

BS 7121-3:2017+A1:2019



BSI Standards Publication

Code of practice for safe use of cranes

Part 3: Mobile cranes

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Published by BSI Standards Limited 2019

ISBN 978 0 539 04387 7

ICS 53.020.20

The following BSI references relate to the work on this document:

Committee reference MHE/3/11

Draft for comment 19/30393610 DC

Amendments/corrigenda issued since publication

Date	Text affected
31 July 2019	A1: See Foreword.

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Foreword

Publishing information

This part of BS 7121 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 June 2017. It was prepared by Subcommittee MHE/3/11, *Crane safety and testing*, under the authority of Technical Committee MHE/3, *Cranes and derricks*. A list of organizations represented on these committees can be obtained on request to their secretary.

Supersession

BS 7121-3:2017 superseded [BS 7121-3:2000](#), which has been withdrawn.

BS 7121-3:2017+A1:2019 supersedes BS 7121-3:2017, which is withdrawn.

Relationship with other publications

[BS 7121-1](#) provides general recommendations for all types of cranes. BS 7121-2 (all parts) covers in-service inspection, maintenance, thorough examination and testing for the safe use of all types of crane. BS 7121-3 provides recommendations for mobile cranes. Other parts of BS 7121 deal with the specific crane types as follows:

- Part 4: Lorry loaders;
- Part 5: Tower cranes;
- Part 11: Offshore cranes;
- Part 12: Recovery vehicles and equipment;
- Part 13: Hydraulic gantry lifting systems;
- Part 14: Side boom pipelayers.

BS 7121 has been accepted as representing the consensus of practical experience for safety on cranes.

Information about this document

Text introduced or altered by Amendment No. 1 is indicated in the text by tags A1 A1. Minor editorial changes are not tagged.

This part of BS 7121 was revised to reflect [BS 7121-1:2016](#).

Use of this document

As a code of practice, this part of BS 7121 takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this part of BS 7121 is expected to be able to justify any course of action that deviates from its recommendations.

It has been assumed in the preparation of this part of BS 7121 that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. “organization” rather than “organisation”).

Contractual and legal considerations

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

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

In particular, attention is drawn to the following statutory regulations:

- The Health and Safety at Work etc. Act 1974 [1];
- The Lifting Operations and Lifting Equipment Regulations (LOLER) 1998 [2];
- The Provision and Use of Work Equipment Regulations (PUWER) 1998 [3];
- The Supply of Machinery (Safety) Regulations 2008 (as amended) [4];
- The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR) [5];
- The Road Traffic Act 1991 [6];
- The Road Vehicles (Construction and Use) Regulations 1986 (as amended) [7];
- The Road Vehicles (Authorisation of Special Types) (General) Order 2003 [8];
- The Vehicle Excise and Registration Act 1994 [9].

NOTE Details of the Lifting Operations and Lifting Equipment Regulations 1998 [2] and the Provision and Use of Work Equipment Regulations 1998 [3], together with an HSE Approved Code of Practice and HSE Guidance, are given in HSE publications Safe use of lifting equipment [N2] and Safe use of work equipment [10].

1 Scope

This part of BS 7121 provides recommendations for the safe use of mobile cranes (see 3.5) used for a wide variety of lifting operations in numerous locations, and is intended to be used in conjunction with BS 7121-1, which gives general recommendations for all types of cranes, and BS 7121-2 (all parts), which gives general guidance on inspection, testing and examination of all types of cranes.

NOTE Mobile cranes are manufactured in many different forms. Mobility is either by means of wheels or crawler tracks. Cranes can be fully mobile and able to travel with rated capacity loads suspended (pick and carry), or semi-mobile and not permitted to travel with suspended loads. Semi-mobile cranes include wheeled and crawler-mounted cranes, fitted with stabilizers or outriggers; and cranes that, due to size and weight, are taken to the work site in parts and assembled at the site. Cranes that are assembled on site to work from a fixed base with outriggers are also covered by this part of BS 7121.

This part of BS 7121 is not applicable to rail-mounted cranes, cruciform self-erecting tower cranes, cranes covered by other parts of BS 7121, or to the use of cranes:

- a) for bungee jumping or similar entertainment activities; or
- b) specifically designed for railway applications; or
- c) as part of a fully automated storage or production system.

While the recommendations in BS 7121-1 are for planning, management, selection of equipment and personnel, etc., for safe lifting with all types of cranes, this part provides specific recommendations for safety when dealing with the hazards caused by mobility and the diversity of locations for mobile crane lifting operations.

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.

[BS 7121-1:2016](#), *Code of practice for safe use of cranes — Part 1: General*

BS 7121-2 (all parts), *Code of practice for safe use of cranes — Part 2: Inspection, testing and examination*

[BS 7121-2-1:2012](#), *Code of practice for the safe use of cranes — Part 2-1: Inspection, maintenance and thorough examination — General*

[BS 7121-2-3:2012](#), *Code of practice for the safe use of cranes — Part 2-3: Inspection, maintenance and thorough examination — Mobile cranes*

[BS 7671](#), *Requirements for electrical installations — IET Wiring Regulations*

[BS EN 14502-1](#), *Cranes — Equipment for the lifting of persons — Part 1: Suspended baskets*

[N1] HEALTH AND SAFETY EXECUTIVE (HSE). *Guidance Note GS6, Avoiding danger from overhead power lines*, Sudbury, HSE Books, 2013.

[N2] HEALTH AND SAFETY EXECUTIVE (HSE). *Safe use of lifting equipment. Lifting Operations and Lifting Equipment Regulations 1998. Approved Code of Practice and guidance L113*, Second edition, Sudbury, HSE Books, 2014.

[N3] HEALTH AND SAFETY EXECUTIVE (HSE). *Guidance Note HSG 118, Electrical safety in arc welding*, Sudbury, HSE Books, 1994.

3 Terms and definitions

For the purposes of this part of BS 7121, the terms and definitions given in [BS 7121-1](#) and the following apply.

3.1 familiarization

process of ensuring that a trained operator is familiar with the characteristics of the MCWP they are required to operate where those characteristics differ from machines on which they have been trained

3.2 fly jib

additional jib fitted to the main boom tip to extend or offset the reach

NOTE 1 The main purpose of the fly jib is to increase the overall length of the main jib and to thereby increase the effective height of the lift. The fly jib can be set in the same line as the axis of the main jib, or can be offset at a fixed angle. If the fly jib is offset at an angle, the crane can be used to reach in over a structure (effectively increasing the radius). The greater the angle of offset, the higher the structure that can be negotiated and/or the further the crane can reach in to lift the load; but because of the increased stresses induced at the fly jib attachment point, only a reduced load can be lifted. A fly jib can be extended by insertion of intermediate lattice sections, but usually it is of shorter length than the main jib.

NOTE 2 Fly jibs can be of telescopic box construction but, because of a relatively high self-weight that can reduce their lifting capacity considerably, these are of limited application only.

3.3 free-on-wheels

ability to lift loads with a stationary, wheeled crane without the use of outriggers or stabilizers

3.4 load-enhancing equipment

equipment fitted to a mobile crane to increase the margin of stability or to reduce the structural stress within the loaded members, allowing the rated capacities for the crane configuration to be increased

NOTE Load-enhancing equipment may be known by a proprietary name (e.g. "Superlift"¹).

3.5 mobile crane

self-powered crane with a boom, which may be fitted on a mast (tower) and capable of travelling laden or unladen, without the need for fixed runways and which relies on gravity for stability, the chassis of the crane not having any capability to carry goods

NOTE 1 Mobile cranes can operate on tyres, crawlers or with other mobile arrangements. In fixed positions, they can be supported by outriggers or other accessories increasing their stability.

NOTE 2 The superstructure of mobile cranes can be of the type of full circle slewing, of limited slewing or non-slewing. It is normally equipped with one or more hoists and/or hydraulic cylinders for lifting and lowering the boom and the load.

NOTE 3 Mobile cranes can be equipped with telescoped booms (pinned), telescopic booms, articulated booms, or lattice booms – or a combination of these – of such a design that they can readily be lowered.

NOTE 4 Loads can be handled by hook block assemblies or other load-lifting attachments for special services.

[SOURCE: BS EN 13000:2010+A1:2014, **3.18**, modified]

¹ Superlift is a trade mark owned by Terex South Dakota, Inc., 500 Oakwood Road, Watertown, USA, 57201, and is the trade name of a product supplied by Terex. This information is given for the convenience of users of this standard and does not constitute an endorsement by BSI of the product named. Equivalent products may be used if they can be shown to lead to the same results.

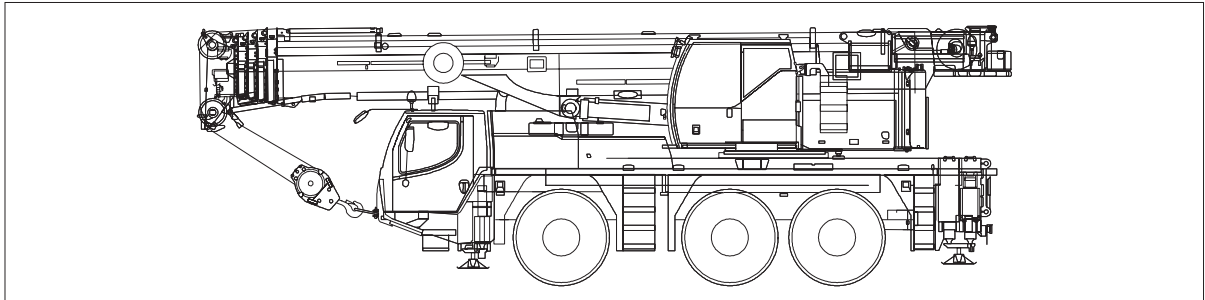
3.6 mobile crane types

3.6.1 all-terrain crane

telescopic jib, wheeled crane with a specially-designed chassis that allows travel on the highway at normal road speeds, and incorporates features, such as additional steering and driven axles, to give it better manoeuvrability on site

NOTE The term “all-terrain” does not mean that the crane can travel over rough, uncompacted ground.
See [Figure 1](#).

Figure 1 — All-terrain crane



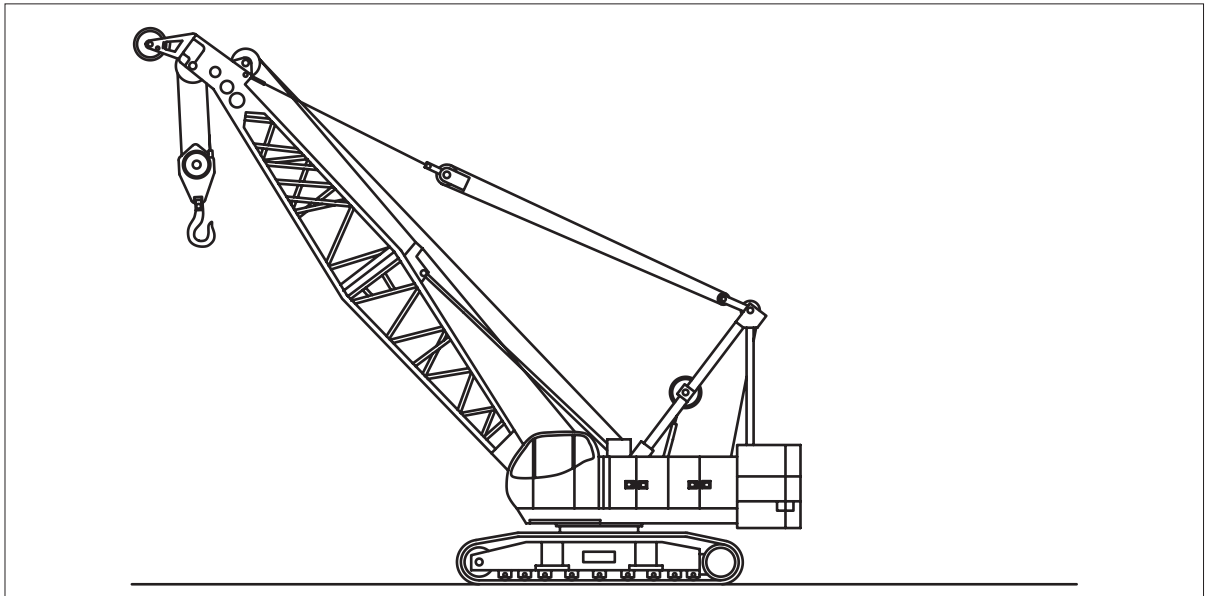
3.6.2 crawler crane

mobile crane mounted on crawler tracks, comprising a fully rotating crane superstructure connected, through a slewing ring or race, to a track-laying undercarriage

NOTE 1 The crane hoist system may have one, two or three rope drums. These can be operated by mechanical, friction clutch gear drives and friction foot brakes, although modern units are more likely to be driven and braked by hydraulic motors. See [Figure 2](#).

NOTE 2 Crawler cranes were developed from the rope-operated dragline excavator.

Figure 2 — Crawler crane



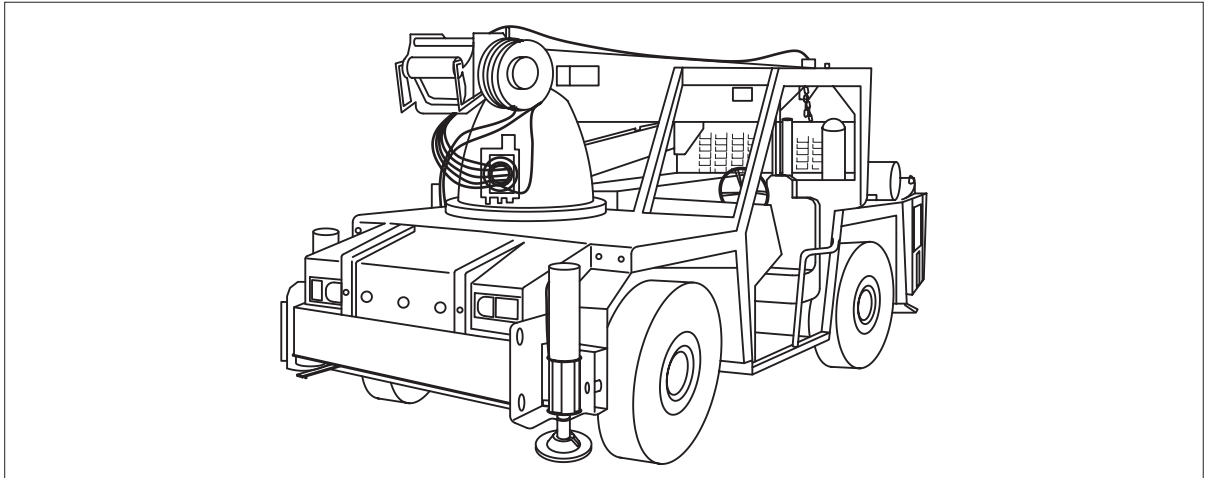
3.6.3 low-headroom crane

crane designed to lift and carry loads in locations where there is an overhead clearance restriction, e.g. on a factory floor

NOTE Low-headroom cranes have two axles (usually one to drive and one to steer, although in special applications both axles can drive). A single engine provides power for travel and crane motions. The jib is of

cantilever, telescopic construction, but there can be the option of extensions (e.g. a fly jib). Travel speed is lower than for small all-terrain cranes. See [Figure 3](#).

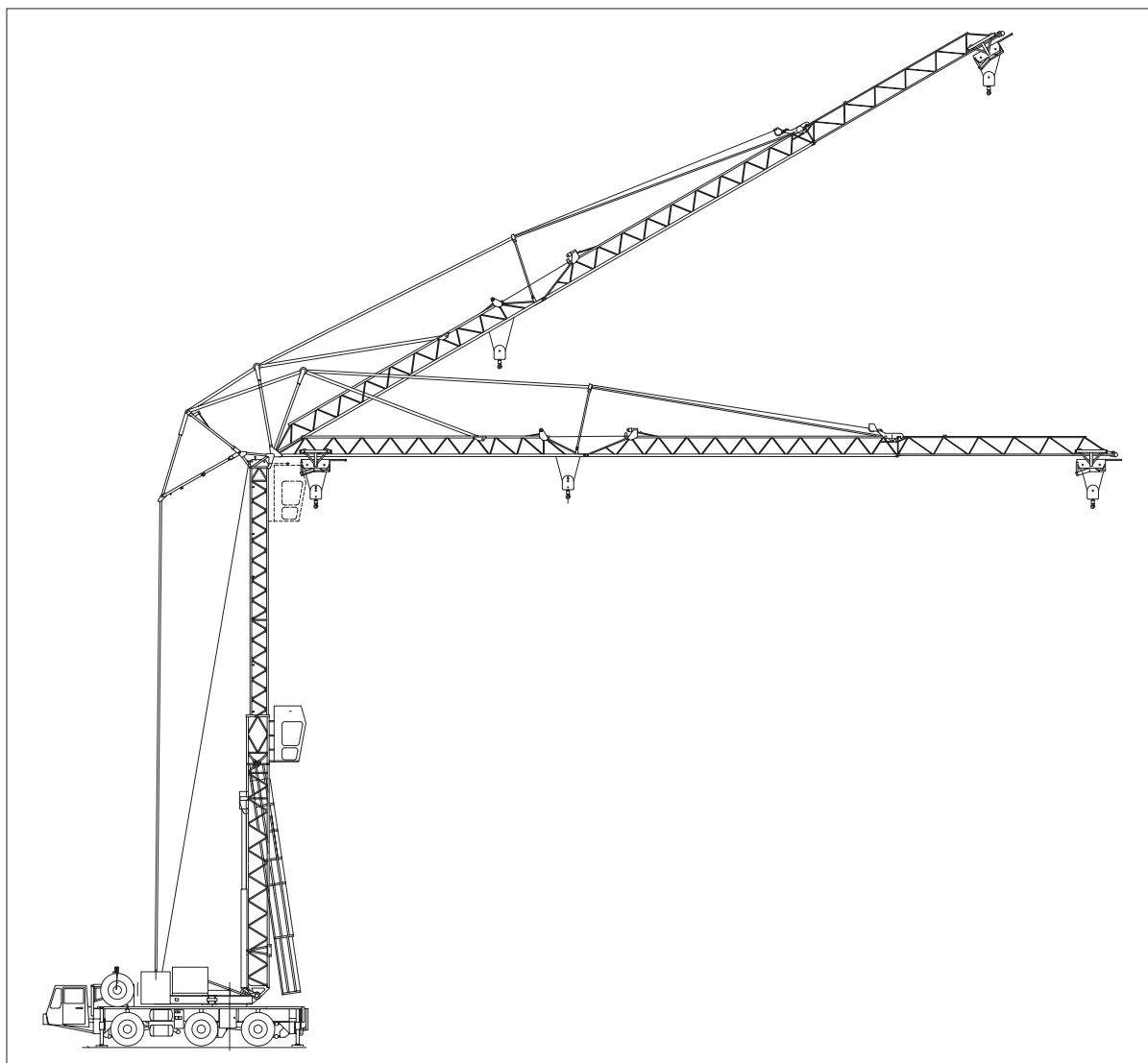
Figure 3 — *Low-headroom crane*



3.6.4 mobile self-erecting tower crane

self-erecting tower crane mounted on a self-propelled chassis

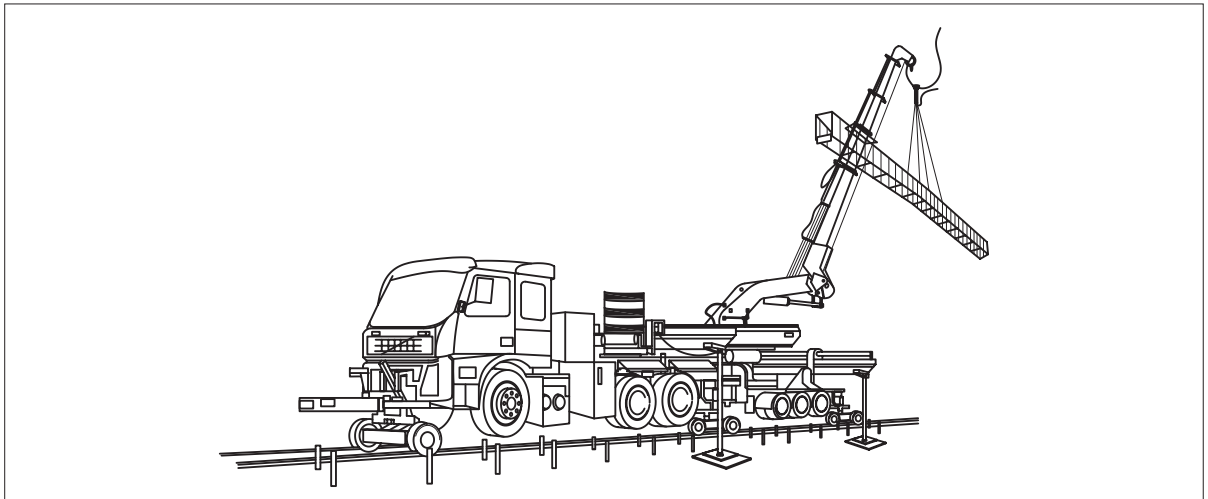
NOTE See [Figure 4](#).

Figure 4 — *Mobile self-erecting tower crane*

3.6.5 road-rail crane

wheeled or crawler crane fitted with rail gear allowing the crane to travel to a location, move on to the rail track, deploy the rail wheels and travel along the rail track guided by the rail wheels

NOTE See [Annex A](#) for more information on road-rail cranes. See [Figure 5](#).

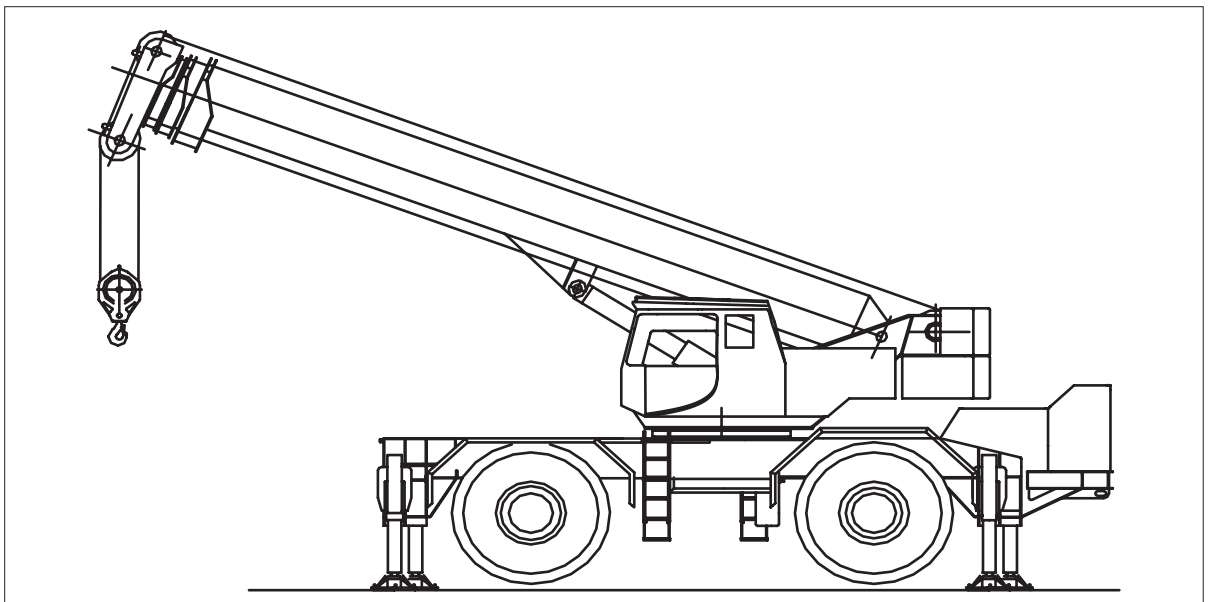
Figure 5 — Road-rail crane

3.6.6 rough-terrain crane

telescopic jib, wheeled-mounted crane, intended for use on a site where a number of loads are lifted at different locations and able to quickly move loads between the lift locations on site, and not intended for travel on the road/highways

NOTE 1 The manufacturer's manual ought to specify the conditions that apply to free-on wheels and pick-and-carry operations.

NOTE 2 See [Figure 6](#). "Rough-terrain" does not mean that this type of crane can travel over, and lift loads on, uneven ground with poor load-bearing ability. Rough-terrain cranes require the same ground conditions as other wheeled vehicles (i.e. ground firm enough for good traction without excessive sinking).

Figure 6 — Rough-terrain crane

3.6.7 semi-mobile crane

mobile crane which can travel to the position from which a lift is to be carried out and is then fitted with additional equipment to enhance its lifting capacity

NOTE 1 Once fitted with the additional equipment the crane is generally not be able to travel.

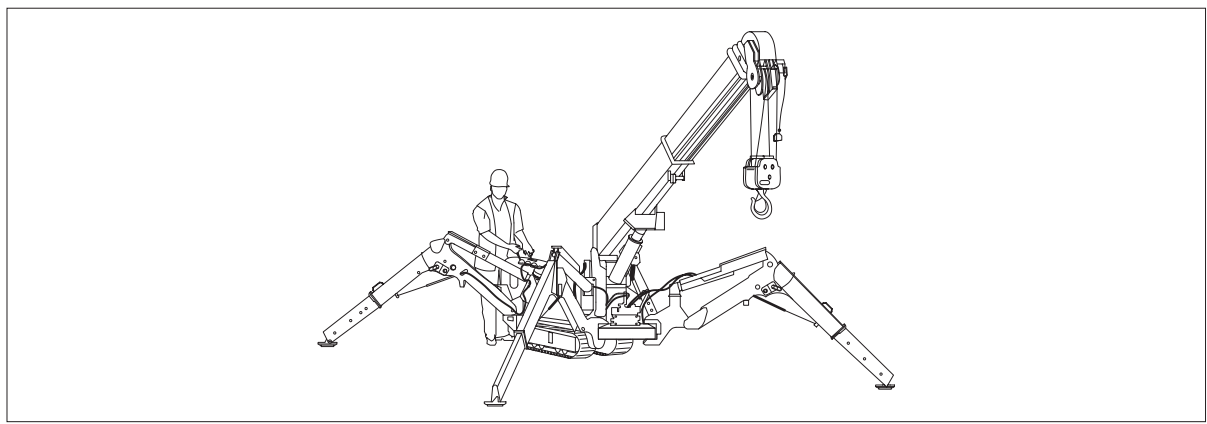
NOTE 2 An example of a semi-mobile crane is a crawler crane fitted with a Ringer² system.

3.6.8 spider crane (mini crawler/crane)

compact crawler type crane for use on congested construction sites, commonly between floors on multi-storey buildings or where access is a problem for conventional lifting machines

NOTE See Figure 7. Additional equipment for use with mini cranes, such as fly-jibs, searcher hooks and a robotic glazing vacuum head, add to their functionality.

Figure 7 — Spider crane

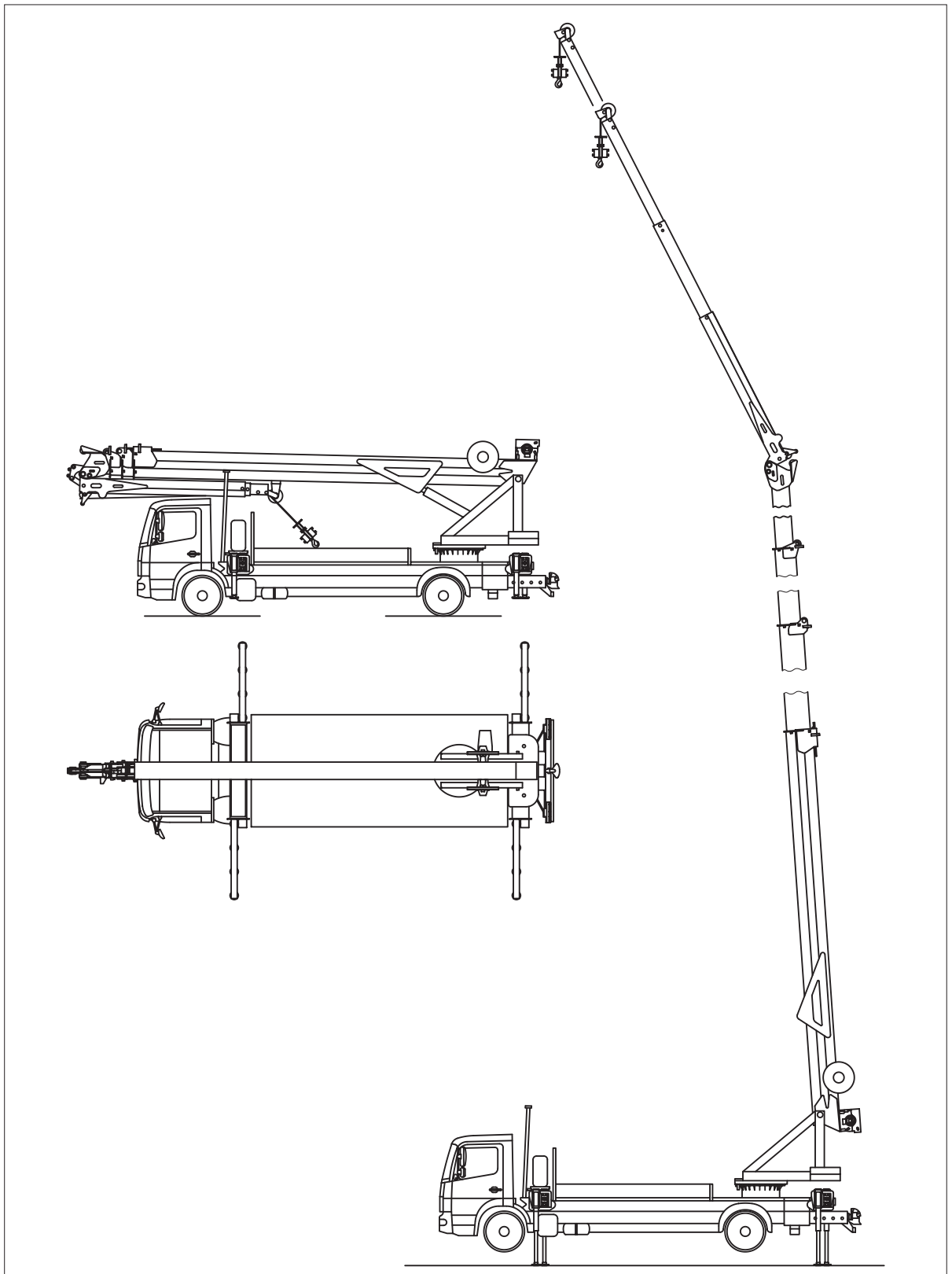


3.6.9 truck-mounted crane

crane unit mounted on a road truck chassis that is able to travel on public highways at normal road speeds

NOTE The chassis can be of an ordinary commercial truck that has been adapted, or it might have been specially manufactured to carry the superstructure unit. In either case the chassis is fitted with a set of outriggers or stabilizers to provide improved stability when lifting loads (see Figure 8).

² Ringer is a trade mark owned by The Manitowoc Company, Inc., 2400 South 44th Street, Manitowoc, Wisconsin, USA, and is the trade name of a product supplied by Manitowoc Cranes. This information is given for the convenience of users of this standard and does not constitute an endorsement by BSI of the product named. Equivalent products may be used if they can be shown to lead to the same results.

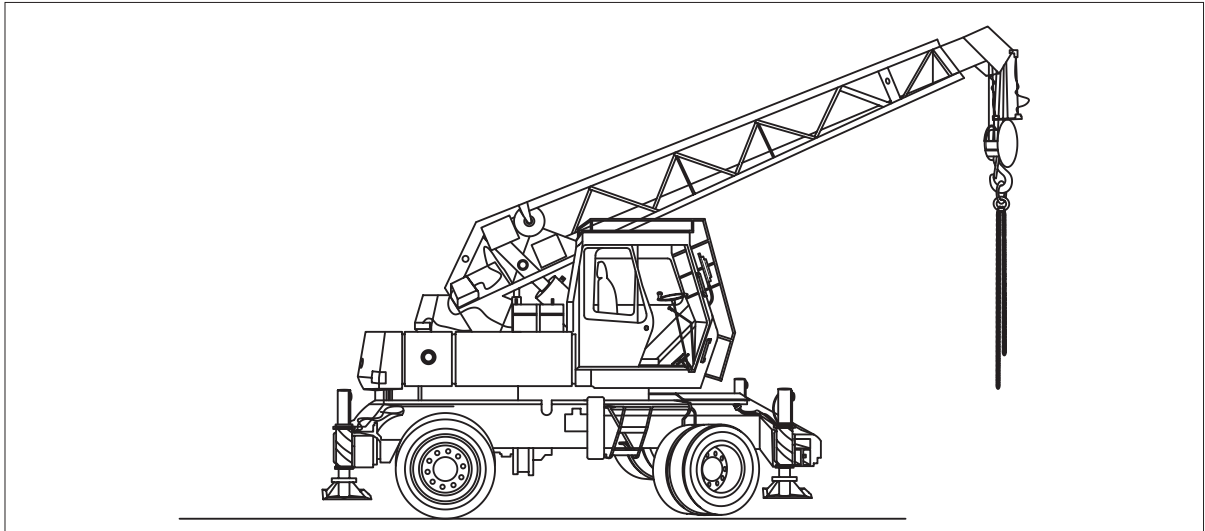
Figure 8 — *Truck-mounted crane*

3.6.10 yard crane

wheeled crane designed for working within a work site or factory where there is a known range of loads to be lifted

NOTE See [Figure 9](#). The crane chassis is short and usually fitted with two axles (one to steer and one driven). Power for travel is provided by the crane engine. Speed of travel is usually around walking pace.

Figure 9 — Yard crane



3.7 pick-and-carry

lifting operation that involves travelling with rated capacity loads suspended

3.8 slew limiter/restricter

device to prevent slewing beyond specified limits

3.9 variable base outriggers

outriggers that allow the crane to operate at a rated capacity which is proportionate to the extent of outrigger deployment at locations where space is limited

4 Management of installation and lifting operations

4.1 Safe system of work

4.1.1 A safe system of work should be established and followed for every crane installation operation or lifting operation, whether it is an individual lift or a group of repetitive operations.

4.1.2 The safe system of work should include:

- a) planning of the lifting operation, including preparation of the lift plan (see [Clause 5](#));
- b) selection, provision and use of a suitable crane(s) and work equipment;
- c) any necessary preparation of a site for the lifting operation, including any entry or exit travel routes for the crane(s);
- d) any rigging, de-rigging or setting up of the crane(s), e.g. manual boom extensions, stabilizers, outriggers and counterweight;
- e) inspection, maintenance, thorough examination and, where necessary, testing of the crane(s) and equipment and ensuring reports are available;

- f) the provision of properly trained and competent personnel who have been made aware of their responsibilities under the Health and Safety at Work etc. Act 1974 [\[1\]](#);
- g) adequate supervision by properly trained and competent personnel having the necessary authority;
- h) preventing unauthorized movement or use at all times;
- i) coordination of crane movements to avoid collisions between cranes and other items of plant or structures;
- j) the safety of persons not involved in the installation or lifting operation; and
- k) the need for the operator, unless in imminent danger, to remain in control of the crane throughout the lifting operation.

4.1.3 The safe system of work should be communicated effectively to all parties concerned.

NOTE It is essential for the safety of the operation to ensure that all personnel involved can communicate clearly in the same language.

4.2 Control of the lifting operation

4.2.1 General

4.2.1.1 In order to implement the safe system of work effectively, one person should be appointed to have overall control of the lifting operation to act on behalf of the management of the employing organization. The appointment of this person does not remove any legal responsibility from the management but enables them to use the appointed person's expertise. The person appointed may have other duties and need not be an employee of the employing organization. The appointed person should have adequate training and experience to enable them to carry out their duties (see [4.3.1](#)) competently.

NOTE The appointed person has a duty to ensure that the crane selected has adequate capacity for the intended use. The crane user has a duty to ensure that all lifts are carried out in accordance with the lift plan.

4.2.1.2 On large construction sites where multiple lifting operations are carried out by various subcontractors, the principal contractor should appoint the appointed person for the site. Each of the subcontractors on site may employ individuals who have undergone appointed person training, but they should remain subservient to the principal contractor's appointed person. The principal contractor's appointed person should ensure that the crane coordinator is advised of all lifting operations, to allow them to perform their duties.

4.2.2 Selection of appointed person

4.2.2.1 When selecting and assessing an appointed person, the employing organization should take into account the variety and complexity of the operation, as well as all the problems that could arise from proximity hazards and environmental causes. The appointed person should be notified formally in writing of their appointment.

NOTE To assist in the selection of an appointed person, some examples of lifting operations that require different levels of expertise, training and experience, and that impose different duties on the appointed person, are given in [4.3](#).

4.2.2.2 An appointed person should be trained in accordance with [BS 7121-1:2016](#), Annex A.

4.2.2.3 The employing organization should review the performance of the appointed person at planned intervals.

NOTE The duties of an appointed person for crane operations can vary according to the complexity of the operation. The duties for a basic lift are considerably fewer and less demanding than for a complex lift. An

appointed person employed for a basic lift might not be competent to carry out a more complicated operation, and another appointment could be required for this. 4.3.2 can be used to make an appropriate appointment and produce a suitable lift plan for each lifting operation.

4.3 Duties of the person appointed to control the lifting operation

4.3.1 General

4.3.1.1 The appointed person's duties should include:

- a) planning the lifting operation (including approval of all risk assessments, lift categorizations and method statements), selection of the crane(s) and lifting accessories, instruction and supervision, and consultation with other responsible bodies to ensure effective collaboration as is necessary for the work to be undertaken safely;
- b) ensuring that the outcomes of the planning process are recorded in a lift plan;
- c) ensuring that adequate pre-operational checks, intermediate inspections, maintenance and thorough examination of the equipment have been carried out;

NOTE 1 For further information see BS 7121-2-3.

- d) ensuring that there is an effective procedure for reporting defects and incidents and for taking any necessary corrective action;
- e) taking responsibility for the organization and control of the lifting operation;
- f) ensuring that the crane supervisor and other members of the lifting team are fully briefed on the contents, scope and limits of the method statement (see 5.3); and

NOTE 2 This is generally acknowledged by the recipients by signing the briefing document.

- g) being familiar with the relevant parts of the project health and safety plan where the lifting operation is being carried out on a site where the Construction (Design and Management) Regulations 2015 [11] apply, and following, where appropriate, the recommendations of Annex B.

NOTE 3 Further guidance on roles and responsibilities under the Construction (Design and Management) Regulations 2015 [11] is given in the HSE's Managing health and safety in construction: Construction (Design and Management) Regulations 2015. Guidance on Regulations [12] and A short guide for clients on the Construction (Design and Management) Regulations 2015 [13].

4.3.1.2 The appointed person should be given the necessary authority for the performance of all these duties, including the authority to:

- a) stop the operation whenever they consider that danger is likely to arise if the operation were to continue;
- b) consult others with specialist knowledge and experience; and
- c) delegate duties and tasks, but not responsibilities, for any part of the safe system of work to suitably qualified individuals.

4.3.1.3 The appointed person should be aware of the limits of their knowledge and experience about lifting operations, and, when conditions exceed these limits, further advice should be sought.

4.3.1.4 Where the appointed person requires the assistance of specialists such as crane suppliers, geotechnical engineers, structural engineers and the designer of the load, care should be taken to ensure that these specialists have the necessary competence for the specific task for which assistance is sought.

4.3.2 Lift category and control measures

4.3.2.1 General

COMMENTARY ON 4.3.2.1

The complexity of a lifting operation depends on the hazards associated with the load path, the load itself and the equipment lifting it, and the environment in which the lifting operation is being carried out. [Table 1](#) lists examples of some load and environment hazards which can be encountered during lifting operations.

Table 1 — Example load and environmental hazards associated with lifting operations

Load hazards	Environmental hazards
Position of centre of gravity, including unknown position	Rain
High temperature load	Ice
Fluid load or unsecured elements within the load	Snow
Lifting of people	Wind
Location of lifting points	Sea state
Complex slinging arrangements	Railways
Uncertainty of magnitude of load: suction, adhesion, etc.	Roads
Use of more than one crane	Waterways
Integrity of load	Petrochemical plants
Dynamics of the load, e.g. floating load	Nuclear plants
High surface area and/or drag coefficient	Airports and aerodromes
Aerial load transfer	Telecommunications masts and other sources of electromagnetic radiation
Orientation of the load	Corrosive atmospheres
Load stability	Adjacent cranes or other plant
Fragility	Power lines: overhead and underground
Sharp edges	Public places
Load restraint	Partially-obscured load path
Lowering heavy loads from elevated locations	Uneven ground (pick-and-carry)
	Ground suction
	Partially-secured load (demolition)
	Lightning
	People (consequence of failure)
	Poor ground conditions, e.g. saturation
	Poor access

- 4.3.2.1.1** To enable a lift to be planned, supervised and carried out effectively, the appointed person should carry out the activities recommended in [4.3.2.2](#), [4.3.2.3](#) and [4.3.2.4](#), depending on whether an assessment of the hazards associated with the load, lifting equipment and the environment in which the crane is to be operated indicates that the lift is:
- basic, i.e. the weight of the load(s) can be simply established and there are no significant hazards within the working area or on the access route for the crane to the working area;
 - intermediate, i.e. there are significant hazards, either within the working area of the crane or on the access route for the crane to the working area; or
 - complex, i.e. the crane is used to lift complex loads or persons, where two or more cranes are used to lift the load, or where the lifting operation is carried out at a location with exceptional hazards.

NOTE 1 As demonstrated in [Figure 10](#), increases in either or both environmental complexity or load complexity (the “complexity index”; see [Table 2](#)) lead to the lift being allocated a higher category.

NOTE 2 Consideration of environmental hazards at the location of the operation includes the access and egress required for the crane and the suitability of the ground to take the loads imposed by the crane during preparation for the lift and during the lift itself.

NOTE 3 Load complexity includes characteristics such as weight, centre of gravity and presence of suitable lifting points. This can be established by a reliable source of information, measuring and weighing the load, or calculation (with allowance for possible inaccuracies).

- 4.3.2.1.2** Having identified the hazards associated with a particular lift, a hierarchy of control measures should be applied to eliminate or control those hazards and reduce the risks.

Figure 10 — Relationship between complexity index and lift category

Environmental complexity (E)	3	Complex	Complex	Complex
	2	Intermediate	Intermediate	Complex
	1	Basic	Intermediate	Complex
		1	2	3
Load complexity (L)				

Key

1 Low
2 Medium
3 High

NOTE [Table 2](#) shows how lifting the same load in differing environments and lifting different loads in the same environment can lead to different lift categories.

Table 2 — Illustration of the categorization of lifts based on environmental and load complexities

Complexity, variables and constants	Lift category		
	Basic	Intermediate	Complex
Increasing environmental complexity	The crane operator has clear sight of the load path and the load is lifted from and to the ground.	The load is to be placed over an obstruction such that the crane operator does not have clear sight of the landing area from the control position.	The load is to be placed on a structure at height, without line of sight and with overhead power lines in close proximity.
Constant low load complexity	A load of known weight with designated top lifting points and central centre of gravity. The load does not contain fluids, is not fragile and is inherently stable when landed.	A load of known weight with designated top lifting points and central centre of gravity. The load does not contain fluids, is not fragile and is inherently stable when landed.	A load of known weight with designated top lifting points and central centre of gravity. The load does not contain fluids, is not fragile and is inherently stable when landed.
	Complexity index E1:L1	Complexity index E2:L1	Complexity index E3:L1

Table 2 (continued)

Complexity, variables and constants	Lift category		
	Basic	Intermediate	Complex
Increasing load complexity	A load of known weight with designated top lifting points and central centre of gravity. The load does not contain fluids, is not fragile and is inherently stable when landed.	A load of estimated weight with an estimated centre of gravity and without designated lifting points. The load does not contain fluids, is not fragile and is inherently stable when landed.	A load of estimated weight and centre of gravity and without designated lifting points. The load contains fluids, is fragile and is not stable when landed.
Constant low environmental complexity	The crane operator has clear sight of the load path and the load is lifted from and to the ground.	The crane operator has clear sight of the load path and the load is lifted from and to the ground.	The crane operator has clear sight of the load path and the load is lifted from and to the ground.
	Complexity index E1:L1	Complexity index E1:L2	Complexity index E1:L3

4.3.2.2 Basic lift

For a basic lift, the duties of the appointed person should include:

- a) an assessment of the proposed location of the lifting operation as part of the planning process to check that there are no significant hazards in the operating area, including any areas required for access or setting up of the crane;

NOTE 1 The appointed person may make an assessment on the basis of information with which they have been provided, visit the site personally or delegate a competent person to undertake the visit on their behalf.

- b) selecting the crane, based on:
- 1) the load characteristics, including weight of the load and any lifting accessories;
 - 2) the maximum height of lift;
 - 3) the maximum radius required and/or the reach and range of movement required; and
 - 4) the rated capacity of the crane, as specified by the manufacturer/installer in the information for use supplied with the crane;

NOTE 2 The manufacturer's sales leaflets ought not to be relied on for the rated capacity for a specific crane.

- c) establishing the maximum permissible wind speed in which the lifting operation can be safely undertaken, taking account of the maximum permissible wind speed specified by the manufacturer for the crane and movement of the load in the wind, including any reduction in permissible wind speed or restrictions in rated capacity required for the wind area of the load, and ensuring that the crane is not operated in wind speeds in excess of that established;

NOTE 3 See BS 7121-1:2016, Annex D, for the effect of wind speed.

- d) ensuring that the crane has a current report of thorough examination stating that it is safe to use, with evidence that pre-use checks have been carried out, and confirming that the equipment is considered safe;
- e) ensuring that the crane has been adequately maintained and that records of the maintenance are available;
- f) selecting appropriate lifting accessories, including their method of attachment to the load, configuration, centre of gravity and any protection used to prevent damage;

- g) ensuring that lifting accessories are thoroughly examined at least within the previous six months, and inspected and checked before use, and that the report of thorough examination is available to confirm that the lifting accessories are safe to use;
- h) ensuring that a system for reporting and rectifying defects is in place;
- i) determining any requirement for personnel in addition to the crane operator, such as a slinger-signaller, signaller or dedicated crane supervisor;

NOTE 4 For guidance on the combination of roles during a basic lift, see [BS 7121-1:2016](#), 6.2.8.

- j) designating a suitable person to check that the lifting accessories and any lifting points on the load are free from any obvious defects before attaching the load to the crane;
- k) defining the extent of any exclusion zone required and how it is to be controlled;
- l) ensuring that the outcomes of the planning process, including the hazards identified (see [Table 1](#)) and the lift categorization (see [Figure 11](#) and [Table 2](#)), are recorded in the lift plan which is signed by the appointed person;

NOTE 5 In many instances, a generic lift plan is suitable for basic lifts, provided that no additional hazards are identified on site.

NOTE 6 A risk assessment and method statement are parts of the lift plan.

- m) briefing all persons involved in the lifting operation about the safe system of work described in the method statement, and obtaining signed acknowledgement from those briefed that they have understood;
- n) instructing all persons involved in the lifting operation to seek advice from the appointed person if any change is required to the lifting operation, or if any doubts about safety arise;
- o) if one or more hand lines/tag lines are required to give more control of the load, designating persons to handle the lines;
- p) checking that no changes are required in the safe system of work if numerous loads are to be lifted over a long period; and
- q) ensuring that a crane supervisor is designated to direct personnel and to identify any hazards not identified in the lift plan, and that the operation is carried out in accordance with the method statement.

4.3.2.3 Intermediate lift

For an intermediate lift, the duties of the appointed person should include the following, in addition to those in [4.3.2.2](#):

- a) identifying all significant hazards in the operating area, including any areas required for access or setting up of the crane, which may involve an assessment of the proposed location of the lifting operation as part of the planning process, which itself may involve a visit to the site;
- NOTE The appointed person may visit the site personally or delegate a competent person to undertake the visit on their behalf.*
- b) ensuring that a site and/or task-specific risk assessment and method statement are prepared, detailing control measures for the identified risks;
 - c) liaising with any other person or authority, as required to overcome any hazard, by including any necessary corrective action or special measures in the safe system of work; and
 - d) considering the effect of the lifting operation on surrounding property or persons, including the general public, arranging for appropriate action to minimize any adverse effects and giving appropriate notice to all persons concerned.

4.3.2.4 Complex lift

For a complex lift, the duties of the appointed person should include the following, in addition to those in [4.3.2.2](#) and [4.3.2.3](#):

- a) visiting the location of the planned lifting operation as part of the planning process and identifying all exceptional hazards in the operating area, including any areas required for access or setting up of the crane;
- b) ensuring that the method statement includes access, ground conditions, setting up, etc., as well as the exact sequence of operations when lifting the load;
- c) preparing a detailed and dimensioned drawing of the site, the crane and the load, identifying the load path, pick-up and set-down areas, together with the position of any exceptional hazards in the area, and including plan and side elevations as necessary to identify the position and extent of any hazards and to enable the operator to position the crane accurately;
- d) ensuring that, where persons are being lifted, the recommendations of [BS 7121-1:2016, 20.1](#), are followed;
- e) ensuring that, where the lifting operation requires more than one crane to lift the load, the recommendations of Clause [15](#) are followed; and
- f) being present on the site during a complex lift, unless they select a competent deputy to attend in their place.

5 Planning of the lifting operation

5.1 General

- 5.1.1** All lifting operations should be planned to ensure that they are carried out safely and that all foreseeable risks are eliminated or mitigated so far as is reasonably practical. Planning should be carried out by the appointed person who has the appropriate knowledge for the lift being undertaken (see [4.3](#)). The outcome of the planning process should be a written lift plan which includes risk assessments, method statements and supporting information, such as a schedule of lifts, drawings and photographs.

NOTE 1 For repetitive or routine basic lifting operations, this planning might only be necessary in the first instance, with periodic reviews to ensure that no factors have changed.

NOTE 2 For lifting operations carried out on construction projects, further information on the duties of personnel is given in [4.3.1.1g](#)).

- 5.1.2** Planning of the lifting operation should take into account:

- a) the load, its characteristics and the method of lifting, particularly when loads are lifted out of water, e.g. flow, suction, loss of buoyancy, position of centre of gravity;
- b) any adhesion between the load and its support and any other forms of resistance to lifting;
- c) the stability of the load when being lifted and set down;
- d) maximum motion speeds, acceleration and deceleration;
- e) the selection of a suitable crane(s) appropriate to the operation, ensuring that adequate clearances are maintained between the load(s) and the crane structure (see [5.5](#));
- f) the selection of lifting accessories/attachments, the weight to be taken into account when assessing the load on the crane(s);
- g) the position of the crane(s) and of the load before, during and after the operation;

- h) the site of the lifting operation, including proximity hazards, space availability and suitability of the ground or foundations and other environmental conditions;
 - i) the proximity of other cranes and/or other plant/structures;
 - j) zones where the crane and/or parts of the crane and load-lifting attachments are prohibited from entering or oversailing, including set-up, calibration and verification of limiting systems;
- NOTE 1 See BS 7121-1:2016, Annex E, for precautions to be taken when using cranes close to or at sites with exceptional hazard potential, such as railways, chemical plant and nuclear installations.*
- k) any necessary set-up (configuration) of the crane(s), including rigging and de-rigging;
 - l) the identification and selection of personnel for the lifting operation, including effective communication taking account of language differences between members of the lifting team;
 - m) the environmental conditions that exist or might occur at the site of the operation or the effect of the load on the crane, e.g. lifting with a floating crane might involve a change of angle of heel or trim of the supporting vessel if lifting on water, which could necessitate stopping the operation when conditions are unsuitable;
 - n) management of change: the need for any deviations from the plan or site changes to be referred back to the appointed person before the lifting operation proceeds.

NOTE 2 Lone working is to be avoided wherever possible. Where this is not possible, it is essential that suitable measures are put in place to minimize risk to the lone worker.

5.2 Risk assessment

- 5.2.1** The risk assessment carried out by the appointed person as part of the planning process should identify the hazards associated with the proposed lifting operation. This should take account of any hazards that are present at the proposed lifting site. The assessment should evaluate the risks involved and the nature and extent of any measures required to mitigate those risks. The appointed person should also take into consideration hazards identified by the overall site risk assessments.

NOTE Attention is drawn to the Management of Health and Safety at Work Regulations 1999 (as amended) [14], which require a risk assessment to be carried out.

- 5.2.2** The results of the risk assessment should be recorded in writing and used in the preparation of the method statement (see 5.3) for that site.

NOTE The employing organization needs to inform the appointed person of hazards identified by the overall site risk assessments.

5.3 Method statement

- 5.3.1** The risk assessment(s), together with the manufacturer's instructions, should be used by the appointed person (see 4.3) to develop a method statement detailing the safe system of work (see 4.1) for the transportation, movement, assembly, rigging, use and de-rigging of the crane at the site.
- 5.3.2** The appointed person should, when necessary, consult others with specialized knowledge and experience.
- 5.3.3** The method statement should include:
- a) the tasks to be performed, together with the configuration of the crane at the end of each day's work;
 - b) plans for safely taking the crane out of service, taking into account manufacturer's requirements for the crane's specific configuration;
 - c) details of the control measures to be followed to eliminate or minimize risk to members of the lifting team;

- d) details of the steps to be taken to eliminate danger to personnel not involved in the lifting operation, and, where necessary, prevent their entry into danger zones, e.g. organizing road closures and segregation zones;

NOTE 1 Exclusion zones require the agreement of the employing organization (site owner or principal contractor) responsible for the enforcement of these zones.

- e) the requirement for pre-use checks to be completed;
- f) a clear statement of the allocation of tasks to all parties involved in the lifting operation;
- g) a description of the item(s) to be lifted, including its weight, dimensions and centre of gravity;
- h) lifting points/method;
- i) type of lifting accessories to be used and configuration;
- j) pick-up and landing points referenced to the site plan;
- k) the height of the lift and the maximum radius where applicable;
- l) the model and configuration of crane to be used;
- m) outrigger/stabilizer support arrangements, including assessment of ground or supporting structure;
- n) overhead hazards;
- o) underground hazards;
- p) personnel involved, together with information as to which roles if any may be combined;
- q) the sequence in which lifting operations are to be undertaken;
- r) control measures to be implemented to eliminate or minimize risk;
- s) method of communication, e.g. hand signals or radios;
- t) environmental limitations, such as maximum permitted wind speed for the lifting operation and sea state for lifting with a floating crane or lifting from a vessel on the sea;
- u) arrangements for any working at height, including rescue plans;
- v) access to attach and remove lifting accessories; and
- w) measures to be taken to ensure that the load remains stable after lifting accessories have been released.

NOTE 2 The lifting operation will be under the control of a crane supervisor who has the authority to stop the work if there are any safety concerns.

- 5.3.4** The method statement should specify clear roles for each member of the lifting team. Arrangements for effective communication among the team (and, if necessary, with adjacent crane operators in case of danger) should be available.

5.4 Team briefing/induction

- 5.4.1** The crane supervisor should ensure that each member of the lifting team is briefed on the specific features of the planned lifting operation at the start of the job. The lift plan should provide the basis of this briefing. The team should also be briefed on the general site precautions. If the composition of the team changes during the work, new members should be briefed on the lift plan and any other relevant issues.
- 5.4.2** A copy of the lift plan and associated supporting documents should be made available to all those involved in the lifting operation. Lifting team members should sign a record to acknowledge their attendance at and understanding of the briefing.

- 5.4.3 During the site induction, the crane supervisor or principal contractor's representative should seek the views of the team about any arrangements for health and safety that might be relevant to them.
- 5.4.4 Arrangements for effective communication among the team (and, if necessary, with adjacent crane operators in case of danger) should be available.
- 5.4.5 The briefing should be given using a language common to all lifting team members, so that they can fully understand it without the need for translation.

5.5 Selection of cranes

Cranes should be selected in accordance with Clause 7.

5.6 Siting of crane

Cranes should be sited in accordance with Clause 8.

5.7 Contracts

5.7.1 General

If an individual or organization does not have expertise in lifting operations they should not hire cranes but should opt for a contract lift. Before entering into a contract, the employing organization should satisfy itself that the contractor has the necessary competence to carry out the work. Crane hire should not be offered to domestic customers.

NOTE 1 See Annex B for an explanation of the various types of contract lift. Responsibilities for insurance in terms of the crane, personnel, load and third parties might also need to be clarified.

Whether lifting operations are being undertaken under crane hire agreements or as contract lifts, the contractor should ensure that:

- a) a person is appointed in accordance with 4.3;
- b) adequate information regarding site conditions is obtained;

NOTE 2 It is the responsibility of the employer to provide this information to the contractor in writing.

- c) the lift is planned and a safe system of work is followed;
- d) the lifting operation is appropriately supervised and carried out in a safe manner;
- e) the crane provided is properly maintained, inspected and thoroughly examined;
- f) a competent operator is provided; and
- g) lifting operations are carried out in accordance with BS 7121.

NOTE 3 Compliance with BS 7121 does not relieve organizations of their statutory and common law obligations.

5.7.2 Contract lifting operations

5.7.2.1 Formally contracted lifting

- 5.7.2.1.1 Before entering into a contract, the employing organization should confirm that a contractor has the necessary competence to carry out the work in accordance with the applicable part(s) of BS 7121.
- 5.7.2.1.2 Where the employing organization enters into a contract with a contractor who undertakes the work on its behalf, the parties to the contract should ensure that:
 - a) all work is carried out in accordance with the applicable part(s) of BS 7121; and
 - b) the contractor has full authority from the employing organization to work, including, where appropriate, authority to control and instruct the employing organization's personnel.

5.7.2.2 Contract lifting as part of the supply and delivery of goods to a non-domestic customer*COMMENTARY ON 5.7.2.2*

An organization requesting the supply and delivery of goods (the employing organization) which involves a lifting operation with a crane to unload the goods from the delivery vehicle is entering into a de facto contract lift agreement with the person delivering the goods (the contractor).

5.7.2.2.1 Before entering into a contract, the employing organization should confirm that a contractor has the necessary competence to carry out the work in accordance with BS 7121.

5.7.2.2.2 The contractor should be given full authority by the employing organization to work in accordance with BS 7121, including, where appropriate, authority to control and instruct the employing organization's personnel.

NOTE Compliance with BS 7121 does not relieve organizations of their statutory and common law obligations.

5.7.2.3 Hybrid lifts*COMMENTARY ON 5.7.2.3*

Where a crane is hired by the owner to the employing organization and the crane owner becomes involved with the planning of the lift, a hybrid situation exists where it is unclear who is responsible for ensuring that the recommendations of 4.1 are complied with. This could result in incomplete planning and an ineffective safe system of work.

Hybrid lifts should not be undertaken.

5.7.3 Duties when a crane and operator are hired

5.7.3.1 When a crane is hired out together with an operator, the crane owner should provide a competent operator and a crane that is properly maintained, inspected and tested in accordance with BS 7121-2 and has a current report of thorough examination, together with a written method statement for the rigging of the specific crane.

5.7.3.2 The user organization should nominate the appointed person in accordance with 4.3 and follow the recommendations of BS 7121. Notwithstanding any advice the crane owner provides about crane selection or any other relevant matter, such as clearances and ground conditions, the responsibility for ensuring that the crane is of a suitable type, size and capacity for the task to be undertaken and for planning the operation remains with the user organization. Therefore, if the user organization does not have expertise in lifting operations, it should not hire cranes, but opt instead for a contract lift.

NOTE Where a crane is hired without an operator, all of these points still apply.

6 Selection and duties of personnel other than the appointed person

Personnel should be selected in accordance with [BS 7121-1:2016](#), Clause 6 and Clause 7.

All members of the lifting team should be aware of the limits of their knowledge and experience about lifting operations, and, when conditions exceed these limits, further advice should be sought.

7 Selection of cranes*COMMENTARY ON CLAUSE 7*

See the appropriate part of BS 7121 for details of the different types of crane and their operational characteristics.

7.1 General

7.1.1 Cranes are available in a number of forms, and the characteristics of the various cranes should be considered in relation to the requirements of the job, including site location and environmental limitations, e.g. weather conditions.

7.1.2 Those involved in the selection, configuration, operation and maintenance of the mobile crane should be competent and should receive regular familiarization on the specific model of crane.

NOTE This is specifically to include the installation and use of the fly and luffing jibs.

7.1.3 Where mobile cranes are used for cyclic operations, the frequency of inspection, maintenance and thorough examination (see [BS 7121-2-3:2012](#), **7.4** and **8.6**) should be increased to ensure that early failure of the crane does not occur.

NOTE The use of mobile cranes for cyclic operations can lead to early development of fatigue cracking in structural welds and premature failure of components such as the slew ring and gearing.

7.1.4 Having decided upon the type of crane and knowing the overall job requirements, a crane capable of safely carrying out the planned lift should be selected.

7.1.5 The following, as a minimum, should be taken into account when selecting a crane:

- a) weights, dimensions and characteristics of the loads;
- b) operational speeds, radii, heights of lifts and areas of movement;
- c) crane type and lifting capacity;
- d) number, frequency and types of lifting operations, with care taken to match the load spectrum and duty cycles of the application to the classification of the crane and to ensure that repeated loads do not exceed 70% to 80% of the crane's rated capacity appropriate to the configuration in which it is being used, unless the crane has a classification permitting repeated lifting at maximum load on every occasion;

NOTE 1 Details of crane classification are given in ISO 4301 (all parts).

- e) length of time for which the crane is required;
- f) remaining life expectancy;
- g) suitability and condition of access roads;
- h) site, ground and environmental conditions, or restrictions arising from the use of existing buildings;

NOTE 2 All loads imposed on the ground by the crane should be considered, e.g. wheel, outrigger, track. Even small cranes can impose high point loads.

- i) space available for crane access, rigging, travelling, operation, de-rigging and egress (see [7.2.2](#));
- j) the control type and operating position most suitable for the lifting operation, selected so that the crane operator has the best possible view of the load path and is adequately protected from crushing hazards;

NOTE 3 Cranes are available with a range of fixed operator control stations and/or remote control.

- k) when lifting below crane base level, the weight of the rope is accounted for in the rated capacity and the length of the rope is adequate and a trial lift is conducted;

NOTE 4 A fail-safe procedure should be provided to ensure that sufficient hoist rope remains on the winch drum at all times to prevent the end of the rope running off the drum.

- l) any special operational requirements or limitations imposed, e.g. requirements such as down-rating, for operation in hazardous environments, such as alongside nuclear installations or railways; and
- m) where necessary, working area limitation systems, e.g. limit radius, height and slew angle.

NOTE 5 Subclauses 7.2 to 7.8 give information on features and suitability of the types of mobile crane currently available. The list is not exhaustive, and could be extended as new types become available.

- 7.1.6** An electro-mechanical control system can be fitted to the hoist control to lock out the “free fall” feature and ensure that the hoist drum remains connected to the power train whenever a load is raised or lowered. Where the control system is operated through a key switch the key should be removed when the hoist drum is in the power load lowering position to ensure that “free fall” cannot be accidentally selected. The appointed person should take account of any such safety features when selecting a crane and should ensure that the safe system of work includes briefing all personnel involved on its correct use.

7.2 Truck-mounted crane

COMMENTARY ON 7.2

Truck-mounted cranes are subject to requirements for braking, steering, lighting, etc., specified in road traffic legislation. The crane travels at normal road speed to the site and can usually be used in a lifting operation without adaptation or addition, although separately transported, additional jib sections and/or counterweight may be fitted to increase the lifting range after arrival at the site.

- 7.2.1** Good access to the site should be provided if a truck-mounted crane is to be used, and the load-bearing ability of approach roads to the site should be assessed before a truck-mounted crane is selected.
- 7.2.2** The width of the truck-mounted crane, any overhead obstructions that reduce the clearance height, and the gradient of, and any tight bends or sharp corners in, approach roads should be considered prior to selecting a truck-mounted crane. The length and manoeuvrability of the truck-mounted crane should be considered in relation to the layout of the site.

7.3 Rough-terrain crane

- 7.3.1** If rough-terrain cranes pick and carry loads on the crane hook (not necessarily up to the full rated capacity) careful consideration should be given to planning and use to ensure a safe system of work.
- 7.3.2** When lifting “free-on-wheels” the ground should be level within the limits specified by the crane manufacturer.

NOTE Rough-terrain cranes are fitted with outriggers, and may be able to travel across moderate slopes without load, and jacked level for lifting loads.

7.4 All-terrain crane

NOTE An all-terrain crane is a hybrid of a truck-mounted crane and a rough-terrain crane. It is as compact as a rough-terrain crane, and able to travel on public highways at the same speeds as a truck-mounted crane. On some models of all-terrain crane, all axles can drive and steer, so that the crane has good traction and manoeuvrability on unmade-up ground. All-terrain cranes can often move into places where a truck-mounted crane cannot enter, and so an all-terrain crane of lower nominal lifting capacity can carry out a lifting operation with greater safety than a larger capacity truck-mounted crane, if the truck-mounted crane is required to stand further from the load landing position. The same ground conditions are required for all-terrain cranes as for truck-mounted cranes, with regard to load bearing and level.

All-terrain cranes can have good ability to climb gradients, but the manufacturer's specification should be consulted to confirm this.

7.5 Yard crane

NOTE 1 Outriggers may be fitted to yard cranes for increased lifting, and these cranes can travel with rated loads suspended from the crane hook in conditions specified by the manufacturers.

The area of operation of a yard crane should be level and laid out so that the crane can travel, with or without load suspended, on a surface able to take the wheel loading, and wide enough to allow the outriggers to be extended if required.

NOTE 2 The jib is usually of lattice construction, either strut or cantilever design, and of fixed length, although it may be extended, if required, with additional jib sections.

7.6 Low-headroom crane

NOTE Use of public highways for travel between sites might be permitted if the low-headroom crane conforms to appropriate road traffic legislation. Low-headroom cranes can be prohibited from travelling on some roads (e.g. motorways).

As the road driving cabin is also the operating cabin for low-headroom cranes, and the crane driver does not rotate with the load, allowance should be made for this limitation when planning the safe system of work.

7.7 Crawler crane

COMMENTARY ON 7.7

Older, mechanical type crawler cranes and some cranes with hydraulic power have a "free fall" feature that allows grabbing and dragline operations.

7.7.1 "Free fall" on the hoist can be dangerous when loads are being lifted, and should not be used.

7.7.2 The use of a crawler crane(s) should be considered for construction sites at which a significant number of loads are handled, over an extended period, and where the following apply:

- a) there is a low ground-bearing pressure;
- b) compactness is required once the crane is rigged;
- c) the ground is poor to travel over; and/or
- d) the ground is sloped.

7.7.3 The operator's manual should be consulted for the manufacturer's permitted out of level operation.

7.7.4 The following should be taken into consideration when selecting a crawler crane:

- a) the crane is generally transported to the site in parts;
- b) rigging and de-rigging might require an auxiliary crane;
- c) all loads imposed on the ground, including jack loads, during track installation, when considering ground conditions (see [8.2](#) and [Annex C](#) on loads imposed on the ground by different types of crane);
- d) sufficient space is required on site for rigging of the crane, particularly if a long jib combination is required; and
- e) a long jib needs to be laid down quickly, in the working position, if adverse weather conditions are expected.

7.8 Spider cranes

The support and foundations for micro crawler/spider cranes or similar should be accounted for in the same manner as any other crane. These cranes are frequently used on suspended slabs or

other structures which have not been designed to resist the loads imposed by the cranes and an appropriate assessment of the structure should be carried out (see [8.2.2.5](#)).

7.9 Jib configurations

7.9.1 General

NOTE There are many different combinations of attachments that can be used with the main jib of the various types of mobile crane. Not all combinations are available on each type.

The recommendations of [7.9.2](#) and [7.9.3](#) are intended to provide guidance for selection of the most appropriate equipment, and should be used when planning a safe lifting operation.

7.9.2 Fly jib

A1 Text deleted **A1**

Where the main boom is being used with the fly jib fitted, the jib's weight should be accounted for as specified in the crane's specific load chart. **A1** Recommendations for the rigging of fly jibs are given in [11.3](#). **A1**

7.9.3 Luffing fly jib

COMMENTARY ON 7.9.3

A luffing fly jib is a development of the fixed offset fly jib and is also of lattice construction. If required, the luffing fly jib can be of greater length than the main jib in use.

- 7.9.3.1** A luffing fly jib should be used with the main jib set at the angle of elevation prescribed by the relevant duty chart for the crane and the configuration decided upon, to reach over existing structures and to handle loads at load radii that could otherwise require a main jib length outside the length permitted by the crane design. Some crane specifications permit use of an angle for the main jib other than the maximum. The crane duty charts and test certificates should be consulted.
- 7.9.3.2** The luffing configuration should be confirmed in the preoperational checks and planning.
- 7.9.3.3** Site requirements for rigging and de-rigging of a luffing fly jib should be considered as part of the selection and risk assessment process. Sufficient and suitable area should be made available for the rigging crane required to assist the assembly and disassembly of the luffing fly jib. If ground loadings are increased significantly when a long luffing fly jib is being raised/lowered, additional ground preparation work should be carried out to spread any higher point loadings. Adjacent overhead or underground hazards should be taken into account. If the luffing jib suspension mast protrudes rearwards beyond the arc of the normal tail swing of the crane, this should be taken into account. The system of work to be followed, taking account of the manufacturer's instructions, should be documented in a method statement. The operator should be competent to carry out the operation safely.

NOTE There have been a significant number of serious accidents whilst attaching and detaching fly jibs to/from mobile cranes.
- 7.9.3.4** Most luffing jib configurations are used on large truck-mounted and fixed-base cranes with hydraulic outrigger systems that provide accurate levelling. For luffing jib configurations on crawler cranes that are not fitted with outriggers to assist in levelling, the appointed person should ensure that effective means are provided to set and keep the crawler crane/luffing jib combination within the limits of level, and configurations, permitted by the crane manufacturer throughout the lifting operation.
- 7.9.3.5** The appointed person should ensure that an anemometer is fitted to the highest point of the crane, to register wind speed at the working height. The safe system of work should cover precautions to

be taken if the wind speed exceeds the safe limit, including a suitable and free area being available to lower the boom system to the ground in the event of high winds.

- 7.9.3.6** In the planning of the luffing boom lifting operations, consideration should be given to the manufacturer's guidance on when the rigged configuration has to be either left in free slew, or lowered to the ground. Where the figure to lower the system is below that of free slew, this should be planned for.

7.10 Main jib extensions

COMMENTARY ON 7.10

Telescopic jib cranes can be fitted with manually set extension sections.

- 7.10.1** The appointed person should, when selecting a crane with a jib extension, provide clear information to the crane supervisor on the exact position where the crane is to stand. When deciding the position of the crane, the following should be considered:
- a) whether additional space is required on site to fit the extension;
 - b) whether the crane operator requires assistance when fitting the extension; and
 - c) whether additional craneage is required when fitting the extension.
- 7.10.2** Jib deflections can be greater than expected, so hoist lines should be plumb when hoisting loads on jib extensions to correct for boom deflection. Estimated values should be similarly increased in addition to the recommendations in [4.1.2a\)](#) and b).
- 7.10.3** The crane supervisor and crane operator should be given clear instructions concerning the setting of the length of the main telescoping jib during briefing on the safe system of work. The crane duty chart should give the manufacturer's requirements that apply to the use of manual extensions.

NOTE Main jib extensions have several forms and may have other names (e.g. "power-pinned fly", "swing around", "lattice extension").

7.11 Special operations

- 7.11.1** The appointed person should assess the risks to personnel and to the crane from the planned operation, before selecting the most suitable type of mobile crane or deciding that a mobile crane is not to be used.
- 7.11.2** The following special operations should be carried out as specified:
- a) piling operations: [Annex D](#);
 - b) de-rigging operations: [Annex E](#);
 - c) lifting of persons: [20.3](#);
 - d) lifting a non-recoverable load: [Annex E](#);
 - e) cranes mounted on floating vessels and floating structures (see [Annex G](#));
 - f) road-rail cranes (see [Annex A](#)).
- 7.11.3** The use of the main hook simultaneously with an auxiliary hook on the same crane should not be undertaken unless the crane's RCI/L allows this duty.

NOTE If the RCI/L does not allow this duty it might be possible, following a rigorous risk assessment, to devise a safe system of work which adequately removes or mitigates the risks involved in lifting with two hooks on the same crane.

8 Siting of cranes

8.1 General

Siting of the crane should take account of all the factors that could affect safe operation, particularly the following:

- a) the crane standing and support conditions;
- b) the presence and proximity of hazards (above and below ground) (see [Table 1](#) and [8.3.1.1](#));
- c) hazards associated with working on or adjacent to a highway or railway;
- d) the effect of wind during in-service and out-of-service conditions; and
- e) the adequacy of access/egress to allow placing or rigging of the crane in the working position and for de-rigging and removing the crane following completion of lifting operations.

NOTE 1 Attention is drawn to the New Roads and Street Works Act 1991 [15].

NOTE 2 Further details regarding the siting of mobile and tower cranes are given in CIRIA publication C703 [16] which might also provide information on other types of cranes, and further details regarding the siting of loader cranes are given by ALLMI [17].

NOTE 3 Further information on the siting of cranes on or adjacent to sites of exceptional hazards is provided in [BS 7121-1:2016](#), Annex E.

8.2 Crane standing or support conditions

8.2.1 General

- 8.2.1.1** The appointed person should obtain an assessment by a competent person as to whether the loads imposed by the crane can be sustained by the ground or any means of support.

NOTE 1 Guidance on the assessment of ground conditions is given in CIRIA publication C703 [16] and the SFFC publication Ground Conditions for Construction Plant [18].

NOTE 2 Ground assessment is normally carried out by, or on behalf of, the owner or occupier of the site.

- 8.2.1.2** The loads imposed by the crane should be obtained from the crane manufacturer or other authority on crane design and construction. The ground loadings should be obtained for the following conditions:

- a) during rigging and derigging of the crane;
- b) the planned lifts;
- c) no load on the hook with the boom fully retracted at maximum elevation;
- d) any movement of the crane in the fully or partially rigged condition.

- 8.2.1.3** The loadings should include the combined effects of the following:

- a) the dead weight of the crane (including any counterweight, ballasting or foundation and, where appropriate, boom extensions);
- b) the dead weight of the load(s) and any lifting attachment(s);
- c) dynamic forces caused by movements of the crane and, for floating cranes, the sea state at the time of lifting;
- d) wind loadings resulting from wind speeds up to the maximum permitted, taking into account the degree of exposure of the site.

- 8.2.1.4** It is likely that in-service conditions produce the greater imposed loading, but out-of-service conditions and rigging/de-rigging conditions should be taken into consideration as well as in-service conditions.
- 8.2.1.5** The vertical and horizontal forces are not likely to be uniformly distributed, so an allowance should be made for these and for any other unpredictable effects.
- 8.2.1.6** The appointed person should ensure that the ground or any means of support is such that the crane can operate within the levels and other parameters permitted by the manufacturer.

8.2.2 Support arrangements for outriggers/stabilizers

NOTE Cranes can be fitted with outriggers or stabilizers to enhance stability and to significantly increase lifting duties. Loads caused by the dead weight of a crane with outriggers or stabilizers plus any suspended load are transmitted to the ground beneath the crane as point loads through the outrigger/stabilizer beams and jack pads, instead of by the tyres, as with fully mobile wheeled cranes.

- 8.2.2.1** When siting a crane, point loads through the outrigger/stabilizer beams and jack pads should be spread over a sufficient area to support the outrigger pad and to prevent the crane overturning or becoming unstable. Any packing should be suitably designed for the purpose.
- 8.2.2.2** The crane operator should not place any packing material on an uneven surface that could cause the packing to excessively distort or fail. There should be no gaps between any separate pieces of packing used within any layer (see [Figure 11](#)).

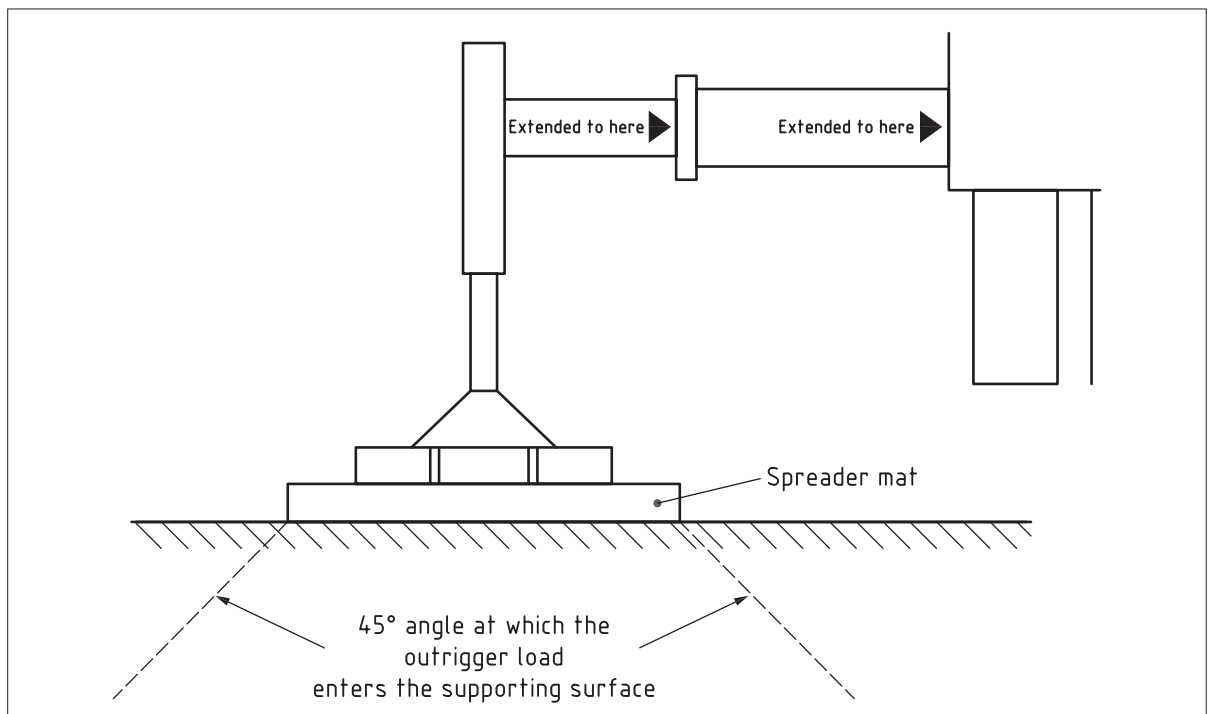
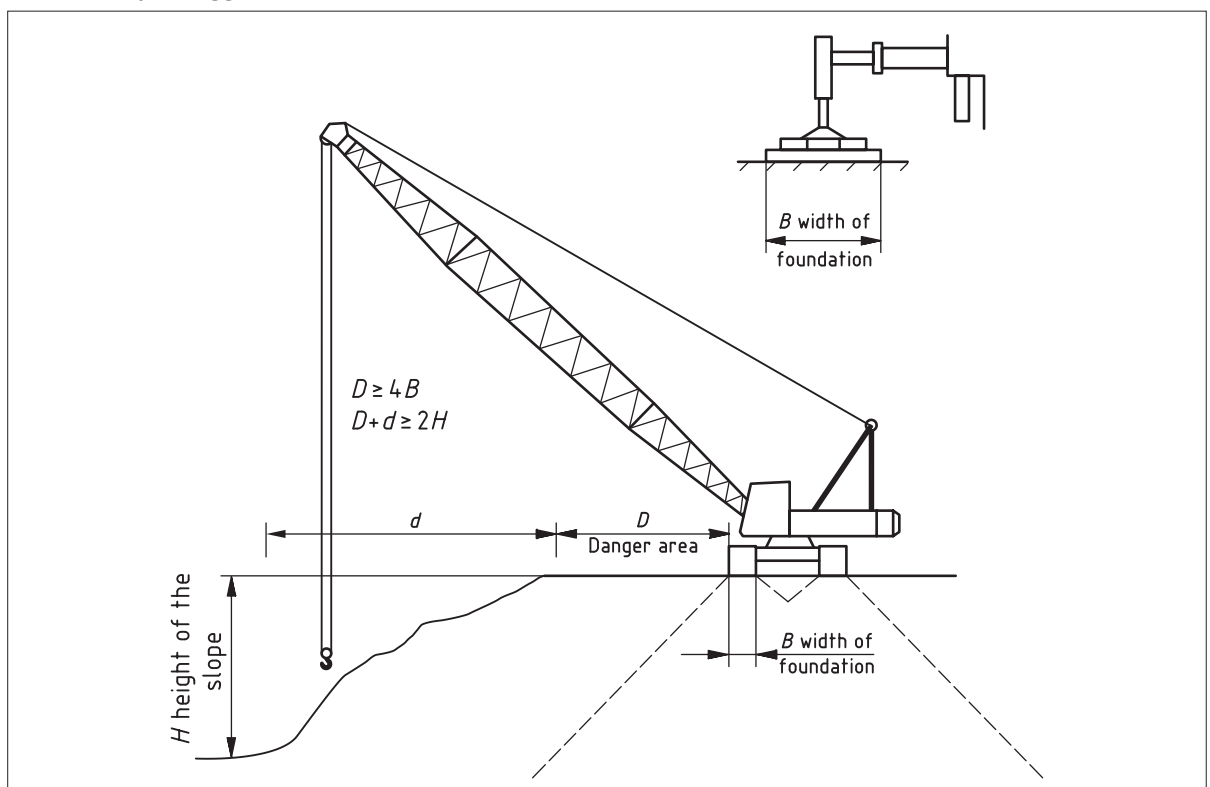
NOTE A bed of sand between the underside of the bottom layer of packing and the ground can provide a more even distribution of ground pressure, as well as prevent damage to the packing material.

- 8.2.2.3** The pressure of the outrigger mat can be considered to pass into the ground at an angle of 45° from the outside edges, so that the distance between the edge of the outrigger mat and the toe of an unsupported excavation should always be greater than the depth of the excavation (see [Figure 12](#)). An outrigger mat can be placed close to an edge that is suitably supported (e.g. by sheet piling), but the appointed person should seek expert advice if there is any doubt concerning this.

NOTE In certain city centre locations there might be a requirement to assess at angles other than 45°. See also [Annex C](#).

- 8.2.2.4** When selecting the siting of a crane for a lifting operation, the appointed person should ensure that the siting can accommodate the crane with the outriggers extended and set as specified in the duty chart, plus any area required for ground matting.
- 8.2.2.5** Where cranes are supported by suspended slabs or structures that have not necessarily been designed for the loads from these cranes, the loads from the cranes both in travel and working conditions should be obtained from the manufacturer and provided to a suitably qualified and experienced engineer to assess the effects on the supporting structure. Appropriate checks on the capacity of the supporting structure to accommodate these loads should be undertaken and appropriate additional support provided where necessary. Unless it can be shown to the contrary by documented advice from the engineer, the loads should be supported by designed back-propping to appropriate foundations. The loads from the manufacturer should be confirmed as upper bound values at the point of crane failure or tipping.

NOTE Further guidance on support arrangements for outriggers is given in CIRIA publication C703 [\[16\]](#) and the SFfC publication *Ground Conditions for Construction Plant* [\[18\]](#).

Figure 11 — Packing for outriggers/stabilizers**Figure 12** — Position of outrigger mat

8.3 Proximity hazards

8.3.1 General

8.3.1.1 Consideration should be given to proximity hazards, such as the following:

- a) overhead electric lines or cables;
- b) nearby structures;

- c) telecommunications masts and sources of electromagnetic radiation;
- d) airports, aerodromes and heliports;
- e) underground services, voids and structures, such as gas mains or electric cables;
- f) other cranes and plant/structures;
- g) other vehicles or ships being loaded or unloaded;
- h) stacked goods;
- i) public access areas, including highways, railways, and rivers;
- j) chemical plant and nuclear installations.

8.3.1.2 Suitable measures should be devised to address each of the hazards identified.

- a) Where any part of the crane or load cannot be kept clear of such hazards, the appropriate authority should be consulted.
- b) Precautions should be taken to ensure that the crane is clear of any underground services or, where this is not possible, that the services are adequately protected against damage.
- c) At any place where a crane or load passes an obstacle, the following steps should be taken.
 - 1) Where practicable, the crane path should be clearly defined by marking to ensure that it is kept free from obstruction, and a clearance of not less than 600 mm should be arranged between any moving part of the crane and any obstacle. Where it is not reasonably practicable to achieve this clearance, effective precautions should be taken to prevent access to any crush areas.
 - 2) Where goods are regularly stacked near a crane, boundary lines for stacking of the goods should be permanently marked on the ground.
 - 3) On sites where there is a possibility of collision between the crane and other plant/structures [e.g. tower cranes, mobile cranes, overhead travelling cranes, dockside cranes, loader cranes, mobile elevating work platforms (MEWPs) or concrete booms], an anti-collision and/or radius-restriction system should be fitted and operational (see [9.8.4](#)). The crane coordinator should plan the sequence of crane movements to prevent collisions. In such circumstances, the operators should obtain the agreement of the crane coordinator before carrying out any operation.
 - 4) During pauses in the lifting operation or on completion of the lifting operation, the crane and its components should be positioned to ensure that collisions cannot take place (see [BS 7121-1:2016](#), [14.2.6](#)).

8.3.2 Overhead electric lines and cables

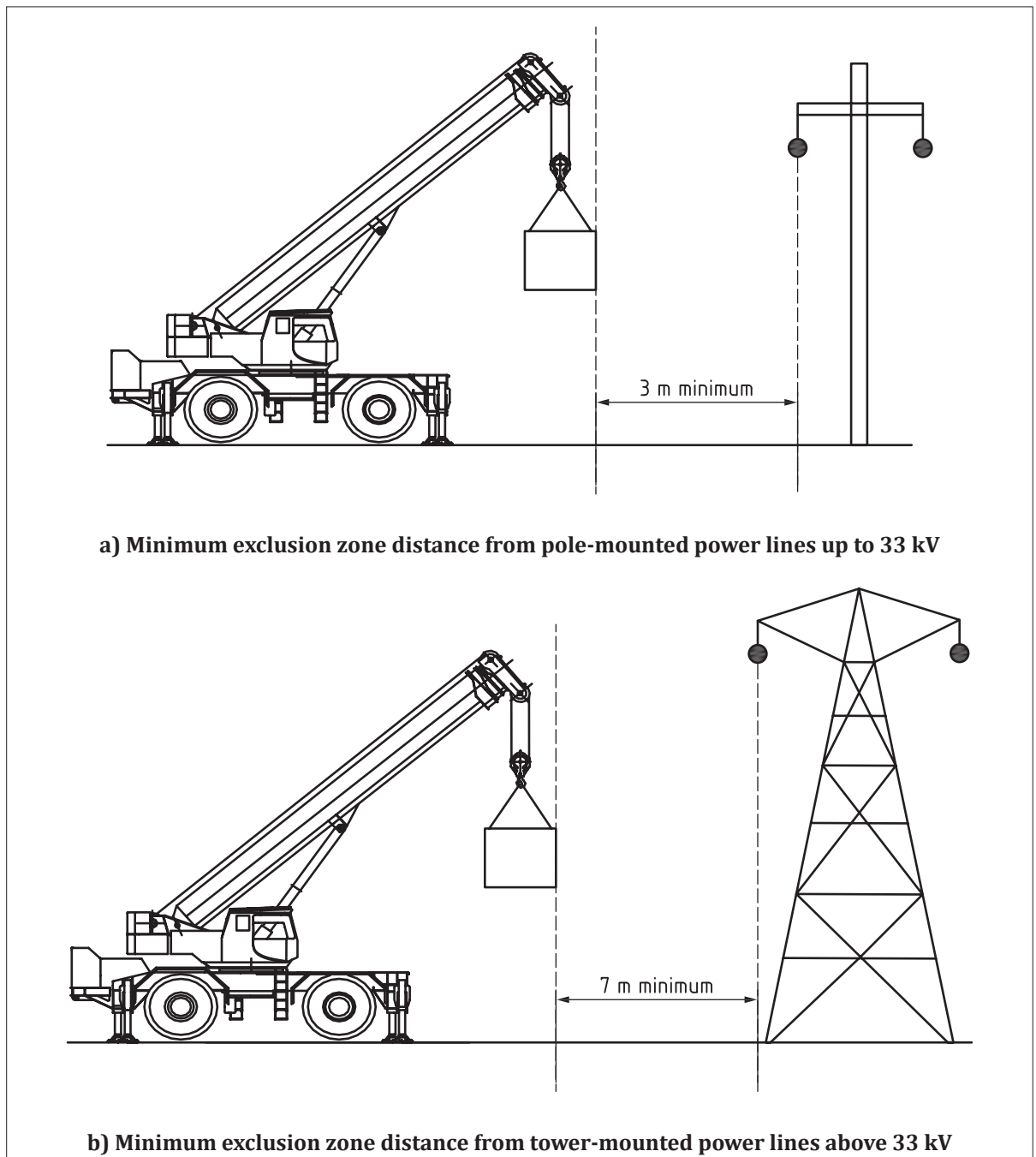
WARNING. If any part of a crane, including rope, slings or load, touches or even approaches overhead electric lines or cables, there is a serious risk of fatal accident.

- 8.3.2.1** Many fatal accidents have occurred due to some part of a crane, such as a rope, sling or load, touching, or even coming near to, overhead electric lines or cables. Where the crane or load can come within 10 m of electric lines or cables and it is reasonably practical to turn the power off, steps should be taken by the appointed person to isolate the power.

- 8.3.2.2** Where the power cannot be isolated, the appointed person should ensure that HSE Guidance Note GS6 [N1] and ACOP L113 *Safe use of lifting equipment* [N2] are followed. All distances should be measured at ground level from a position estimated by eye to be vertically below the outermost conductor at a tower or pole position, and should include an allowance for the load (see [Figure 13](#)).

WARNING. All overhead lines and other electrical apparatus should be treated as live unless declared “dead” and “safe” by the line operator. If in doubt, seek advice.

Figure 13 — *Minimum exclusion zone distances*



8.3.2.3 A notice bearing the following wording should be placed in the cab of any crane that could operate in the vicinity of overhead electric lines or cables:

“If machine makes contact with live electric line or cable, observe the following precautions.

- Remain inside cab.
- Warn all other personnel to keep away from the crane and do not to touch any part of the crane, rope or load.
- Try, unaided, and without anyone approaching the machine, to move the crane until it is clear of the power line or cable.

- If the machine cannot be moved away, remain inside the cab. If possible, alert someone outside the crane to inform the electricity supply authority immediately. Take no action until it has been confirmed that conditions are safe.
- If it is essential to leave the cab (e.g. because of fire), jump clear as far away from the crane as possible. Do not touch the crane and the ground at the same time.
- Inform the responsible engineer of the works or other authority immediately, and until assistance is received, position someone near the crane to warn of danger.”

8.3.2.4 Devices are available that are designed to be fitted to a crane to give warning when the crane comes within a predetermined distance of overhead electric lines and cables. Such devices are not recommended and should not be considered a substitute for a safe system of work.

8.3.2.5 Where cranes are frequently used in the vicinity of overhead power lines, consideration should be given to the fitment of height limiters (see **9.8.4**). Consideration should also be given to the earthing of mobile cranes, particularly when working in substations.

NOTE Information on earthing in substations is given in National Grid National Safety Instruction and Guidance NSI 8, Mobile Elevated Work Platforms, Lorry Loaders, Vehicles, Cranes and Objects in Substations [19]. See also [17.2.2](#).

8.3.3 Crane control in the vicinity of aerodromes/airfields

If a crane is to be used within 6 km of an aerodrome/airfield and its height exceeds 10 m or that of surrounding structures or trees if higher, the appointed person should consult the aerodrome/airfield manager for prior permission to work.

NOTE 1 Restrictions could be placed on the overall height of the crane and there could be a requirement to fit warning (obstacle) lights to the top of the crane. Further details are given in CAA document CAP 1096 Guidance to crane operators on aviation lighting and notification [20].

NOTE 2 The Air Navigation Order [21] makes it an offence to act recklessly or negligently in a manner that could endanger aircraft.

8.3.4 Highways

For lifting operations beside a highway or other road used by vehicles or pedestrians, the appointed person should establish a safe system of work to ensure that injuries to persons cannot be caused by the crane and/or the load when the crane is preparing for or carrying out the lifting operation. Arrangements should be made for traffic to be stopped or diverted away from the working area if appropriate. The local highways and police authority should be consulted prior to carrying out any lifting operation next to a highway or other road. Where possible, physical measures should be designed to prevent traffic colliding with the crane, e.g. temporary concrete blocks. Physical measures should be in place to segregate persons.

NOTE Traffic and pedestrian management are covered by the New Roads and Street Works Act 1991 [15] and Safety at Street Works and Road Works: A Code of Practice [22].

8.3.5 Sites of exceptional hazards

COMMENTARY ON 8.3.5

The use of cranes during temporary works, construction, commissioning, engineering and maintenance activities on or adjacent to sites of exceptional hazards, such as railways, chemical plants and nuclear installations, requires particular attention during planning, set-up, use, maintenance and de-rigging. If the crane or its load falls onto high-hazard areas within the site, a catastrophic accident might result with multiple fatalities or long-lasting environmental issues.

The additional recommendations of [BS 7121-1:2016](#), Annex E, should be followed for the operation of cranes on or adjacent to sites of exceptional hazards.

9 Safety

9.1 General

The person or organization with overall control of the location of the lifting operation and the employers of personnel involved in the lifting operation have the responsibility for safety during lifting operations. To ensure that this responsibility is discharged effectively, the appointed person (see [4.3](#)) should be given the necessary authority to ensure that adequate systems to achieve safety are in operation.

NOTE Safety matters relating to lifting operations include the use, maintenance, repair and renewal of safety equipment and the instruction of, and allocation of responsibilities to, the various personnel in relation to the equipment.

9.2 Modifications and materials

Modifications to the structure, controls systems or any other part of the crane and the use of materials should be in accordance with [BS 7121-2-1:2012](#).

9.3 Identification of person directing crane movements

- 9.3.1** The person directing crane movements (slinger-signaller or signaller) should be easily identifiable to the crane operator, for example by wearing distinctive high-visibility clothing or by using radio call signs.
- 9.3.2** When choosing high-visibility clothing, backgrounds, type of illumination and other relevant factors should be taken into account.

9.4 Personal protective equipment (PPE) and safety equipment

- 9.4.1** The appointed person should ensure that:
- a) PPE is available that is appropriate for the conditions of the location, such as helmets, safety spectacles, fall protection equipment, safety boots, ear defenders, high-visibility clothing and life jackets or other buoyancy aids;
 - b) equipment is inspected before and after use, and maintained in good working order or replaced where appropriate; and

NOTE Further information on the selection, use and maintenance of personal fall protection systems and equipment is given in [BS 8437](#).

- c) a record of inspection and repairs is maintained where appropriate.

- 9.4.2** All personnel working on, visiting or in the vicinity of the crane should be made aware of the requirements relating to their personal safety and to the use of the PPE provided.

- 9.4.3** Personnel should be instructed in the correct use of the appropriate PPE provided.

NOTE Attention is drawn to the Personal Protective Equipment at Work Regulations 1992 [\[23\]](#), which require that any PPE provided is used.

- 9.4.4** Certain personal protective and safety equipment, for example helmets, safety spectacles and fall protection equipment, can deteriorate with age and should therefore be considered for renewal periodically. Damaged safety equipment should be replaced immediately.

NOTE The Health and Safety at Work etc. Act 1974 [1] and the Personal Protective Equipment at Work Regulations 1992 [23] require that employees cooperate with their employer, and use and report defects in appropriate personal protective equipment provided for their safety.

9.5 Work at height

COMMENTARY ON 9.5

Work at Height is defined by the Work at Height Regulations 2005 [24] as:

- a) work in any place, including a place at or below ground level;
- b) obtaining access to or egress from such place while at work, except by a staircase in a permanent workplace.

Any work at height on a mobile crane should be planned to either eliminate the need for work at height or, where this is not possible, to reduce the risk to persons to as low as is reasonable practicable. Planning for work at height should include planning for emergencies and rescue.

Planning of work at height should give priority to collective means of fall protection before considering the use of personal fall protection, which may include the use of scaffolding and power access such as MEWPs.

NOTE Further guidance on work at height is given in CPA publication Best Practice Guide - Work at Height on Mobile Cranes [25] and the FEM publication FEM 5.002 Guideline – Safety Measures and Procedures related to work at height – Mobile Cranes [26].

9.6 Access and egress (including emergency escape)

9.6.1 General

- 9.6.1.1** If additional means of access/emergency escape are required on the crane, these should be incorporated only with the agreement of the crane manufacturer or appropriate design authority. All access, including that for the driving position(s) of the crane and for inspection, maintenance, repair, rigging and de-rigging of the crane, should be maintained in good condition.

NOTE Requirements for safe access and means of emergency escape are specified in product standards such as BS EN 13557, BS EN 13586, BS EN 14502-1 and BS EN 14502-2, and in standards for particular crane types such as BS EN 13000. Attention is drawn to the Work at Height Regulations 2005 [24] regarding the provisions for safe access and rescue.

- 9.6.1.2** All access ways should be kept clear of obstructions and other hazards.

9.6.2 Boarding and leaving the crane

- 9.6.2.1** Persons should only board or leave a crane with the operator's permission. The operator should be made aware of the precautions that are necessary while a person(s) is boarding or leaving.
- 9.6.2.2** If the boarding or leaving point is out of sight of the operator, means should be provided to make the operator aware of the other person's whereabouts.
- 9.6.2.3** Personnel should be instructed to use only the proper access and means of emergency escape.

9.7 Fire extinguishers

The selection, location, use and maintenance of fire extinguishers should be made in conjunction with advice from the relevant fire authority following a suitable and sufficient risk assessment. Potential users of fire extinguishers should be adequately trained.

9.8 Limiting and indicating devices

9.8.1 General

The correct operation of all limiting and indicating devices should be verified during the pre-use inspections. These devices should be maintained in good working order in accordance with the manufacturers' instructions.

9.8.2 Level indicators and inclinometers

Where fitted, crane level indicators and inclinometers should be used in accordance with the instruction manual and maintained in good working order.

9.8.3 Wind-speed indicating and monitoring devices

9.8.3.1 An anemometer should be fitted where the need for this is identified by the risk assessment (see [5.2](#)). Where fitted, anemometers or other wind-speed measuring devices should have their indicators located in clear view of the crane operator and, if appropriate, the person controlling the lift. The correct operation of these devices should be determined regularly and they should be maintained in good working order.

9.8.3.2 The sensor of the indicator should be positioned so that it can measure airflow uninterrupted by the crane structure in all operating modes.

NOTE 1 Sensors are normally positioned on the highest point of the crane.

NOTE 2 It might be necessary to use more than one anemometer, depending on crane configuration.

NOTE 3 Where it is not possible to fit an anemometer to the crane, a hand-held anemometer may be used.

NOTE 4 Frequent calibration of wind-speed indicators is not generally required as they are an indicator to the crane operator to assist in a judgement about when to take a crane out of service because of increasing wind speed.

9.8.4 Zoning, radius-limiting and anti-collision devices

9.8.4.1 Zoning, radius-limiting and anti-collision devices should be fitted where the risk assessment completed as part of the planning process (see [5.2](#)) identifies a risk of cranes and/or the fixed load attachments:

- a) entering or oversailing a prohibited zone;
- b) exceeding specified radius; or
- c) colliding with fixed structures, other cranes and/or other mobile plant.

9.8.4.2 The functioning of these devices should be confirmed during the pre-operational inspections.

9.8.5 Rated capacity indicator and limiter (RCI/L)

The functioning of the RCI/L should be confirmed during the pre-operation inspections.

9.8.6 Transport position indicators and locking devices

The functioning of any indicators and locking devices should be confirmed during the pre-operational inspections.

NOTE Examples of these indicators include boom stowed, slew ring locked, outriggers or stabilizers stowed, hook block stowed, and counterweight locked.

9.9 Machinery guarding

All machinery guarding should be properly fitted whenever the crane is in motion or use and maintained in good condition.

NOTE Attention is drawn to [PD.5304](#), BS ISO 11660-2 and the appropriate crane specifications.

10 Crane documentation

10.1 Rated capacity charts

Readily understandable rated capacity charts applicable to the various specified operating conditions of the crane, should be available to the crane operator in the cab. If the crane is being downrated for special applications, such as such as magnet or grabbing operations, this information should also be provided.

NOTE Operation of the crane outside these parameters, even in an unloaded situation, could be dangerous.

10.2 Instruction manuals

Operating instructions in the appropriate language(s), containing adequate information on the rigging, use, alteration and de-rigging of the crane, should be kept with the crane.

10.3 Reports of thorough examination/test certificates

10.3.1 All current reports of thorough examination for any crane and lifting accessories carried on the crane should be kept with the crane.

10.3.2 Where records are kept electronically, it should be possible to print a paper copy.

10.4 Maintenance records

Maintenance records should be maintained in accordance with [BS 7121-2-1:2012](#), 7.9.

11 Rigging and de-rigging

11.1 Planning

11.1.1 Rigging and de-rigging of the crane should be thoroughly planned and properly supervised in the same way as the lifting operation (see Clause 5). Any supporting structure on which the crane is to be rigged should be checked by a competent person to ensure it is adequate for the loads to be imposed.

11.1.2 A correctly-planned rigging and de-rigging procedure should ensure that:

- a) rigging of the crane does not commence unless an instruction manual is available for reference by rigging staff and they have indicated an understanding of its relevant contents;
- b) the rigging/de-rigging manual is appropriate to the particular crane and bears the crane manufacturer's serial and type numbers and any owner's specific crane identifier;
- c) the entire rigging and de-rigging operation is controlled by the lead rigger;
- d) all personnel involved have confirmed they have a sound knowledge of their part in the operation;
- e) any departure from prescribed procedure is approved by the designer of the crane or another competent engineer;
- f) only correct parts and components of the original equipment manufacturer's standard and quality are used when replacement is necessary;
- g) the manufacturer's recommendations for the method of moving a crane from the place of rigging to its place of work are followed;
- h) the crane is level to within the limits specified by the manufacturer; and
- i) a safe means of access and egress is provided (see [9.7](#)).

NOTE Attention is drawn to the Work at Height Regulations 2005 [24].

11.2 Manufacturer's rigging and de-rigging instructions

- 11.2.1** The crane manufacturer's instructions should be closely followed. Any departure from the specified sequential procedure should be approved by the designer or another competent engineer, to ensure stability of the crane and that structural and mechanical parts are not subjected to excessive loading.
- 11.2.2** Manuals sometimes deal with de-rigging procedures by the simple statement that they are the reverse of rigging procedures. The appointed person should ensure that such a statement is correct and, if there is any doubt, obtain further information from the manufacturer.

11.3 Fly jibs

COMMENTARY ON 11.3

A significant number of fatalities and serious injuries have occurred during the rigging and de-rigging of fly jibs, particularly where retaining pins have not been inserted and removed in the correct order, causing the fly jib to fall in an uncontrolled manner.

The rigging or de-rigging of all types of fly jib should be carefully planned (see [11.1](#)). Before rigging or de-rigging starts the personnel who are to carry out the operation should be briefed on the planned procedure and familiarized with the procedure set out in the crane manufacturer's instructions for the specific model of fly jib and crane (see [11.2](#)).

The planned procedure should include the suitability of the site, particularly if rigging requires the use of another crane. 

11.4 Identification of components

- 11.4.1** All major components that form part of a crane and are separated for transportation, particularly those that are load-bearing or ensure the stability of the assembled crane, should carry a clear identification mark.
- 11.4.2** Components should be marked in the same manner as shown in the crane instruction manual.

NOTE 1 LOLER 1998 [2] state that it is necessary to identify any part of a crane jib that can be removed so as to indicate the crane of which it is a part.

NOTE 2 Nuts and bolts manufactured from high-tensile steel or other special steels carry markings so that they can be distinguished from other nuts and bolts. High-tensile bolts are tightened to a specified preload so that torsional loads are transferred across the joint by friction, rather than by shear across the bolt shank, and there is sufficient preload on the joint to reduce the effects of cyclic loading (fatigue). The reuse of high-tensile bolts needs to be in accordance with the manufacturer's conditions.

11.5 Electrical supply

- 11.5.1** Where a crane is electrically-operated or its batteries are charged from a source external to the crane:
- a) the crane should have an effective earth connection;
 - b) the characteristics of the power supply and of the crane equipment should be checked for compatibility before connection;
 - c) cables providing power to the crane should be protected from mechanical damage.
- 11.5.2** Where conducting material is used for protection, it should be bonded to earth at each end. The protection should never be used as an earth conductor.
- 11.5.3** Care should be taken to ensure that any trailing cable is not damaged during operational movement or when the crane is travelling. The travel distance should be well within the length of the trailing cable.

- 11.5.4** In addition to any isolator within the crane that is capable of cutting off the electrical supply to the crane motions, there should be an identified isolator remote from the crane that can be used to cut off the electrical supply to the crane itself. All isolators should be capable of being locked in the off position and be identified with the individual crane power supplies they control.
- 11.5.5** The installation of electrical supplies should be in accordance with [BS 7375](#) and [BS 7671](#).
-

12 Procedures and precautions

12.1 Crane operation

12.1.1 General

- 12.1.1.1** All crane movements, whether or not a load is lifted, should be carried out by a competent crane operator nominated by the appointed person.

NOTE 1 The appointed person may nominate a trainee crane operator if the trainee crane operator is directly supervised by a competent crane operator who has also been nominated for the purpose by the appointed person.

Maintenance personnel who are required to move cranes during maintenance work and testing should be competent and trained in crane driving to the extent required to enable them to carry out duties safely.

NOTE 2 Special arrangements may be required when carrying out maintenance or repairs on the crane (see Clause 13).

NOTE 3 Use of mobile cranes for cyclic operations can lead to early development of fatigue cracking in structural welds and premature failure of components such as the slew ring and gearing.

- 12.1.1.2** The structural integrity of the load should be confirmed by the appointed person before the lift.

12.1.2 Crane level

Danger can occur if side loadings are introduced during a lifting operation when a crane is out of level (see [Figure 14](#) in subclause 11.2) causing instability and/or structural damage. This is particularly the case with modern mobile cranes that can use long slender jib combinations to lift loads to significant heights. Where the crane is fitted with a device to indicate the inclination of the crane, this should be used whenever the crane is set up to lift a load. The device should be checked for accuracy at regular intervals as part of the crane's planned maintenance schedule. If such a device is not fitted, other methods should be used to ensure that the crane is within the parameters stated by the manufacturer. Checks should be made before first use and at regular intervals thereafter.

12.1.3 Outriggers/stabilizers

12.1.3.1 General

Most wheeled mobile cranes are equipped with hydraulically operated outriggers or stabilizers, which should be deployed correctly in accordance with manufacturers' instructions and relevant duty chart.

NOTE This might include the requirement to ensure that the axles are locked.

12.1.3.2 Partially extended outriggers

Some cranes can lift loads with partially extended outriggers. The manufacturer's duty charts and other requirements should be consulted.

NOTE See [Figure 11](#) for an example of rigger beam marking.

Use of partially extended outriggers should be carefully planned and controlled by the appointed person.

Partial extension may increase the loading imposed by the outrigger jacks, and extra packing should be provided to spread the loading if required. Partial and full extension should not be used simultaneously.

WARNING: When designing outrigger extension beams, the manufacturer includes reinforcement at the loading points for full and/or partial extension, so beams should not be set at any other intermediate points.

12.1.4 Independently set outrigger length extension

COMMENTARY ON 12.1.4

Some modern cranes have the ability to independently set each outrigger extension length. The RCI is updated with the outrigger beam extension, and can base its calculation of the crane's rated capacity upon this information. The crane capacity, rather than being in concentric circles radiating from the crane, would appear more of a contour map. As the crane slews the crane's RCI updates the operator in real time.

Whilst this system gives flexibility of set up, additional and extra care should be used by the appointed person during planning taking account of the manufacturer's instructions, and the lift supervisor when siting the crane, so the set up matches the plan. If this is not possible a management of change plan should be in place.

12.1.5 Lifting without outriggers

Some wheeled cranes equipped with outriggers/stabilizers have duties for lifting "free on wheels". This option should only be used if this is permitted by the manufacturer and included in the crane's programmed duty chart. If appropriate, the appointed person should brief the crane supervisor and crane operator. Before lifting "free-on-wheels", the set-up of the crane (the correct inflation and condition of tyres) should be within the recommendations given in the crane operating manual.

NOTE This option may only be used if lifting with outriggers deployed is not possible.

12.1.6 Pick and carry

NOTE Not all cranes that are permitted to lift free on wheels are designed to pick and carry loads.

Speed of travel, load position, tyre and ground conditions, etc., should not exceed the restrictions specified in the crane duty chart and operator's manual. Pick and carry operations should be carried out in accordance with the safe system of work. Travel speed should be compatible with smooth motion and any swing of the load should be carefully controlled using hand lines.

12.2 Rated capacity

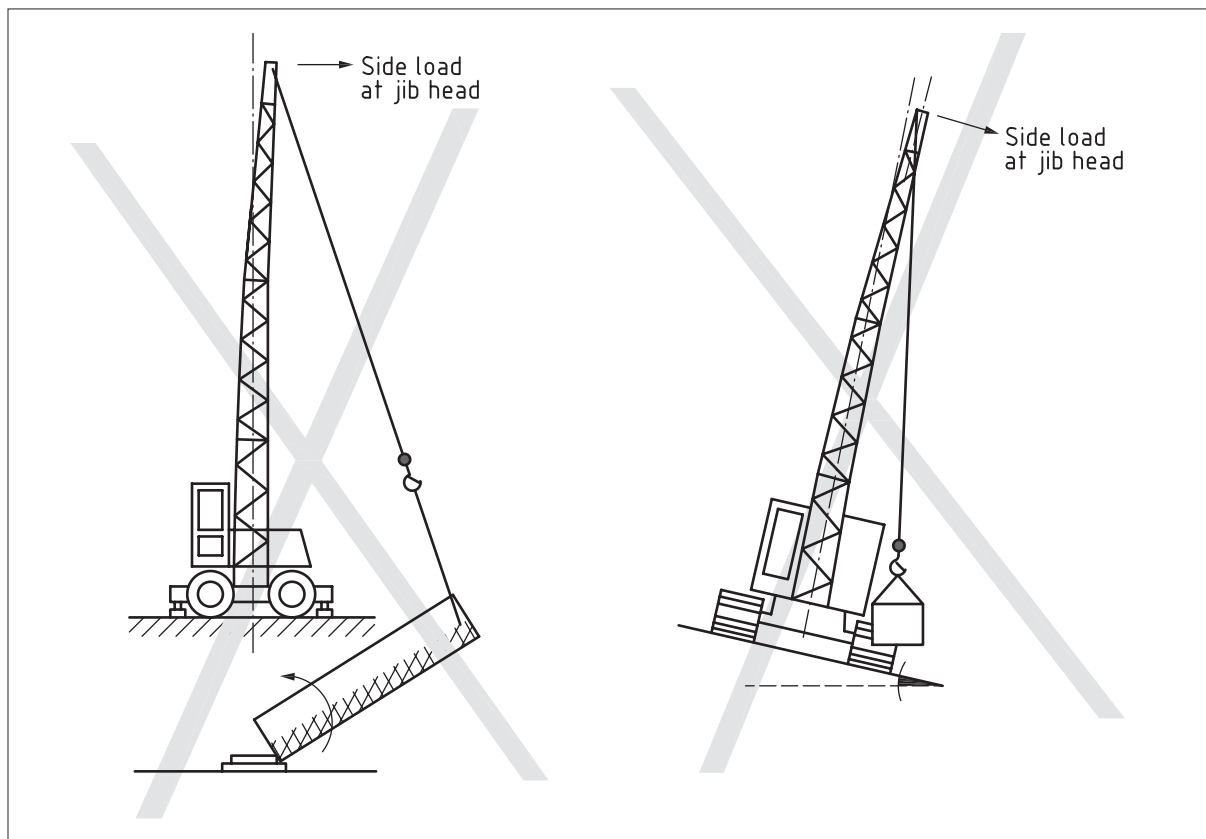
12.2.1 The rated capacity of the crane and lifting accessories should not be exceeded other than for testing supervised by a competent person.

12.2.2 Care should be taken to ensure that the hoist rope is vertical at all times. Pendulum swinging of the load should be prevented by careful control of the operating motions to match the swing of the load and to keep it under control at all times (see [Figure 14](#)).

NOTE A crane is designed to lift and lower vertically. A swinging load can increase the load radius and thereby exceed the rated capacity of the crane.

12.2.3 Rated capacity loads apply only to freely suspended loads. No crane motion (hoisting, slewing, derricking, telescoping, or travelling) should be used to drag any load along the ground with the hoist rope out of the vertical position. Before lifting a load, the hoist line should be plumb (see [Figure 14](#)).

WARNING: If the crane is used with the hoist line out of the vertical position, crane stability can be affected, and loadings (stresses) can result in excess of the design limits. Even with a rated capacity indicator fitted, structural failure can occur without warning.

Figure 14 — Control of pendulum swinging of load

12.3 Mode of operation and control

12.3.1 Identification of controls and direction of movement

12.3.1.1 To ensure safe use of the crane each control should be marked to identify the motion controlled and the direction of movement. Markings should be in English or by internationally agreed symbols. The following should apply before commencing any lifting operation.

- The crane operator should be familiar with the controls and the control layout.
- The crane operator should ensure that the rated capacity indicator/limiter is set to the configuration for the crane.
- The crane operator should have a clear and unrestricted view of the load and operational area, or should be assisted by directions from one or more slinger or authorized signaller positioned with a clear and uninterrupted view. Where multiple signallers are used, the procedure for handing control from one to another should be agreed in advance and be unambiguous (see [BS 7121-1:2016](#), Clause 17).

NOTE In some circumstances this might be a legal requirement.

- The crane operator should ensure that loads and crane hoist ropes are clear of obstructions.
- If audio communications are used, the crane operator and signaller should ensure that the calling signal functions correctly and that verbal messages can be clearly heard (see [BS 7121-1:2016](#), Annex F).

12.3.1.2 The hoist rope should be vertical throughout the hoisting operation. The load should be initially lifted just clear of the supporting surface and then brought to rest while the slings, balance of the load, etc., are checked, before proceeding. Care should be taken by the crane operator to avoid shock or side

loadings on the jib or structure. Care should be taken to avoid the lifting accessory or load coming into contact with the structure of the crane.

12.4 Working on cranes

12.4.1 General

If personnel are required to work on cranes for inspection, maintenance or other reasons, a system should be in operation to ensure that they are not endangered by movement of the crane and that a secure working place is provided. For cranes with which the crane operator has a clear view of all the moving parts, the system may be by verbal communication provided that it is clearly defined and readily understood by all personnel. If vision is restricted, an appropriate system of work should be developed, which may include a permit to work, if required.

12.4.2 System of work

12.4.2.1 An effective system of work should be used to ensure that the crane cannot move before authority is given to carry out the work.

12.4.2.2 The system of work should be fully understood by the personnel associated with the work. The system of work should require confirmation that, before the crane is returned to service:

- a) all personnel have been withdrawn;
- b) all gear, tools and loose materials have been removed;
- c) all guards have been replaced; and
- d) all safety devices are in operation.

12.4.2.3 Any corrective action taken on defects in the crane prior to returning to service, and the results of all tests in the programme should be documented in the crane records (see [BS 7121-2-1](#) and [BS 7121-2-3](#)).

12.5 Reporting of defects and incidents

The appointed person should ensure that there is an effective procedure for reporting defects and incidents to the crane owner. This should include notification of defects and incidents to the crane owner, a record of action taken, and clearance of the crane for further service (see [BS 7121-2-1](#) and [BS 7121-2-3](#)).

12.6 Leaving the crane unattended

12.6.1 The crane operator should always be present at the controls when a load is suspended from a crane.

12.6.2 Cranes should not be left unattended, even for a short period, unless all loads are removed from the lifting attachment and the lifting attachment is left in a safe position. The power supplies to all motions should be switched off or the engine stopped, and appropriate motion brakes and locks applied to render the machine in a safe condition. The ignition key and any other keys should be removed from the crane whenever the crane operator is absent from the machine.

12.6.3 If the crane is left unattended for a long period, and for out-of-service conditions, all switches should be locked off, fuel supplies should be cut off, and any access doors to machinery or control cabs should be locked to prevent unauthorized access. Machinery should be left in the out-of-service condition as specified in the operating instructions.

13 Pre-use checks, maintenance and inspection

- 13.1** Pre-use checks, maintenance and inspection should be carried out in accordance with [BS 7121-2-1](#) and [BS 7121-2-3](#).
- 13.2** Regular inspection of the side restraint system of the jib should be included in the planned maintenance schedule for the crane, and any corrective action required should be carried out immediately. Any report by the crane operator of unusual side deflection or movement should be investigated immediately.

NOTE Although side load can be detrimental to any crane, a crane with a cantilever, telescopic jib is at greater risk than other types of crane, especially if the jib section width is less than the depth. Lifting loads with a crane with a cantilever, telescopic jib that is badly aligned can also cause a crane to lose stability or suffer structural damage. As with the out of level condition, the risk of failure increases with longer jib lengths set at smaller radii.

14 Thorough examination, including testing

Thorough examination should be carried out in accordance with [BS 7121-2-1](#) and [BS 7121-2-3](#).

NOTE The thorough examination of mobile cranes after rigging is covered by [BS 7121-2-3:2012, 8.1.1](#).

15 Multiple lifting and lowering

15.1 General

- 15.1.1** Greater attention should be given to the planning and supervision of a lift involving two or more mobile cranes than a lift involving only one mobile crane, as the effects of the relative motion between the cranes can induce additional loads on the cranes, the load and the lifting accessories/attachments. Because of this and the difficulty in monitoring these additional loads, multiple lifting should only be used when the physical dimensions, characteristics, weight or required movement of the load prevent the operation being carried out by a single crane.
- 15.1.2** Multiple lifting should be planned with extreme care and include an accurate assessment of the proportion of the load to be carried by each crane. The planning should ensure that the hoist ropes or hooks remain vertical (see [Figure 14](#)). The mobile cranes should not be subjected to forces in excess of those that would occur were they handling their rated capacities as single lifts.
- 15.1.3** Loads should not be pulled or dragged sideways using either the slewing motion or the hoist line. The hoist line should always be in the plane of the jib and hanging vertical. Side-loading of the jib should be avoided.
- 15.1.4** Multiple lifting usually also involves multiple lowering. When lowering, a mobile crane can transfer load to another crane involved in the operation. During lifting, a crane operator can monitor and control the amount of load their crane is taking during lowering, but the operator of the mobile crane receiving the load has no direct control of the amount of load the crane is receiving. This becomes more complex if more than two mobile cranes are involved in the operation. The lift plan should therefore address the means of controlling the distribution of load during lowering. In particular, the rating of the mobile cranes should allow for foreseeable variations of load share, taking account of the response time of the operators and mobile cranes. The means of communication between the crane supervisor and the crane operators should be such as to facilitate a reliable and timely exchange of information and instructions. Where technically possible, the use of additional load monitoring equipment should be considered, for example, providing the crane supervisor with remote load readouts for all the cranes.

- 15.1.5** Multiple lifting should not be carried out using mobile cranes in conjunction with tower cranes (see [BS 7121-5](#)) or other lifting equipment.

15.2 Main factors to be considered when planning multiple lifting

15.2.1 Weight of the load

The total weight of the load and its distribution should be calculated if not already known. Where the information is taken from a drawing, allowance should be made for material density variations, casting and rolling margins and manufacturing tolerances.

15.2.2 Centre of gravity

Due to the variable effect of manufacturing tolerances and rolling margins, quantity of weld metal, etc., the centre of gravity of the load might not be known accurately and the proportion of the load being carried by each mobile crane could therefore be uncertain. Wherever possible, the position of the centre of gravity of the load should be established by calculation or weighting.

15.2.3 Weight of the lifting accessories/attachments

- 15.2.3.1** The weight of the lifting accessories/attachments should be part of the calculated load on the mobile crane. When handling heavy or awkwardly-shaped loads, the deduction from the rated capacity of the crane to allow for the weight of the lifting accessories/attachments might be significant. The weight of the lifting accessories/attachments and hook blocks, where appropriate, and its distribution should therefore be accurately known.

- 15.2.3.2** Where the crane ropes are reeved round pulleys that are part of a specially-designed lifting accessory/attachment, e.g. a lifting beam, the weight of the removed hook block and hook should be taken into account when determining the net weight of the lifting accessories/attachments.

15.2.4 Capacities of the lifting accessories/attachments

The distribution within the lifting accessories/attachments of the forces that arise during the lifting operation should be established. The lifting accessories/attachments used should, unless specially designed for the particular lifting operation, have a capacity margin well in excess of that needed for its proportioned load.

NOTE Special lifting accessories/attachments might be necessary to suit the maximum variation in distribution and direction of application of loads or forces that can occur during multiple lifting.

15.2.5 Choice of cranes

- 15.2.5.1** To minimize the variations in the direction and magnitude of the forces acting on the mobile crane during the multiple lift, the crane motions should be synchronous in their effect. Mobile cranes of equal capacity and similar characteristics (make, model, configuration and reeving) should therefore be used.
- 15.2.5.2** The rated capacity of a mobile crane should be calculated on the assumption that the load is raised and lowered in a vertical plane. The crane structure should be designed to withstand any lateral loads imposed by accelerations in the various crane motions, but it is unsafe to rely on this lateral strength to withstand horizontal components of out-of-vertical lifts.
- 15.2.5.3** If the mobile cranes have dissimilar characteristics, it is unlikely that the motions of the cranes are accurately synchronized. The effect of the hoist ropes being out-of-vertical, which could arise from inequalities of speed, should be assessed, and means for minimizing such inequalities should be determined.

15.2.6 Positioning of mobile cranes

- 15.2.6.1** The risk of jib side loads is very high during slewing operations, so mobile cranes should be positioned to minimize side loads on their jibs and arranged to avoid slewing wherever possible.
- 15.2.6.2** Mobile crane positions should be checked at each stage of the lifting operation to ensure that no collisions can occur between the cranes themselves and external obstacles.

15.2.7 Instrumentation

Instruments are available to monitor the angle of the load and verticality and the force in each hoist rope or hook constantly throughout the lifting operation. Such instruments and the restriction of the motion speeds, together with the strict use of one motion at any one time, should be used to control the loads on the mobile cranes within the planned values.

15.2.8 Supervision

- 15.2.8.1** One competent person should be in attendance and in overall control of a multiple crane operation. Only this person should give instructions to personnel operating or driving mobile cranes, except in an emergency, when a commonly recognized stop signal should be given by any person observing a situation leading to danger.
- 15.2.8.2** If all the necessary points cannot be observed from one position, other personnel should be posted at various positions to observe and report to the person in charge of the operation.
- 15.2.8.3** Effective communication should be arranged between all persons involved in the lifting operation.

15.2.9 Rated capacity during multiple lifting

If the appointed person is satisfied that all the relevant factors given in [15.2.1](#) to [15.2.8](#) have been accurately identified and are being monitored by instruments, each mobile crane may be used up to its rated capacity. When all the factors cannot be accurately evaluated, an appropriate down-rating (possibly 30% or more) should be applied to all the mobile cranes involved.

16 Weather conditions

16.1 General

The effects of weather should be given careful consideration during planning.

NOTE Certain weather conditions, such as electric storms, strong wind, heavy rains, ice or snow, can impose loads on a crane and adversely affect the safety of crane operations. See [16.2](#).

16.2 Wind

- 16.2.1** A crane should not be operated in wind speeds that are in excess of those specified in the operating instructions for the crane. Gusting wind conditions can have an additional adverse effect on the safe handling of the load and the safety of a crane. Even in relatively light wind conditions, extra care should be taken when handling loads presenting large wind catching areas, which can act as sails and affect their ability to be handled safely or the stability of the crane.

NOTE Information on the effect of wind and down-rating of the in-service lifting capacity is given in [BS 7121-1:2016](#), Annex D. Guidance on the assessment of wind loading is given in CIRIA C654 [\[27\]](#) and [BS 2573-1](#).

- 16.2.2** The limitations on wind speed for rigging, testing and de-rigging the crane could be lower than the limitations for normal operation and, in cases of doubt, advice should be obtained from the designer or a competent engineer.
- 16.2.3** Test sites (see [BS 7121-2-1:2012](#), [10.11.5.1](#)) should not be located in areas which are known to be exposed to extreme weather conditions.

- 16.2.4** Advice issued by the crane manufacturer regarding the out-of-service conditions should be strictly followed (see [BS 7121-1:2016](#), Annex D).

16.3 Visibility

In poor visibility, suitable means of communication should be provided to ensure the safe operation of the crane. In extreme conditions, crane operations should be stopped until there is sufficient improvement in visibility to enable operations to be resumed safely.

16.4 Rain or snow/ice

During adverse weather conditions, the appointed person should ensure that adequate precautions are taken to avoid danger when the crane or the load is affected by rain or snow/ice.

16.5 Water condition

Where a crane is used on a vessel and subject to adverse sea states, account should be taken of the angles of heel being experienced and of the vessel stability (see [Annex G](#)).

17 Out-of-service conditions

17.1 General

When the crane is out-of-service, even for overnight, it should be left in the condition specified in the manufacturer's instructions to ensure that it is not adversely affected by the weather conditions at the site. The appointed person should ensure that weather forecasts are obtained for the location of the lifting operation and that the appropriate information is passed to the crane supervisor, along with any specific instructions for action in response to the forecast conditions. Planning and provision for inclement weather to allow adequate time for the crane to be put in a safe condition with reference to the configuration the crane is working on.

17.2 Thunderstorms

- 17.2.1** A crane jib, particularly a long one, could act as a conductor and attract a lightning strike during a thunderstorm. If there are clear signs of an approaching thunderstorm, lifting operations should cease and all personnel should be moved out of the vicinity of the crane, until the possibility of danger passes.

- 17.2.2** A crane struck by lightning can be seriously damaged both structurally and mechanically. A thorough examination should be carried out before a crane struck by lightning is returned to service.

NOTE 1 A thorough examination might reveal internal damage to some parts (e.g. the slew ring, which might not show signs of deterioration until many hours usage).

Cranes should be earth-bonded in accordance with the manufacturer's instructions.

NOTE 2 Requirements for lightening protection are given in [BS EN 62305-1](#).

17.3 On-site travel

17.3.1 General

- 17.3.1.1** On-site travel of a fully rigged crane should only be carried out if there is no possible alternative. On-site travel of a fully rigged crane should be planned, supervised and carried out with the same thoroughness as lifting of loads. This phase of the lifting operation should be included in the planning brief to all personnel involved in the lifting operation.
- 17.3.1.2** Manufacturer's operating manuals should provide all relevant information on safe procedures for travelling mobile cranes, and these should be complied with.

17.3.1.3 Before starting to travel a fully-rigged crane, checks should be carried out to ensure that the undercarriage is prepared correctly in accordance with the manufacturer's instructions.

17.3.1.4 Travelling mobile cranes with the jib extended or elevated presents particular hazards. As part of the planning these should be addressed, taking note of the requirements set out in the crane manufacturer's machine-specific manual. These additional hazards include:

- a) inclines and cross-falls and obstructions on the route; and
- b) wind loading.

Travel should be carried out in accordance with the manufacturer's instructions.

17.3.1.5 The crane operator and attendant(s) should walk the route prior to travelling the crane to identify any obstructions or other hazards, including overhead lines, and discuss how problem areas should be negotiated. Any problem areas identified outside the existing lift plan should be referred to the appointed person. An attendant(s) should escort any crane travelling on site.

NOTE Crawler cranes are able to travel, rigged ready for lifting, over uneven, sloping and unmade-up ground, but this ability is limited by the site conditions and the chosen crane and jib configuration. Long jib combinations increase the potential hazards of travel on site.

17.3.2 Wheeled cranes

17.3.2.1 Wheeled cranes that are required to be travelled on site for some distance should be covered in the safe system of work for the lifting operation. The crane travel route should be checked to determine whether it is able to take the wheel loads and to ensure that there are no overhead hazards (e.g. pipes and cables) with insufficient clearance above the crane. Checks should be carried out to ensure that the ground or structure over which the crane is to travel is suitable and has an adequate bearing capacity.

NOTE Wheel loads on cranes can be considerable, especially when rigged in the "ready-for-work" condition, with additional counterweight and jib sections.

17.3.2.2 The outriggers should be extended and the jack feet or floats kept just clear of the ground.

17.4 Movement to site

17.4.1 Wheeled cranes

NOTE Wheeled mobile cranes used on the public road are covered by a number of statutory regulations.

Access routes to the site of the lifting operation may have height as well as weight limitations. The crane supplier should check that any over-bridges on the route do not have a clearance height below the travelling height of the crane(s). The crane operator should ensure that the crane is in the correct road travel mode before setting out, and that the jib is correctly placed on the jib rest or secured in the lowest position recommended by the manufacturer.

17.4.2 Crawler cranes

Before deciding to use a crawler crane for the planned lifting operation, the crane supplier should consider any problems associated with transportation of the crane and equipment to the site, including any consultation required with the relevant authority concerning weight and height restrictions on the route to the site.

18 Slinging and handling of loads

The appointed person should plan how the load is to be slung (see [BS 7121-1:2016](#), Clause 16). Details should be recorded in the lift plan.

19 Signalling systems

Signalling systems should be selected and used in accordance with [BS 7121-1:2016](#), Clause 17.

20 Special applications of cranes

20.1 General

20.1.1 In all cases involving special duties, guidance should be sought from the crane manufacturer or other competent person.

20.1.2 The weight of any special lifting attachments should be included as part of the load. Each attachment should be tested, certified and clearly marked with the rated capacity and weight of the attachment. Attachments should only be used for their design purpose.

20.2 Raising or lowering of personnel

20.2.1 General

20.2.1.1 Raising and lowering of personnel by equipment that is not specifically designed for this purpose should only be carried out in exceptional circumstances, when it is not practicable to do so by other, less hazardous means.

20.2.1.2 Careful planning should be carried out prior to each raising and lowering operation.

NOTE 1 Attention is drawn to LOLER 1998 [2] regarding the planning of lifting operations.

NOTE 2 Further information on raising and lowering personnel is given in ISO 12480-1 and [BS EN 14502-1](#).

20.2.2 Carrier

The type of carrier selected when raising/lowering personnel should be based on a risk assessment and vary according to the application, for example construction, forestry, rescue. New carriers selected for use should conform to [BS EN 14502-1](#).

20.2.3 Compatibility of carrier and crane

20.2.3.1 Capacity

The crane selected to lift the carrier should have a rated capacity for the crane configuration to be used which is at least twice the weight of the carrier, its lifting accessories and its load.

20.2.3.2 Motion control system

20.2.3.2.1 The crane should be equipped with a motion control system that brings motion to rest automatically when the controls are released.

20.2.3.2.2 The crane should be equipped with power lowering. A crane with free-fall capability should not be used to lower and raise persons unless the free-fall facility is locked out.

20.2.3.2.3 Load-bearing hydraulic cylinders should be fitted with a device to stop movement in case of hose rupture or pipe fracture.

20.2.3.2.4 The crane control system should be able to provide a smooth transition of the carrier. The working speed of the carrier should be limited to a maximum of 0.5 m/s on all motions.

20.2.3.2.5 Means should be provided so that, if the power supply or control system fails, the carrier can be positioned to enable access/egress without risk.

20.2.3.3 Wire ropes

Wire ropes used for hoisting and lowering the carrier should have a minimum diameter of 8 mm.

20.2.3.4 Hook

The crane hook should be provided with a safety catch.

20.2.4 Thorough examination and pre-use checks

Thorough examination and pre-use checks of cranes and carriers for lifting persons should be carried out in accordance with [BS 7121-2-1:2012](#), Clause 12.

20.2.5 Other devices/facilities

20.2.5.1 Anemometer

The crane should be fitted with an anemometer or other device to monitor in-service wind speeds.

20.2.5.2 Storage

Storage accommodation for equipment, including any emergency egress equipment, should be provided in the carrier.

20.2.5.3 Rated capacity limiter/rated capacity indicator

20.2.5.3.1 The rated capacity limiter/rated capacity indicator on the crane should be maintained in good working order.

20.2.5.3.2 Limit switches should be provided to prevent over-hoisting, over-lowering or over-derricking.

20.2.5.3.3 The operator should check limit switches for correct operation each day before personnel carrying operations are carried out.

20.2.5.3.4 Limit switches are not necessarily fail-safe, so care should be taken if motion limits are approached.

20.2.5.3.5 A fail-safe procedure should be provided to ensure that sufficient hoist rope remains on the winch drum at all times to prevent the end of the rope running off the drum while lowering the empty carrier.

20.2.5.3.6 To ensure that sufficient rope remains on the drum at all times, the carrier should be lowered to the bottom of the shaft, cofferdam or caisson:

- a) prior to first use;
- b) after each time the shaft, cofferdam or caisson depth increases; and
- c) after the crane hoist rope or hook is replaced.

20.2.5.3.7 Care should be taken when the crane is moved to different locations to ensure that sufficient rope is fitted for each operation.

20.2.5.3.8 Operation of limit switches, check valves and similar devices could prevent some motions of the crane with the carrier still suspended. Precautions should be taken to ensure that persons in the carrier are

not left suspended for an excessive period, and/or a procedure for raising or lowering the carrier to a safe position should be provided.

20.2.6 Operation

20.2.6.1 Organizational requirements

20.2.6.1.1 Lifting, lowering and supporting the carrier should be carried out by the operator in controlled conditions, directed by a slinger-signaller who should be present at all times during the lifting operation. The slinger-signaller should be positioned such that they can see both the carrier and the crane operator at all times.

20.2.6.1.2 The crane operator should be present at the normal crane control station when the carrier is occupied. Audible communication should be possible between the persons in the carrier and the crane operator at all times during the lifting operation.

NOTE This may be provided by dedicated radio or wired telephone.

20.2.6.1.3 During the operation:

- a) an adequately trained and briefed person should be present to perform any emergency recovery procedure;
- b) the crane operator and signaller should not perform any other work at the same time, and should only be responsible for operating one crane or directing one carrier;
- c) cranes and other machines should not operate simultaneously in the same place if there could be a risk of collision;
- d) all movements should proceed gently and not exceed 0.5 m/s; and
- e) load-lifting attachments for carriers should not be used for any other purpose.

20.2.6.1.4 Carriers should not be used in the following conditions:

- a) winds exceeding 7 m/s (25 km/h), measured with a calibrated hand-held anemometer at a similar level to that to which the carrier will be lifted;
- b) electrical storms;
- c) snow or ice;
- d) fog;
- e) sleet; and
- f) other weather conditions that could affect the safety of personnel.

20.2.6.1.5 Unintentional rotation of the carrier should be prevented, for example by using guide ropes or anchoring. The means of preventing unintentional rotation should not inhibit any emergency procedures and otherwise interfere with the safe operation of the carrier.

20.2.6.1.6 Lifts should not be made on any other hoist lines of the crane while any person occupies a carrier attached to the crane.

20.2.6.1.7 The crane, load-lifting attachments and carrier should be inspected every working day during use.

NOTE For further information on inspections, see BS 7121-2. An example of a personnel carrier pre-use check form is given in [BS 7121-2-1:2012](#), Annex C.

20.2.6.2 Precautions for persons in the carrier

20.2.6.2.1 The payload of the carrier should not be exceeded.

20.2.6.2.2 The stability of the carrier should not be affected by the operation. Additional care should be taken if the carrier is of a length that could lead to excessive tilting through movement of persons or tools within the carrier.

20.2.6.2.3 Users of a carrier should wear suitable full-body harnesses with work restraint systems attached to a suitable anchorage point in the carrier. The most suitable type of work restraint system is an adjustable lanyard, adjusted to be as short as possible to ensure that a person is restrained within the carrier.

NOTE Further information on the use of personal fall protection equipment is given in [BS 8437](#).

20.2.6.2.4 Consideration should be given to the rescue of persons from a carrier if the carrier is unable to be lowered for any reason, such as machine malfunction or carrier entanglement. Any rescue procedure should be properly planned, taking into account the reasons why the carrier is stranded at height and any need for urgent action.

NOTE In many circumstances the rescue plan simply involves lowering of the carrier by the supporting crane.

20.2.6.2.5 In the event that fall-arrest equipment is selected, a rescue plan should be prepared to avoid the consequences of suspension trauma when a person is suspended from a fall-arrest harness.

20.2.6.2.6 Any tools/materials in the carrier should be secured to prevent displacement, tipping and/or falling out.

20.2.6.2.7 Personnel should remain entirely inside the carrier during raising, lowering and positioning to avoid pinch points. Personnel should only stand on or work from the floor of the carrier.

20.2.6.2.8 Carriers should be secured so that access and egress can be accomplished without danger.

20.2.6.2.9 Crane-suspended man riding cages should not generally be provided instead of fixed access/egress.

20.2.7 Work from a carrier

COMMENTARY ON 20.2.7

Exposed electrical conductors in the vicinity of the lifting operation can present electrical hazards. Exposed high-voltage conductors can cause electric shocks or burns even if not touched by personnel. If there are electrical conductors adjacent to the work area, seek advice from the owner of the conductor. Overhead lines usually belong to the local electricity supplier or the National Grid company. These suppliers can provide advice on safe working distances from electrical conductors.

20.2.7.1 If electric arc welding is carried out from a carrier, precautions should be taken to prevent stray welding return currents from flowing through the load-lifting attachments, crane hoist rope or hook, or other part of the crane. Electric arc welding should be carried out in accordance with HSG 118 [N3]. The return welding current lead should be secured to the welded part, as close as practicable to the point of the weld.

NOTE Complete insulation of the crane hoist rope or use of clean dry webbing lifting attachments can also prevent stray currents.

20.2.7.2 Electric-powered hand tools, if used, should be battery-powered.

20.2.7.3 Power cables provided to the carrier should not interfere with safe operation of the carrier.

20.2.7.4 Power cables should not be used as tag lines.

20.3 Grabbing and magnet crane services

20.3.1 General

When using cranes for special duties such as grabbing or magnet crane service, allowance should be made not only for the weight of the grab, magnet or other attachments, together with load, but also for additional loadings imposed on the crane resulting from fast slewing, grab suction effects, impacts, etc. Consequently the weight of the grab and contents, or the weights of the magnet and load, should be less than the corresponding rated capacity for normal crane duty. Reference should be made to the crane designer or another competent engineer for details of special duty ratings.

20.3.2 Grabbing service

20.3.2.1 Mobile cranes should only be used for grabbing duties if this is permitted by the manufacturer.

20.3.2.2 For mobile cranes with grabbing duties permitted by the manufacturer, the lifted load is the weight of the grab and its contents. The weight of the contents depends on the density of the material. Any grab used should be of appropriate capacity for the material, with regard to the rated capacity of the crane and the grab. A weight check should be carried out in case of doubt.

20.4 Magnet service

NOTE Requirements for magnetic lifters are specified in [BS EN 13155](#).

Where a load is supported by a magnet, precautions should be taken to ensure that there are no hazards to personnel caused by unexpected release of the load. The magnet should be marked with the rated capacity (working load limit) and used in accordance with the manufacturer's instructions.

20.5 Vacuum lifting devices

NOTE Requirements for vacuum lifters are specified in [BS EN 13155](#).

Where a load is supported by a vacuum, precautions should be taken to ensure that there are no hazards to personnel caused by unexpected release of the load. The vacuum should be marked with the rated capacity (working load limit) and used in accordance with the manufacturer's instructions.

20.6 Demolition: balling operations

A mobile crane should not be used for balling operations.

20.7 Dynamic compaction

Dynamic compaction should only be conducted with a standard mobile crane with manufacturer's approval.

Annex A (informative)

Road-rail cranes

A1 A road-rail crane usually comprises either a road legal vehicle (lorry), adapted to operate on rail if required, and usually fitted with a loader crane that can drive on the highway to the access point to gain entry to the railway infrastructure; or a non-road legal vehicle such as an excavator, adapted for lifting duties with an approved RCI system, known as a road rail excavator crane.

Rail operation is achieved by rail axles fitted to the vehicles that are hydraulically lowered onto the rails, and in some cases, the axles are powered by a hydraulic motor. Many of these vehicles have free-on-wheels capabilities, though the vehicles fitted with loader cranes and having no counterweight are usually restricted to lift and carry operations at $\pm 5^\circ$ over the tail end of the vehicle.

Lift planning requires extra competence and understanding of movement, gradients and super elevation (known as “cant” in the rail industry) and the effect they have on centre of gravity and crane stability. This is especially important since in most cases, outriggers/stabilizers are not used.

Training of those involved in the planning and supervision of lifting within the rail industry is specific to the rail industry, and is recorded on a Network Rail database called Sentinel.

Operation and driving of road rail cranes when not on the rails might require an industry approved training scheme for the base vehicle, with supplementary training for driving and operating on the railway to rail industry approved standards and M&EE codes of practice. The training and ongoing competence assessments are also recorded on Sentinel.

[Figure A.1](#) gives examples of road-rail cranes.

Figure A.1 — Typical road-rail crane varieties

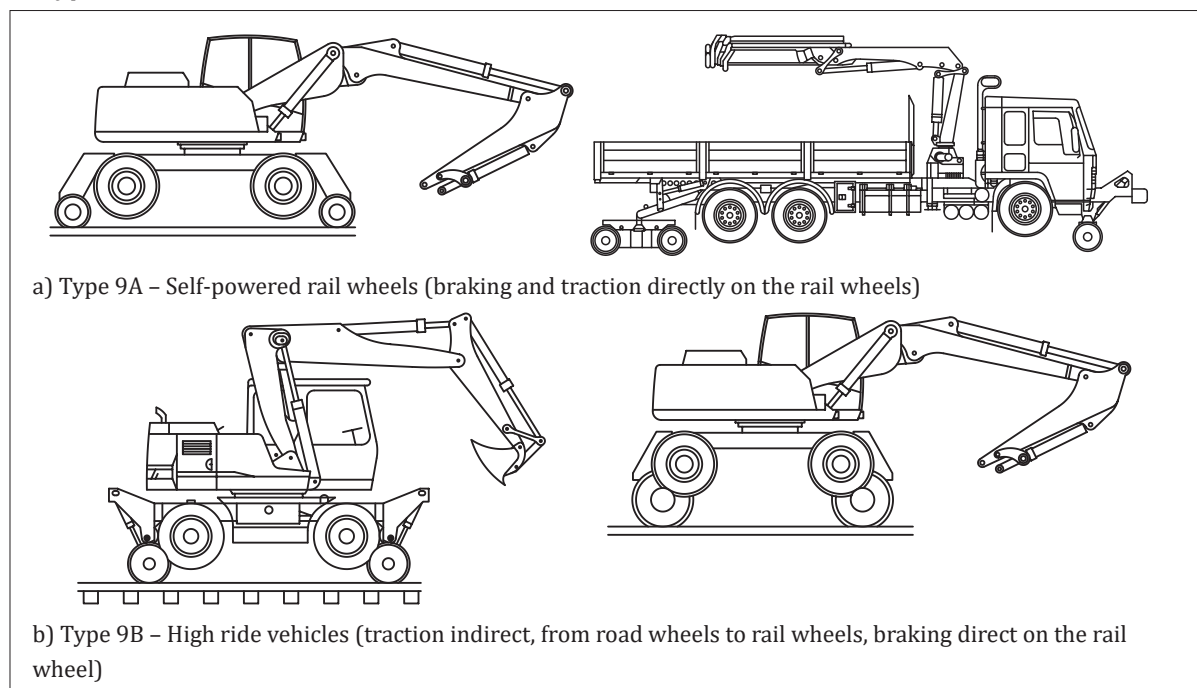
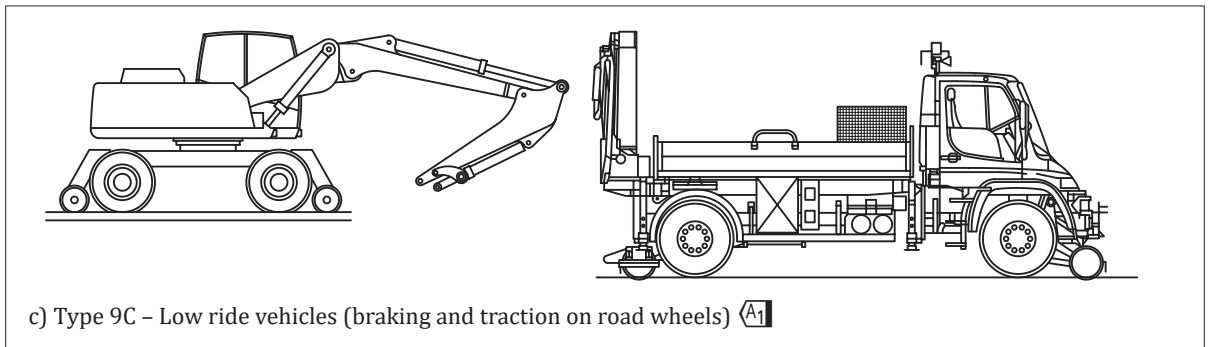


Figure A.1 (continued)

Annex B (informative)

Contract lift or crane hire

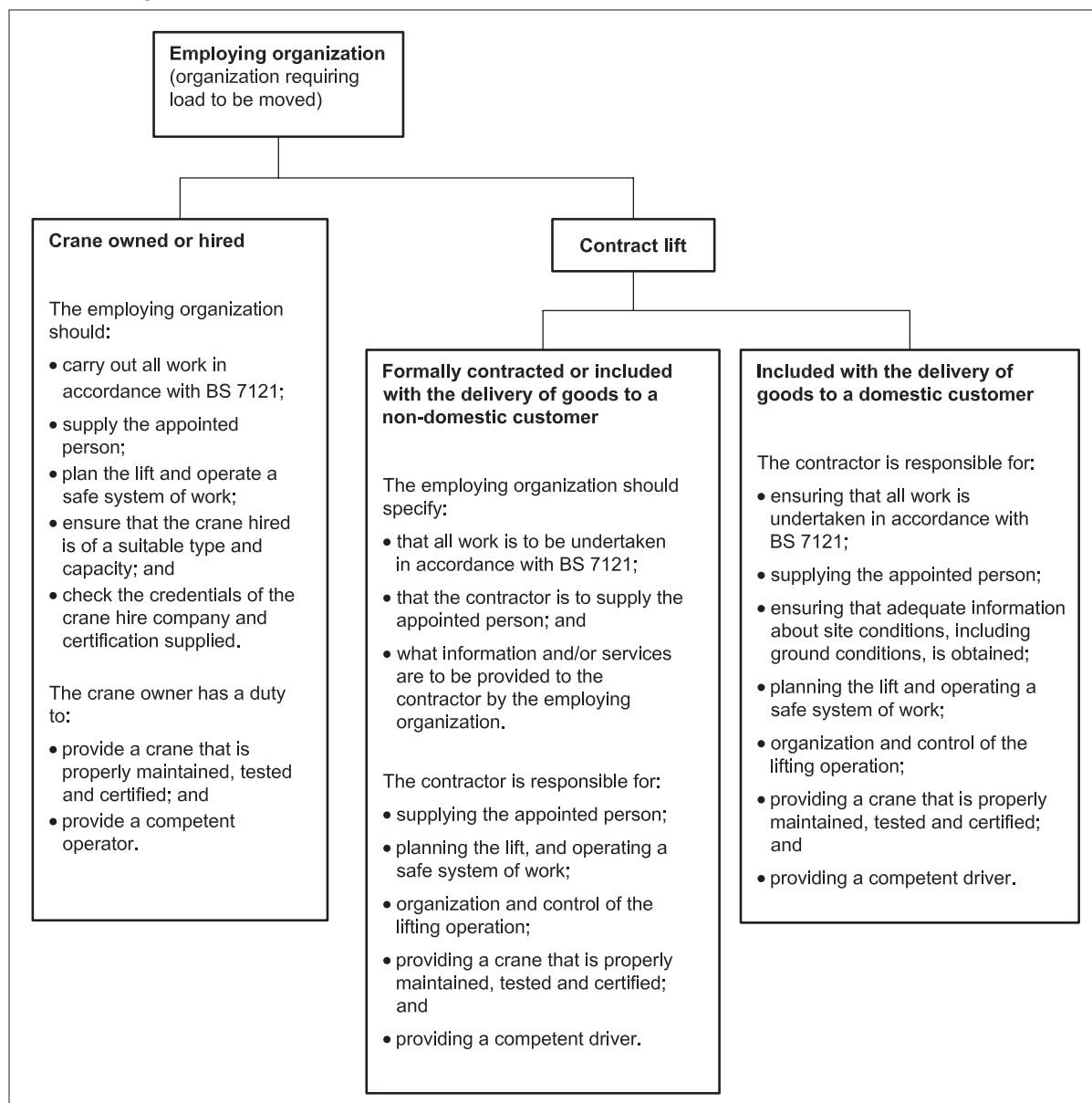
Given the wide variety of contractual arrangements used, it is important to ensure that the planning, organization, control and management of lifting operations are not compromised. In general, any organization requiring a load to be moved by crane, which does not have its own craneage, has two basic options: hiring a crane (crane hire) or employing a contractor to carry out the lifting operation (contract lift). The difference between the two options is summarized in [Figure B.1](#).

The contract lift includes three possibilities:

- a) a formal contract lift where a crane owner is contracted by an employing organization to lift a load on their behalf using a crane (see [5.7.2.1](#));
- b) lifting operations as part of the supply and delivery of goods to a non-domestic customer, e.g. where a temporary accommodation supplier is delivering a site cabin to a construction site on a vehicle and unloads and installs the cabin using a mobile crane they have supplied for the purpose (see [5.7.2.2](#)); and
- c) lifting operations as part of the supply and delivery of goods to a domestic customer, e.g. where a hot tub supplier is delivering a hot tub to a householder on a vehicle and unloads and installs the hot tub using a mobile crane they have supplied for the purpose (see [5.7.2.3](#)).

In option c), the crane supplier assumes full responsibility for all aspects of the lifting, including ground conditions, operation as the householder would not be expected to have sufficient knowledge to advise the supplier of any significant hazards or be aware of the requirements of LOLER [\[2\]](#) and BS 7121.

Where an organization owns its own crane, they are responsible for managing the lifting operation in accordance with Clause [4](#) to Clause [20](#).

Figure B.1 — *Contract options*

Annex C (informative)

Loads imposed on the ground by mobile cranes

The loads imposed on the ground by mobile cranes varies according to the configuration of the crane, operating conditions, load radius, mass of the load and outrigger/track configuration. [Figure C.1](#) to [Figure C.3](#) show the effects of these variables on loads imposed on the ground.

NOTE Further guidance on loads imposed on the ground by mobile cranes is given in the SFFC publication *Ground Conditions for Construction Plant* [18].

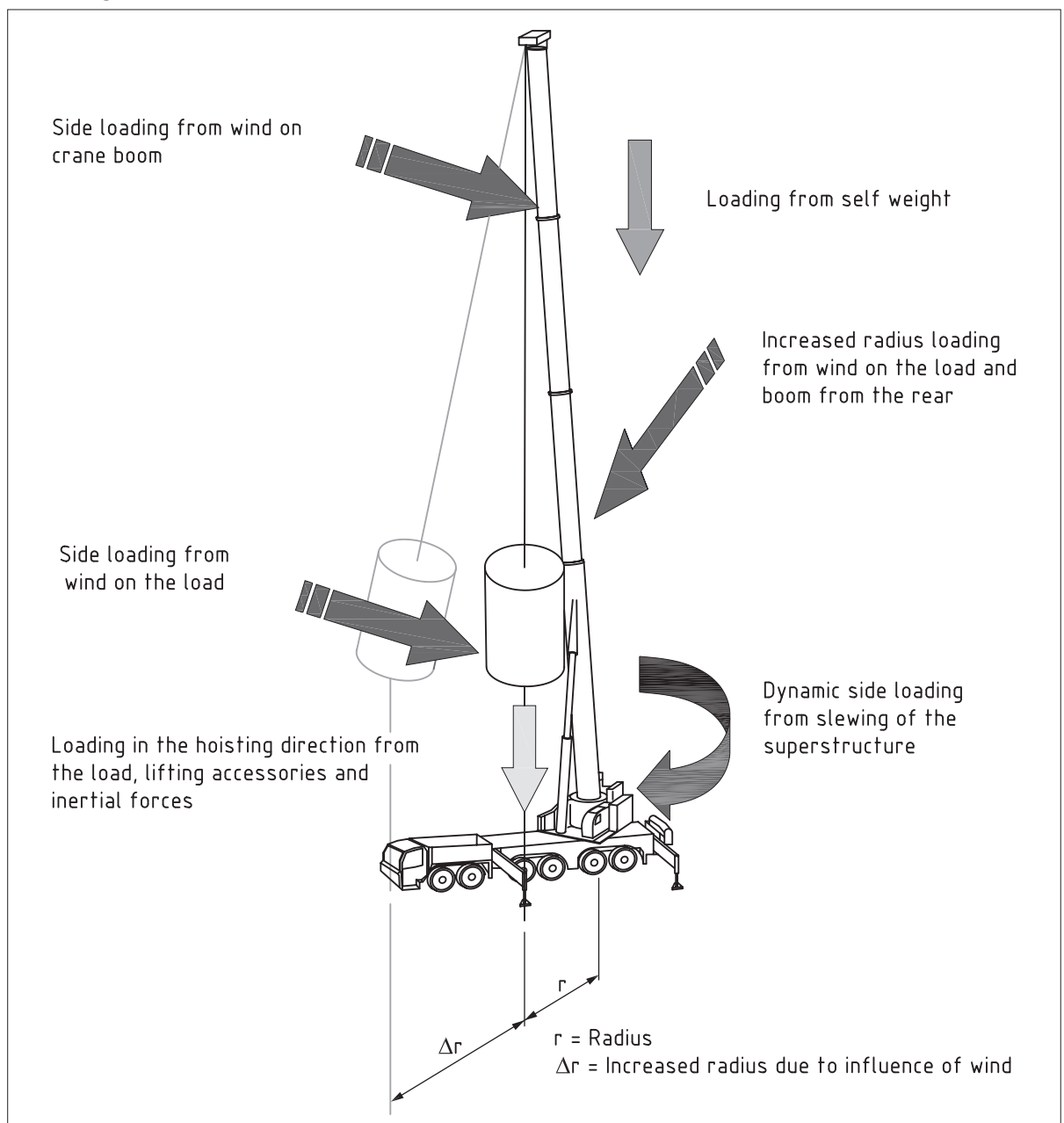
Figure C.1 — *Loadings on a mobile crane*

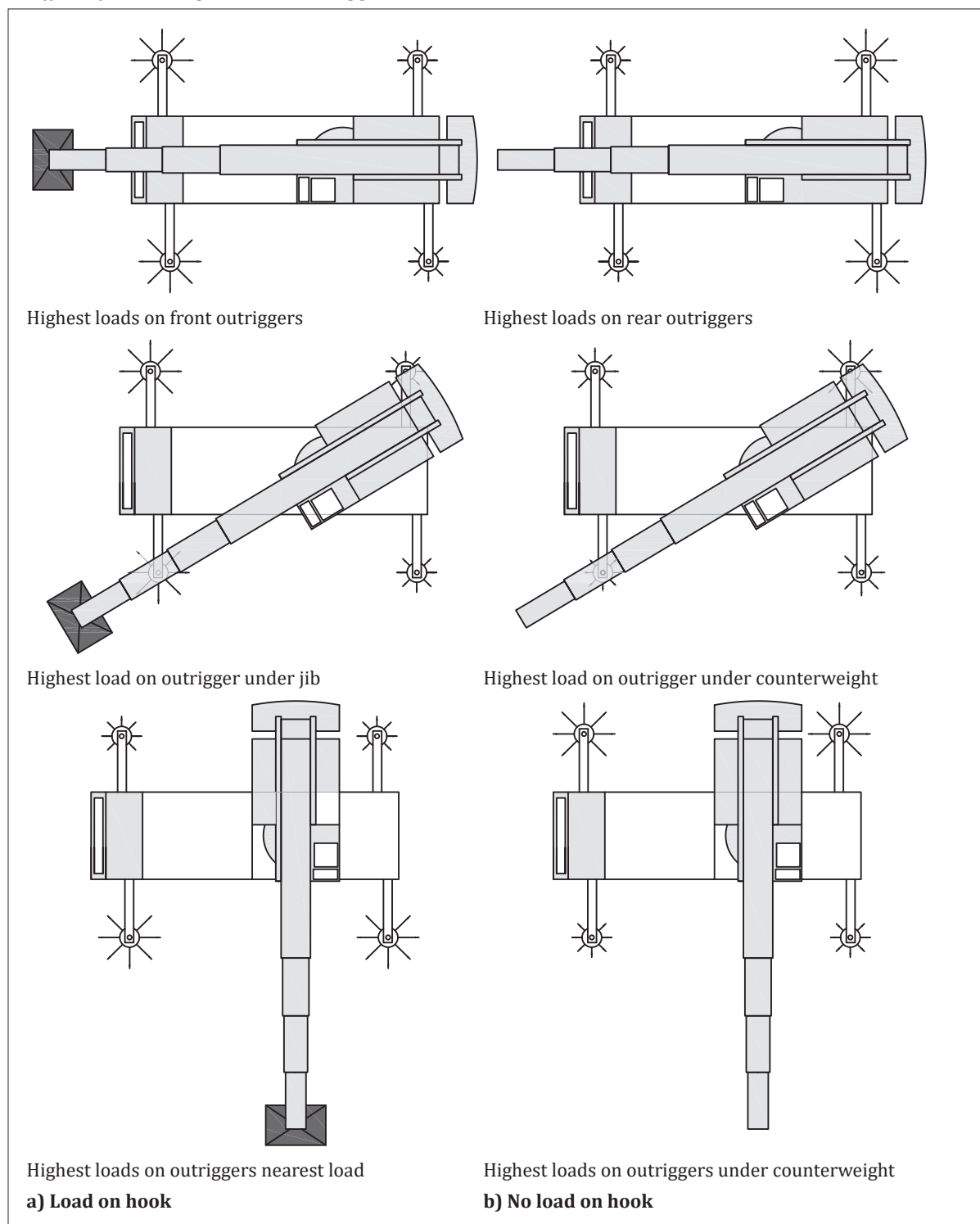
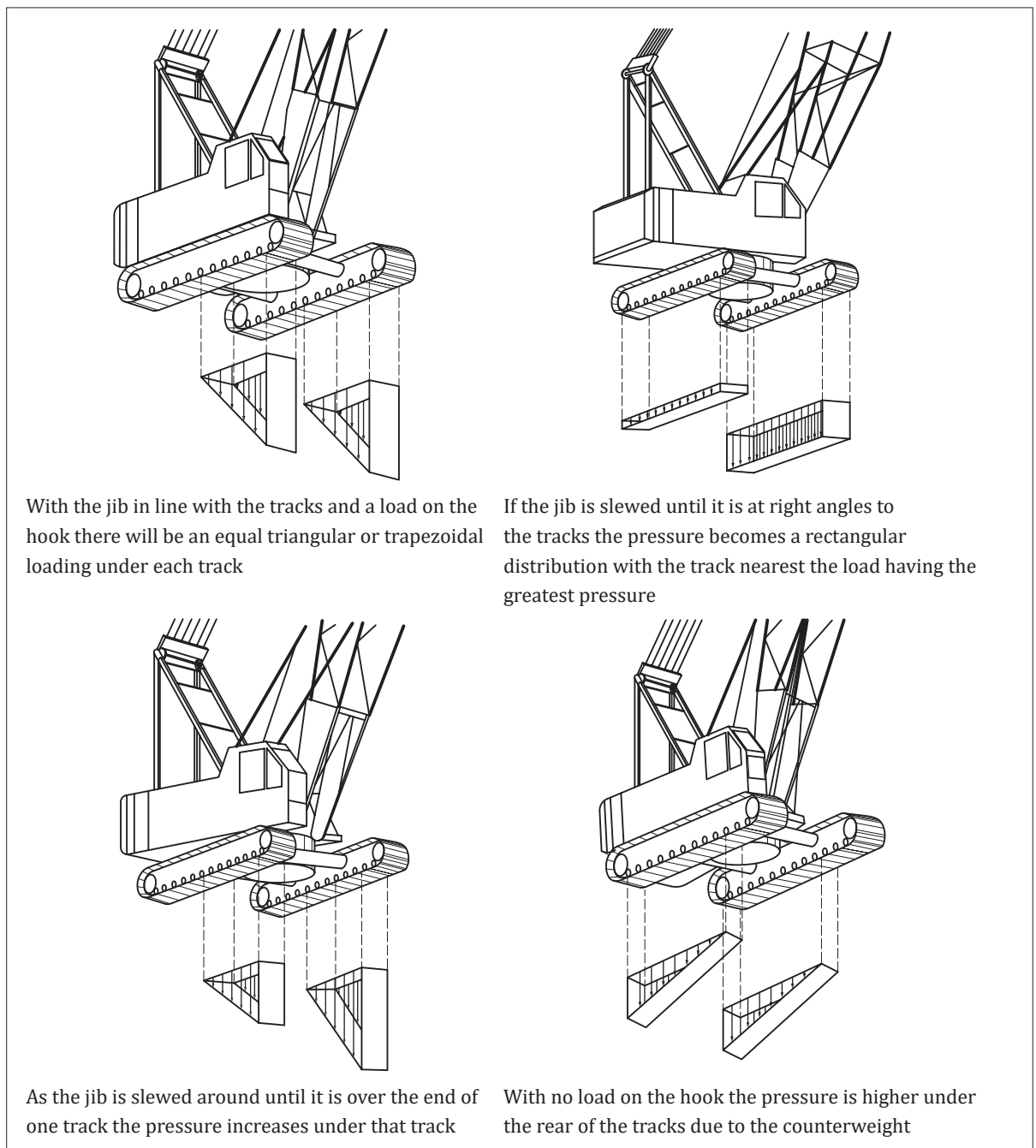
Figure C.2 — *Effect of load and position on outrigger loads*

Figure C.3 — *Effect of load and position on crawler track loads*

Annex D (normative)

Piling operations

D.1 General

A mobile crane should only be used for piling operations where this is permitted by the crane manufacturer and where there are no viable alternatives. The guidance in [D.2](#) to [D.4](#) should be followed.

D.2 Hydraulic equipment

Hydraulic equipment for driving or extracting piles usually includes hoses to supply and return oil from the power pack to the clamps and motors. The additional weight of the hoses can be significant and an allowance should be made for this, especially if working at height. Care should be taken to avoid hoses being caught on obstructions, to avoid side loading of the crane jib and damage to high-pressure hydraulic services. Visual or other means of communication should be established between the crane operator and the operator of the pile driver/extractor if these controls are not in the crane cabin.

D.3 Driving piles

The appointed person should consider the following prior to deciding which type of mobile crane to use.

- a) Impacts or dangerous vibrations should not be transmitted from the driving device to the crane.
- b) If the driving device remains attached to the crane hook by a sling during operation, the sling should be of sufficient length to accommodate the speed of driving, so that no unplanned load is taken by the crane.
- c) The crane operator should be experienced in pile driving operations and should be briefed on the ground characteristics, so that the driving device can be followed down at a rate that prevents excessive load on the crane.
- d) Strut jib cranes are most suitable for pile driving operations. The available jib length should provide sufficient margin of headroom for clutching of sheet piles.

NOTE If precast piles are used, with a drop hammer and hanging leaders attached to the jib of a crawler crane, the crane is then part of a piling machine and is not covered by this code of practice.

D.4 Extracting piles

All hazards should be carefully considered prior to selecting a mobile crane for extracting piles.

NOTE 1 Using a telescopic boom to extract piles can damage the crane.

The appointed person should consider the following prior to deciding which type of mobile crane to use to extract piles.

- a) The condition of the piles should be determined and an estimation made of the resistance to extraction.

NOTE 2 Piles that have been in the ground for a long time could be corroded and friction in the pile clutches high.

- b) Information should be sought on any difficulties encountered when the piles were driven.

NOTE 3 If the foot of a pile encounters rock it can curl up, or clutches can split, making extraction impossible even with a heavier extractor and an increase in crane size.

- c) The crane supervisor should be trained and experienced in pile extracting and should be given clear instructions on how to report back if any difficulties are encountered.
- d) The crane operator should be experienced in handling the type of extractor in use, and should not exceed the load specified in the safe system of work.
- e) Rated capacity indicators can be adversely affected by pile extracting operations, and additional checks and maintenance should be carried out on these after operations are carried out.

- f) Welds, ropes, fixings, sheaves, etc., should be inspected once per week during pile extracting operations.

Annex E (normative)

De-rigging operations

- E.1** The appointed person should ensure that the complete de-rigging operation is properly planned. If possible, the original drawings for the structure should be obtained and used to draw up a schedule of the individual loads. The schedule should contain details of the weights and dimensions of each load, so that the most suitable cranes, ancillary equipment and personnel can be selected. The appointed person should check all drawings against the existing structure, to verify the drawings' relevance and identify any changes made to the structure that could affect the schedule of lifting operation.
- E.2** Even if a full set of drawings and information on individual weights are available, the appointed person should arrange for a thorough inspection of the structure and plant before a final lifting plan is drawn up. The inspection should include an analysis of the effects of corrosion (from environmental and processing causes). Dynamic effects that could occur from movement of fluid, etc., in containers should be considered prior to making the final crane selection.
- E.3** If the structure to be de-rigged is a process plant, allowance should be made for the extra weight that deposits of process material could add to the schedule of weights. If deposits are likely to have occurred, the item to be lifted should be inspected, the weight of any deposits assessed, and a minimum allowance of 20% added to the weight of the load.
- E.4** If no authenticated information is available on the weights to be lifted, the appointed person should draw up a schedule of parts to be lifted and make accurate calculations for the weight of each part. The calculated weight should be increased by an appropriate factor to take account of the accuracy of the calculated weight. The schedule should also include all dimensions so that the de-rigging operation can be thoroughly planned and a safe system of work drawn up.
- E.5** The safe system of work should include steps to ensure that all loads are free from adhesion to any supporting surface prior to lifting.
- NOTE Steel wedges can be used to part corroded flanges. Jacking equipment can be used to break suction.*
- E.6** The safe system of work should include instructions for a final inspection of the load, by the crane supervisor, before the operation begins.
- E.7** Objects should not be de-rigged from a point above ground if it is not possible to return them to the original position (see [Annex F](#)).

Annex F (normative)

Non-recoverable lifts/loads

F.1 A non-recoverable lift, i.e. a lift in which the possibility of replacing the lift on the point from which it was lifted is removed as part of the lifting process, e.g. supporting a steel beam which is being cut from a structure, should be avoided where possible by providing an alternative support or lifting approach. Where there is no alternative to a non-recoverable lift then the additional measures taken to avoid overloading the lifting equipment should include:

- a) an assessment of the weight and geometry to be lifted, including the degree of certainty (accuracy) of the assessment, should be obtained from a suitably qualified and experienced engineer, and documented;

NOTE Where the weight and geometry can be confirmed by pre-weighing by jacking or similar then this degree of certainty can be high; where it is based on estimated geometry and composition then the degree of certainty will be low.

- b) the consequences of failure of any component of the lifting equipment or foundations should be taken into account along with the potential effects on nearby structures or assets.

F.2 By combining the risk associated with the load to be lifted and the consequences of failure, the effects of the load should be increased by a factor from 1.25 where the load geometry and weight are known and the consequences of failure are low. Where the load geometry and weight are less certain a larger factor should be applied.

NOTE It is expected that for normal activities this could be as much as 2 and for exceptional circumstances the factor could go toward 5. In such cases it might be prudent to consider an alternative approach.

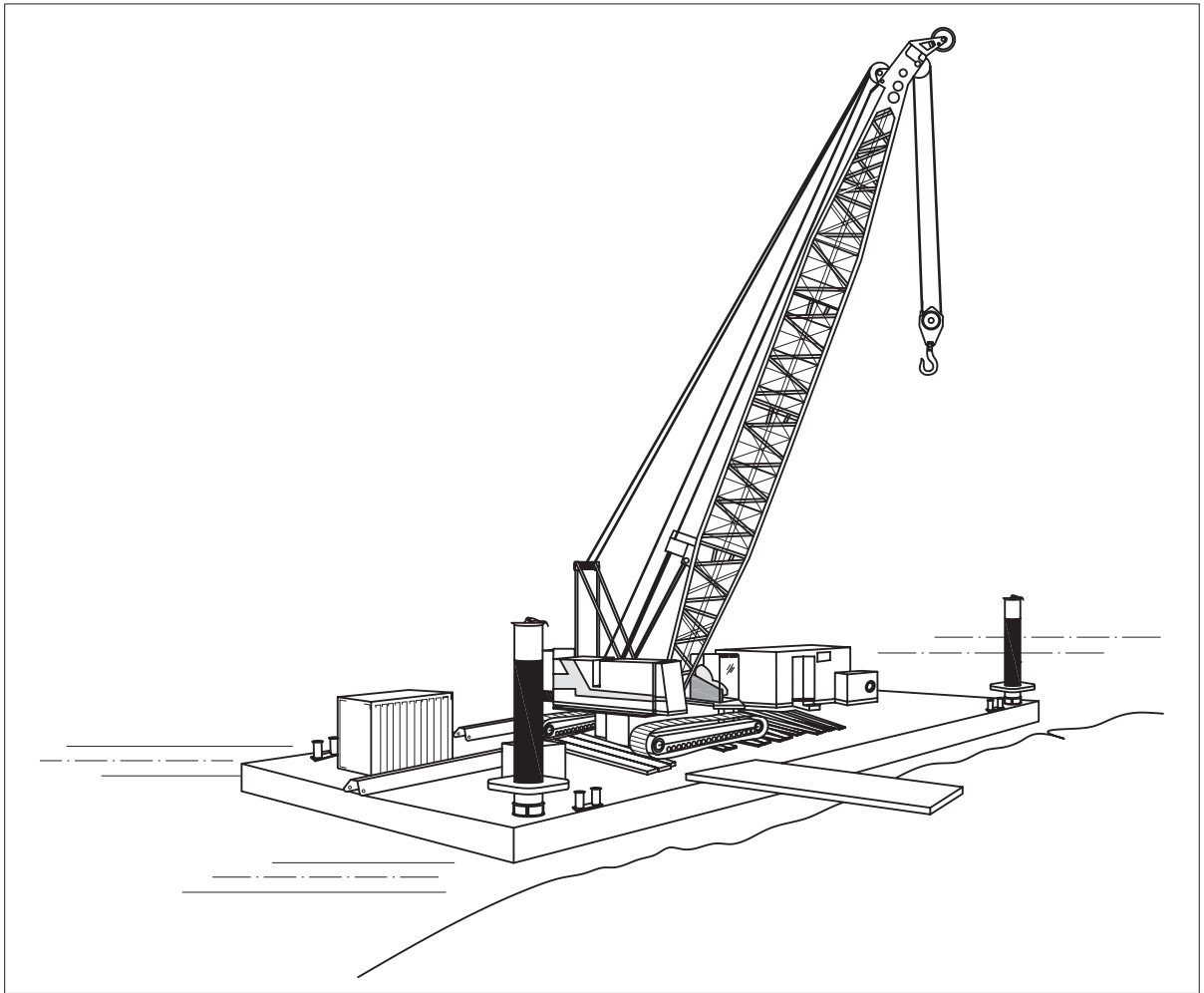
Annex G (normative)

Mobile cranes mounted on water-borne craft

G.1 General

When a mobile crane is to be mounted on water-borne craft this should be considered a major modification requiring the assembly of the crane and the vessel to be assessed, tested and thoroughly examined as a floating crane. The crane should be attached to the water-borne craft by suitable devices to prevent unintentional sudden movement of the crane.

Examples of mobile cranes mounted on waterborne craft include flat deck modular pontoons (see [Figure G.1](#)) or purpose-built ramped pontoons with raised platforms for working (see [Figure G.2](#)).

Figure G.1 — Typical flat top modular pontoon

G.2 Pre-mounting assessment

When a mobile crane is to be mounted on a waterborne craft, the structure of the craft should first be assessed to determine that it is suitable to take the loadings of both the crane and the load to be lifted.

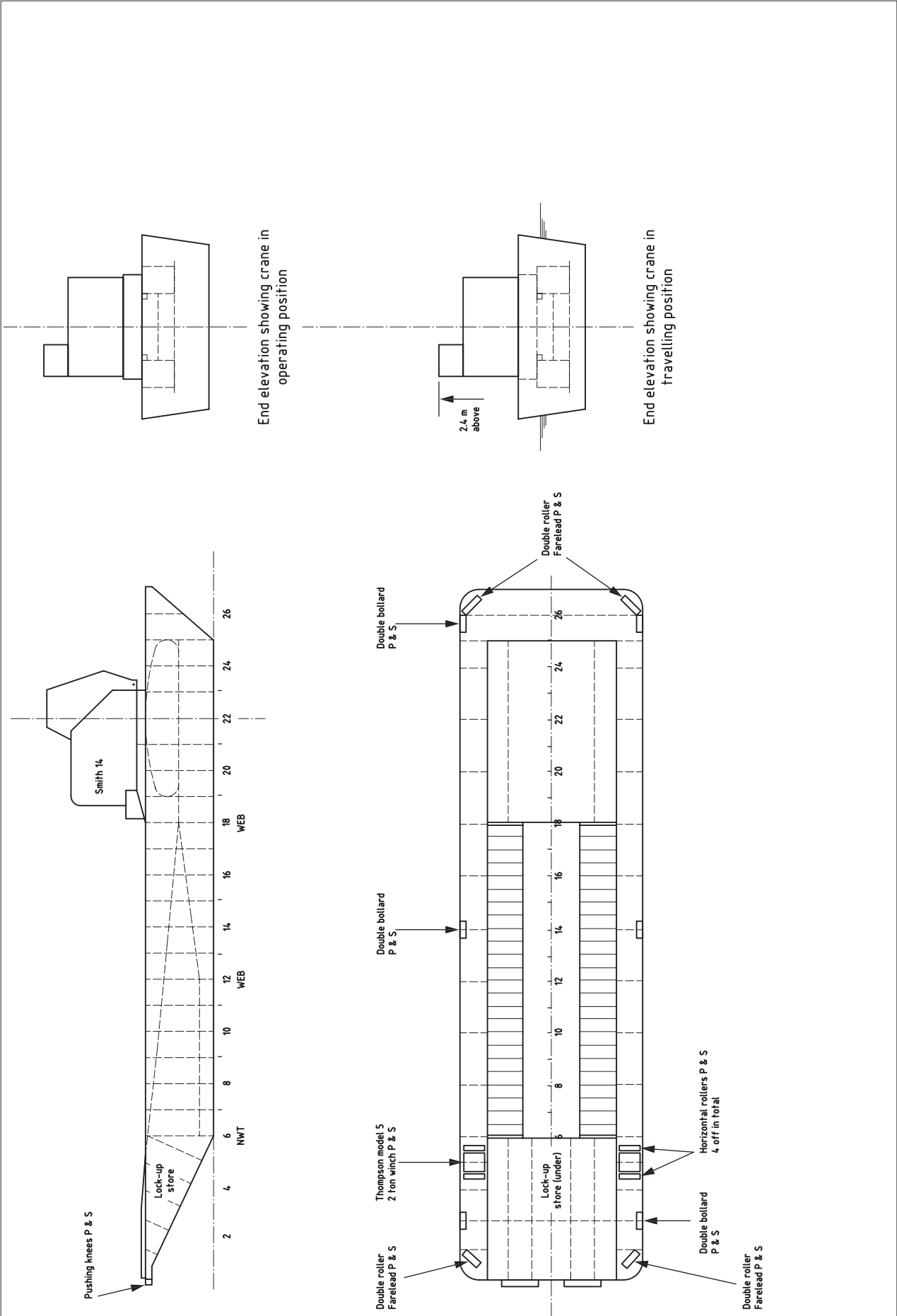
The stability margin for a crane/vessel combination should be calculated by a competent person familiar with the use of mobile cranes on vessels. The margin should be such that the maximum overturning moment of the crane does not exceed two-thirds of the restoring moment of the crane/vessel combination under both rated capacity and stability test conditions.

Information on the craft should be obtained regarding the amount of list and freeboard allowable under both rated capacity and overload conditions from a competent person or authority experienced in crane design and stability of water-borne craft.

NOTE This competent person may be a naval architect.

In addition, confirmation should be obtained from the crane manufacturer on how far the crane is to be de-rated from land-based ratings whilst on the barge or pontoon. This is necessary to minimize any excessive loads in the structure which would be applied when any part of the barge or pontoon is at maximum list.

Figure G.2 — Typical ramp pontoon



G.3 Loading of the crane onto the waterborne craft

Loading of the mobile crane onto the waterborne craft should be planned to ensure the stability of both the craft and the shore side bank. If ramps are used these should be of sufficient length and strength to support the crane fully when in transit from the bankside onto the craft, and vice versa. The craft should be moored tightly to the bank to prevent it moving away as the mobile crane is loaded/unloaded.

G.4 Thorough examination and stability testing before use

Before the mobile crane and waterborne craft combination is taken into use it should be subjected to thorough examination and stability testing in accordance with of [BS 7121-2-3:2012](#), Clause 11.

On completion of the stability test, a thorough examination of the crane should be carried out.

When the testing has been completed, the competent person should issue a certificate which should be appended to the report of examination.

G.5 Verification before use

Before using the mobile crane in every location the following details should be verified:

- a) the calculated angle of heel and trim of the craft when the crane is in operation, ensuring that a minimum freeboard is maintained;
- b) the crane manufacturer's allowable rated capacity whilst working on the pontoon or barge, taking account of information obtained from the assessment;
- c) the amount and position of any ballast required;
- d) the depth of water below the craft's keel;

NOTE This is to ensure the craft does not ground during the test.

- e) the limiting weather and sea state condition allowed by the crane designer, certifying authority or other competent person.
-

G.6 Rated capacity indicator/limiter (RCI/L)

The crane RCI/L should be checked to ensure that the rated capacity reduction and any increase in radius due to the list of the vessel have been taken into account.

G.7 Mooring and anchoring (in use)

In restricted width waters the craft may be moored to the two banks of the water course. Mooring lines should be sufficiently free to allow the vessel to take up a natural list in the water and allow the craft to heel with the shifts in the centres of gravity.

When in use in open waters the craft may also operate with spud legs or anchors with lines to maintain position for duties in open water. In this case, a four-point anchoring system should be used. Anchoring should be sufficiently free to allow the vessel to take up a natural list in the water and allow the craft to heel with the shifts in the centres of gravity. Spud legs should have sufficient strength to support shifts in the centre of gravities and the load on the leg (i.e. vessel hull, crane and load).

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