



Cranes, hoists and winches

Part 11: Vehicle-loading cranes (EN 12999:2011, MOD)

AS 1418.11:2014, Cranes, hoists and winches, Part 11: Vehicle-loading cranes (EN 12999:2011, MOD), is a modified adoption of EN 12999:2011, Cranes—Loader cranes, and is reproduced with the permission of CEN, Avenue Marnix 17, B-1000 Brussels, Belgium. All exploitation rights of the European Standards in any form and by any means are reserved world-wide to CEN and its National Members, and no reproduction may be undertaken without express permission in writing by CEN through Standards Australia Limited.



This Australian Standard® was prepared by Committee ME-005, Cranes. It was approved on behalf of the Council of Standards Australia on 4 April 2014.
This Standard was published on 27 June 2014.

The following are represented on Committee ME-005:

- Australian Chamber of Commerce and Industry
- Australian Industry Group
- Australian Institute for Non-Destructive Testing
- Bureau of Steel Manufacturers of Australia
- Crane Industry Council of Australia
- Department of Commerce, WorkSafe Division, WA
- Department of Justice and Attorney General, Qld
- Elevating Work Platform Association of Australia
- Engineers Australia
- NSW Department of Trade and Investment, Regional Infrastructure and Services
- Transport for NSW
- WorkCover New South Wales
- WorkSafe Victoria

Additional Interests:

- 600 Cranes Australia
 - Cargotec Australia
 - Cranetech Australia
 - Engineering Assessors
 - Field Engineers
 - Hyva Pacific/Ferrari Cranes
 - Lampson, Australia
 - Maxilift Australia
 - Metcalf Crane Services
 - Palfinger Australia
 - PR Spry and Associates
 - Terex Lifting Australia
 - West Trans Equipment
 - Victorian Crane Association
-

This Standard was issued in draft form for comment as DR AS 1411.18.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

Keeping Standards up-to-date

Australian Standards® are living documents that reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued.

Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments that may have been published since the Standard was published.

Detailed information about Australian Standards, drafts, amendments and new projects can be found by visiting **www.standards.org.au**

Standards Australia welcomes suggestions for improvements, and encourages readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at **mail@standards.org.au**, or write to Standards Australia, GPO Box 476, Sydney, NSW 2001.

Australian Standard[®]

Cranes, hoists and winches

Part 11: Vehicle-loading cranes (EN 12999:2011, MOD)

Originated as AS 1418.11—2004.

Previous edition 2007.

Third edition 2014.

Reissued incorporating Amendment No. 1 (March 2015).

Reissued incorporating Amendment No. 2 (June 2015).

Reissued incorporating Amendment No. 3 (December 2018).

COPYRIGHT

© Standards Australia Limited

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968.

Published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001, Australia

ISBN 978 1 74342 697 5

PREFACE

This Standard was prepared by the Standards Australia Committee ME-005, Cranes, to supersede AS 1418.11—2007, *Cranes, hoists and winches*, Part 11: *Vehicle-loading cranes*.

This Standard incorporates Amendment No. 1 (March 2015), Amendment No. 2 (June 2015) and Amendment No. 3 (December 2018). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

The objective of this Standard is to set out requirements for vehicle-loading cranes.

This Standard is an adoption with national modifications and has been based on EN 12999:2011, *Cranes—Loader cranes* and has been varied as set out in Appendix ZZ to take account of Australian conditions.

EN 12999:2011 Amendment 1:2012 has been incorporated into the source text and the amended text has been flagged with ‘A1’ symbols.

As this Standard is reproduced from an European Standard, the following applies:

- (a) In the source text ‘this European Standard’ should read ‘this Australian Standard’.
- (b) A full point substitutes for a comma when referring to a decimal marker.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the annex or appendix to which they apply. A ‘normative’ annex or appendix is an integral part of a Standard, whereas an ‘informative’ annex or appendix is only for information and guidance.

References to European Standards should be replaced by references to Australian or Australian/New Zealand Standards as follows:

<i>Reference to European Standard</i>		<i>Australian/New Zealand Standard</i>	
EN		AS/NZS	
61000	Electromagnetic compatibility (EMC)	61000	Electromagnetic compatibility (EMC)
61000-6-2	Part 6-2: Generic standards—Immunity for industrial environments	61000.6.2	Part 6.2: Immunity for industrial environments
61000-6-4	Part 6-4: Generic standards—Emission standard for industrial environments	61000.6.4	Part 6.4: Emission standard for industrial environments

Only European Standards that have been adopted as Australian or Australian/New Zealand Standards have been listed.

CONTENTS

1	Scope	7
2	Normative references	7
3	Terms, definitions and terminology	8
3.1	Terms and definitions	8
3.2	Terminology	12
4	List of significant hazards	14
5	Safety requirements and/or safety measures	17
5.1	General	17
5.2	Structural calculation	18
5.2.1	Information to be given in the calculation	18
5.2.2	Dynamic factors	18
5.2.3	Loads and forces	20
5.2.4	Load combinations	21
5.3	Stress analysis	22
5.4	Mechanical arrangements	23
5.4.1	Stabilizers	23
5.4.2	Manual boom extensions	24
5.4.3	Securing for transport	24
5.4.4	Hoists	24
5.4.5	Load hooks	24
5.5	Hydraulic system	25
5.5.1	General	25
5.5.2	Pump	25
5.5.3	Hydraulic reservoir	25
5.5.4	Pressure limiting device	25
5.5.5	Hoses, tubes and fittings	26
5.5.6	Precautions against hydraulic line rupture	26
5.5.7	Sink rate for boom system	26
5.5.8	Slewing mechanism	27
5.6	Limiting and indicating devices	27
5.6.1	General	27
5.6.2	Rated capacity limiter	28
5.6.3	Lowering facility	28
5.6.4	Rated capacity indicators	29
5.6.5	Limiters	29
5.6.6	Operational warning	29
5.6.7	Acoustic warning	29
5.6.8	Stopping device	29
5.7	Controls	30
5.7.1	General	30
5.7.2	Symbols	30
5.7.3	Layout of bi-directional controls	31
5.7.4	Guidance for high seat controls	31
5.8	Control stations	31
5.8.1	General	31
5.8.2	Raised control stations	32
5.9	Electrical systems	33
5.9.1	General	33
5.9.2	Electromagnetic compatibility	33

5.10	Installation.....	33
5.10.1	General	33
5.10.2	Mounting	33
5.10.3	Stability.....	34
5.10.4	Noise.....	35
5.10.5	Vibrations	35
5.10.6	Electrical systems (installation).....	35
5.10.7	Hydraulic components.....	35
5.10.8	Access	35
6	Verification of the safety requirements and/or measures.....	36
6.1	General	36
6.2	Testing and test procedures	40
6.2.1	General	40
6.2.2	Functional test.....	40
6.2.3	Static test	40
6.2.4	Dynamic test	41
6.2.5	Stability test	41
6.2.6	Test documentation	42
6.3	Noise emission measurement.....	43
7	Information for use.....	43
7.1	General	43
7.2	Manuals	43
7.2.1	Provision of manuals	43
7.2.2	Instructions for the installer.....	43
7.2.3	Operator's manual	44
7.2.4	Maintenance manual	45
7.3	Marking.....	45
7.3.1	General	45
7.3.2	Manufacturer's plate	46
7.3.3	Installer's plate.....	46
7.3.4	Load signs.....	46
7.3.5	Special signs on timber handling cranes	49
7.3.6	Marking of slewing centre	49
Annex A	(informative) Examples of configurations and mountings	51
A.1	Boom systems	51
A.1.1	Loader cranes with straight boom system	51
A.1.2	Loader cranes with articulated boom system	51
A.2	Examples of loader crane mountings	52
Annex B	(informative) Stress history parameter s and stress history classes S.....	56
Annex C	(informative) Explanatory notes.....	58
C.1	Rated capacity limiters	58
C.2	Timber handling cranes - Line rupture.....	58
C.3	Control stations	58
Annex D	(informative) Examples of dangerous movements	59
Annex E	(normative) Symbols for working and setting-up functions.....	60
Annex F	(informative) Control system – Preferred vertical layout for controls operated from the ground	62
Annex G	(informative) Control system - Horizontal layout order.....	64
Annex H	(informative) Control levers for high seats and remote controls	67
H.1	High seat controls	67
H.1.1	Multidirectional (joy-stick) controls.....	67
H.1.2	Bi-directional controls	67
H.2	Remote controls	67
Annex I	(not used)	70

Annex J (normative) Cabins fitted on vehicle mounted loader cranes up to a net lifting moment of 250 kNm	71
Annex K (informative) Examples of raised control stations	74
Annex L (normative) Raised control stations - Measures regarding hand rails and hand holds, ladders and steps	76
Annex M (informative) Installation of a loader crane on a vehicle	79
M.1 General	79
M.2 Installation: minimum data	79
M.2.1 Crane dimensions in transport position: data	79
M.2.2 Crane data (see Figure M.2)	80
M.2.3 Mounting data	80
M.2.4 Power requirements	80
M.2.5 Stability calculations: data	80
M.3 Power take off (PTO) and pump displacement	81
M.4 Calculation method for determination of sub-frame dimensions	82
M.4.1 General considerations	82
M.4.2 Stresses	82
M.4.3 Material and limit states	82
M.4.4 Symbols and equations	83
Annex N (informative) Selection of a suitable set of crane standards for a given application	85
Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC	86
Bibliography	87

INTRODUCTION

A3

‘Text deleted’

AUSTRALIAN STANDARD

Cranes, hoists and winches**Part 11:****Vehicle-loading cranes (EN 12999:2011, MOD)****1 Scope**

This European Standard specifies minimum requirements for design, calculation, examinations and tests of hydraulic powered loader cranes and their mountings on vehicles or static foundations.

This European Standard does not apply to loader cranes used on board ships or floating structures or to articulated boom system cranes which are designed as total integral parts of special equipment such as forwarders.

The hazards covered by this standard are identified in Clause 4.

This European Standard does not cover hazards related to the lifting of persons.

This European Standard is not applicable to loader cranes which are manufactured before the date of its publication as EN.

NOTE The use of cranes for lifting of persons can be subject to specific national regulations.

2 Normative references

[A1] 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. **[A1]**

EN 349:1993+A1:2008, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

EN 12077-2:1998+A1:2008, *Cranes safety — Requirements for health and safety — Part 2: Limiting and indicating devices*

EN 14492-2:2006+A1:2009, *Cranes — Power driven winches and hoists — Part 2: Power driven hoists*

EN 12644-1:2001+A1:2008, *Cranes — Information for use and testing — Part 1: Instructions*

EN 12644-2:2000+A1:2008, *Cranes — Information for use and testing — Part 2: Marking*

EN 13001-1:2004+A1:2009, *Cranes — General design — Part 1: General principles and requirements*

EN 13001-2:2004+A3:2009, *Cranes safety — General design — Part 2: Load effects*

prEN 13001-3-1:2010, *Cranes — General design — Part 3-1: Limit states and proof competence of steel structure*

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

EN 13586:2004+A1:2008, *Cranes — Access*

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

EN 61000-6-4:2007, *Electromagnetic compatibility (EMC) — Part 6-4: Generic standards — Emission standard for industrial environments (IEC 61000-6-4:2006)*

EN 60204-32:2008, *Safety of machinery — Electrical equipment of machines — Part 32: Requirements for hoisting machines (IEC 60204-32:2008)*

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

www.standards.org.au

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 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components (ISO 4413:2010)*

EN ISO 4871:2009, *Acoustics — Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 5353:1998, *Earth-moving machinery and tractors and machinery for agriculture and forestry — Seat index point (ISO 5353:1995)*

EN ISO 11201:2010, *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 11201:2010)*

EN ISO 11688-1:2009, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

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

EN ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)*

3 Terms, definitions and terminology

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010 and the following apply. ¹⁾

3.1.1

loader crane

powered crane comprising a column, which slews about a base, and a boom system which is attached on to the top of the column, usually fitted on a commercial vehicle (including trailer) with a significant residual load carrying capability, and being designed for loading and unloading the vehicle as well as for other duties as specified by the manufacturer in the operator's manual

NOTE 1 A loader crane, as defined above in 3.1.1, installed on a static foundation is still considered a loader crane.

NOTE 2 Annex A gives examples of configuration and mountings.

3.1.2

articulated movement

movement of boom members pivoting about a pin joint

3.1.3

base

housing incorporating anchoring points and bearings for the slewing column

1) For convenience of reference the definitions are - with the exception of 3.1.1 loader crane - grouped in alphabetical order in the English version.

3.1.4**boom**

structural member in the boom system of the loader crane

3.1.5**boom extension, hydraulic**

part of the boom which is capable of hydraulic telescopic movement to vary its length

3.1.6**boom extension, manual**

part of the boom which can be manually extended or retracted

3.1.7**boom system**

complete system, consisting of booms, boom extensions and cylinders

3.1.8**column**

structural member which supports the boom system

3.1.9**control system**

interface between the operating levers and the actuating components which provide movements of the loader crane

3.1.10**control station**

position from which the loader crane may be operated

3.1.11**crane inclination**

angle between the slewing axis and a vertical line, due to working on slanted or uneven ground

3.1.12**danger zone**

any space within and/or around machinery in which a person can be exposed to a hazard

[EN ISO 12100:2010]

3.1.13**dead load**

force due to masses of fixed and movable crane parts which act permanently on the structure while the crane is being used

3.1.14**dynamic pressure**

pressure in a hydraulic system component or part of hydraulic system caused by dynamic forces on actuators when handling the load

3.1.15**fixed load lifting attachment**

equipment from which the net load may be suspended and which is fitted directly to the boom head as an integral part of the crane

 *deleted text* 

3.1.16**flow sensitive check valve**

valve which stops the flow when a pre-set pressure drop level is exceeded

3.1.17**gross load**

sum of payload, lifting attachments and if applicable a portion of the hoist rope

3.1.18**high seat**

control station connected to the column, consequently rotating with the crane

3.1.19**hoist**

machines for lifting and lowering suspended loads over predetermined distances, using ropes, chains or belts

3.1.20**hydraulic line rupture**

failure of a hydraulic line which results in a loss of pressure in the line

3.1.21**load holding valve**

valve which is normally closed and is opened by an external force to enable flow of fluid out of a hydraulic actuator

3.1.22**main relief valve**

valve which limits the pressure supplied to the hydraulic system of the crane

3.1.23**maximum working load**

the maximum load that may be lifted

NOTE The largest load appearing in the load plate.

3.1.24**maximum working pressure**

maximum pressure in pump circuit or individual working function

3.1.25**net lifting moment**

rated capacity multiplied by outreach

3.1.26**non-fixed load lifting attachment**

lifting accessory which can be fitted directly or indirectly to the hook or any other coupling device of a crane by the user without affecting its integrity

3.1.27**outreach**

horizontal distance between the axis of rotation of the column and point of load attachment

3.1.28**outreach, hydraulic**

outreach which can be obtained with hydraulically actuated parts of the boom system

3.1.29**payload**

load which is lifted by the crane and suspended from the non-fixed load-lifting attachment(s) or, if such an attachment is not used, directly from the fixed load-lifting attachment(s)

3.1.30**port relief valve**

valve which limits the pressure supplied to a hydraulic actuator

3.1.31**pressure relief valve**

valve which automatically relieves the hydraulic oil to the tank when the pressure exceeds a specified value

3.1.32**raised control station**

control station at a height above the ground level, i.e. a high seat attached to the column of the loader crane or a platform positioned above the base of the loader crane (see Annex K)

3.1.33**rated capacity**

load that the crane is designed to lift for a given operating condition (e.g. configuration, position of the load)

3.1.34**rated capacity indicator**

device which gives, within tolerance limits specified in 5.6.2.1, at least a continuous indication that the rated capacity is exceeded, and another continuous indication (on certain crane types) of the approach to the rated capacity

3.1.35**rated capacity limiter**

system that automatically prevents the crane from handling loads in excess of its rated capacity, see also C.1

3.1.36**setting-up function**

crane function used to prepare the crane for lifting

3.1.37**sink rate**

distance in a given time at which the load lowers due to internal leakage of hydraulic components

3.1.38**slewing**

rotational movement of the column and boom system about the axis of the column

3.1.39**stabilizer**

aid to the supporting structure connected to the base of the crane or to the vehicle to provide stability, without lifting the vehicle from the ground

3.1.40**stabilizer extension**

part of the stabilizer capable of extending the stabilizer leg laterally from the transport position to the operating position

3.1.41**stabilizer leg**

part of a stabilizer capable of contacting the ground to provide the required stability

3.1.42**static foundation**

fixed support incorporating mounting points for a crane

3.1.43**timber handling crane**

loader crane specifically designed, manufactured and equipped with a grapple for loading/unloading of unprepared timber (e.g. tree trunks, branches)

NOTE The operator controls the crane from a high seat or from a cabin.

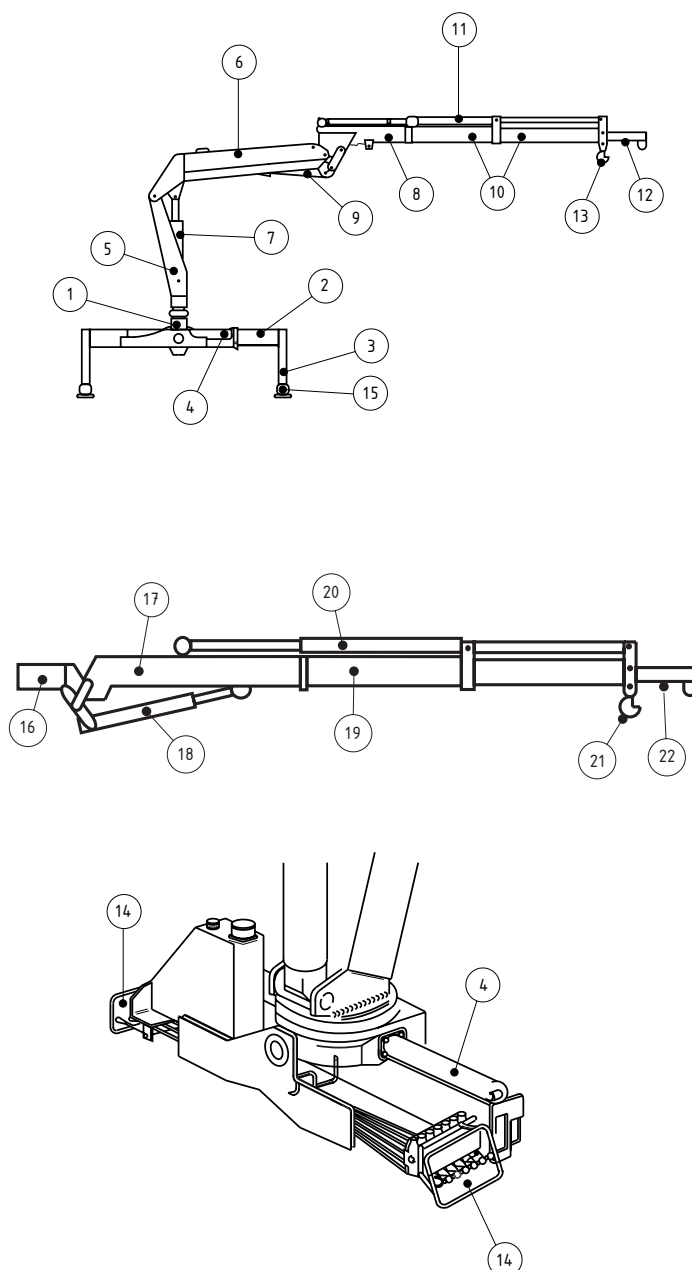
3.1.44**total lifting moment**

sum of net lifting moment and the moment produced by dead loads

3.2 Terminology

The terms which are used in this European Standard for the main parts of a loader crane are indicated in Figure 1.

Boom system consists of items 6 to 12 plus items 16 to 22, if applicable.



Key

1 base	7 1 st boom cylinder	13 hook	19 boom extension, hydraulic
2 stabilizer extension	8 2 nd boom	14 controls	20 extension cylinders
3 stabilizer leg	9 2 nd boom cylinder	15 stabilizer foot	21 hook
4 slewing mechanism	10 boom extension, hydraulic	16 3 rd boom adapter	22 boom extension, manual
5 column	11 extension cylinders	17 3 rd boom	
6 1 st boom	12 boom extension, manual	18 3 rd boom cylinder	

Figure 1 — Main parts of a loader crane

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 intended use and foreseeable misuse.~~ It also contains corresponding cross-references to the relevant clauses in this European Standard that are necessary to reduce or eliminate the risks associated with those hazards. Before using this European Standard it is important to carry out a risk assessment of the crane. As a minimum the hazards covered by Table 1 should be included in the risk assessment.

Table 1 — List of significant hazards and associated requirements

No.	Hazards	Relevant clause(s) in this European Standard
1	Mechanical hazards due to:	
	- Inadequacy of mechanical strength of the crane and its parts	5.1, 5.2, 5.3, 5.4, 5.5.1, 5.5.4, 5.5.5, 5.5.8, 5.8.2.1, 5.8.2.2, 5.10.2
1.1	Crushing hazard	5.8.1, 5.8.2.2, 5.8.2.3, 5.10.2.3
1.2	Shearing hazard	
1.3	Cutting or severing hazard	
1.4	Entanglement hazard	
1.5	Drawing-in or trapping hazard	
1.6	Impact hazard	
1.7	Stabbing or puncture hazard	
1.8	Friction or abrasion hazard	
1.9	High pressure fluid injection or ejection hazard	5.5.1, 5.5.5, 5.10.7, 7.2.3.6, 7.2.4.2
1.10	Ejection of parts	5.4.1.2, 5.4.1.3, 5.4.2, 5.4.3
1.11	Loss of stability	5.4.1, 5.6.1.1, 5.6.1.2, 5.6.1.8, 5.6.3, 5.10.2.1, 5.10.3
1.12	Slip, trip, fall	5.8.2.2, 5.8.2.3, 5.8.2.4, 5.10.8
2	Electrical hazards due to:	
2.1	Contact of persons with live parts (direct contact)	5.9, 5.10.6, 7.2.3.1 d)
2.2	Contact of persons with parts which have become live under faulty conditions (indirect contact)	

Table 1 (continued)

No.	Hazards	Relevant clause(s) in this European Standard
2.3	Approach to live parts under high voltage	5.6.1.3
2.4	Electrostatic phenomena	Not applicable.
2.5	Thermal radiation or other phenomena such as the projection of molten particles and chemical effects from short circuits, overloads, etc.	Not applicable.
3	Thermal hazards, resulting in:	
3.1	Burns, scalds and other injuries by possible contact of persons with objects or materials with an extreme high or low temperature, by flames or explosions and also by radiation of heat sources	5.5.5, 5.10.2.3
3.2	Damage to health by hot or cold working environment	7.2.3.8
4	Hazards generated by noise	5.10.4, 7.2.3.9
5	Hazards generated by vibration	5.10.5
7	Hazards generated by materials and substances (and their constituent elements) processed or used by the machinery	5.10.2.3
7.1	Hazards from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	7.2.4.1
8	Hazards generated by neglecting ergonomic principles in machinery design, as e.g. hazards from:	
8.1	Unhealthy postures or excessive effort	5.4.1.3, 5.4.2, 5.7, 5.8, 5.10.8
8.2	Inadequate consideration of hand-arm or foot-leg anatomy	5.7, 5.8
8.3	Neglected use of personal protective equipment	
8.4	Inadequate local lighting	7.2.3.7 f)
8.6	Human error, human behaviour	5.6, 5.7.1, 5.7.2, 7.2.3, 7.2.4

Table 1 (continued)

No.	Hazards	Relevant clause(s) in this European Standard
8.7	Inadequate design, location or identification of manual controls	5.4.1.3, 5.4.3, 5.7, 5.8
8.8	Inadequate design or location of visual display units	5.6.1.1
9	Combination of hazards	
10	Unexpected start-up, unexpected overrun/overspeed (or any similar malfunction) from:	
10.1	Failure/disorder of the control system	5.5.6.1, 5.5.6.2, 5.5.7, 5.6.6, 5.6.8, 5.7.1
11	Hazards caused by missing and/or incorrectly positioned safety related measures/ means	
11.1	Guards	5.5.5, 5.7.1, 5.8.2.2, 5.8.2.3, 5.10.2.3
11.2	Safety related (protection) devices	5.4.1, 5.4.3, 5.6.3, 5.6.6, 5.6.7
11.4	Safety signs, signals, symbols	5.4.1.3, 5.6.7, 5.7.2, 7.3.4, 7.3.5
11.5	Information or warning devices	5.6.1, 5.6.4, 5.6.7, 7.1, 7.2, 7.3
11.6	Visibility	5.4.3, 5.8.1, 7.3.4.1
11.7	Emergency devices	5.6.3, 5.6.8
15	Assembly errors	7.2.2, 7.2.4
18	Loss of stability/overturning of machine	5.4.1, 5.6.1, 5.6.2, 5.6.4, 5.6.5, 5.6.6, 5.10.3

Table 1 (continued)

No.	Hazards	Relevant clause(s) in this European Standard
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	5.10.3, 6.2.5
27.1.2	Uncontrolled loading – overloading – stabilizing moment exceeded	5.5.4, 5.6.1, 5.6.2, 5.6.3, 5.6.4, 5.6.5
27.1.3	Uncontrolled amplitude of movements	5.6.6
27.1.4	Unexpected/unintended movement of loads	5.5.6, 5.5.7, 5.5.8
27.1.5	Inadequate holding devices/ accessories	5.4.2, 7.2.3.7
27.2	From access of persons to load support	7.2.3.1 e)
27.4	From insufficient mechanical strength of parts	5.1, 5.2, 5.3, 5.5.8, 5.10.2
27.8	From abnormal conditions of assembly/testing/use/maintenance	5.10, 7.1, 7.2. 7.3
29	Hazards generated by neglecting ergonomic principles	
29.1	Insufficient visibility from the driving position	5.8.1

5 Safety requirements and/or safety measures

5.1 General

Machinery shall conform to the safety requirements and/or measures of this clause. In addition, the machine shall be designed in accordance with the principles of EN ISO 12100 for hazards relevant but not significant which are not dealt with by this European Standard.

The rated capacity shall be calculated from the following:

- a) the working pressure in the cylinders;
- b) the area of the load carrying cylinders;
- c) the geometry;
- d) dead loads;

e) load combinations.

For the purpose of the calculations rated capacity is equal to gross load.

5.2 Structural calculation

5.2.1 Information to be given in the calculation

The following information shall be given in the calculation:

- a) type of crane and method of operation;
- b) the assumed number of all load or working cycles;
- c) details of the load-carrying system reflecting actual service conditions including outline drawings and principal dimensions;
- d) the assumed loading conditions including maximum crane inclination;
- e) the governing hoisting class, hoist drive class and stress history classes or stress history parameters;
- f) the material for the individual components and joints;
- g) the shapes, dimensions and static cross-section values of all load-carrying members;
- h) the analyses separately for the individual structural components and essential connections.

5.2.2 Dynamic factors

5.2.2.1 Hoisting and gravity effects of the mass of the crane

The dynamic effects due to vibrations of the structure when raising or lowering a load shall be included in the loading by applying the factor ϕ_1 on the gravitational forces due to the masses of the crane. It shall be used for the design of the crane structure itself and its supports. The value of ϕ_1 shall be the lowest of the two values 1,1 and ϕ_2 , or expressed as an equation:

$$\phi_1 = \min (1,1 ; \phi_2)$$

NOTE In general $\phi_1 = 1,1$. However, it shall not exceed the value of ϕ_2 in case ϕ_2 is less than 1,1.

5.2.2.2 Hoisting and gravity effects of the gross load

In the case of hoisting or grounding a load as well as starting or stopping a vertical motion, the vibrational effects shall be included in the loading by multiplying the gravitational force due to the mass of the hoist load by a factor ϕ_2 .

The factor ϕ_2 shall be taken as follows:

$$\phi_2 = \phi_{2,\min} + \beta_2 \times v_h$$

$\phi_{2,\min}$ and β_2 are given in Table 2a for the appropriate hoisting class. Loader cranes are assigned to hoisting classes HC1 and HC2 in accordance with their dynamic and elastic characteristics:

HC1 for crane mounted on a vehicle or structures of equivalent flexibility;

HC2 for rigidly mounted cranes.

Rigidly mounted cranes, equipped with a device that limits the peak pressure (e.g. an accumulator) in the first boom cylinder, may be assigned to HC1.

v_h is the steady vertical hook speed, in metres per second, related to the lifting attachment. Values of v_h are given in Table 2b.

Table 2a — Value of β_2 and $\phi_{2,min}$

Hoisting class of appliance	β_2	$\phi_{2,min}$
HC 1	0,17	1,05
HC 2	0,34	1,10

Table 2b — Values of v_h

Load combination	Type of hoist drive and its operation method		
	HD1	HD4	HD5
A1, B1	$v_{h,max}$	$0,5 \times v_{h,max}$	$v_h = 0$
C1	$v_{h,max}$	$v_{h,max}$	$0,5 \times v_{h,max}$

where

HD1 is the hoist drive can only be operated at a fixed speed;

HD4 is the start of the lift is performed with continuously increasing speed;

HD5 is the hoist drive control is automatic and ensures that the speed influence on the dynamic force is negligible;

$v_{h,max}$ is the maximum vertical hook speed.

In load combinations A1 and B1, $v_{h,max}$ is the maximum vertical hook speed that is given by any single hydraulic drive action.

In load combination C1, $v_{h,max}$ is the maximum vertical hook speed from all articulation hydraulic drives acting simultaneously.

NOTE In load combinations A and B it is assumed that the dynamic peaks from simultaneous movements do not coincide. The unlikely event that the dynamic peaks coincide and are superimposed is covered by load combination C1.

5.2.2.3 Effect of sudden release of a part of the gross load

For cranes that release or drop a part of the gross load as a working procedure during intended use, such as when grabs or magnets are used, the peak dynamic effect on the crane can be simulated by multiplying the gross load by the factor ϕ_3 .

The value is given by:

$$\phi_3 = 1 - \Delta m \times (1 + \beta) / m$$

where

m is the mass of the gross load;

Δm is the released or dropped part of the gross load;

$\beta = 0,5$ for cranes equipped with grabs or similar slow-release devices;

$\beta = 1,0$ for cranes equipped with magnets or similar rapid-release devices.

5.2.2.4 Effects caused by acceleration/deceleration of the slewing drive

The dynamic factor Φ_{sh} shall have the value 1,05 for hook duty and 1,3 for bucket or grapple duty.

5.2.3 Loads and forces

5.2.3.1 General

The following loads and forces shall be taken into account:

a) regular loads:

- 1) dead loads;
- 2) gross load;
- 3) dynamic forces;
- 4) centrifugal forces;

b) occasional loads:

- 1) in-service wind loads;
- 2) other climatic and environmental effects such as temperature, snow and ice;
- 3) loads on stairways, platforms and hand rails;

c) exceptional loads:

- 1) test loads;
- 2) loads caused by movements suddenly stopped by a mechanical device, e.g. end stroke of slewing cylinder or a safety device, e.g. emergency stop, hydraulic line rupture valve;
- 3) sudden release of the load, e.g. rope failure, sling failure;
- 4) forces due to simultaneous dynamic peaks caused by raising or lowering a load at the maximum sum of the vertical speeds from all articulation drives.

5.2.3.2 Regular loads

5.2.3.2.1 Dead loads

See 3.1.13.

5.2.3.2.2 Gross load

See 3.1.17.

5.2.3.2.3 Forces due to acceleration/deceleration of the slewing drive

The horizontal loads from the masses of the crane and of the payload shall be calculated as follows:

$$F_{hi} = m_i \cdot g \cdot \tan \alpha, \alpha \geq 3^\circ$$

where

F_{hi} is the horizontal load i acting on the payload or a mass point of the boom;

m_i is the payload or mass point of boom;

g is the gravity constant;

α is the maximum inclination for the crane in accordance with the manufacturer's specification. However, the minimum value that may be used is $\alpha = 3^\circ$.

5.2.3.2.4 Centrifugal forces (see Table 3)

The centrifugal forces acting on slewing cranes shall only be calculated from the dead load of the boom system components, the counterweight, if applicable, and the gross load without applying the factors mentioned in 5.2.2.

5.2.3.2.5 Forces on stabilizer legs

The stabilizer legs shall be loaded by simultaneously acting vertical and horizontal forces. The horizontal force shall act at the stabilizer foot with the leg at its maximum length and in the most unfavourable direction. The magnitude of the horizontal force shall be at least 5 % of the vertical force.

5.2.3.3 Occasional loads

5.2.3.3.1 Wind loads

Wind loads shall be calculated according to EN 13001-2. Only in-service wind needs to be applied.

5.2.3.3.2 Loads on stairways, platforms and hand rails

See 5.8.2.

5.2.3.4 Exceptional loads

Such loads may act in exceptional situations (e.g. testing, hydraulic line rupture).

5.2.4 Load combinations

5.2.4.1 Basic load combinations

Loads shall be combined to determine the stresses the crane will experience during operation. Basic load combinations are given in Table 3.

NOTE In general, load combinations A cover regular loads, load combinations B cover regular loads combined with wind loads, and load combinations C cover regular loads combined with occasional and exceptional loads.

5.2.4.2 Load combinations to be covered (see Table 3)

- A1 and B1 Intended service conditions, raising/lowering loads with dynamic peak from any single hydraulic function while slewing: A1 without wind effects, B1 with wind effects.
- A2 and B2 Intended service conditions, with grapple, magnet or similar accessory allowing sudden release of a part of the gross load while slewing: A2 without wind effects, B2 with wind effects.
- C1 Simultaneous dynamic peaks caused by raising or lowering a load at the maximum sum of the vertical speeds from all articulation drives, taking into account the available oil flow.
- C3 Crane under test condition.

5.2.4.3 Application of Table 3

Basic load combinations for the calculation to prove that mechanical hazards from yielding and elastic instability from extreme values do not occur are given in Table 3.

For the proof of fatigue strength, load combinations A1 and A2, with all partial safety factors γ_p set to 1,00, shall be applied.

Table 3 — Load combinations to be covered

Categories of load	Loads		Load comb. A			Load comb. B			Load comb. C			Row
			γ_p	A1	A2	γ_p	B1	B2	γ_p	C1	C3	
Regular	Gravity, Acceleration of lifting drives	Moved masses of the crane	1,22	ϕ_1	ϕ_1	1,16	ϕ_1	ϕ_1	1,1	ϕ_1	1	1
		Mass of the gross load	1,34	ϕ_2	ϕ_3	1,22	ϕ_2	ϕ_3	1,1	-	-	2
	Acceleration of slewing drive	Moved masses of the crane	1,22	ϕ_{5h}	ϕ_{5h}	1,16	ϕ_{5h}	ϕ_{5h}	-	-	-	3
		Mass of the gross load	1,34	ϕ_{5h}	ϕ_{5h}	1,22	ϕ_{5h}	ϕ_{5h}	-	-	-	4
	Centrifugal loads ^a	Masses of the crane	1,22	1	1	1,16	1	1	-	-	-	5
		Mass of the gross load	1,34	1	1	1,22	1	1	-	-	-	6
Occasional	Climate effects	In service wind ^b	-	-	-	1,22	1	1	-	-	-	7
Exceptional	Forces due to one exceptional event		-	-	-	-	-	-	1,1	ϕ_2	1	8
^a Only centrifugal loads that increase the load effects shall be included.												
^b Forces acting simultaneously with wind forces shall only be applied to such an extent that the drive force in row 3 and row 4 is not exceeded.												

5.2.4.4 Loads from foreseeable misuse

When calculating the effects of foreseeable misuse, all partial safety factors γ_p shall be set to 1,1.

5.3 Stress analysis

The strength of the steel structure may be assessed in accordance with prEN 13001-3-1. In case the assessment is made with the allowable stress method, the partial safety factors γ_p in Table 3 shall be set to 1.

Hydraulic cylinders may be assessed in accordance with prEN 13001-3-1 or the allowable stress method, in the latter case applying the safety factor 1,5.

The limit states given in prEN 13001-3-1 should be used in conjunction with a static analysis that is made for all boom positions and for all crane configurations.

5.4 Mechanical arrangements

5.4.1 Stabilizers

5.4.1.1 General

Stabilizers shall be provided when necessary to fulfil the stability requirements (see 5.10.3) when loader cranes are fitted on vehicles.

5.4.1.2 Stabilizer leg

The stabilizer leg shall have a foot for ground support.

Stabilizer feet shall be designed to adjust to a ground unevenness of at least 10°.  Timber handling cranes may however have fixed stabilizer feet, in which case the leg shall be designed for the additional bending moment. 

The area of each foot shall be such that the resultant maximum ground pressure is less than 4 MPa. For the main stabilizers, the maximum ground pressure shall be calculated as:

$$P = \frac{M_{dyn}}{L \cdot A}$$

where

M_{dyn} is the maximum moment at slewing centre including dynamic factors;

L is the distance from slewing centre to stabilizer leg;

A is the area of stabilizer foot.

In case of auxiliary stabilizers, their feet shall have the same size as for the main stabilizers. Alternatively a detailed calculation of the entire installation shall be carried out or stabilizers forces shall be measured.

When the stabilizer leg has a tilting device, locking means which can withstand operational forces from intended use (e.g. pins) shall be provided to secure the leg in both the working and transport position (see 5.4.3). If stabilizer legs have to be tilted (rotated) up or down manually, the maximum force to activate one of them shall not exceed 250 N, measured at the stabilizer foot.

5.4.1.3 Stabilizer extension

Stabilizers extensions shall be marked to show when they are correctly deployed.

Manually operated extensions shall be fitted with:

- a) handles for the manual operation;
- b) devices for locking extensions in the working and transport positions (see 5.4.3);
- c) pull out stops.

Locking means in the working position shall be fitted if the hydraulic cylinders are not able to resist the forces during load handling.

5.4.2 Manual boom extensions

Manual boom extensions shall have pull out stops and mechanical locking means for their retracted and extended positions.

5.4.3 Securing for transport

5.4.3.1 General

[A1] A system (e.g. angle sensor) detecting that the first boom is not stowed below permissible transport height shall be provided to all vehicle mounted loader cranes, see 5.6.1.3. **[A1]**

Locking means shall be provided to prevent uncontrolled movements of the crane and stabilizers installed on vehicles when travelling.

Each of the stabilizer extension locking devices shall be designed to withstand, with no permanent deformation, the forces resulting from an acceleration of 2 g, applied in the direction of the movement.

5.4.3.2 Manually operated extensions

Manually operated stabilizer extensions shall be locked in the transport position by two separate locking devices for each stabilizer, at least one of these shall be automatically operated, e.g. a spring operated cam lock and an automatic spring latch. These shall be attached to the crane and/or stabilizers and shall be protected against unintentional removal, e.g. by locking pins with spring clips.

It shall be clearly visible to the operator when the manual locking devices are in the locked and unlocked position. In addition, it shall be indicated when the stabilizers are not locked in the transport position, see 5.6.1.5.

5.4.3.3 Hydraulically operated extensions

Hydraulically operated stabilizer extensions shall be fitted with an automatic hydraulic or automatic mechanical locking device for the transport position, in addition to a control valve that is closed in its neutral position. Any valve used for automatic hydraulic locking shall be in accordance with 5.5.6.1. A mechanical locking device shall be designed to withstand, without permanent deformation, the force due to the foreseeable misuse of attempting to extend the stabilizers with the locking devices engaged.

5.4.4 Hoists

Power driven hoists shall be in accordance with EN 14492-2. The nominal capacity of a hoist shall not be larger than 0,4 times the pushing capacity of the extension system unless the rated capacity limiter limits the hoist capacity with respect to the pushing capacity of the extension system. Further information on design of rope reeving systems can be found in CEN/TS 13001-3-2.

5.4.5 Load hooks

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

NOTE More information can be found in DIN 15400 and DIN 15401-2.

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

- a safety device or
- the shape of the hook.

Hooks equipped with a safety-latch fulfil these requirements.

5.5 Hydraulic system

5.5.1 General

The hydraulic system and components shall conform to the requirements specified in EN ISO 4413.

The hydraulic components and lines shall be sized such that the hydraulic system can be operated at the intended working pressure and flow (including any pressure required during test procedures) without any failures and excessive temperatures being created.

Hydraulic systems shall be designed such that all components are compatible with each other and with the fluid being used in the system at specified environmental conditions. The hydraulic system shall have adequate filters to ensure that the fluid does not become contaminated.

Each hydraulic circuit shall be provided with means for checking the pressure.

Pressure and flow control devices or their enclosures shall be fitted with tamper-evident devices where an unauthorized alteration to pressure or flow can cause a hazard. Means shall be supplied for locking the setting of adjustable components or of locking their enclosures, if changes or adjustment can cause a hazard.

5.5.2 Pump

A pump shall have the capacity to deliver the correct flow and pressure specified by the crane manufacturer for the hydraulic system when being driven at the specified speed. The pump size and its specified driven speed shall be chosen to ensure that the capacity of the power supplier is utilized efficiently. There shall be a device that limits the pressure supplied by the pump to the loader crane.

NOTE See Annex M for guidance on selecting the correct pump size.

The pump shall be suitable for the fluid used in the hydraulic system.

5.5.3 Hydraulic reservoir

The hydraulic reservoir shall have sufficient fluid capacity for the pump to operate correctly when all the hydraulic cylinders are fully extended, including any auxiliary equipment. There shall also be sufficient capacity for the fluid in the system when all the cylinders are retracted. Devices shall be incorporated to enable monitoring the maximum and minimum fluid level. An access opening and a drain valve with plug shall be provided for cleaning purposes.

5.5.4 Pressure limiting device

If a load carrying circuit cannot withstand the maximum pressure that can occur, means shall be provided to limit the maximum pressure to the design value.

Such pressure limiting devices shall, except for

- loader cranes with a rated capacity of less than 1 000 kg and a maximum net lifting moment of less than 40 000 Nm;
- timber handling cranes,

be set so that no uncontrolled movement can take place with loads up to 1,3 times the rated capacity.

5.5.5 Hoses, tubes and fittings

Burst pressure for hoses shall be minimum four times the maximum working pressure for hoses without end fittings. Burst pressure for fittings and raw material for tubes shall be minimum 2,5 times the maximum working pressure.

Hoses, tubes and fittings shall be so located, installed and, where appropriate, protected so that they do not get damaged by chafing, trapping, etc.

Hydraulic hoses containing fluid with a pressure of more than 5 MPa and/or having a temperature over 50 °C and which are located within 1,0 m of the operator, shall be guarded.

Any part or component which may divert a possible jet of fluid can be considered as a protection device.

Hoses intended to withstand a pressure of more than 15 MPa shall not be fitted with reusable end fittings.

Hydraulic hoses that are used for the connection of interchangeable equipment shall be designed or identified or located to avoid any incorrect connection causing a hazard, e.g. to reverse the direction of movement of a hydraulic cylinder.

5.5.6 Precautions against hydraulic line rupture

5.5.6.1 Loader cranes other than timber handling cranes

All load carrying circuits shall be equipped with automatic means, e.g. load holding valves, to prevent uncontrolled movement of the crane in the case of hydraulic line rupture. This does not apply to rotators attached to the boom tip. Flow sensitive check valves shall only be used for equalizing and pressure sensing lines. The maximum flow through these lines shall not exceed 3 l/min.

Valves used for this means shall be close coupled to the cylinder. They shall be either:

- a) integral with the cylinder, or
- b) directly and rigidly flange mounted, or
- c) placed close to the cylinder or connected to it by means of short rigid pipes having welded, flanged or threaded connections.

Burst pressure of the raw material for tubes between lock valve and actuator shall be minimum 3 times the maximum working pressure.

5.5.6.2 Timber handling cranes

In the event of hydraulic line rupture the lowering speed of the boom shall not exceed the maximum lowering speed at rated capacity by more than 30% (see explanatory Note in C.2).

Stabilizer leg and extension cylinders shall be equipped as specified in 5.5.6.1.

5.5.7 Sink rate for boom system

The sink rate measured at the boom system tip caused by leakage in hydraulic components shall not exceed 0,5 % of outreach per minute. For cranes with more than 12 m outreach, the sink rate shall not exceed 0,2 % of outreach per minute. For timber handling cranes, however, the sink rate may be 2 % of outreach per minute for all outreaches. Sink rate shall be tested at rated capacity at maximum hydraulic outreach (i.e. without manual extensions).

5.5.8 Slewing mechanism

The slewing mechanism shall be able to withstand the maximum slewing forces (see 5.2.3.3.1), to bring it to a stop and sustain the load under the most adverse operating conditions.

5.6 Limiting and indicating devices

5.6.1 General

5.6.1.1 Rated capacity limiters shall be provided on all cranes having a rated capacity of 1 000 kg or above, or a maximum net lifting moment of 40 000 Nm or above due to the load. The rated capacity shall be determined at all outreaches corresponding to the boom system being horizontal. Rated capacity indicators shall be provided on all cranes.

Limiting and indicating devices shall conform to EN 12077-2. Safety related parts of limiting and indicating systems shall conform to EN 954-1:1996 category 1, except for electronic parts of the system for limiting devices, which shall conform to EN 954-1:1996 category 2.

In case a recognized fault in the rated capacity limiter causes it not to remain effective, all crane movements shall stop. In the event the crane has been stopped due to the rated capacity being reached or due to a fault in the rated capacity limiter, all movements that increase the load moment of the crane shall be blocked, while other movements may remain available. Blocked movements may only be allowed after that a lowering facility in accordance with 5.6.3 has been activated.

NOTE Regarding rated capacity limiters on loader cranes see also explanatory note given in C.1. For examples of dangerous movement for different crane types see informative Annex D.

For loader cranes with a rated capacity of less than 1 000 kg and a maximum net lifting moment of less than 40 000 Nm the relief valves in accordance with 5.6.2.2 and 5.6.2.3 shall provide overload protection when a rated capacity limiter is not provided. The provision of a clearly marked pressure gauge showing the approach to the rated capacity, visible from the operator's station, will fulfil the function of a rated capacity indicator for these cranes.

5.6.1.2 If the rated capacity is lower in sectors of the slewing range the crane shall be provided with slew limiters. These shall operate to override the controls of the crane when attempting to slew into this sector with a load higher than the rated capacity or lift loads above the rated capacities within the sector. The rated capacity indicator/limiter shall operate in all sectors of the slewing range.

5.6.1.3 A warning visible and audible from the transport driving position  shall indicate that the first boom is not correctly stowed (as described in 5.4.3.1 and 7.2.3.4). The audible warning  may be silenced by an acknowledgement button or by a signal that the parking brake of the vehicle is engaged.

 **NOTE** The same warning device may be used to fulfil the requirements of both 5.6.1.3 and 5.6.1.5. 

5.6.1.4 Cranes, equipped with stabilizers, shall be provided with a level indicator in clear view of the operator at each fixed stabilizer control station.

5.6.1.5 Cranes, with manually operated stabilizer extensions, shall have a warning visible and audible from the transport driving position that indicates when the stabilizers are not locked in the transport position. Cranes, with hydraulically operated stabilizer extensions, shall have a warning visible and audible from the transport driving position that indicates when the stabilizers are not in the transport position. The audible warning may be silenced by an acknowledgement button or by a signal that the parking brake of the vehicle is engaged.

 **NOTE** The same warning device may be used to fulfil the requirements of both 5.6.1.3 and 5.6.1.5. 

5.6.1.6 For cranes with a rated capacity of 1 000 kg or above, or a maximum net lifting moment of 40 000 Nm or above, the hoist shall be included in the system of the rated capacity limiter. Hoists that are able to lift loads in excess of 1 000 kg shall always be included in the system of the rated capacity limiter.

The upper hoisting limiter may be activated by the maximum line pull of the rope, providing the contact between the hook and the boom is designed to withstand the corresponding force.

NOTE More information about the calculation of ropes can be found in CEN/TS 13001-3-2.

5.6.1.7 For cranes with a rated capacity of 1 000 kg or above, or a maximum net lifting moment of 40 000 Nm or above, equipped with manual extensions, these extensions shall be included in the system of the rated capacity limiter. A mode selector may be provided to select the boom system configuration on the limiting and indicating device when manual extensions are fitted.

5.6.1.8 For cranes with a rated capacity of 1 000 kg or above, or a maximum net lifting moment of 40 000 Nm or above, the stability of the vehicle shall be included in the safety function of the rated capacity limiter.

NOTE Stability in this case means: Deployment of every stabilizer is monitored by the rated capacity limiter and the rated capacity is reduced or the crane is stopped, if not fully deployed.

This requirement does not apply to timber handling cranes.

5.6.2 Rated capacity limiter

5.6.2.1 The tolerance of the rated capacity limiter shall be such that it is activated between 100 % and $(100 + \Delta \%)$ of the rated capacity. The value of Δ depends on hydraulic outreach in accordance with the following equation:

$$\Delta \leq 8 + 0,5 R \leq 20$$

where

R in the hydraulic outreach in metres.

For timber handling cranes and for loader cranes with a rated capacity of less than 1 000 kg and a maximum net lifting moment of less than 40 000 Nm, the tolerance $\Delta = 20 \%$ may be used independently of the hydraulic outreach.

For hoists, the tolerance $\Delta = 25 \%$ of the rated capacity may be used independent of the outreach. However, the tolerance as above still applies to the crane.

NOTE It is generally accepted that a rated capacity limiter for loader cranes limits the load moment. At long outreach the main part of the total lifting moment comes from the dead loads and only a small part from the payload. Tolerances for the rated capacity limiter as stated above have been set considering the ratio of load moment to dead weight moment.

5.6.2.2 For loader cranes with a rated capacity of less than 1 000 kg and a maximum net lifting moment of less than 40 000 Nm or timber handling cranes, overload protection may be provided by a main relief valve or port relief valves for the boom cylinders. These pressure relief functions shall have tolerances in accordance with 5.6.2.1.

5.6.2.3 For loader cranes with a rated capacity of less than 1 000 kg and a maximum net lifting moment of less than 40 000 Nm, other than timber handling cranes, overload protection may be provided by a pressure relief function in the load holding valves for the boom cylinders. These pressure relief functions shall have tolerances in accordance with 5.6.2.1.

5.6.2.4 Any device capable of inhibiting the rated capacity limiter shall be fitted with a tamper-evident device.

5.6.3 Lowering facility

To avoid locking in of the loader crane, a lowering facility may be provided. This facility shall not allow any movement which may lead to a component failure or a loss of stability.

If this facility is fitted it shall be clearly identified. This facility shall only function whilst the control is held by the operator and for a period of maximum 5 s at intervals not shorter than 30 s.

5.6.4 Rated capacity indicators

The rated capacity indicator shall give a warning to the operator and persons in the vicinity of the crane when the load exceeds 90 % of the rated capacity. If the rated capacity is being exceeded there shall be a separate warning for overload to the operator.

There shall be a clear difference between the warning for approach to rated capacity and the warning for overload. Both warnings shall be continuous and shall be distinguishable as a warning to the persons concerned whilst the crane is being operated.

The warning of persons in the danger zone is not required for a loader crane with an outreach less than 12 m.

5.6.5 Limiters

5.6.5.1 Motion limiters

Slewing, raising/lowering and telescoping motion limits shall be determined by the stroke of the cylinder or by appropriate stops.

Unless the geometry of the crane ensures that the boom system remains stable in all working positions (e.g. booms approaching or passing the vertical), the crane shall be equipped with motion limiters for that purpose. This requirement does not apply to movements for coming in to or out of transport position.

5.6.5.2 Speed limiters

Speed limiters shall be incorporated into the slewing, raising/lowering and telescoping motion to ensure that any forces resulting from these motions are restricted to the design criteria of the loader crane.

5.6.6 Operational warning

Cranes with a remote control system shall have a device to warn persons in the vicinity that the crane is in operation. The warning device shall be either acoustic or by flashing lights that are visible from all directions. The warning shall be continuously given when the crane is in operation.

5.6.7 Acoustic warning

When a crane has a remote control system or a boom system having an outreach greater than 12 m, an audible warning device, e.g. horn, shall be provided. The audible warning device shall be capable of being actuated by the operator from each control station, unless the control station is not intended for normal operation or it is solely used for operating the stabilizer functions.

5.6.8 Stopping device

A control device to bring the loader crane safely to a complete stop shall be fitted at every control station unless the control station is solely used for operating the stabilizer functions. The device shall be designed, fitted and shall function as follows:

- a) it shall be easily visible by red coloured actuators, where practicable in front of an yellow background;
- b) activating the device shall not require any decision by the operator about the resultant function and effects, e.g. mushroom-type push button;
- c) the actuator shall be arranged for easy access and for non-hazardous operation by the operator;
- d) after stopping the crane no further dangerous movements of the boom system shall appear;

- e) the actuator shall lock-in where operated.

5.7 Controls

5.7.1 General

The following specify arrangement and direction of movements of controls assigned to working functions, such as slewing column, raising/lowering boom. Stabilizer functions are also included.

The requirements cover bi-directional and multidirectional (joy-stick) control levers.

The layout order of bi-directional controls shall follow the sequence of working functions from the base of the loader crane to the load handling device. Control levers for setting-up functions shall be separated by space or clearly distinguished (other than by using symbols) from other control levers.

All controls shall return automatically to the control position when they are released. They shall be marked permanently with clearly visible symbols as given in 5.7.2.

All controls shall be in accordance with the safety and ergonomic principles as specified in EN 13557 with the exception of lever force and lever spacing for remote controls.

For remote controls the lever force shall be between 2 N and 20 N and the minimum free space between lever tops shall be 8 mm. The minimum centre-centre distance between levers on remote controls shall be 30 mm.

5.7.2 Symbols

Symbols for the working and setting up functions of loader cranes having boom systems with two articulated booms shall be in accordance with Annex E. For loader cranes having other boom systems, any additional symbols that are necessary shall be derivatives of Annex E. The symbols shall be used as follows for bi-directional control levers:

- On the control lever knobs: Inside arrows indicate the movement of the corresponding lever. Only one symbol for a crane function and one arrow for the lever movement shall be combined. See Figure 2;
- When placed on a separate plate adjacent to the control levers, the symbols can be used without lever movement arrows. Two symbols for each lever can be used. See Figure G.3;
- The minimum size of a symbol shall be such that it is circumscribed by a 15 mm circle. For remote controls the minimum symbol size shall be 12 mm. In the case of multi-symbols the minimum size shall relate to the smallest, e.g. in accordance with Figure 2.

Dimensions in millimetres

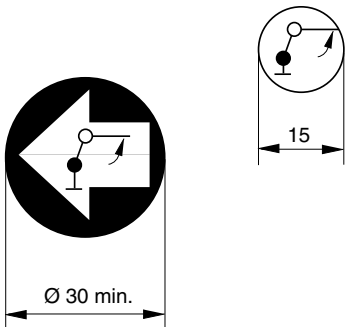
Knob of control lever	Meaning of symbol/arrow combination
 for one symbol/arrow combination	Move control lever to the left to raise second boom and Move control lever to the right to lower second boom

Figure 2 — Symbols for working function