BRITISH STANDARD

BS EN
14492-1:2006
+A1:2009
Incorporating corrigendum March 2010

Cranes — Power driven winches and hoists —

Part 1: Power driven winches

ICS 53.020.20

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British Standards

Full document details: BS EN 14492-1:2006+A1:2009

National foreword

This British Standard is the UK implementation of EN 14492-1:2006+A1:2009, incorporating corrigendum March 2010. It supersedes BS EN 14492-1:2006 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by [A1] ⟨A1].

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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 subcommittee can be obtained on request to its secretary.

EN 14492-1:2009 is a "harmonized" European Standard and fully takes into account the requirements of the following European Commission mandates given under the EU Machinery Directive (98/37/EEC), and it is intended to lead to CE marking:

— 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.

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

The UK Committee would like to inform users 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.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2008

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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 and includes Amendment 1 approved by CEN on 6 August 2009.

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Foreword

This document (EN 14492-1:2006+A1:2009) 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 April 2010, and conflicting national standards shall be withdrawn at the latest by April 2010.

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

This document includes Amendment 1, approved by CEN on 2009-08-06.

This document supersedes EN 14492-1:2006.

The start and finish of text introduced or altered by amendment is indicated in the text by tags ⟦A1⟩ ⟨A1⟧.

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).

⟦A1⟩ For relationship with EU Directive(s), see informative Annexes ZA, ZB and ZC which are integral parts of this document. ⟨A1⟧

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, Bulgaria, 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

〚A1〛 This European standard is a harmonized standard to provide one means for power driven winches to conform to the essential health and safety requirements of the Machinery Directive 98/37/EC and the Machinery Directive 2006/42/EC. 〚A1〛

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.

〚AC1〉 *deleted text* 〈AC1〛

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)*

〚A1〉 *deleted text* 〈A1〛

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)*

A1 EN ISO 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849:2006)* A1

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*

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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*

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 β - α or β + α (see Figure 1)

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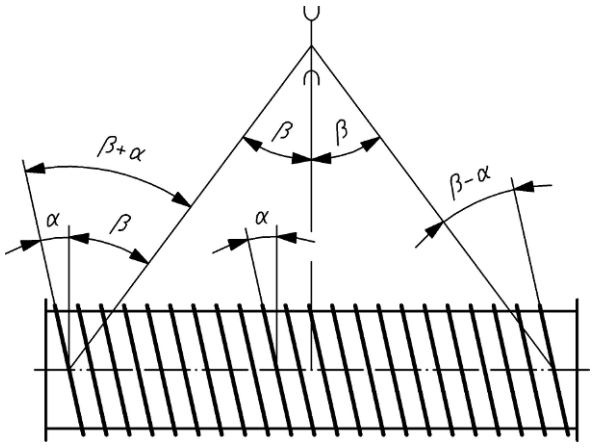

Key

β = fleet angle on the pulley

β - α or β + α = 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.

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.

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.

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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 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.) ⟨A1⟩ 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, using pictograms (symbols), where appropriate. ⟨A1⟩

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 125 % greater than the rated capacity of the winch, it 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:

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

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

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:

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

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

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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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