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Cranes — Light crane systems

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National foreword

This British Standard is the UK implementation of EN 16851:2017.

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Krane - Leichtkransysteme

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Contents

Page

European foreword

This document (EN 16851:2017) 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of an identical text or by endorsement, at the latest by July 2017, and conflicting national standards shall be withdrawn at the latest by July 2017.

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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 Annex ZA, which is an integral part of this document.

For relationship with other European Standards for cranes, see Annex D.

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, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

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

This European Standard has been prepared to provide one means for equipment of cranes to conform to the essential health and safety requirements of the Machinery Directive.

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document (see Clause 1).

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

1 Scope

This European Standard applies to:

— light crane systems, either suspended or free-standing systems;

— pillar jib cranes;

— wall-mounted jib crane.

NOTE 1 For illustration of crane types, see Annex B.

NOTE 2 The rated capacity of the light crane systems is generally below 10 t, but the standard is still applicable, if the rated capacity is higher.

This European Standard is applicable to cranes and crane systems, whose structures are made of steel or aluminium, excluding aluminium structures containing welded joints.

This European Standard is not applicable to cranes covered by another product specific crane standard, e.g. EN 15011 or EN 14985.

This European Standard gives requirements for all significant hazards, hazardous situations and events relevant to cranes, when used as intended and under conditions foreseen by the manufacturer (see Clause 4).

The specific hazards due to potentially explosive atmospheres, ionizing radiation, operation in electromagnetic fields beyond the range of EN 61000-6-2 and operation in pharmacy or food industry are not covered by this European Standard.

This European Standard does not include requirements for the lifting of persons.

This European Standard is applicable to cranes, which are manufactured after the date of approval by CEN of this European Standard.

2 Normative references

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

EN 349, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

EN 515, *Aluminium and aluminium alloys - Wrought products - Temper designations*

EN 614-1, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

EN 755-9, *Aluminium and aluminium alloys - Extruded rod/bar, tube and profiles - Part 9: Profiles, tolerances on dimensions and form*

EN 795, *Personal fall protection equipment - Anchor devices*

EN 894-1, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 1: General principles for human interactions with displays and control actuators*

EN 894-2, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 2: Displays*

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

EN 12644-1, *Cranes — Information for use and testing — Part 1: Instructions*

EN 13001-1, *Cranes - General design - Part 1: General principles and requirements*

EN 13001-2, *Crane safety - General design - Part 2: Load actions*

EN 13001-3-1, *Cranes — General Design — Part 3-1: Limit States and proof competence of steel structure*

EN 13001-3-2, *Cranes - General design - Part 3-2: Limit states and proof of competence of wire ropes in reeving systems*

EN 13001-3-3, *Cranes - General design - Part 3-3: Limit states and proof of competence of wheel/rail contacts*

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

EN 13135, *Cranes - Safety - Design - Requirements for equipment*

EN 13157, *Cranes — Safety — Hand powered cranes*

EN 13557:2003+A2:2008, *Cranes - Controls and control stations*

EN 13586, *Cranes — Access*

EN 14238, *Cranes — Manually controlled load manipulating devices*

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

EN 15011, *Cranes — Bridge and gantry cranes*

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

EN ISO 3744:2010, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane (ISO 3744:2010)*

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

EN ISO 11201, *Acoustics - Noise emitted by machinery and equipment - Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections (ISO 11201)*

EN ISO 11202:2010, *Acoustics - Noise emitted by machinery and equipment - Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections (ISO 11202:2010)*

EN ISO 11203:2009, *Acoustics - Noise emitted by machinery and equipment - Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level (ISO 11203:1995)*

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

EN ISO 12100:2010, *Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)*

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

EN ISO 13857, *Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857)*

EN ISO 14120, *Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards (ISO 14120)*

ISO 3864 (all parts), *Graphical symbols — Safety colours and safety signs*

ISO 4306-1, *Cranes — Vocabulary — Part 1: General*

ISO 4309, *Cranes — Wire ropes — Care and maintenance, inspection and discard*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4306-1, EN ISO 3744 and the following apply.

3.1
light crane system
assembly of lifting devices, bridges, trolleys and tracks with their suspensions for lifting operations

3.2
bridge
beam carrying lifting device(s) and supported on trolleys running on tracks

Note 1 to entry: Wording of the definition differs from that given in ISO 4306-1.

3.3
track
stationary beam on which a bridge or lifting device(s) are running

Note 1 to entry: Characteristic for tracks in light crane systems is that a track can be removed from the supporting building structures without influence on strength of the supporting structures.

3.4
suspension
necessary clamps, hanger rods and other fittings from which a track is suspended from a building or other supporting structure

3.5
monorail
track on which lifting devices or trolleys are running

Note 1 to entry: Monorail together with lifting device is a particular type of a light crane system.

3.6
jib crane
crane operating in a fixed position, equipped with a slewing jib and lifting device(s)

3.7
free-standing system
floor-mounted light crane system

Note 1 to entry: A free-standing system can be supported by the surrounding structures using bracings.

Note 2 to entry: Characteristic for a free-standing system is that it can be removed from the supporting building structures without influence on strength of the supporting structures.

Note 3 to entry: For an example of free-standing system see Figure B.4.

3.8
trolley
wheel assembly running on a track or on a bridge and supporting a bridge or lifting device

Note 1 to entry: Definition differs from that specified in ISO 4306-1.

3.9
loading/unloading station
arrangement enabling a piece of track to be lowered down and lifted up together with the lifting device or trolley

3.10
turntable
component able to rotate in a horizontal plane and containing a piece of track, enabling the lifting device or trolley to change from one track to another

3.11
switch
component enabling the lifting device or trolley to change from one track to another

3.12
interlock
mechanism aligning a moving bridge with a stationary track or aligning two bridges and keeping this aligned connection steady for lifting device or trolley to move through the connection

4 List of significant hazards

Table 1 contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this European Standard, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

Table 1 — List of significant hazards and associated requirements

No.	Type or group	Origin (sources)	Subclauses of this European Standard
1	**Mechanical hazards**		
1.1	**Hazards generated by machine parts or work pieces, e.g. by:**		
1.1.1		Relative location	5.4.3, 5.4.5, 5.4.6, 5.4.7, 5.4.8, 5.4.10, 5.7.3, Clause 6, 7.2
1.1.2		Mass and stability	5.1, 5.2, 5.3, 5.4.1, 5.4.2, 5.4.3, 5.4.4, 5.4.6, 5.4.7, 5.4.8, 5.4.9, 5.4.10, Clause 6, 7.2, 7.4
1.1.3		Mass and velocity	5.1, 5.2, 5.3, 5.4.1, 5.4.2, 5.4.3, 5.4.10, 5.5, 5.7.3, Clause 6, 7.2
1.1.4		Inadequacy of mechanical strength	5.1, 5.2, 5.3, 5.4.1, 5.4.2, 5.4.3, 5.4.4, 5.4.6, 5.4.7, 5.4.9, 5.4.10, Clause 6, 7.1, 7.4
1.2	**Accumulation of energy inside the machinery, e.g. by:**		
1.2.1		Fluids under pressure	5.4.11, Clause 6, 7.1, 7.2
1.3	**Elementary forms of mechanical hazards:**		
1.3.1		Crushing	5.7.3, 7.1
1.3.2		Shearing	5.1, 5.7.3, 7.1
1.3.3		Cutting or severing	5.7.3, 7.1
1.3.4		Drawing-in or trapping hazard - moving transmission parts	5.7.3, 7.1
1.3.5		Impact	5.7.3, 7.1, 7.2
1.3.6		High pressure fluid injection or ejection hazard	5.4.11, 5.7.3, 7.1

No.	Type or group	Origin (sources)	Subclauses of this European Standard
2	**Electrical hazards due to:**		
2.1		Contact of persons with live parts (direct contact)	5.4.11, 5.7.3, 7.2
2.2		Contact of persons with parts which have become live under faulty conditions (indirect contact)	5.1
2.3		Approach to live parts under high voltage	5.4.11, 5.7.3, 7.2
2.5		Thermal radiation or other phenomena such as the projection of molten particles and chemical effects from short-circuits, overloads, etc.	5.1
3	**Thermal hazards, resulting in:**		
3.1		burns and scalds, by possible contact of persons with objects or materials with an extreme temperature, by flames, by radiation, etc.	5.7.3, 7.3
4	**Hazards generated by noise, resulting in:**		
4.1		Hearing losses	5.7.5
4.2		Interference with speech communication, signals	7.3.1
5	**Hazards generated by vibration**		
5.1		Whole body vibration, particularly when combined with poor postures	
6	**Radiation**		
6.1		External radiation	5.1
7	**Processed materials and substances, used materials, fuels**		
7.1		Hazards from contact with harmful fluids, gases, mists, fumes and dusts	7.1
7.2		Fire or explosion hazard	Clause 1, 7.1
8	**Neglected ergonomic principles in machine design, e.g. hazards from:**		
8.1		Unhealthy postures or excessive efforts	5.1, 5.7.3

No.	Type or group	Origin (sources)	Subclauses of this European Standard
8.2		Inadequate consideration of hand-arm or foot-leg anatomy	5.7.3
8.3		Neglected use of personal protection equipment	5.7.3, 5.7.5, 7.2, 7.3
8.4		Inadequate local lighting	5.7.4
8.6		Human errors, human behaviour	5.7.1, 7.2, 7.3
8.7		Inadequate design, location or identification of manual controls	5.1, 5.7.1
8.8		Inadequate design or location of visual display units	5.7.1, 5.8.4
9	**Unexpected start-up, unexpected overrun/over speed (or any similar malfunction) from:**		
9.1		Failure/disorder of control systems	5.1, Clause 6, 5.9
9.2		Other external influences (gravity, wind, etc.)	7.2
9.3		Errors in the software	Clause 6, 5.9
9.4		Errors made by the operator (due to mismatch of machinery with human characteristics and abilities, see hazard N° 8.6)	5.7.1, 5.7.2, 7.2, 7.3
10		**Impossibility of stopping the machine in the best possible conditions**	5.7.1, 5.7.2, 7.2
11		**Failure of the power supply**	5.4.11
12		Failure of the control circuit	5.1, 5.7.1, 5.9
13	**Break-up during operation**		
13.1		Thermal effect on the crane	Clause 7
14		Falling or ejected object or fluid	5.1, 5.4.4, 5.4.5, 5.4.6, 5.4.7, 5.4.8, 5.4.9, 5.4.10, 5.7.3.4, Clause 6
15		Loss of stability / overturning of machinery	5.4.9, Clause 6, 7.4
16		Slip, trip and falling of persons (related to machinery)	5.7.2
17	**Hazards relating to the travelling function**		
17.1		Movement without an operator at the driving position	5.1, 5.7.2, 5.9

No.	Type or group	Origin (sources)	Subclauses of this European Standard
17.2		Excessive speed of pedestrian controlled machinery	5.7.2, 5.9
17.3		Excessive oscillations when moving	5.7.2, 7.2
17.4		Insufficient ability of machinery to be slowed down, stopped and immobilized	5.4.10, 5.7.2, Clause 6
17.5		From derailment due to travelling	5.4.1, 5.4.5, 5.4.6, 5.4.7, 5.4.9
18	**Linked to the work position (including driving station) on the machine**		
18.1		Fall of persons during access to (or at/from) the work position	5.7.3, 5.7.4
18.2		Mechanical hazards at the work position	5.7.3, 7.1, 7.2
18.3		Insufficient visibility from the working position	5.7.4
18.4		Inadequate lighting	5.7.4
18.5		Inadequate seating	5.7.1
18.6		Noise at the driving position	5.7.5
18.7		Vibration at the driving position	5.7.1
19	**Due to the control system**		
19.1		Inadequate location of controls /control devices	5.1, 5.7.1, 5.7.2
19.2		Inadequate design of the actuation mode and/or action mode of controls	5.1, 5.7.1
20		**From handling the machine (lack of stability)**	5.5
21	**From/to third persons**		
21.1		Unauthorized start-up/use	7.3
21.2		Drift of a part away from its stopping position	5.4.11
21.3		Lack or inadequacy of visual or acoustic warning means	5.8
22	**Insufficient instructions for the driver / operator**		
22.1		Movement into prohibited area	5.8, 7.2, 7.3
22.2		Tipping - Swinging	7.2, 7.3

No.	Type or group	Origin (sources)	Subclauses of this European Standard
22.3		Collision: machines-machine	5.4.10, 5.5, 5.6, 5.8, 7.2, 7.3
22.4		Collision: machines-persons	7.2, 7.3
22.5		Ground conditions	7.3
22.6		Supporting conditions	7.3
23	**Mechanical hazards and events**		
23.1	**From load falls, collision, machine tipping caused by:**		
23.1.1		Lack of stability	5.1, 5.4.2, 5.4.8, 5.6, 7.2, 7.3, 7.4
23.1.2		Uncontrolled loading - overloading – overturning moment exceeded	5.1, 5.4.8, 5.4.9, 5.6, 5.8, 5.9, Clause 6, 7.2, 7.3
23.1.3		Uncontrolled amplitude of movements	5.1, 5.6, 7.2, 7.3
23.1.4		Unexpected/unintended movement of loads	5.1, 5.4.8, 5.4.10, Clause 6, 7.2, 7.3
23.1.5		Inadequate holding devices / accessories	5.1, Clause 6, 7.2, 7.3
23.1.6		Collision of more than one machine	5.5, 5.6, 7.2, 7.3
23.1.7		Two-block of hook to hoist	5.5, 5.6, 7.2, 7.3, 5.9
23.2		From access of persons to load support	7.2, 7.3
23.3		From derailment	5.4.1, 5.4.3, 5.4.5, 5.4.6, 5.4.7, 5.4.9
23.4		From insufficient mechanical strength of parts Loss of mechanical strength, or inadequate mechanical strength	5.1, 5.2, 5.3, 5.4.1, 5.4.2, 5.4.4, 5.4.5, 5.4.6, 5.4.7, 5.4.10, 5.6, Clause 6, 7.4
23.5		From inadequate design of pulleys, drums	5.1, Clause 6
23.6		From inadequate selection/ integration into the machine of chains, ropes, lifting accessories	5.1, Clause 6, 7.2, 7.3
23.7		From abnormal conditions of assembly / testing / use / maintenance	5.4.10, Clause 6, 7.2, 7.3
23.8		Load-person interference (impact by load)	7.2, 7.3
29	**Hazards generated by neglecting ergonomic principles**		
29.1		Insufficient visibility from the driving position	5.7.1, 5.8.4

5 Safety requirements and/or protective measures

5.1 General

Light crane systems and jib cranes shall comply with the safety requirements and/or protective measures of Clause 5. In addition, these cranes shall be designed according to the principles of EN ISO 12100 for relevant but not significant hazards, which are not dealt with by this European Standard.

The service conditions that are selected and used as the basis of design, in accordance with EN 13001-1 and EN 13001-2 shall be specified in the technical file of the crane. The design duty (classification) shall be specified in terms of classes U and Q with the average distances of movements. See Annex A for guidance and examples of classification of typical applications.

Light crane systems and jib cranes shall be in accordance with EN 13135, e.g. design of electrical equipment and design for high-risk applications.

Machinery included in light crane systems and jib cranes shall be in accordance with the following European Standards as applicable:

— EN 14492-2;

— EN 14238;

— EN 13157.

Proof of competence calculations shall be in accordance with EN 13001 series as applicable, i.e.

— EN 13001-1, duty classes and limit state method in general;

— EN 13001-2, loads and load combinations;

— EN 13001-3-1, structures;

— EN 13001-3-2, ropes;

— EN 13001-3-3, wheel/rail contact;

— EN 13001-3-5, forged hooks.

Local stresses in wheel supporting flanges shall be calculated in accordance with EN 15011.

For aluminium structures, see additional requirements in 5.2.

Sharp edges shall be deburred in order to avoid injury during erection. A proper corrosion protection of the crane tracks and components should be applied according to the intended use of the crane.

All connections shall be secured, so that they cannot get loose and wear of parts shall not lead to any risk of load drop or other dangerous situation.

The design and the installation shall be such as to ensure that uncontrolled movements are avoided. The crane shall be designed so that the operator is able to control all movements at all times.

Where hand powered trolleys or bridges are used, the force needed to move the trolley or bridge shall not exceed 200 N.

5.2 Aluminium structures

5.2.1 General

The proof of competence shall follow the methodology given in EN 13001-3-1 with the changes and setting of design parameters as specified in 5.2. The yield stress f_y shall be taken as the 0,2 % proportional limit f_o specified for aluminium.

5.2.2 Products and materials

European Standards specify materials and their specific values. For structural members made of aluminium, materials in accordance with the following European Standards should be used:

— extruded products: EN 755-1 and EN 755-2.

Table 2 shows a preferred selection of materials for extruded products in accordance with the EN 755 series. Where those materials are used, the design values for strength (f_y, f_u) shall be those listed in Table 2. The values are applicable for temperatures up to 80 °C. For more information, see the specific European Standard.

Grades and qualities other than those mentioned in the above European Standards and in Table 2 may be used if the mechanical properties and the chemical composition are specified in a manner corresponding to the relevant European Standard, and if the following conditions are fulfilled:

— the design value of f_y is limited to $f_u/1,1$ for materials with $f_u / f_y < 1,1$;

— the percentage elongation at fracture A ≥ 7 % on a gauge length $L_0 = 5,65 \times \sqrt{S_0}$ (where S_0 is the original cross-sectional area);

— temper conditions shall be specified and defined in accordance with EN 515.

Table 2 — Design values of material strength in accordance with EN 755–2

Alloy	Temper	Thickness t	Design strength	
			f_y yield	f_u ultimate
		mm	N/mm²	N/mm²
EN AW-6060	T5	$t \leq 25$	100	140
	T6	$t \leq 15$	140	170
	T64	$t \leq 15$	120	180
	T66	$t \leq 25$	150	195
EN AW-6061	T4	$t \leq 25$	110	180
	T6	$t \leq 25$	240	260
EN AW-6063	T5	$t \leq 25$	110	160
	T6	$t \leq 25$	160	195
	T66	$t \leq 10$	200	245
	T66	$10 < t \leq 25$	180	225
EN AW-6005A	T6	$10 < t \leq 25$	200	250
EN AW-6106	T6	$t \leq 10$	200	250
EN AW-7020	T6	$t \leq 15$	290	350
		$15 < t \leq 40$	275	350
Temper designations: refer to EN 515.				

5.2.3 Proof of static strength

For calculation of the limit design stress in structural members (i.e. excluding bolted and pin connections), the general resistance factor shall be set to $\gamma_m = 1{,}1$, and the specific resistance factor for all types of materials and directions of stresses shall be set to $\gamma_{sm} = 1$.

5.2.4 Proof of fatigue strength

Characteristic fatigue strength $\Delta\sigma_c$ shall be taken in accordance with Table 3. The slope constant shall be set to m = 7.

Where a member has a detail with geometric form to cause local stress concentration, the nominal stress in the member shall be increased with the relevant stress concentration factor, when applied to the proof of fatigue strength. Such details are e.g. holes in a member or stepped discontinuities with edges perpendicular to the direction of normal stress.

Table 3 — Characteristic fatigue strength of aluminium structures

Description	Yield stress f_y N/mm²	Characteristic fatigue strength $\Delta\sigma_c$ N/mm²
Non-welded structural member under normal stresses		
- all tempers	$100 \leq f_y \leq 200$	63
- without geometric notch effects	$200 < f_y \leq 290$	71

5.2.5 Proof of elastic stability

The material parameter values shall be set as follows:

— modulus of elasticity E = 70 000 N/mm²;

— Poisson's ratio ν = 0,3.

Dimensional tolerances of extruded structural members shall conform to EN 755-9.

5.3 Actions on supporting structures

Actions on supporting structures shall be given in technical documentation in accordance with Annex B.

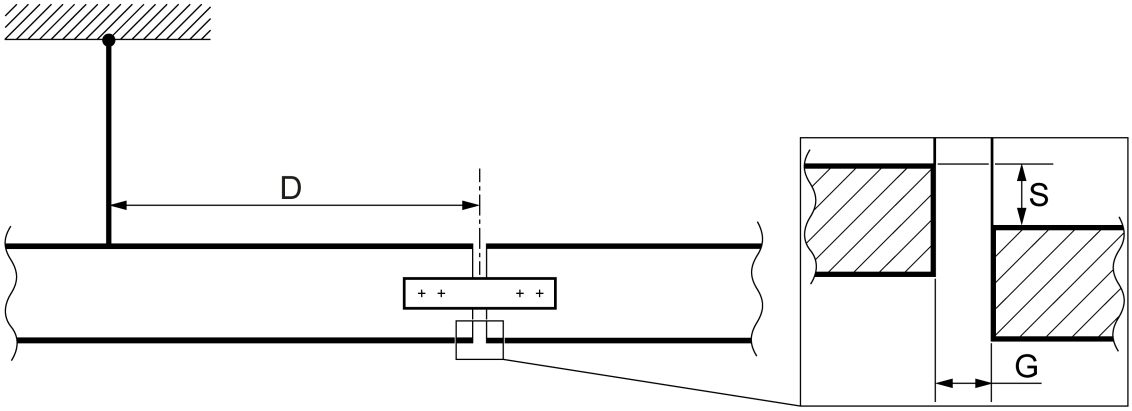
5.4 General components

5.4.1 Joints in crane tracks, crane bridges and monorails

Joints shall ensure specified alignment of the connected parts and the continuity of the rolling surface of trolleys.

Joints shall be designed for the maximum forces induced on the joint. The shocks against the end stops, the buffers or any other dynamic loading shall be taken into account. If other means are not provided to prevent the joint from opening during operation, then the joint shall be designed such it cannot open, e.g. by means of positive locking.

The allowable distance between a joint and the nearest support (D) as well as the allowable gap (G) and step (S) of the running surface shall be specified and documented in the installation and maintenance instructions, see Figure 1.



Key

D distance from the joint to the nearest support

G gap at the joint

S step at the joint

Figure 1 — Joint

5.4.2 Suspensions

Means shall be provided in order to limit excessive horizontal displacement of the light crane system. Suspensions should have means for height and position adjustment.

5.4.3 Bridge skewing

The bridge attachment to a trolley running on the track shall be built in such a way that it allows necessary degrees of freedom around the horizontal and vertical axis without damaging the light crane system, e.g. the vertical axis shall have sufficient freedom so that the crane bridge movement does not become obstructed on the track during operation.

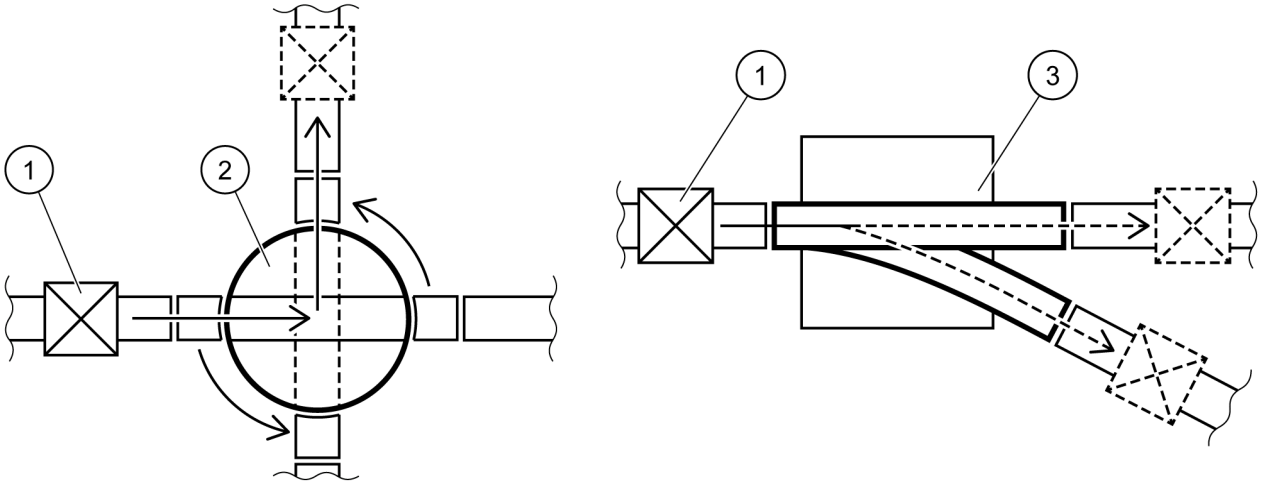
5.4.4 Backup devices for trolleys and suspensions

Where a trolley or a suspension of a track is equipped with a backup device as a safe guard against a failure of the primary component, the backup device shall be designed taking into account the dynamic effects due to the failure of the primary component.

Instructions shall be provided for actions after the failure, e.g. inspection of the structure, repair and putting light crane system back to service, see 7.3.3.

5.4.5 Turntables and switches

Mechanism shall be such as to prevent a trolley from falling or from becoming obstructed by the mobile part during operation. If an obstruction occurs, it shall not lead to a hazardous situation. Figure 2 shows examples of turntable (Figure 2 a)) and switch (Figure 2 b)).



a) Turntable **b) Switch**

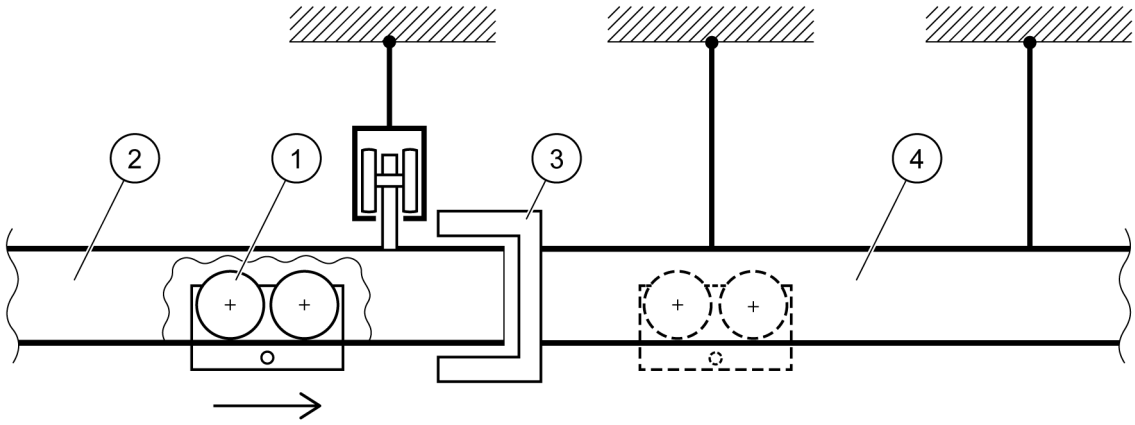
Key

1 running component
2 turntable
3 switch

Figure 2 — Turntable and switch

5.4.6 Interlock

Mechanism shall be such as to prevent a trolley from falling or from becoming obstructed when passing from one side to the other. Figure 3 shows a typical example of an interlock.



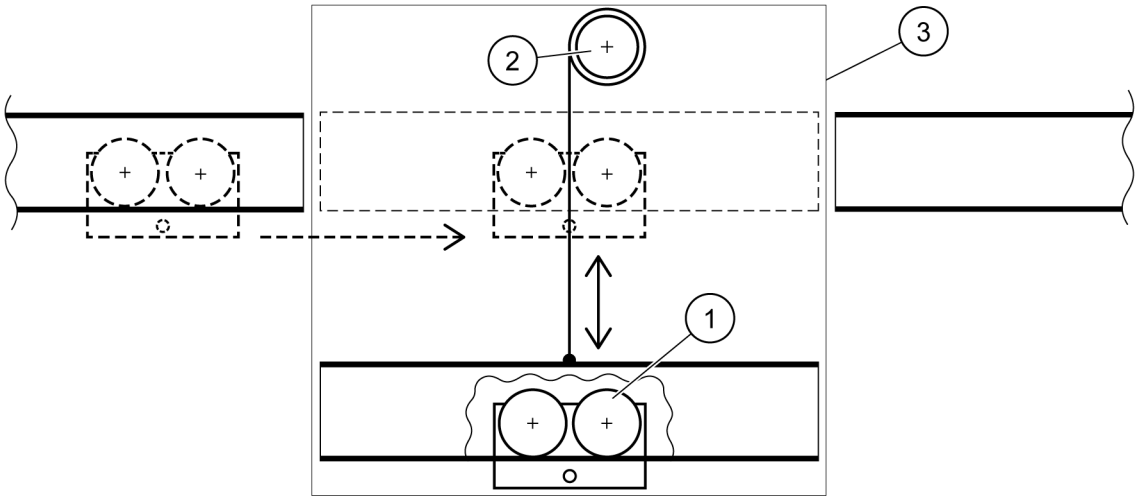
Key

1 trolley
2 crane bridge
3 interlock
4 track

Figure 3 — Interlock

5.4.7 Loading/unloading station

Mechanism shall be such as to prevent a trolley from falling or from becoming obstructed when passing to and from loading/unloading station. Figure 4 shows a typical example of a loading/unloading station. The machinery for lifting the loading station shall conform to European crane standards listed in 5.1 as relevant.



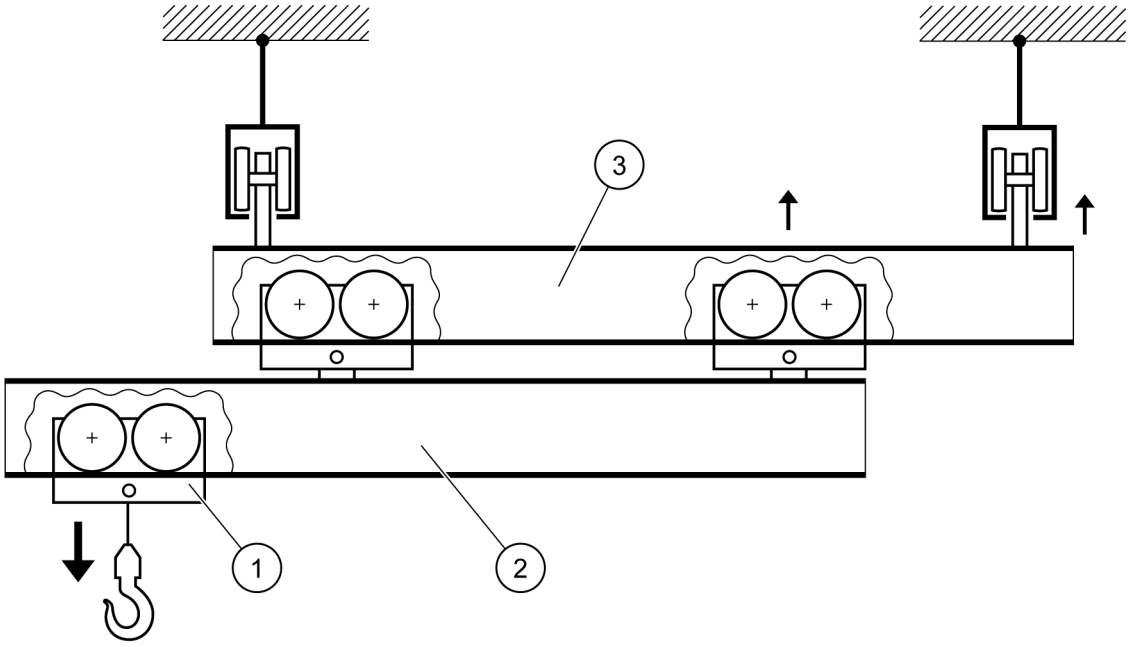
Key

1 trolley
2 lifting machinery
3 loading/unloading station

Figure 4 — Loading/unloading station

5.4.8 Telescopic and cantilevered crane systems

Where in case of a cantilevered load the wheels tend to lift from their usual running surfaces, means shall be provided, e.g. counterweights or counter wheels, to prevent uncontrolled movements and jamming of the moving parts. For an example of telescopic system, see Figure 5.



Key

1 lifting device
2 telescopic crane bridge
3 crane bridge

Figure 5 — Telescopic system

5.4.9 Trolleys

Trolleys shall incorporate features to prevent unintentional derailment, accidental fall or climbing on the rail. This requirement can be fulfilled by the use of devices such as guide rollers and / or wheel flanges. The trolley shall be prevented from falling or overturning in the event of a single-wheel failure.

5.4.10 End stops and motion limiters

Any motion that has a designed restriction of movement and those motions that have a restriction shall be provided with motion limiters. A motion limiter can be, for example, an electrical switch or a mechanical end stop. End stops shall be capable of stopping the movement from the maximum speed without overloading the crane.

The ends of bridges and tracks shall be equipped with mechanical end stops. End stops of the parallel runways for crane or track shall be aligned. Where provided, the electrical motion limiters shall be in accordance with EN 12077-2.

Where end stops for the crane or the trolley are fixed by a bolt tightening friction grip joint relying only on friction, to provide the possibility of adjustment of the travel range, there shall also be:

— a positive locking provided behind the end stop as a back-up means or

— the end stop construction shall be designed with a risk coefficient $\gamma_n = 1,6$.

Where the design permits only limited rotation of a jib crane, end stops for the rotation movement shall be provided.

5.4.11 Power supply

The electric power supply shall conform to EN 60204-32.

Means to shut off the pneumatic power shall be provided.

In some cases, the power supply may be able to move the lifting device by itself, e.g. due to weight of festoon cable. Where this is not an intended feature, the lifting device or bridge shall be equipped with a braking system.

5.5 Tandem operation of cranes/trolleys from a single control station

When two or more cranes/trolleys are used for handling a single load from a single control or control station, the control systems of the individual cranes shall be interconnected to ensure that during tandem operation:

— the hoisting speeds are the same within the tolerances required for the particular application;

— the horizontal speeds are the same within the tolerances required for the particular application;

— any interruption of the operation on one crane/trolley shall have a corresponding effect on the other. This requirement does not apply to fully pneumatic or hydraulic powered and operated cranes/trolleys with horizontal speeds less than 15 m/min and hoisting speeds less than 2 m/min.

At horizontal speeds exceeding 60 m/min or hoisting speeds exceeding 20 m/min, the relevant motion control shall provide self-correcting synchronization and any interruption in the operation on one crane/trolley shall have a corresponding effect on the other.

Where the cranes can be used separately and in tandem, the controls shall be clearly marked accordingly.

5.6 Use of multiple lifting devices

Where use of multiple lifting devices may overload any component in the crane, measures shall be taken to prevent overloading by mechanical or electrical means. Examples of such overloading cases are

— crane bridge capacity is less than the combined capacity of the lifting devices;

— several adjacent lifting devices loading one suspension of a monorail;

— several adjacent bridges loading one suspension of a track;

— telescopic system and cantilevered beams of tracks/bridges with several lifting devices;

— two jibs on one pillar capable to operate in the same slewing zone.

5.7 Man-machine interface

5.7.1 Control devices and control stations

Control devices and control stations shall be in conformance with EN 13557.

More information on ergonomic design principles of controls and control stations is given in EN 614-1.

5.7.2 Horizontal speeds

Power driven horizontal motions that are not automated shall have a maximum speed allowing the operator

— to have full control of the lifting device;

— to have full control of the movement of the load;

— to follow the load.

Speeds of movements with pendant control shall not exceed 63 m/min. In case of cableless controlled (e.g. radio control) movements, the speed shall not exceed 80 m/min.

5.7.3 Guarding and access

5.7.3.1 Access

The crane shall have permanent access to all control stations, in accordance with EN 13586.

The crane shall be designed such that access to maintenance and inspection points is possible in one of the following ways or by a combination of those:

— the crane has permanent access ways for maintenance and inspection, designed in accordance with EN 13586;

— access is through external access ways on the surrounding building or similar permanent construction;

— access is from a mobile elevating work platform.

In the two latter cases, the access relies on external means, which are not part of the crane. However, those means shall be specified and their use described in the maintenance instructions of the crane.

Where maintenance or inspection requires access to enclosures, the openings shall conform to EN 13586.

For requirements not covered by EN 13586, the following clearances are generally recommended as minimum values:

— clearance above the crane with access ways to the interrupted roof: 500 mm;

— clearance between two cranes mounted above each other with access ways in either of the cranes: 500 mm;

— if it is foreseeable for personnel to access the top of a permanent obstacle, then clearance under the crane to that permanent obstacle: 500 mm;

— clearance between the end carriage and the building taking into account the maximum skew position and allowable wear and there is no permanent access: 50 mm.

NOTE Guidance is also given in ISO 11660-5.

Some maintenance and inspection work may require the use of a safety harnesses. Where such equipment is required attachment points in conformity with EN 795 shall be provided.

5.7.3.2 Guarding

To avoid crushing and shearing hazards the minimum distance between moving parts within the crane shall be in accordance with EN 349 unless equivalent safety is provided by other means, for example a person detector and motion limiter system.

Where there is a danger of a shearing or falling hazard occurring on the access way, the transfer points shall be provided with gates. These gates shall be fitted with an interlocking device that disables the relevant motion.

Where the running surfaces are exposed and they are at a lower level than 2,5 m above the access level, the hazard zone shall be guarded in accordance with EN ISO 13857. The clearance between the running surface and the guard shall be a maximum 6 mm.

Open gears, chain drives and similar power transmissions in personnel working and traffic zones shall be guarded in accordance with EN ISO 14120. Exceptionally, guarding of the slewing gears is not required, if the drawing in point of the pinion/gear is located sufficiently remote from the access ways, in accordance with EN ISO 13857.

5.7.4 Lighting

The manufacturer shall clarify needs for crane-mounted lights depending on the availability of other lights on site. Attention shall be paid on lighting

— on the current area where the load attachment is at a given time (i.e. working area);

— on access walkways, stairs and ladders.

The crane shall be equipped with lighting that provides illumination of at least 50 lx on the working area, unless sufficient illumination for the purpose of application is provided through the general illumination on the site of installation.

5.7.5 Reduction of noise by design

5.7.5.1 General

Normally noise is not a significant hazard in light crane systems or jib cranes. Noise can be a significant hazard in cases where the operator's position is situated close to one or more of the mechanisms or components mentioned in 5.7.5.2, when their power level or operational speed is high.

When noise is a significant hazard, there is need for low noise design. In this case, the methodology for low noise design in EN ISO 11688-1 shall be considered.

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

5.7.5.2 Main sources of noise

On light crane systems and jib cranes, the main sources of noise are the following:

— hoisting mechanism (motor, gear, brakes);

— trolley traversing mechanism (motor, gear, brakes, especially rail/wheel contact);

— crane travel mechanism (motor, gear, brakes, especially rail/wheel contact);

— crane and trolley festoon and energy chains;

— external devices, e.g. motor fans;

— pneumatic and hydraulic pumps, either on the trolley or in the load lifting attachment.

5.7.5.3 Measures to reduce noise at the source

Typical measures to reduce noise are

— selection of low noise components;

— use of elastic mountings that prevent the transmission of structure born noise from the components to the structures.

Other measures of identical or better efficacy can be used.

5.7.5.4 Protective measures

Typical measure is the use of noise reducing housing around noisy components.

5.7.5.5 Determination of noise emission values

Noise emission values shall be determined as specified in the noise test code given in Annex C.

NOTE Effects of the supporting structure and the surrounding building (if applicable) are outside of the scope of this European Standard.

5.7.5.6 Information on residual noise

The information on residual noise shall be given to the user, see Clause 7.

5.8 Equipment for warning

5.8.1 General

Warning labels and markings shall be provided to inform the crane operator, service personnel, inspectors, slingers and other persons on or near the crane about the hazards related to the crane and its operations, and on the action they would need to take to minimize the risks.

NOTE 1 EN ISO 12100 gives the principles of presenting hazard information using labels.

NOTE 2 EN 12644–2 gives requirements and information on the marking of cranes.

NOTE 3 Visual warning means are safety colours, pictorial signs, text warnings and warning lights.

5.8.2 Warning markings

Warning markings shall be of contrasting colours, which will cause the markings to stand out in the operating environment, in accordance with ISO 3864 (all parts). Warning markings shall have a reasonable life for the anticipated operating environment.

5.8.3 Cableless control warning light

For cableless controlled cranes means for warning as specified in EN 13557:2003+A2:2008, C.8 b), are not required.

5.8.4 Location of the visual display unit

Location of the visual display units, where provided, shall be in accordance with EN 894-1 and EN 894-2 to minimize the operator's head movements but still avoiding unnecessary hindrance of the field of vision over the working area.

5.9 Safety related functions of control systems

For control systems in a machinery, which is in the scope of a particular harmonised standard (e.g. EN 14492-2, EN 14238), the required performance level shall be as given in such standard.

Safety related functions of other control systems shall fulfil at least Performance Level c of EN ISO 13849-1:

— control circuits built with electromechanical, hydraulic and pneumatic components shall fulfil at least Performance Level c and category 1;

— control circuits built with electronic or programmable components, respectively, shall fulfil at least Performance Level c and category 2.

In high-risk applications, as specified in EN 13135, a risk assessment shall be undertaken to establish a higher performance level requirement than described above.

Generally for light crane systems and jib cranes, at least the following safety related functions shall be addressed where applicable:

— overload protection;

— limiting of motions at the ends of ranges of movements (e.g. hoisting, travel, traverse, slewing);

— limiting of motions at the turntables, interlocks, switches and at the loading stations;

— emergency stop.

The stop function in cableless control systems as laid down in EN 13557:2003+A2:2008, Annex C (C.3), i.e. when:

— either the communication is lost or disturbed or

— a stop button on the transmitter is actuated,

shall fulfil at least Performance Level c and category 3. This requirement does not concern normal use, e.g. where hold-to-run push buttons are used to start and stop crane motion.

The control system is defined in EN ISO 12100:2010, Annex A to end at the output of the power control elements. By this definition, e.g. mechanical brakes, load holding valves, gearboxes and other comparable elements are considered to belong to the operating part of the system and not to the safety related control system. In general, warning, indicating and monitoring systems need not be considered to be safety related control functions.

6 Fitness for purpose testing

6.1 Functional test

All motions of the light crane systems and jib cranes shall be operated throughout their range of movements, without load, up to their maximum operating speeds. For hand powered cranes the maximum travel speed may be taken as walking speed. Motion limiters and buffer positions shall initially be approached and contact made at slow speed prior to contact being made at maximum specified speed. Where buffer stops are used without other motion limiters, they shall only be contacted once at 100 % speed. During these tests, the crane shall be monitored to check that it operates smoothly, the braking systems of power driven movements operate effectively and motion limiter and indicator settings are accurate. All functions of the crane shall be tested, particularly those related to safety, including back-up brake sequencing, for correct operation.

Where, in case of power driven lifting movement, a second (back up) limiter is provided, the function shall be tested by using both a low speed and the maximum specified speed. The first limiter shall be bypassed for this test. In both cases, the second limiter shall bring the system into a safe condition.

6.2 Static test

The light crane systems and jib cranes shall be tested with a load of 125 % of rated capacity positioned 100 mm to 200 mm above the ground.

The test shall be carried out in all critical hoist positions, such as the middle span of a bridge, the maximum outreach of a jib crane, extreme positions of movements including any cantilever, so as to qualify overload and stability requirements.

Where cranes are equipped with more than one lifting device that can be used separately, they shall be tested individually prior to the crane test unless previously tested by the manufacturer. The crane shall be tested with the most unfavourable loading combinations of the lifting devices in the specified use.

The test load shall be applied for a period necessary to make the observations and measurements, in minimum 10 min, to evaluate the fitness for purpose. The measurements shall verify that deflections are within the specified limits.

Tests are considered successful, if no fractures, permanent deformations or damages affecting the function or safety of the crane are visible and if no connections have loosened or show signs of damage.

Hand-powered lifting equipment shall be tested separately as stand-alone equipment in accordance with EN 13157.

6.3 Dynamic test

Dynamic test shall be performed with test load that is at 110 % of the rated capacity. The tests shall include repeated starting and stopping of each motion, including all combined movements as provided by the intended use over the whole sequence and range of the movements.

During these tests, the crane shall be continuously monitored to check for

— smooth operation of the crane;

— effective operation of the braking systems;

— effectiveness and accuracy of limiting and indicating devices.

The dynamic tests are considered successful if the components in question have fulfilled their function, the subsequent examination does not reveal any damage to the drive or supporting structure and if no connection has loosened or been damaged.

The performance of the rated capacity limiter shall be tested in accordance with the relevant product standard prior to installation of the lifting equipment onto the crane.

7 Information for use

7.1 General

The crane shall be provided with instructions in accordance with EN ISO 12100 and EN 12644-1 except as otherwise given in this European Standard.

The design life of the crane based upon the selected service conditions (see 5.1) shall be indicated by the manufacturer in years in relation to average load or load distribution and annual usage.

The design life of the crane is defined for the purpose of calculation and should not be considered as a guarantee of life. However, it can be used as guidance for long-term maintenance and refurbishment purposes; see ISO 12482. Monitoring the use can be achieved by the use of cycle counter devices; see EN 13135 for special applications.

7.2 Operator’s manual

Where there is more than one lifting device on the crane or on the track, or where there are any limitations for the rated capacity on certain areas of the crane bridge or track, a description of the permissible loads of each lifting device and the permissible combinations of loads on the lifting devices shall be given. Descriptions of the operation of the load limiter and indicator systems, where provided, shall also be included.

Information regarding the operation of other performance limiters shall be provided in the instruction manual.

Instructions shall be given on safe slinging to avoid accidental releasing from the hook and the load falling. The manual shall warn about remaining hazards related to a falling load or a part of the load in case of a failure in compiling and attaching the load.

The manual shall give information on correct operation of the crane by the operator to avoid impact, by the moving load, with persons or property.

The manual shall describe the necessary daily checks to ensure that, e.g. the motion limiters, indicators and warning devices are performing satisfactorily.

The instructions shall inform the correct ways of using multiple motion commands in order to suppress load sway.

The manual shall describe the procedure for shutting down the crane and leaving it in an out-of-service condition.

The manual shall indicate the manner in which the operator shall receive instruction/information regarding current wind speeds and the action to be taken to shut down the crane.

Where the load lifting attachment or the typical loads have such a shape that allows a person to enter and stay on during lifting, the crane operator shall be instructed to refuse the lifting the persons.

7.3 User's manual

7.3.1 General

The user's manual shall inform on safe use of the crane and training for the slingers and the crane operator.

NOTE 1 Information is available in ISO 9926-1, ISO 12480-1 and ISO 15513.

Where crane generated or ambient noise can disturb communication between the operator and the slingers or other personnel the user's manual shall draw attention to the arrangement of other means of communication, e.g. use of hand signals, radio.

The manual shall state the recommended ambient lighting of the site for safe operation of the crane.

The manual shall state that any modified clearances around the crane shall conform to 5.7.3.1.

The forces transmitted by the crane to the supporting structures shall be provided.

NOTE 2 Information on the forces to be taken into account is given in Annex B.

Emission sound pressure levels at the operator positions, generated by the crane, determined in accordance with Annex C shall be indicated.

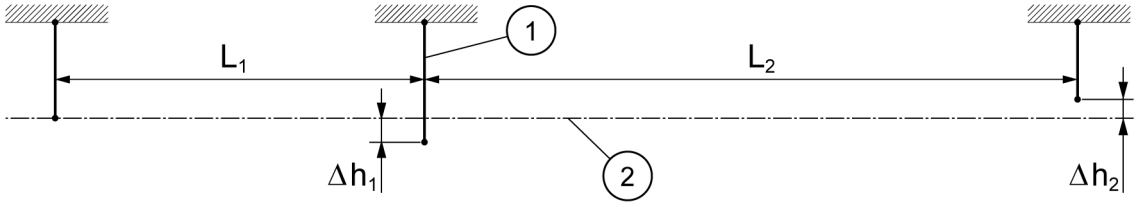
Where the A weighted emission sound pressure level at operator positions exceeds 80 dB(A), the A-weighted sound power level emitted by the crane shall also be indicated.

As it may be impractical to reach acceptable environmental conditions for the measuring of the sound power level in accordance with EN ISO 3744:2010, Annex A or the crane is very large, it is acceptable to determine and declare the sound pressure levels in specified locations around the crane as described in Annex C.

7.3.2 Instructions for installation

Instructions on erection, assembly and fitness for purpose testing (see Clause 6) shall be provided. Instructions shall include structural details of the attachments of the crane to the supporting building.

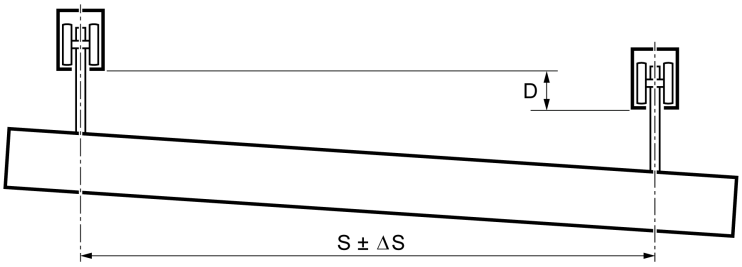
Dimensional tolerances for the support point of the tracks, which are relevant for operation or safety of the crane, shall be specified by the manufacturer, e.g. misalignments of the support points from a straight line in vertical and horizontal directions. Examples of misalignments are shown in Figures 6 to 8.



Key

1 support
2 horizontal plane
L_1, L_2 distances between supports
Δh_1, Δh_2 vertical misalignments

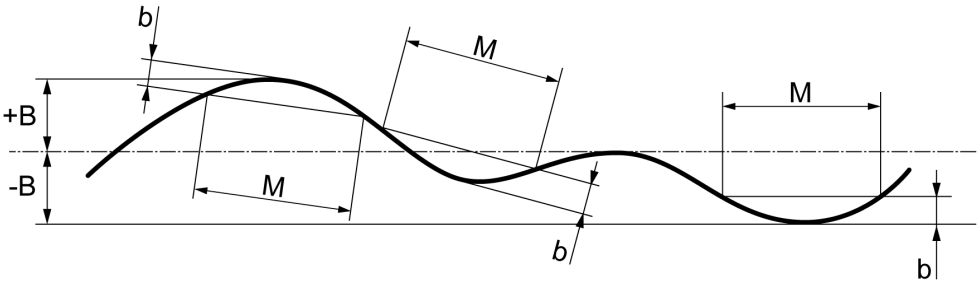
Figure 6 — Vertical misalignment of supports



Key

D vertical misalignment of parallel bridge tracks
S span
ΔS tolerance of the span

Figure 7 — Vertical misalignment of parallel bridge tracks



Key

B total misalignment at the whole length of the track
b local misalignment at a specified measuring length
M measuring length

Figure 8 — Horizontal misalignments, plan view of a crane track

7.3.3 Instructions for maintenance

Instructions for maintenance shall comply with EN 12644-1, EN 60204-32 and EN 13135 except as otherwise given in this subclause.

Instructions shall be given on:

— inspection methods and intervals;

— criteria for the replacement of components;

— criteria replacement of worn out or damaged parts;

— tests to be carried out after replacement of components;

— test to be carried out periodically;

— access to maintenance zone when external means of access are used.

Instructions shall include the deflection limits under the rated load.

NOTE Periodic test can be subject to national regulations.

Abrasion and wearing limits shall be given for components subject to wear, for example:

— sheaves;

— ropes (for information, see ISO 4309), pins and rope terminals;

— rope drums;

— hooks;

— brake linings, discs, drums;

— couplings;

— current collectors used in slip-ring systems and in conductor bars;

— wheels;

— chains and sprockets;

— running surfaces;

— guide rollers.

Instructions shall also be given for maintaining the braking capacity of mechanical brakes that are subject to minimal wear due to the performance of their operational systems.

Instructions shall be provided to verify (or enable checking) the operation and setting of the safety systems, for example the rated capacity limiter. This may require marking of the original setting values on the equipment or in the documentation.

Information shall be given on required personal protective equipment.

Potentially hot components shall be identified, and their guarding and/or marking shall be described.

Where necessary, instructions on the disposal of materials that are replaced during maintenance and final dismantling shall be given.

7.4 Marking of rated capacities

The rated capacity of a lifting device is the maximum load permitted to be lifted with the lifting device under the fixed load lifting attachment. The rated capacity shall be clearly marked on the lifting device, examples: “500 kg” or “RC 500 kg”. If no other limitations are specified, the rated capacity of any lifting device may be lifted at any position of a bridge or track, where the lifting device can move.

The rated capacity and any limiting conditions (see 5.6) shall be plainly and permanently marked on the monorail, crane bridge or jib so as to be clearly visible to the operator.

Annex A
(informative)

Guidance for specifying the operating duty

Table A.1 provides guidance on selection of duty classes U and Q of EN 13001-1 for cranes in the scope of this European Standard.

Table A.1 — Guidance for selection of classes U and Q

No.	Description of application	U class	Q class
1	Hand powered cranes	U0-U2	Q1-Q4
2	Painting shop feeding crane, intermittent operation	U0-U1	Q2-Q4
3	Boat lift crane	U1-U3	Q1-Q3
4	Assembly and maintenance cranes, intermittent operation	U1-U3	Q0-Q2
5	Warehouse cranes, intermittent operation	U2-U5	Q1-Q3
6	Warehouse cranes, continuous operation	U5-U8	Q1-Q3
7	Machining centre feeding crane	U2-U3	Q0-Q3
8	Assembly line cranes, intermittent operation	U3-U6	Q2-Q4
9	Assembly line cranes, continuous operation	U6-U7	Q3-Q5
10	Cranes with load manipulator	U4-U6	Q1-Q4
11	Welding gun support crane	U6-U7	Q2-Q4
12	Workshop cranes in general, intermittent operation	U2-U5	Q0-Q2
13	Workshop cranes, continuous operation	U5-U7	Q1-Q4

Annex B
(normative)

Actions on supporting structures and installation dimensions

B.1 Loads and load combinations

Table B.1 shows the applicable dynamic load factors to be provided by the crane manufacturer to the designer of the supporting structure. Table B.2 shows, what the relevant load actions are and how those are combined for calculation of the total load actions on the supports.

NOTE 1 For light crane systems and jib cranes only a selection of all load combinations as given EN 13001–2 are necessary.

For each box of Table B.2 a set of simultaneously acting forces/moments shall be given, e.g. [M, V] in Figure B.1 and correspondingly with other Figures B.2 to B.4. Forces/moments shall be given as characteristic static values, i.e. based on load actions without partial load factors and dynamic factors.

In order to find the maximum forces, the critical positions of lifting devices, bridges and jibs shall be taken into account.

Structural details of the attachments of the crane to the supporting building shall be provided by the crane manufacturer.

NOTE 2 By the given format of the load actions given in this annex, the crane manufacturer enables the designers of the supporting structures to create relevant load combinations in conformance with EN 1991–3.

Table B.1 — Dynamic factors

Factor	Load action to be amplified
ϕ_1	Dynamic factor for hoisting and gravity effects acting on the mass of the crane
ϕ_2	Dynamic factor for inertial and gravity effects by hoisting an unrestrained grounded load
ϕ_3	Dynamic factor for inertial and gravity effects by sudden release of a part of the hoist load
ϕ_{5T}*	Dynamic factor for loads caused by acceleration of traversing
ϕ_{5B}*	Dynamic factor for loads caused by acceleration of travelling
ϕ_6	Dynamic factor for test loads
ϕ_7	Dynamic factor for buffer force
ϕ_L	Dynamic factor for operation of overload protection, e.g. a slipping clutch
The dynamic factors ϕ_{5T}* and ϕ_{5B}* in this context shall be given as the ratio of maximum dynamic support force to the static support force. This definition differs from that in EN 13001–2.	

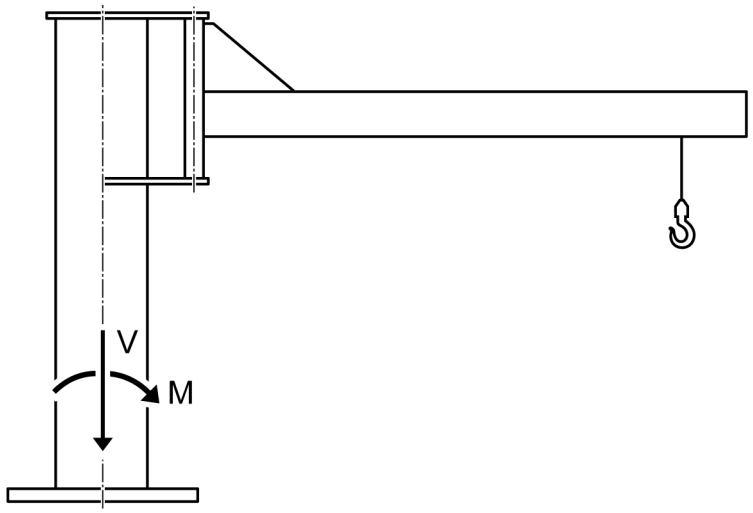
Table B.2 — Load combinations for determining the crane actions on supporting structures

Basic load action	Regular load combinations		Exceptional load combinations		
	1	2	3	4	5
Dead weight of the crane	ϕ_1	ϕ_1	1	1	1
Mass of the hoist load(s)	ϕ_2	ϕ_3	-	-	ϕ_L
Acceleration of traversing	ϕ_{5T}*	ϕ_{5T}*	-	-	-
Acceleration of travelling	ϕ_{5B}*	ϕ_{5B}*	-	-	-
In-service wind	1	1	0,16	-	-
Test load	-	-	ϕ_6	-	-
Buffer force	-	-	-	ϕ_7	-

B.2 Jib cranes

B.2.1 Pillar jib crane

Actions on supporting structures are expressed as the vertical force (V) and overturning moment (M) at the base plate, see Figure B.1.



Key

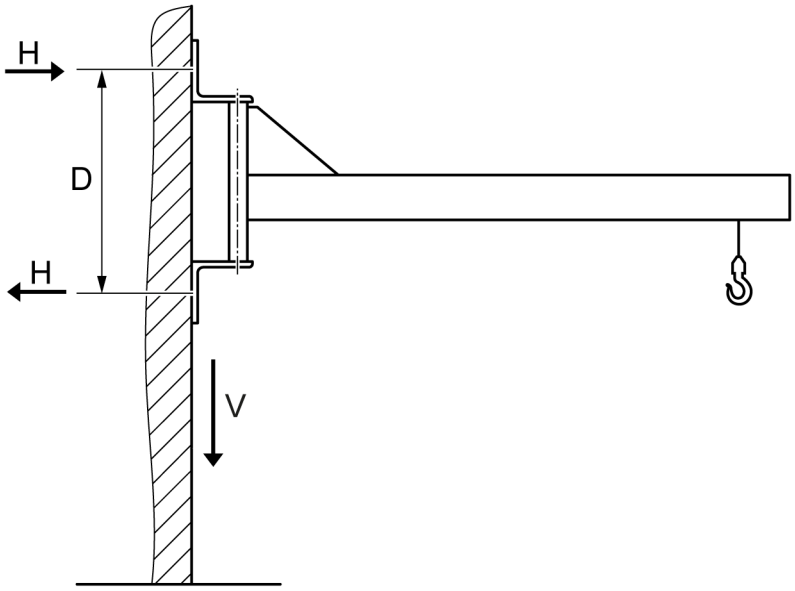
M overturning moment

V vertical force

Figure B.1 — Actions on supporting structures, pillar jib crane

B.2.2 Wall-mounted jib crane

Actions on supporting structures are expressed as the vertical force (V) and horizontal force (H) at the supporting wall; see Figure B.2.



Key

D distance between the fixing points

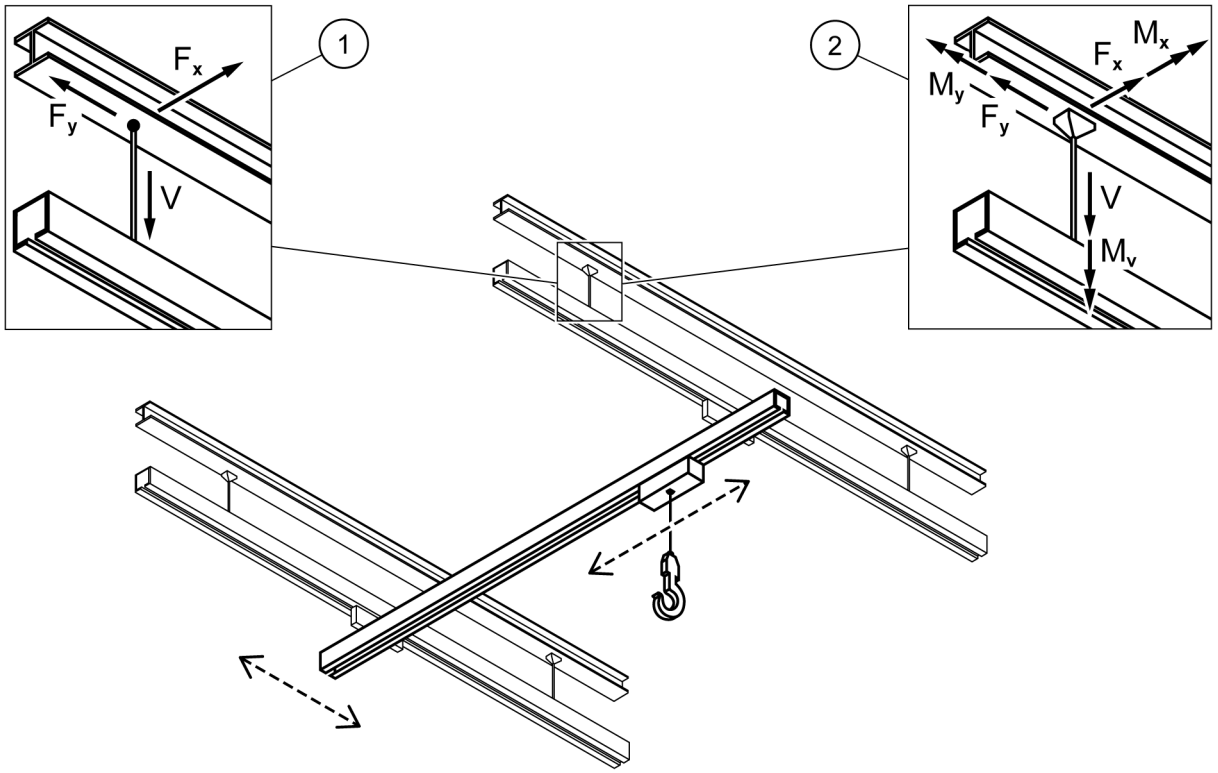
H horizontal force

V total vertical force

Figure B.2 — Actions on supporting structures, wall-mounted jib crane

B.3 Suspended light crane systems

Actions on supporting structures are expressed as the vertical force (V) and horizontal forces (F_x, F_y) at the suspension point, see Figure B.3. In case of rigid suspension, the moments (M_x, M_y, M_z) shall also be given.



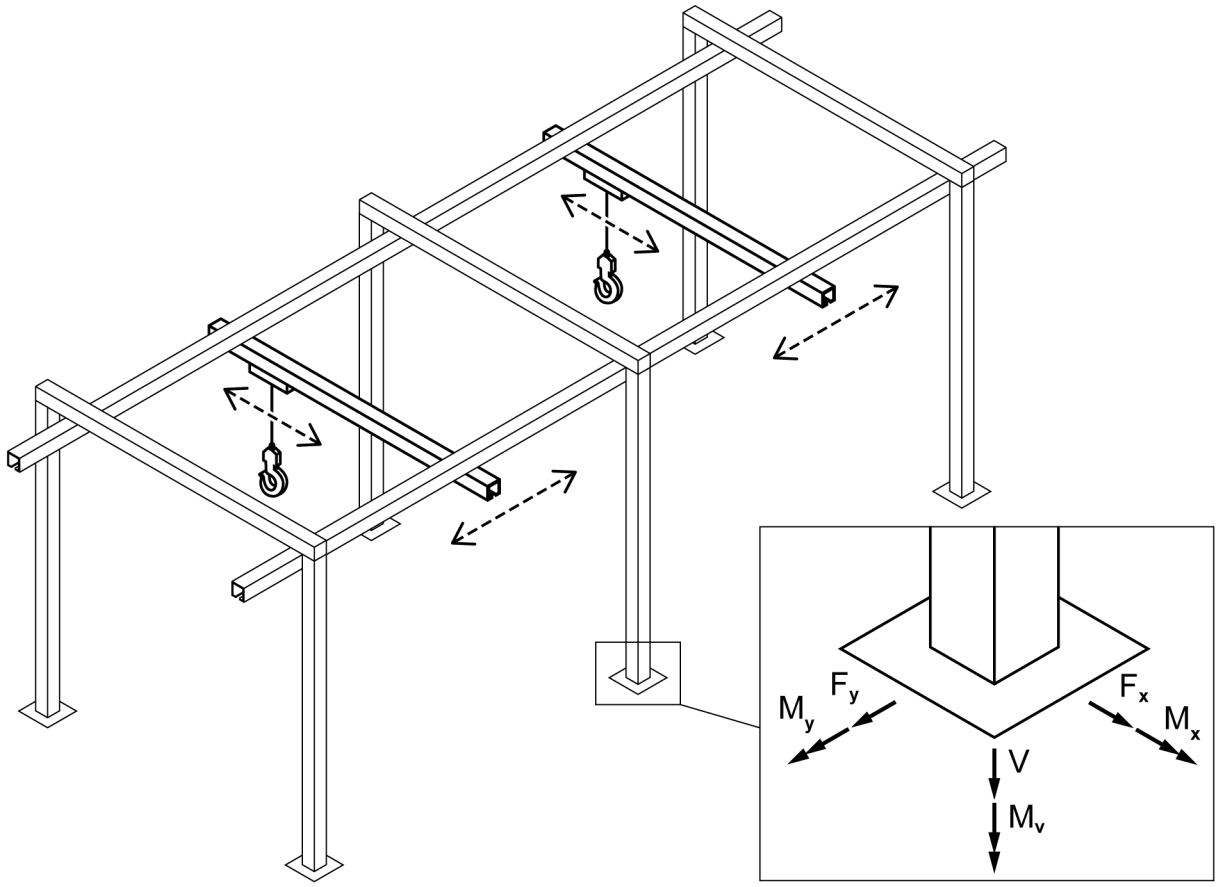
Key

1	articulated suspension
2	rigid suspension
F_x, F_y, V,	forces at the support point
M_x, M_y, M_v	moments at the support point

Figure B.3 — Actions on supporting structures, suspended light crane system

B.4 Free-standing systems

Actions on supporting structures are expressed as the vertical force (V), horizontal forces (F_x, F_y) and moments (M_x, M_y, M_z) at the support point, see Figure B.4.



Key

F_x, F_y, V, forces at the support point

M_x, M_y, M_v moments at the support point

Figure B.4 — Actions on supporting structures, free-standing light crane system

Annex C
(normative)

Noise test code

C.1 General

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 light crane system and jib cranes.

Noise emission characteristics include emission sound pressure levels at operator's positions. 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 determination methods allowed by this European Standard are:

— a calculation method (C.3) to determine the overall noise emitted by the noisiest components of the crane.

  This method shall be used systematically and the value resulting from the calculation shall be given in the instructions for use (see 7.3.1) unless the measured values are available.

  Noise caused by rail-wheel contact in travelling and noise emitted by the runway structures as well as noise from crane power supply festoon system or conductor bars are excluded, because they may not be fully in crane manufacturer's control.

  This method underestimates the actual noise emission value of the crane when installed at the user's place,

— a measurement method (C.4) of the sound pressure level at the operator's position once the crane is installed at the user's place.

  This sound pressure level is not an emission sound pressure level because it includes the crane, the structure to which the crane is fixed and the acoustic characteristics of the room or surroundings.

  This method has priority over the calculated values, when the sound pressure value added by the uncertainty exceeds 70 dB(A) at a working place.

The measurement determines two values, one for hoisting and traversing and another for the travelling of a crane. Both values shall be given in the instructions for use (see 7.3.1). For the sound pressure level at the operator's position, both values shall be considered. The actual value may be higher than the biggest of them, when there is a situation where hoisting, traversing and travelling occur at the same time.

For the cranes that have an A-weighted emission sound pressure level at the operator's position higher than 80 dB the sound power level shall be indicated. Determination of the required values is presented in C.4.1.2.

The C-weighted peak emission sound pressure levels in the light crane systems and jib cranes are typically so low that they need not to be measured and reported.

C.2 Description of machinery family

This annex is applicable to individual light crane system in the scope of this European Standard as fully assembled in the intended working condition including the fixed load lifting attachment.

C.3 Determination of a conventional emission sound pressure level by calculation

C.3.1 Principle of the method

The conventional emission sound pressure level at the operator's position is calculated as the summation of the contributions at this position of the main noise sources present on the crane. These contributions are derived from the sound power levels of these main noise sources as provided by their manufacturers.

C.3.2 Calculation

The contribution of a given noise source with A-weighted sound power level L_{WA} is given by Formula (C.1):

$$L_{pA} = L_{WA} - 10\lg\left(\frac{S}{S_0}\right) \tag{C.1}$$

where

L_{pA} is the resulting A-weighted sound pressure level at the operator's position;

L_{WA} is the A-weighted sound power level of the source, in decibels; reference: 1 pW;

S $= 2\pi r^2$, where r is the distance between the considered place and the sound source;

S_0 $= 1\ \mathrm{m}^2$.

The values of the sound power level of the components to be used in the calculation shall correspond to the rated loads and speeds of the crane.

The noise sources to be taken into account in the calculation are

— hoist mechanism;

— trolley traverse mechanism;

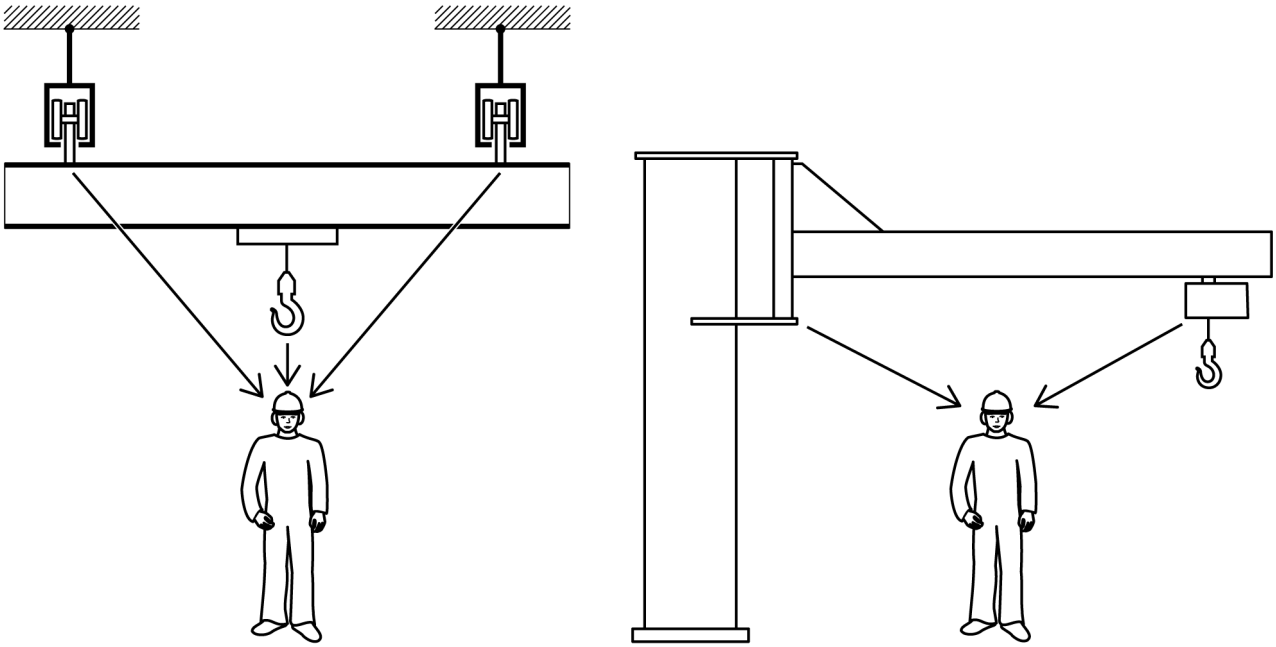
— crane travelling mechanisms;

— fixed load lifting attachment, when power operated.

The values shall include the noise of the electrical control cubicles and power source.

The typical locations of these noise sources are shown in Figure C.1. The operator is assumed to be in a vertical plane containing the sources. For the power operated load lifting attachment, the nearest normal operating distance shall be considered.

The values of the A-weighted sound power levels and the distances *r* used for the calculations shall be reported.



a) **b)**

Figure C.1 — Noise sources of a light crane system and jib cranes

The conventional A-weighted emission sound pressure level at a certain position under the influence of different sound sources shall be calculated by adding the sound pressure levels from the different sources in accordance with Formula (C.2):

$$L_{pA(total)} = 10\lg\left[\sum_{i=1}^{N} 10^{0,1L_{pAi}}\right] \quad \text{(C.2)}$$

where

$L_{pA(total)}$ is the conventional A-weighted emission sound pressure level, i.e. the total A-weighted sound pressure level at the considered position resulting from *N* sources;

L_{pAi} is the A-weighted sound pressure level resulting from sound source *i*;

N is the total number of sound sources.

The uncertainty of the calculation is that with which the sound power levels of the components have been determined.

This calculation method does not take into account the effect of structure-borne noise and sound reflection by the ground and therefore the calculated noise levels are usually lower than levels that would be measured.

NOTE Formula (C.3) below illustrates the method for the addition of two A-weighted sound pressure levels, 70 dB(A) and 72 dB(A) respectively:

$$L_{pa(total)} = 10\lg\left[10^{0,1\times 70} + 10^{0,1\times 72}\right] = 72,1\,dB(A) \quad \text{(C.3)}$$

C.4 Determination of emission sound pressure level at control stations and other specified positions and determination of sound power level by measurement

C.4.1 Measurement method and points

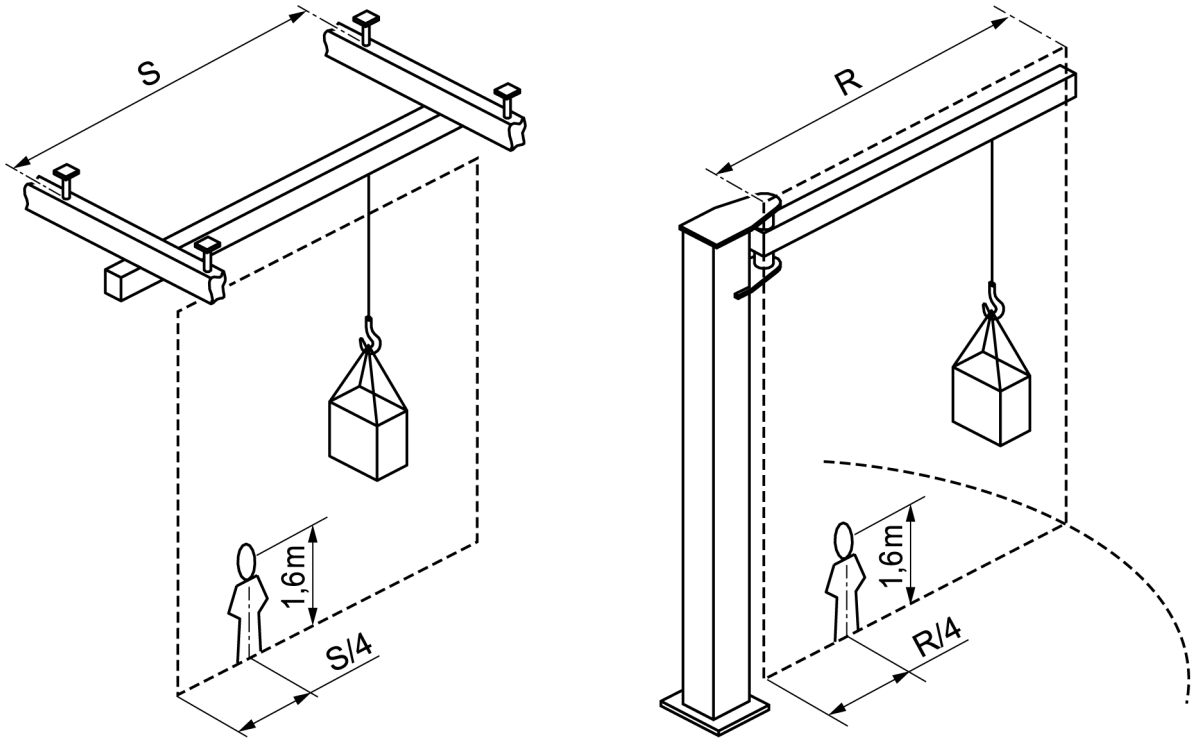
C.4.1.1 Measurement of sound pressure level at working positions

Emission sound pressure level measurements shall be made in accordance with EN ISO 11201 at the following positions.

The measurements shall be made in or at all control stations.

In case of movable pendant control station, the measurement point shall be at the vertical plane defined by the pendant controls, at the height 1,6 m and at the distance one quarter of the crane span from the vertical plane of the runway rail, or at the distance one quarter of the jib outreach from the slew centre. See Figure C.2.

This measurement covers the non-fixed operator positions like those of radio control. During measurement of the crane travelling or the jib slewing, the measuring point shall be kept stationary.



a) Crane span **b) Jib outreach**

Key

S span

R outreach

Figure C.2 — Noise measurement points

C.4.1.2 Determination of sound power level or sound pressure level at determined positions

Where the A-weighted sound pressure level at a working position exceeds 80 dB(A), the determination of the sound power level is required. In the case of very large machinery, instead of the A-weighted sound power level, the A-weighted emission sound pressure levels at specified positions around the machinery may be indicated. For the light crane systems and jib cranes, one of the following cases shall be applied, when the A-weighted sound pressure level at a working position exceeds 80 dB(A).

a) Indoor cranes are usually installed in the proximity of reflecting and absorbing surfaces around the crane, which vary from one installation place to other. These kinds of installation conditions do not meet the requirements for the acoustic environment for the determination of sound power level (see EN ISO 3744:2010, Annex A). Therefore, the A-weighted sound pressure levels shall be measured and declared at the six positions defined by coordinates:

   1) x = 0,20 *l*, 0,50 *l*, 0,80 *l*;

   2) y = -*h*, *h*;

   3) z = 1,6 m;

   and at two positions:

   x = 0,10 *l*; 0,90 *l*; y = 0; z = 1,6 m

   where

   - *l* is the span (S) of the crane or the jib outreach (R);
   - *h* is the height from the floor level to the top of a lifting device;
   - x is the coordinate below and parallel with the essential symmetry line of the girder(s), at floor level, origin at the vertical line of one of the supporting travel rails;
   - y is the horizontal coordinate parallel with the tracks of the crane bridge or the coordinate in direction of the slew circle;
   - z is the vertical coordinate.

   The working cycle during the measurement shall be as described in C.4.3.2, 1).

b) Where the A-weighted sound power levels for the hoisting and traversing motion of the lifting device (under loaded condition) and for the fixed load lifting attachment can be measured in a qualified acoustic environment, those values can be declared instead of the power level of the whole crane. During measurement of the traversing, the lifting device shall be travelling along the running surface(s), as this represents the actual use.

NOTE Case b) above is typically applicable for serially manufactured lifting device. The custom-built lifting devices are typically individual and are not operable with load in a qualified acoustic environment before installation at the end user's site.

C.4.2 Installation and mounting conditions

The crane shall be installed on its tracks or foundation in the condition it is intended to be used excluding the sound alarm signals, which shall be disconnected during the noise measurements.

The mechanisms of the non-fixed load lifting attachments causing noise may be switched off during the noise measurement cycle.

NOTE Noise caused by the non-fixed load lifting attachments is the matter of the manufacturer of the equipment.

C.4.3 Operating conditions

C.4.3.1 General

In all cases, the testing position of the light crane system for the measurements should be so selected that the reflections and other environmental disturbances are minimized.

The load handled during the work cycles should be preferably the rated load, but in the case of difficulty to use the rated load, a load representing the typical loads and having a mass that is at least 50 % of the rated load mass may be used.

C.4.3.2 Hoisting and traversing

The work cycle during measurement shall be as follows:

1) hoist the load with maximum speed at the point one quarter of span or outreach (beside the measuring point). Duration shall correspond to one-half of the total lifting height.

2) start traversing during the hoisting (about at the mid height of hoist path) and go on to the point 3/4 of the span or outreach.

3) start lowering before stopping the traversing motion and go on to the ground level.

4) return the load to the start position in the reverse manner.

5) in case of jib crane with powered slewing, this shall be operated during traversing.

Where there are limitations in making movements simultaneously, the cycle description shall be modified accordingly.

Test cycles and measurements shall be repeated at least three times.

The test result $\overline{L_{pA1}}$ is the arithmetic mean of the measured maximum values.

C.4.3.3 Travelling

Noise measurement during bridge travelling shall be made separately holding the load at the mid span of the bridge.

The measuring period shall start when the reference box reaches the stationary microphone, and it shall end when the other side of the reference box has passed the microphone.

NOTE The reference box is a hypothetical surface that is the smallest rectangular parallelepiped that just encloses the noise sources (the whole crane structure) and terminates on the reflecting plane (floor).

Test cycles and measurements shall be repeated at least three times.

The test result $\overline{L_{pA2}}$ is the arithmetic mean of the measured maximum values.

C.5 Uncertainties

No technical data on noise emission are presently available to estimate the standard deviation of reproducibility for the family of machinery covered by this noise test code. Therefore, the values of the standard deviation of reproducibility stated in the basic noise emission standards may be regarded as interim upper boundaries and used for the determination of the uncertainty *K* when preparing the noise declaration. Investigations requiring a joint effort of manufacturers are necessary to determine a possibly lower value of the standard deviation of reproducibility, which will result in a lower value of the uncertainty *K*. Results of such investigations will be reflected in a future version of this European Standard.

C.6 Information to be recorded

Measurements shall be recorded in accordance with EN ISO 11202:2010, Clause 12.

For the calculation method, the information to be recorded shall be as specified in EN ISO 11203:2009, Clause 7.

C.7 Information to be reported

The reports shall include the A-weighted emission sound pressure levels and the positions where they were measured or calculated.

Where required, the A-weighted sound power level of the crane, or sound power levels of the mechanisms during work cycles, shall be reported. The method of determining the power levels shall be indicated.

Where the sound pressure levels in specified positions are reported (C.4.1.2, a)) instead of the required sound power level, this fact shall be reported. The acoustic environment condition shall also be reported (for guidance on description of environment, see EN ISO 3744:2010, Table A.1).

The noise values measured during crane travelling shall be reported separately from the values representing the specified work cycle, because such values may be more strongly affected by the noise generated in the runways and the building.

In the calculation method, the assumptions made for the calculation, the precise positions of sound sources and operator(s), the values used as sound power input data and the results of the calculations shall be reported.

C.8 Declaration and verification of noise emission values

The declaration and verification of noise emission values shall be made in accordance with EN ISO 4871. These values shall be preferably the measured values obtained in accordance with C.4 or the calculated values (C.3). Example is given in Table C.1.

The noise declaration shall be a dual number declaration as defined in EN ISO 4871, i.e. the noise emission level and the uncertainty being indicated separately. It shall give the value of the A-weighted emission sound pressure level at the control stations and other specified working positions, where this exceeds 70 dB; where this level does not exceed 70 dB, this fact shall be indicated.

The noise declaration shall mention explicitly that noise emission values have been obtained in accordance with this noise test code and shall indicate the basic standard that has been used, i.e. EN ISO 11201. The noise declaration shall clearly indicate any deviation(s) from this noise test code and/or from the basic standard used.

Table C.1 — Example of information declared, either calculated or measured values, for each position

<table>
<tr><td colspan="3">Model number, operating conditions and other identifying information:
type, model, rated capacity, position, etc.</td></tr>
<tr><td rowspan="2">Calculated sound pressure value according to C.3
$L_{pA(total)}$</td><td colspan="2">Measured sound pressure values at working positions according to C.4</td></tr>
<tr><td>Hoisting and traversing
$\overline{L_{pA1}}$</td><td>Travelling
$\overline{L_{pA2}}$</td></tr>
<tr><td>Uncertainty K_c
Within the range of 1,5 dB to 4 dB</td><td>Uncertainty K_{m1}
Within the range of 1,5 dB to 4 dB</td><td>Uncertainty K_{m2}
Within the range of 1,5 dB to 4 dB</td></tr>
<tr><td rowspan="2">A-weighted sound power level(s) according to C.4.1.2, b)
L_{WA}</td><td colspan="2">Measured sound pressure values at specified points according to C.4.1.2, a)</td></tr>
<tr><td>Specified points $P_i(x_i, y_i, z_i)$
…
…</td><td>L_{pAi}</td></tr>
<tr><td>Uncertainty K_{WA}</td><td></td><td>Uncertainty K_m</td></tr>
</table>

Where the information to be declared in Table C.1 is available both by calculation and by measurement, only the information obtained by measurement shall be declared.

Noise emission data shall also be given in the sales literature.

When the noise emission values of an individual crane are verified, the measurements shall be conducted by using the same mounting, installation and operating conditions as those used for the initial determination of noise emission values.

Annex D
(informative)

Selection of a suitable set of European Standards for cranes in a given application

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

YES

Use it directly, plus the standards that are referred to

NO

Use the following:	
EN 13001–1	Cranes — General design — Part 1: General principles and requirements
EN 13001–2	Crane safety — General design — Part 2: Load actions
EN 13001–3–1	Cranes — General Design — Part 3–1: Limit States and proof competence of steel structure
EN 13001–3–2	Cranes — General design — Part 3–2: Limit states and proof of competence of wire ropes in reeving systems
EN 13001–3–3	Cranes — General design — Part 3–3: Limit states and proof of competence of wheel/rail contacts
EN 13001–3–5	Cranes — General design — Part 3–5: Limit states and proof of competence of forged hooks
EN 13135	Cranes — Safety — Design — Requirements for equipment
EN 13557	Cranes — Controls and control stations
EN 12077–2	Cranes safety — Requirements for health and safety — Part 2: Limiting and indicating devices
EN 13586	Cranes — Access
EN 14502–1	Cranes — Equipment for the lifting of persons — Part 1: Suspended baskets
EN 14502–2	Cranes — Equipment for the lifting of persons — Part 2: Elevating control stations

EN 12644–1	Cranes — Information for use and testing — Part 1: Instructions
EN 12644–2	Cranes — Information for use and testing — Part 2: Marking

Annex ZA
(informative)

Relationship between this European Standard and the essential requirements of Directive 2006/42/EC aimed to be covered

This European Standard has been prepared under a Commission's standardization request "M/396" to provide one voluntary means of conforming to essential requirements of Directive 2006/42/EC Machinery.

Once this standard is cited in the Official Journal of the European Union under that Directive 2006/42/EC, compliance with the normative clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive 2006/42/EC, and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Annex I of Directive 2006/42/EC

Essential Requirements of Directive 2006/42/EC	Clause(s)/subclause(s) of this EN	Remarks/Notes
all requirements	all clauses	all requirements are covered

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] EN 755 (all parts), *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles*

[2] EN 1991-3, *Eurocode 1 - Actions on structures - Part 3: Actions induced by cranes and machinery*

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

[4] EN 12999, *Cranes — Loader cranes*

[5] EN 13155, *Cranes — Safety — Non-fixed load lifting attachments*

[6] EN 13000, *Cranes — Mobile cranes*

[7] EN 13852–1, *Cranes - Offshore cranes - Part 1: General-purpose offshore cranes*

[8] EN 13852–2, *Cranes - Offshore cranes - Part 2: Floating cranes*

[9] EN 14439, *Cranes — Safety — Tower cranes*

[10] EN 14492–1, *Cranes — Power driven winches and hoists — Part 1: Power driven winches*

[11] EN 14502–1, *Cranes - Equipment for the lifting of persons - Part 1: Suspended baskets*

[12] EN 14502–2, *Cranes — Equipment for the lifting of persons — Part 2: Elevating control stations*

[13] EN 14985, *Cranes - Slewing jib cranes*

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

[15] EN ISO 11688-2, *Acoustics - Recommended practice for the design of low-noise machinery and equipment - Part 2: Introduction to the physics of low-noise design (ISO/TR 11688-2)*

[16] ISO 7752-4, *Cranes — Controls — Layout and characteristics — Part 4: Jib cranes*

[17] ISO 9926-1, *Cranes — Training of drivers — Part 1: General*

[18] ISO 11660-5, *Cranes — Access, guards and restraints — Part 5: Bridge and gantry cranes*

[19] ISO 12480-1, *Cranes — Safe use — Part 1: General*

[20] ISO 12482, *Cranes — Monitoring for crane design working period*

[21] ISO 15513, *Cranes — Competency requirements for crane drivers (operators), slingers, signallers and assessors*

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