of the calculation	–
5.16.6	Rope drum	Check of the calculation	–
5.16.7	Rope fastening onto the rope drum	Function test	–
5.16.8	Rope end terminations	Visual inspection	Visual inspection
5.16.9	Mechanical protection	Visual inspection	Visual inspection
5.17.2	Rated capacity limiter	Function test Check of calculation	Function test

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Table 5 (*continued*)

Sub-clause number	Requirement	Method of type verification	Method of individual verification
5.17.3	Motion limiters	Function test	–
5.17.4	Free spooling clutch	Function test Check of calculation	Function test
5.17.5	Auxiliary means for pulling out the pulling medium	Function test	Function test
5.17.6	Rope drives	Check of calculation	–

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7 User information

7.1 General

NOTE Reference is made to Clause 5 of EN ISO 12100-2:2003.

The manufacturer shall provide operating instructions containing information and instructions for the commissioning, use, regular tests and inspections and maintenance of the winch mechanism. Information for use of the machine shall be provided in accordance with Clause 6 of EN ISO 12100-1:2003.

7.2 Special requirements

The operating instructions shall describe the type of the winch with clear reference to the present winch.

The use for which the winch mechanism is intended shall be clearly described. The admissible scope of use of the winch (lifting, pulling, etc. of loads) shall be clearly described. This shall also contain design limitations, e.g. the theoretical duration of service. The measures to be taken when the winch mechanism has reached the end of its theoretical duration of service shall be described in accordance with ISO 12482-1.

Information regarding the utilisation of the hoisting and lowering limiter during normal operation and periodical inspection shall be given.

Optional features of the winch, e.g. devices for lowering the load in the event of a power failure, shall be described.

If a second limiter is required referring to 5.2.4.2 and this limiter is a friction torque limiter, the inspection of the function of the first limiter shall be described in the handbook.

The operating instructions shall always include the following instructions:

a) the necessary training for the operating personnel shall be described;

b) the user shall ensure that the operating personnel are given the necessary training;

c) the operator shall always work in compliance with the operating instructions;

d) the user shall initiate movements of the load with the lowest available speed. The rope (chain, belt) shall be tightened and shall not be in the slack-condition when the load movement begins;

e) it is forbidden to move loads above the rated capacity of the winch;

f) do not try to move fixed or obstructed loads;

g) with winches for lifting and lowering suspended loads, side-pull of load is not allowed;

h) excessive inching (e.g. giving short pulses to the motor) shall be avoided;

i) ban on transporting persons.

All maintenance and repair work required to ensure the safe functioning of the winch mechanism shall be described, e.g.:

j) lubrication of ropes, chains, gearboxes, bearings, hooks etc.;

k) inspection of wearing parts such as ropes, chains, hooks, belts and brake linings. Specification of test and inspection intervals and discard criteria;

l) operating principle of safety devices and requirements in the event that these devices are triggered, e. g., resetting the emergency stop device;

m) information shall be given how to verify the proper function of the limiters.

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n) measures to avoid possible damage of the winch in case if the phase sequence is incorrect, shall be given in the user information.

The following information shall be provided, if necessary:

— limitations for operation, e.g. setting down the load when in the vicinity of the upper hook position.

For pneumatic and hydraulic winches the following data shall be provided in the user information regarding the supply of pressurised fluid:

— pressure;

— flow;

— quality.

Regarding noise the following information shall be given:

o) if the value of the A-weighted emission sound pressure level at the operator position is lower than 70 dB, this fact shall be indicated;

p) if the value of the A-weighted emission sound pressure level at the operator position exceeds 70 dB, this value shall be stated;

q) if the value of the A-weighted emission sound pressure level at the operator position exceeds 85 dB, the A-weighted sound power level shall be stated;

r) for construction winches, the A-weighted sound power level shall always be stated;

s) the measurement procedure and detailed operating conditions during noise emission measurements shall be stated;

t) a recommendation for operators and servicemen to wear hearing protection when the winch is used in a noisy environment or the A-weighted emission sound pressure level due to the winch is high at the operator´s position.

The manufacturer shall provide information how to check and to set the rated capacity limiter. Setting and checking of the rated capacity limiter shall be done in accordance with the instructions of the manufacturer by competent persons only. He shall request from these competent persons, to document the test result in the logbook.

For the installation and use of the winch in supporting structures the manufacturer shall provide those information which enables the designer of the supporting structure to take into account the static and dynamic maximum forces which may occur during operation of the rated capacity limiter of the winch. Information to be provided (see 5.2.2):

In case of direct acting rated capacity limiters:

ϕ_{DAL}: force-limit factor.

In case of indirect acting rated capacity limiters:

α: triggering-factor;

C_{med} rigidity of the hoisting medium (rope or chain or belt);

Δt_{IAL} time lapse after attaining load level $\alpha \cdot m_{RC}$ to when actual motion braking commences [s];

Δt_{bt} motion braking time affected by the combined hoist medium tension and brake torque [s].

Also $F_{max,L}$ in accordance with 5.2.2.3 shall be provided.

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7.3 Marking

Marking shall be in accordance with EN 12644-2.

Every winch shall be provided with the following information in a lasting and easily legible manner on a part which can be removed only by using tools:

1) name and address of the manufacturer;

2) the prescribed marking [1];

3) type designation;

4) serial number

5) year of construction;

6) explosion proof class, if applicable;

7) rated capacity or the pulling force shall be specified on the nameplate. The user shall be able to clearly recognize the rated capacity or pulling force. In case of winches with multi-layer winding, the specifications for the first and last rope layer shall also be specified on the nameplate;

8) group of mechanisms;

9) rope/chain: ident number of the manufacturer or information concerning the load bearing means, i.e.
for ropes: minimum breaking force, maximum diameter, maximum number of winding layers;
for chains: diameter, pitch and grade;
for belts: material, tensile strength (breaking force), dimensions, operating limit temperatures.

10) characteristics of the power supply;

11) rated hoisting speed.

In addition, vehicle recovery winches and winches on boat trailers shall be provided with the following information in a lasting and easily legible manner on a part which cannot be removed: "This winch shall only be used for vehicle recovery or for pulling and lowering boats off trailers."

Where, due to special constraints, it is not possible to mark the winch with the information listed above, a minimum marking shall be provided which allows a clear relation of the winch to the instructions for use containing this information.

---

1) For machines and associated products which are intended to be placed on the market within the EEA, CE marking in accordance with the relevant European directives, e.g. Machinery Directive, Low Voltage Directive.

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Annex A
(informative)

Examples of winches

A.1 Drum winches

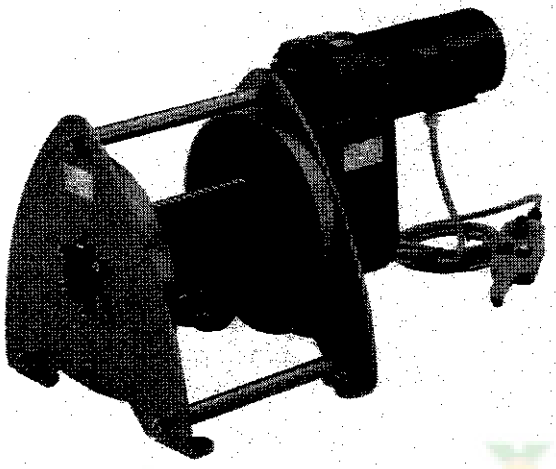

Figure A.1.1 — Drum winch, manufactured in series

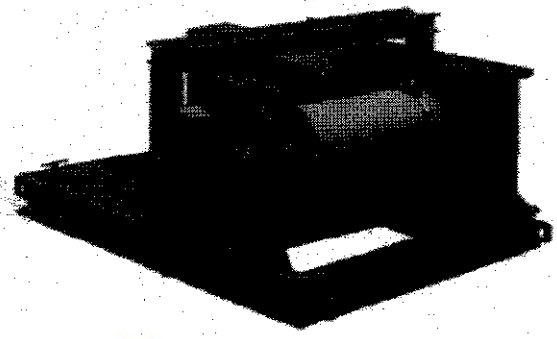

Figure 1.2 — Drum winch, manufactured individually

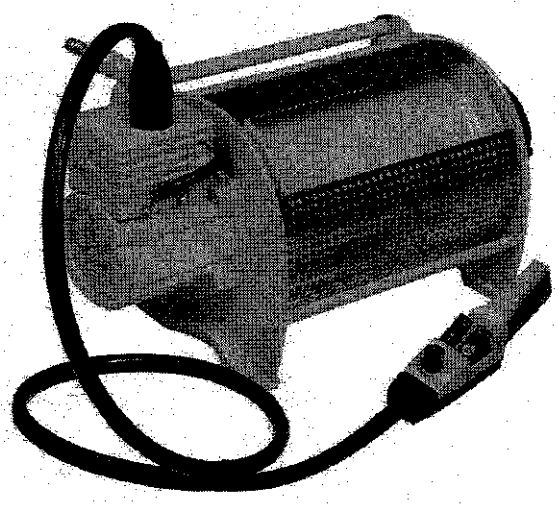

Figure A.1.3 — Drum winch, pneumatically driven

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A.2 Traction winches

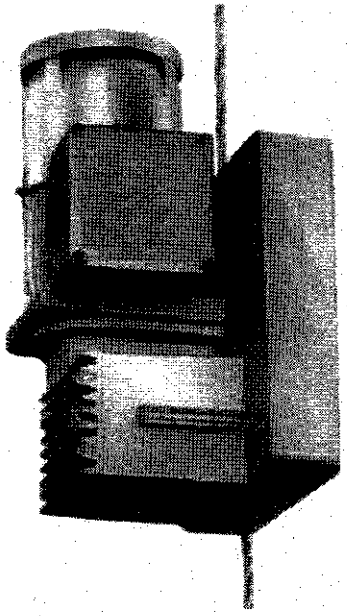

Figure A.2.1 — Traction winch, standard type

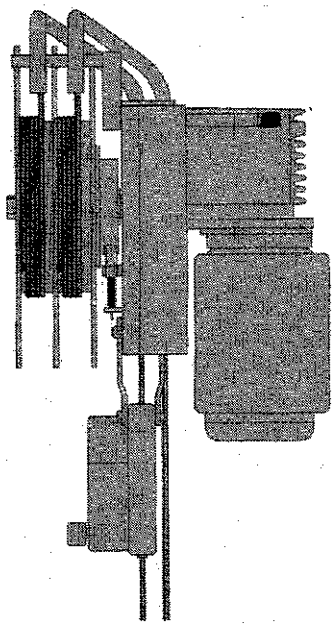

Figure A.2.2 — Traction winch with 2 load bearing ropes and storage drum

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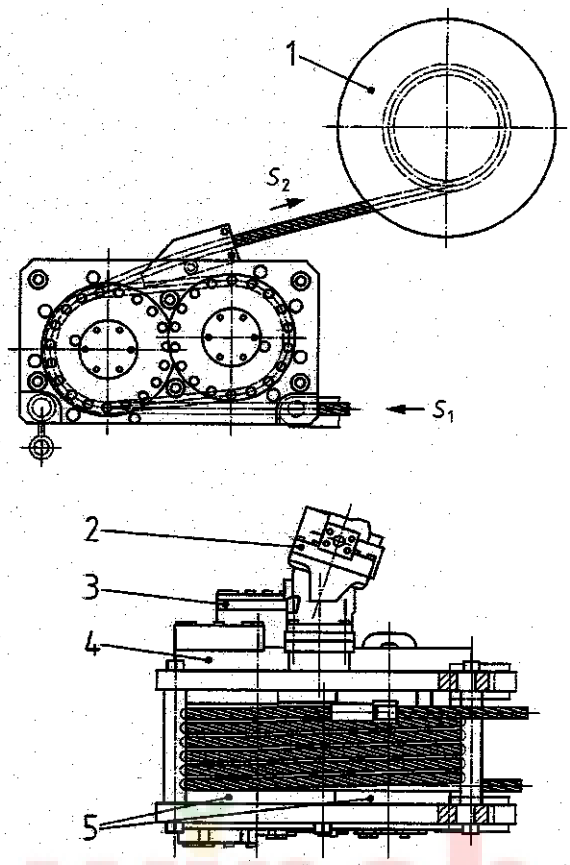

Key

1	generation of the tension force by driven storage drum	4	gear
2	motor	5	drum heads
3	brake	S_1	rope exit to the load

Figure A.2.3 — Traction winch with storage drum

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A.3 Vehicle recovery winches

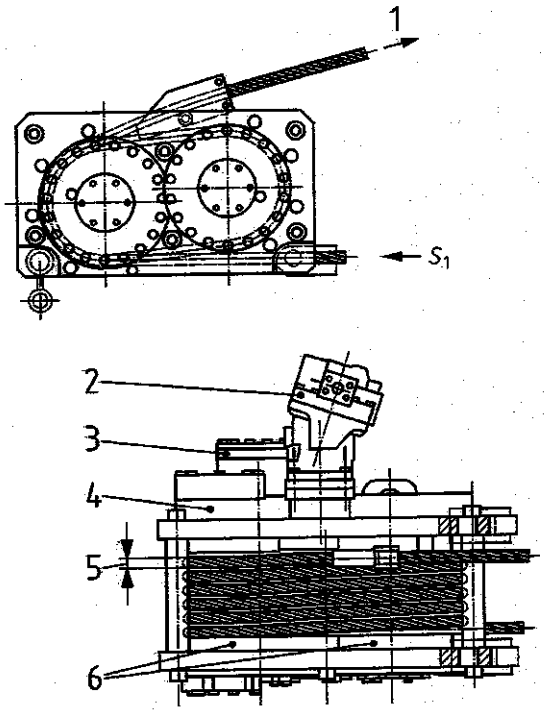

Figure A.3.1 — Vehicle recovery winch with electrical drive

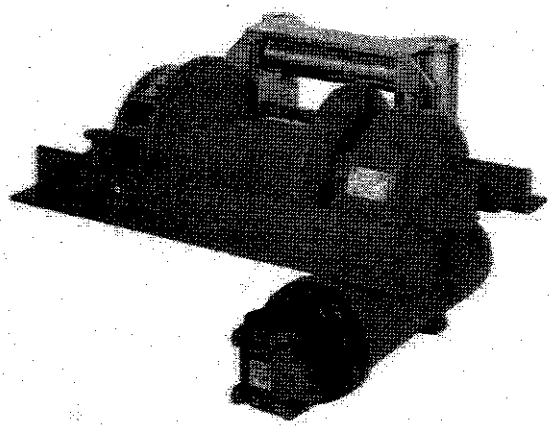

Figure A.3.2 — Vehicle recovery winch with hydraulic drive

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A.4 Winches for boat trailers

Figure A.4 — Winch for boat trailers with electrical drive

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A.5 Forestry winches

Figure A.5. — Forestry winch with rope drum and hydraulic drive

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Annex B
(informative)

Additional requirements for winches intended to be used in potentially explosive atmospheres

B.1 Introduction

Explosion hazards can occur when the concentration of the flammable substances in air exceeds the lower explosion limit and if an effective ignition source is present.

Examples of flammable substances which increase concentration above the normal:

— solvent vapours from the flash-off process;

— gases from fuels and/or product by the combustion of the heating system;

— gases released from deposits;

— combustible heating gases;

— solvent vapours from any leakage from broken pipes or fittings;

— cleaning fluids;

— solvent vapours from recirculation process.

Examples of ignition sources are:

— hot surfaces e.g. of heating systems and electrical equipment;

— sparks created by mechanical induced energy, e.g. fans, conveyors;

— electrostatic discharges;

— electrical sparks;

— welding and other sources of thermal energy used during maintenance and cleaning.

B.2 General

Where winches are intended for use in hazardous areas EN 1127-1 specifies methods for the identification of hazardous situations that may lead to an explosion. It details the design and construction measures to achieve the required safety. It includes the relationship between categories and zones and the applicable equipment in the different zones.

Information on the control and classification of hazardous places for gases and vapours by the use of ventilation is given in EN 60079-10.

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B.3 Hazard sources in explosion hazard areas

B.3.1 Electrically caused hazards

a) Elimination of hazards caused by electrical sparks, e.g. in the case of connecting parts, installations, switchgear, equipotential bonding (refer also to EN 60079-0, EN 60079-1, EN 60079-7).

b) Elimination of build-up of hazardous electrostatic charges, e.g. in the case of plastic enclosures, insulating material, equipotential bonding (refer also to EN 60079-0, EN 60079-7).

c) Elimination of hazards caused by build-up of electrostatic charges, e.g. in the case of fans made of plastic, components made of plastic with turning or sliding movements (refer also to EN 60079-0).

B.3.2 Mechanically caused hazards

a) Elimination of hazards caused by mechanically generated sparks, e.g. by swaying load handling attachments; friction producing large amounts of energy on rollers, wheels, clutches, brakes; impacts; sparks caused by impacts while maintenance work is being carried out; impact sparks in the case of fans (refer also to EN 60079-0, EN 1127-1 as well as recommendations by expert authorities). The risk of hazards may be reduced by selecting appropriate materials. Soft materials which tend to yield are favourable. Copper, beryllium bronze and stainless steels are preferred. Hard steels, aluminium and magnesium as well as rusty parts should be avoided. Brakes and clutches should include an appropriate lining material and/or be protected in a suitable way. Striking or scraping of rotating parts against stationary parts should be prevented by an appropriate safety distance.

b) Elimination of hazards caused by hot surfaces, e.g. in the case of bearing points such as friction bearings and sliding bearings; guide arrangements, friction on rollers, wheels, clutches and brakes (refer also to EN 1127-1 as well as recommendations by expert authorities). In addition to a low-friction design, measures should also be taken by selecting appropriate materials and types of protection and the scraping of rotating parts against stationary parts should be avoided.

c) Elimination of hazards caused by build-up of electrostatic charges, e.g. in the case of fans made of plastic, components made of plastic with turning or sliding movements (refer also to EN 60079-0). In addition to the maximum permissible surface resistance of 1 GΩ, consideration should also be given to the size and shape of the parts as well as to a maximum circumferential speed not exceeding 50 m/s, e.g. in the case of fans.

B.3.3 Hazards caused by environmental conditions

a) Enclosures should feature sufficient protection against the ingress of hazardous quantities of dust and water. (Refer also to EN 60079-0, EN 60079-7).

b) Components which serve explosion protection purposes should be protected from damage caused by corrosion by means of sufficient corrosion protection (for example, by greasing with acid-free grease, by protective measures to cover against dust and moisture, by selecting appropriate materials.).

c) Measures should be taken to prevent hazards in the case of impermissible high or low ambient temperatures. The permissible ambient temperatures should be specified on the data plate. Protection against high temperatures may be provided by shielding measures and temperature monitoring measures as permitted by the relevant regulations. Low temperatures (lower than – 20 °C) may be avoided by heating, e.g. with resistances. Attention shall be given to ensure designs are compliant with explosion protection standards in C.2.

d) The permissible installation height above sea level is limited to 1 000 m. At greater heights, the over-temperature limit value of the components should be reduced or the maximum permissible ambient temperature shall be reduced.

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B.3.4 Measures to eliminate hazards in explosion hazard areas

Hazards should be eliminated by means of structural design and selection of materials. In this respect, the existing CEN Standards shall be considered and recommendations of test and inspection authorities and expert bodies shall be observed. Since test and inspection obligations do not exist for all hazard classes, the manufacturer should exercise great care.

The owner shall be responsible for assigning the zones (Zone 0, Zone 1, Zone 2 or Zone 20, Zone 21, Zone 22) and correct selection of the equipment (temperature class, gas group, equipment category). He may be advised by third parties (explosion-proof equipment manufacturers, authorities).

B.3.5 Marking

In addition to 7.3 the following markings apply:

— specification of the test office;

— specification of the test number;

— specifications relating to the explosion-proof design (types of enclosure, temperature classes, explosion-proof group);

— manufacturer, test symbol as well as date;

— serial number;

— the "Ex" symbol.

B.4 User information

Qualified and/or expert persons shall be employed for maintenance and repair work, for regular inspections as well as for operating winch mechanisms.

Damage caused by environmental influences, inappropriate operating conditions and malfunctions shall be rectified immediately.

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Annex C
(informative)

Additional requirements for operation in aggressive environments and outdoors

C.1 General

Provision should be applied with respect to the definition and classification of corrosivity environment as per ISO 9223.

When problems relating to operation in aggressive environments and the outdoors raise questions, the following standards may be usefully consulted for specific needs or applications:

EN ISO 8044:1999, *Corrosion of metals and alloys — Basic terms and definitions (ISO 8044:1999)*

EN ISO 8565:1995, *Metals and alloys — Atmospheric corrosion testing — General requirements for field tests (ISO 8565:1992)*

ISO 8407:1991, *Corrosion of metals and alloys — Removal of corrosion products from compression test specimens*

ISO 9223:1992, *Corrosion of metals and alloys — Corrosivity of atmospheres — Classification*

ISO 9224:1992, *Corrosion of metals and alloys — Corrosivity of atmospheres — Guiding values for corrosivity categories*

ISO 9225:1992, *Corrosion of metals and alloys — Corrosivity of atmospheres — Measurement of pollution*

ISO 9226:1992, *Corrosion of metals and alloys — Corrosivity of atmospheres — Determination of corrosion rate of standard specimens for the evaluation of corrosivity*

C.2 Ropes and chains

On request, the manufacturers of ropes and chains should supply all information for selection, protection, inspection, maintenance and discard criteria for them, when used in specific aggressive environments and outdoors.

General considerations are needed for specific areas: structures, electric equipment and motors, electric cables, copper terminals etc.

The following examples of corrosion may be taken in respect of various situations in aggressive environments:

a) Structures:

   — selection of materials in relation of the temperatures;

   — special considerations for marine environment applications;

b) electric equipment and motors:

   — in case of tropical climatic conditions with sensitive dampness, treatment against moisture and fungosity should be provided;

   — various coatings may be used to provide protection against corrosion, for insulation purposes etc.;

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— motor protection may include cover for dripping, grade "F" for minimum insulation, heating anti-condensation (motor > 1 kW), minimum mechanical protection IP 55 in accordance with EN 60529;

c) electric cables:

— environmental conditions have a marked influence on the selection of electric cables, particularly with regard to the type of sheaths. Consideration shall be given also to the material raceways;

d) copper ends of cables and other similar parts of electrical equipment require specific protection when they operate in the presence of ammonia and acetylene.

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Annex D
(informative)

Additional requirements for operation at low temperatures

As to winches for use at low temperatures, attention is drawn to the following, for example:

— suitability of materials for load-bearing components;

— suitability of lubricants;

— suitability of the welding process;

— icing of the motors, brakes and switchgear;

— tendency of the seals to become brittle;

— tendency of the cables and insulation to become brittle;

— tendency of the plastics to become brittle;

— corrosion as a result of dew forming;

— suitability of ropes, chains and belts;

— compliance with relevant standards and regulations;

— test of the complete series winch mechanism under the specified operating conditions, as required.

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Annex E
(informative)

Documents for hooks

Documents for consideration:

a) Design system 1:

DIN 15400, *Lifting hooks, mechanical properties, load capacities, stresses and materials*

or

b) Design system 2:

UNI 9465, *Lifting hooks for lifting appliances — Mechanical properties — Lifting capacities, stresses and materials*

NOTE Although Annex E is an informative annex, the standards of the 2 systems should not be mixed.

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Annex F
(normative)

Noise test code

F.1 Scope

This noise test code specifies all the information necessary to carry out efficiently and under standardized conditions the determination, declaration and verification of the noise emission characteristics of power driven winches.

Noise emission characteristics include emission sound pressure levels and the sound power level. The determination of these quantities is necessary for:

— manufacturers to declare the noise emitted;

— comparing the noise emitted by machines in the family concerned;

— purposes of noise control at the source at the design stage.

The use of this noise test code ensures reproducibility of the determination of the noise emission characteristics within specified limits determined by the grade of accuracy of the basic noise measurement method used. Noise measurement methods allowed by this European Standard are engineering methods (grade 2).

The C-weighted peak emission sound pressure levels of winches usually have such a low value that it is not necessary to measure and to declare them.

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F.2 Standards used in this annex

EN ISO 3744, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane (ISO 3744:1994)*

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

EN ISO 11201, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Engineering method in an essentially free field over a reflecting plane*

F.3 Description of the machine family

This annex applies to winches within the scope of this European Standard.

F.4 Determination of the emission sound pressure level at the operator´s position by measurement

F.4.1 General

The A-weighted emission sound pressure levels shall be measured in accordance with EN ISO 11201.

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The test cycles and measurements shall be repeated at least three times, the test result being the arithmetic average value. This average value shall be the A-weighted emission sound pressure level to be declared together with the location at a distance of 1 m where it has been determined.

F.4.2 Winches other than construction winches

NOTE 1 These are winches within the scope of this European Standard, with the exception of construction winches.

Winches are erected separately but sometimes also integrated into machines. Therefore, when winches are integrated into machines, the location of the operator is unknown when manufacturing the winch. Thus, the A-weighted emission sound pressure level shall be measured at a distance of 1 m from the main noise source of the winch.

NOTE 2 The emission sound pressure level at the operators position which is normally at a distance other than 1 m, can be determined in accordance with the following equation, after the winch has been integrated in the installation which is operated in a building of usual structural design:

$$L_{Pr} = L_{P1} - 10\lg\left(\frac{d_r}{d_1}\right) \qquad \text{(F.1)}$$

where

L_{P1} is the sound pressure level measured at a distance of d_1 = 1 m from the source of sound;

L_{Pr} is the sound pressure level to be determined at a distance of d_r from the source of sound.

The Equation (F.1) above results in a reduction of the A-weighted sound pressure level by 3 dB with doubled distance. This empirical value takes structural influences into account for normal enclosed areas, e.g. the reflection of sound waves from walls.

F.5 Determination of the sound power level

F.5.1 General

As basic noise emission measurement standard EN ISO 3744 shall be used, with exception of the microphone positions.

F.5.2 Winches other than construction winches

NOTE 1 These are winches within the scope of this European Standard, with the exception of construction winches.

The A-weighted emission sound pressure level at the location of the operator is usually below 85 dB. Therefore, this noise test code does not deal with the determination of the sound power level for winches other than construction winches.

However, if it is necessary to determine the sound power level, this shall be done in accordance with EN ISO 3744, i.e.

$$L_W = L_{pf} + 10\lg\left(\frac{2\,\pi\,r^2}{S_0}\right) \qquad \text{(F.2)}$$

where

L_W is the sound power level [dB];

L_{pf} is the average A-weighted emission sound pressure level on the measurement surface (hemisphere) [dB];

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S_0 is 1 [m²];

r is the radius of the hemisphere (distance of the microphone from the main noise source of the winch, (see F.4.2) [m].

NOTE 2 It may be necessary to state the sound power level, if the sound pressure level at the location of the operator is determined for the entire installation in which the winch unit is integrated.

F.5.3 Construction winches

NOTE Construction winches are defined in Directive 2000/14/EC Annex I cl. 12. "Construction winch: A power-operated, temporarily installed lifting appliance which is equipped with means for raising and lowering a suspended load."

For construction winches, the largest dimension does not exceed 8 m. Therefore, the measurement surface of the microphone positions shall be a hemisphere and there shall be six microphone positions.

The locations of the 6 microphone positions distributed on the surface of a hemisphere of radius r are listed in the form of Cartesian coordinates in Table F.1. The radius r of the hemisphere shall be equal to or greater than twice the largest dimension of the reference parallelepiped. The reference parallelepiped is defined as the smallest possible rectangular parallelepiped just enclosing the construction winch and terminating on the reflecting plane. The radius of the hemisphere shall be rounded to the nearest higher of the following values: 4 m or 8 m.

Table F.1 — Coordinates of the 6 microphone positions

Microphone number	x/r	y/r	z (m)
1	+ 0,70	+ 0,70	1,50
2	- 0,70	+ 0,70	1,50
3	- 0,70	- 0,70	1,50
4	+ 0,70	- 0,70	1,50
5	- 0,27	+ 0,65	0,71 r
6	+ 0,27	- 0,65	0,71 r

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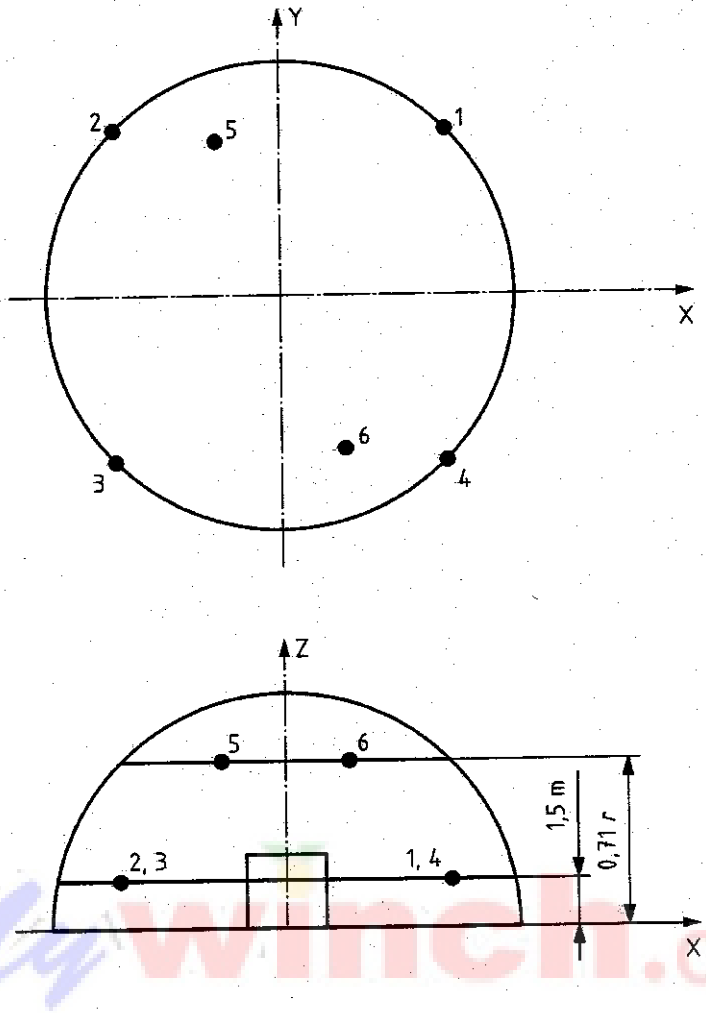

Key

r Radius of the hemisphere

Figure F.1 — Microphone positions on the hemisphere

The influence of the environment shall be corrected by:

$$K_{2A} = 0 \tag{F.3}$$

where

K_{2A} is the environmental correction factor (see EN ISO 3744:1995, 8.4) [dB].

The surface sound pressure level shall be determined at least three times. If at least two of the determined values do not differ by more than 1 dB, further measurements will not be necessary; otherwise the measurements shall be continued until two values differing by no more than 1 dB are obtained. The A-weighted surface sound pressure level to be used for calculating the sound power level is the arithmetic mean of the two highest values that do not differ by more than 1 dB.

F.6 Mounting and operating conditions

F.6.1 General

The mounting and operating conditions shall be the same for the determination of both, the emission sound pressure level and the sound power level.

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The winch shall be warmed up in accordance with the instructions before the noise measurement commences. Safety requirements shall be observed.

F.6.2 Winches other than construction winches

The test cycles during measurement shall represent the normal application, i.e. lifting the load at the maximum speed appropriately defined for the suspended load. These test conditions include all relevant noise sources of the winch unit.

When determining the emission sound pressure level at the operator´s position in order to minimize the test effort it is sufficient to measure the noise at a single microphone position.

The load handled during the test cycles shall be close to the rated capacity, with the following exception. For winch units with a reeving (e.g. 2/1, 4/1), the measurement may be carried out with a smaller reeving and a correspondingly smaller load instead of the reeving provided for the rated capacity. This means for example, that with a rated capacity of 40 t with 4/1 reeving, the measurement may also be carried out with a load of 10 t with 1/1 reeving.

F.6.3 Construction winches

The test shall be carried out with the construction winch installed in a stationary position. For the purpose of the test, the lifting speed shall be no less than the rated lifting speed and the lowering speed shall be no less than the rated lowering speed.

The winch shall be mounted on a reflecting surface of concrete or non-porous asphalt. The geometrical centre of the lifting equipment shall be positioned above the centre of the hemisphere; the winch shall be connected but no load shall be applied.

The frequency of the supply current, specified for the motor by the manufacturer, shall be stable at plus or minus 1 Hz.

The operating conditions during the test shall be actuating the drum movement clockwise and anti-clockwise with the higher speed foreseen by the manufacturer; the hook shall be free of load. The period of observation shall at least be 15 s.

F.7 Uncertainties

At the present point of time no technical data are available to determine the standard deviation of the reproducibility for the machine family covered by this annex. Therefore the values specified in the basic standards for noise emission may be considered as upper limits which can be used to determine uncertainty K when preparing the noise declaration. Investigations which require the effort of all manufacturers are necessary to determine possible lower values for the standard deviation of the reproducibility resulting in low values of uncertainty K. The results of such investigations will be reflected in future versions of this European Standard.

F.8 Information to be recorded

The information to be recorded is that required by EN ISO 11201:1995, Clause 12, and, if the sound power level is determined, by EN ISO 3744:1995, Clause 9.

Details of the operating conditions during the determination of noise emission shall be recorded, including the speed used and the corresponding net power.

F.9 Information to be reported

The information to be given in the test report is that required by EN ISO 11201:1995, Clause 13, and, if the sound power level is determined, by EN ISO 3744:1995, Clause 10.

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Details of the operating conditions during the determination of noise emission shall be reported, including the speed used and the corresponding net power.

F.10 Declaration and verification of noise emission values

The noise emission quantities to be declared are those listed in Clause 7.

Noise emission values shall be declared in accordance with EN ISO 4871.

The declaration shall have a single-number format (see EN ISO 4871) i.e. the values measured in accordance with F.4 and F.5 and the uncertainty K as described in F.7 shall be declared separately.

If verification is carried out, this shall be done using the same test conditions as those used for the initial test.

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Annex G
(informative)

Selection of a suitable set of cranes standards for a given application

Is there a product standard in the following list that suits the application?	
EN 13000:2004	Cranes — Mobile cranes
prEN 14439 :2002	Cranes — Safety - Tower cranes
prEN 14985 :2004	Cranes — Slewing jib cranes
prEN 15011:2004	Cranes — Bridge and gantry cranes
EN 15056:2006	Cranes — Requirements for container handling spreaders
EN 13852-1:2004	Cranes — Offshore cranes — Part 1: General-purpose offshore cranes
EN 13852-2:2004	Cranes — Offshore cranes — Part 2: Floating cranes
EN 14492-1:2006	Cranes — Power driven winches and hoists — Part 1: Power driven winches
EN 14492-2:2006	Cranes — Power driven winches and hoists — Part 2: Power driven hoists
EN 12999:2002	Cranes — Loader cranes
EN 13157:2004	Cranes — Hand powered lifting cranes
EN 13155:2003	Cranes — Non-fixed load lifting attachments
EN 14238:2004	Cranes — Manually controlled load manipulating devices

YES

Use it directly, plus the standards that are referred to

NO

Use the following:	
EN 13001-1:2004	Cranes — General design — Part 1: General principles and requirements
EN 13001-2:2004	Cranes — General design — Part 2: Load actions
CEN/TS 13001-3-1: 2004	Cranes — General design — Part 3.1: Limit states and proof of competence of steel structures
CEN/TS 13001-3-2: 2004	Cranes — General design — Part 3.2: Limit states and proof of competence of wire ropes in reeving systems
EN 13135-1:2003	Cranes — Safety — Design — Requirements for equipment — Part 1: Electrotechnical equipment
EN 13135-2:2004	Cranes — Equipment — Part 2: Non-electrotechnical equipment
EN 13557:2003	Cranes — Controls and control stations
EN 12077-2:1998	Cranes safety — Requirements for health and safety — Part 2: Limiting and indicating devices
EN 13586:2004	Cranes — Access
EN 14502-1:2005	Cranes — Equipment for lifting persons — Part 1: Suspended baskets
EN 14502-2:2005	Cranes — Equipment for the lifting of persons — Part 2: Elevating control stations
EN 12644-1:2001	Cranes — Information for use and testing — Part 1: Instructions
EN 12644-2:2000	Cranes — Information for use and testing — Part 1: Marking

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Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 98/37/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive Machinery 98/37/EC, amended by 98/79/EC.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

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Annex ZB
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 94/9/EC

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