

Draft for Public Comment



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Part 2-3: Inspection, maintenance and thorough examination - Mobile cranes

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Introduction

Your comments on this draft are invited and will assist in the preparation of the resulting British Standard. If no comments are received to the contrary, this draft may be implemented unchanged as a British Standard.

Please note that this is a draft and not a typeset document. Editorial comments are welcome, but you are advised not to comment on detailed matters of typography and layout.

Submission of Comments

- The guidance given below is intended to ensure that all comments receive efficient and appropriate attention by the responsible BSI committee.
- This draft British Standard is available for review and comment online via the BSI British Standards Draft Review system (DRS) as <http://drafts.bsigroup.com>. Registration is free and takes less than a minute.
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- All comments will be checked by a moderator before they are made public on the site - the technical content of your comment will not be judged or modified; similarly your grammar or spelling will not be corrected. You will receive acknowledgement by email of all comments you submit via the DRS.
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BS 7121-2-3

Code of practice for the safe use of cranes

**Part 2-3: Inspection, maintenance and through examination –
Mobile cranes**

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Foreword

Publishing information

This sub-part of BS 7121-2 is published by BSI Standards Limited, under license from the British Standards Institution and came into effect on **XX Month 200X**. 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

Together with BS 7121-2-1, BS 7121-2-4, BS 7121-2-5, BS 7121-2-7 and BS 7121-2-9, this sub-part of BS 7121-2 supersedes BS 7121-2:2003, which will be withdrawn when all the sub-parts have been published.

Relationship with other publications

The BS 7121 series is being revised. The following new sub-parts of BS 7121-2 are currently in preparation.

- Part 2-1: *Inspection, maintenance and thorough examination – General;*
- Part 2-3: *Inspection, maintenance and thorough examination – Mobile cranes;*
- Part 2-4: *Inspection, maintenance and thorough examination – Loader cranes;*
- Part 2-5: *Inspection, maintenance and thorough examination – Tower cranes;*
- Part 2-7: *Inspection, maintenance and thorough examination – Overhead travelling cranes including portal and semi-portal cranes;*
- Part 2-9: *Inspection, maintenance and thorough examination – Cargo handling and container cranes.*

When all sub-parts of BS 7121-2 have been published, CP 3010 will be withdrawn and BS 5744 will be revised to cover manually operated and light cranes only.

This sub-part of BS 7121-2 is intended to be used in conjunction with BS 7212-2-1.

Information about this document

The Health and Safety Executive (HSE) commends the use of this British Standard to those who have duties under the Health and Safety at Work etc. Act 1974 [1]. This standard was drawn up with the participation of HSE representatives and it will be referred to in the relevant HSE publications.

The BS 7121-2 series has been accepted by the HSE as representing the consensus of opinion based on practical experience for safety of cranes.

Hazard warnings

WARNING. This British Standard calls for the use of procedures that can be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Use of this document

As a code of practice, this sub-part of BS 7121-2 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 sub-part of BS 7121-2 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 British Standard 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.

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.

Particular attention is drawn to the following specific regulations:

- Health and Safety at Work etc. Act 1974 [1].
- Lifting Operations and Lifting Equipment Regulations (LOLER) 1998 [2].
- Provision and Use of Work Equipment Regulations (PUWER) 1998 [3].
- Supply of Machinery (Safety) Regulations 2008 (as amended) [4].
- Merchant Shipping Act 1995 [5].
- Road Vehicles (Construction and Use) Regulations 1986 (as amended) [6].
- Road Traffic Act 1991 [7]

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 [8] and Safe use of work equipment [9].

1 Scope

This sub-part of BS 7121-2 gives recommendations for the pre-use checks, in-service inspection, maintenance, thorough examination (in service and following exceptional circumstances) and supplementary testing of mobile cranes, including truck cranes, wheeled rough terrain cranes, wheeled yard cranes, crawler mounted cranes and mini-cranes.

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 7121-2-1:2012, *Code of practice for the safe use of cranes – Part 2-1: Inspection, maintenance and thorough examination – General*

3 Terms and definitions

For the purposes of this sub-part of BS 7121-2, the terms and definitions given in BS 7121-2-1 apply.

4 General

Regular pre-use checking, in-service inspection, maintenance and thorough examination of cranes are essential if cranes are to function safely and reliably. The nature of these activities can be summarized as follows.

- Pre-use checks are visual checks which are carried out to ensure that the crane has not suffered any damage or failure, and is safe to use.
- In-service inspections and maintenance are carried out, to ensure that components are repaired or replaced before they deteriorate to a point at which they would become unsafe.
- Thorough examinations are carried out at specified intervals, after installation on a new site, after major alteration or repair or after the occurrence of exceptional circumstances which could jeopardize the safety of the crane.
- Supplementary testing is carried out in support of thorough examination and the extent and nature of any testing are specified by the competent person carrying out the thorough examination.

5 Personnel carrying out pre-use checks, in-service inspections, maintenance and thorough examinations

Attributes, competencies, competency assessment, training plans and training records of personnel should be in accordance with BS 7121-2-1:2012, Clause 5.

6 Pre-use checks and in service inspections

6.1 General

Pre-use checks and in-service inspection of cranes, together with a system to rectify any defects disclosed, are required by the Health and Safety at Work etc Act 1974 [1] (Section 2 (2)(a)); PUWER 1998 [3] (Regulation 6) and LOLER 1998 [2] (Regulation 9 (3)(b)) to ensure

that the crane is safe to use and that any deterioration is detected and rectified before the crane becomes unsafe.

Examples of checklists for pre-use checking and in-service inspections are given in Annex A.

Pre-use checks and in-service inspections should only be carried out by personnel who have been adequately trained and assessed as competent to carry out the required tasks (see Clause 5). LOLER 1998 [2] requires that results of all in-service inspections are recorded in writing. It is recommended that the results of all pre-use checks are also recorded in writing.

The crane user should ensure that sufficient time is allowed for pre-use checks to be carried before the crane starts work. The user should also ensure that a safe system of work is in place to prevent the person who is carrying out the checks/inspections from being exposed to danger.

6.2 Pre-use checking and in-service inspection intervals

Pre-use checks should be carried out at the start of each shift during which the crane is to be used. In-service inspections should be carried out at intervals which ensure that any deterioration is identified before there is a risk of failure of the crane or injury to persons. Further guidance is given in HSE document L113 [8].

6.3 Reporting of defects

In the case of a mobile crane the pre-use checks and in-service inspections are generally carried out by the mobile crane operator.

LOLER 1998 [2] requires that defects be reported immediately they are identified. There should be provision for the operator(s) of mobile cranes to make written reports of defects or observations immediately they are identified.

This facility should augment the normal verbal reporting that should routinely take place between crane operator and crane owner/site manager. The written report should be to a pre-defined format, (a company pro-forma, a section on the daily time sheet, etc), which requests details of the defect or observation and supporting information such as date, time, crane identification, error codes, circumstances, etc., The operator should also fill in a written report when there are no defects or observations to report (a "nil report") and these should be submitted at least weekly.

All the defect reports, including the "nil reports", should be forwarded to the crane owner, (or the crane owner's delegated representative), who should arrange for any necessary action to be taken on the basis of the report. A copy of the original report should be retained by the crane user.

Once the defect/observation has been dealt with and cleared this should then be recorded with supporting information on the original defect report.

The "cleared" reports should be securely lodged in the crane owning company's maintenance management system and should be made available on demand to the users of the crane as well as other authorized bodies.

6.4 Inspection of second-hand mobile cranes

When purchasing second-hand mobile cranes their condition should be inspected and assessed; nothing should be taken for granted. Second-hand cranes might contain latent defects which might otherwise only become apparent when the machine is put into service. They might have suffered significant damage and have been inadequately repaired. Second-hand cranes might also have been imported into the European Community without being modified to meet EU requirements, so called "Grey imports".

The assessment of a second-hand crane should include a review of maintenance records and previous reports of thorough examination, together with consultation of the manufacturer to obtain details of any major repairs etc. The contents of any data logger should be

downloaded and reviewed. The assessment might require the removal of access covers or stripdown of major assemblies to reveal parts that could not ordinarily be seen. Once the crane's condition has been fully assessed any necessary repairs should be carried out and an appropriate in-service maintenance interval established (see **7.4**).

7 Maintenance of mobile cranes

7.1 General

Under the Provision and Use of Work Equipment Regulations (PUWER) 1998 [3] employers are required to ensure that cranes are maintained in an efficient state, in efficient working order and in good repair. To ensure adequate maintenance an effective maintenance management system should be set up in accordance with BS 7121-2-1:2012, **7.1**.

7.2 Maintenance of the mobile crane chassis

Mobile cranes are currently exempt from the Goods Vehicles (Licensing and Operators) Regulations 1995 (as amended) [9], and the Goods Vehicles (Plating and Testing) Regulations 1988 (as amended) [10].

The Road Vehicles (Construction and Use) Regulations 1986 (as amended) [11] Regulation 100 requires that mobile cranes should "at all times be in such condition,...that no danger is caused or is likely to be caused to any person in or on the vehicle or on a road".

The safety of the crane driver and other road users is critically dependent on the condition of the crane chassis including the brakes, suspension, steering, lights, wheels and tyres. Maintenance should be carried out in accordance with the manufacturer's service manual and at the intervals given in the manual. These intervals are usually recommended on the basis of engine hours run and distance travelled where the first limit reached determines the need for maintenance.

Correct maintenance of the chassis of a mobile crane is essential to ensure the following and avoid putting the crane operator and other road users at risk:

- correct brake performance to ensure that the crane can stop in time within the correct braking distances;
- sufficient tyre tread grip to enable the crane to stop with the correct braking distances;
- avoidance of hydraulic fluid leaks from the suspension system which could lead to contamination of the road surface and potential loss of control for other road users;
- avoidance of tyre blowouts which could lead to loss of control of the crane;
- avoidance of steering system failures which could lead to loss of control of the crane;
- correct functioning of the crane lighting so that the crane operator is able to see clearly and other road users are able to see the crane;
- correct functioning of wipers, washers and demisters so that the crane operator can see clearly;
- avoidance of failure of the vehicle suspension system;
- avoidance of failure of the crane chassis;
- security of outrigger plates, covers, guards and other potentially loose items.

It is essential that the chassis of a mobile crane is effectively cleaned before maintenance and inspection is carried out to ensure that defects can be detected.

7.3 Manufacturer's technical product training

Before carrying out maintenance on a specific make and model of crane all maintenance personnel should receive technical training from the crane or component manufacturer. If

direct training by the manufacturer is not available, training may be carried out in-house. In this case training should be carried out by a competent trainer who has received model specific technical training directly from the manufacturer, to ensure that the source of such training is only one step removed from the manufacturer.

In the situation where the manufacturer no longer exists, a careful selection of alternative competent training providers should be made.

7.4 Maintenance intervals

7.4.1 General

The Health and Safety at Work etc. Act 1974 [1] sets out a general duty requiring that work equipment is maintained so that it is safe.

For mobile cranes, planned preventive maintenance (see BS 7121-2-1:2012, **7.2.2** and **7.2.3**) should be carried out at intervals which ensure that worn and damaged components are renewed before the mobile crane becomes unsafe, breaks down or fails.

NOTE Breakdown causes downtime and a consequent loss of production for the user, whilst a component failure could result in a partial or total collapse of the crane with potentially fatal consequences for persons in the vicinity.

7.4.2 Pre-delivery maintenance and inspection prior to long-term hires

Before a mobile crane, including a crawler, mobile tower or mini-crane, is delivered to site for a long-term hire, it should be inspected by maintenance personnel to identify any worn or faulty components, which should be renewed. The results of the inspection should be recorded. This record may be required by the competent person carrying out the thorough examination of the crane.

NOTE It is considerably easier and less costly to replace components and carry out lubrication and adjustments in a depot, than when the crane has been set up on site. Work on a crane on site can involve work at height and can present difficulty in handling heavy components.

7.4.3 In-service maintenance interval

A mobile crane should be maintained at regular intervals to avoid breakdown, failure or collapse. The frequency at which inspection and maintenance is carried out should be based on the recommendations contained in the manufacturer's manual for the crane. This should however generally be taken as the maximum interval, as various factors, including the following, might require the interval to be reduced.

- *Usage* – Double shifting, frequent lifting at or near the rated capacity, high cycling, long hoist ropes and excessive slewing, which might accelerate wear of all components.
- *Road use* – Excessive travel on the highway or on site.
- *Environment* – Corrosive environments such as marine or industrial sites. which might accelerate corrosion of electrical connectors and components, drive train, structural components, fasteners and wire ropes.
- *Feedback* – Feedback from maintenance records, condition monitoring and thorough examination reports which might indicate accelerated rates of wear and deterioration.

Once established, the inspection and maintenance interval should be recorded in the machine history file. It is essential that any variation from the manufacturer's recommended intervals is recorded and justified each time a change is made.

NOTE The manufacturer's recommended service interval may be extended in certain circumstances where predictive maintenance techniques are used.

7.5 Information for maintenance

The wide variation of designs and the increasing complexity of mobile crane technology make it essential that all maintenance personnel are supplied with adequate information to

enable them to carry out their duties effectively and safely. The recommendations given in BS 7121-2-1:2012, **7.8** should be followed.

7.6 Inspection during maintenance

7.6.1 General

This inspection is normally undertaken by maintenance personnel and is in addition to the in-service inspections undertaken in accordance with Clause **6**.

When inspections are being carried out as part of maintenance it is important that maintenance personnel record all faults and do not omit to record faults that are then rectified as part of the maintenance process. Such masking of faults would invalidate the machine history and hinder the review process.

7.6.2 Clearance of defects

It is important that defects identified during checks and inspections are classified and rectified before they can affect the safety of persons. It is helpful to categorise defects as follows:

- defects affecting the safety of persons that are to be remedied immediately;
- defects that are to be remedied prior to the next maintenance activity;
- defects that are to be remedied at the next maintenance activity.

The rectification of all defects identified should be recorded as evidence that the work has been carried out.

A system should be in place to ensure that a crane cannot be used if safety critical defects have not been rectified.

NOTE Where cranes are on long term hire there is a need for site managers to allocate time for routine inspection and maintenance. It is unreasonable for a site manager to expect this work to be undertaken overnight, in darkness, or always at weekends. Time needs to be built into normal working hours for this work (see **7.8.2**).

7.7 Management review of maintenance records and procedures

For the safe and efficient operation of a mobile crane fleet, a regular management review of the mobile crane maintenance records and procedures should be carried out by the managers responsible for the maintenance operation to enable them to be confident that a robust maintenance system is in place and will rapidly highlight any shortcomings and the need for corrective action. The review should include:

- checks that faults are being corrected appropriately and the maintenance schedule is being completed to plan;
- checks to determine if the maintenance regime and frequencies are appropriate and to analyse trends.

The review should be carried out initially at least monthly. Once a suitable level of confidence in the systems has been established the review frequency may be reduced in the light of experience.

7.8 Site issues for maintenance

7.8.1 General

Maintaining a mobile crane (especially a crawler crane) on site presents a particular set of issues when compared with carrying out maintenance operations in a workshop or yard. These issues should be addressed at the planning stage before the crane is set up on site and taken into use. This should be done in close collaboration with the crane user as their cooperation is essential for the effective maintenance of mobile cranes on site.

7.8.2 Maintenance downtime

Regulation 5 of PUWER 1998 [3] requires employers to ensure that cranes are maintained in an efficient state, in efficient working order and in good repair.

As the main purpose for a mobile crane being on site is to carry out lifting operations, site managers can be, understandably, reluctant to stop the crane while maintenance is carried out. However, it is essential that maintenance downtime is scheduled into the work programme, so that maintenance is not pushed to the back of the queue and does not end up being carried out hurriedly in unsafe conditions such as poor light.

Mobile crane owners should make clear to those hiring their cranes that adequate maintenance downtime has to be built into the work programme. Hirers should be informed at the planning stage of the frequency and length of time required for maintenance operations. In certain circumstances it might be of benefit to substitute another crane to allow maintenance to be carried out in a workshop, rather than on site.

Projects in built up areas often have environmental restrictions imposed on them which severely limit working time at weekends and evenings. Such restrictions should be taken into account in maintenance planning.

Mobile crane hirers should be informed that when maintenance of a mobile crane is taking place the maintenance team have full control of the mobile crane.

7.8.3 Communication

Those planning and carrying out maintenance on mobile cranes on site should ensure that they have effective lines of communication with the site staff for both routine maintenance and attending to breakdowns. Maintenance personnel should always report their arrival on site, agree the programme of work to be carried out and report back once the tasks have been completed. This can avoid much frustration and misunderstanding on both sides.

7.9 Spare parts

Maintenance operations on mobile cranes can only be fully effective if the correct spare parts are available at the correct location in a timely manner. A robust spare parts management system should be put in place to avoid any unnecessary additional direct and indirect costs and any adverse affects on the safety of the crane.

Spare parts should always be obtained from the crane manufacturer. If this is not possible parts should be obtained that meet the original manufacturer's specification. Where necessary a full engineering assessment of the part(s) should be carried out to ensure that this is the case.

7.10 Use of special materials in crane construction

Modern mobile cranes make extensive use of high tensile steels. When repairs are carried out to any parts of the crane structure, the correct procedure laid down by the manufacturer should be strictly followed to avoid changing the properties of the material.

8 Thorough examination of mobile cranes

8.1 General

LOLER 1998 [2] Regulation 9 requires mobile cranes to be examined in the following circumstances (see BS 7121-2-1:2012, **8.3**):

- before being put into use for the first time, unless the crane is new and the owner has an EC Declaration of Conformity dated not more than twelve months prior to the crane being used for the first time;

- periodically (maximum interval 6 months for cranes that lift people and 12 months for cranes that lift goods only);
- after exceptional circumstances have occurred.

8.2 Thorough examination interval

The statutory maximum intervals of six and twelve months may be reduced, taking into account environmental factors or the general age and condition of the crane etc. The decision to reduce the interval between thorough examinations may be made by the competent person, mobile crane owner or mobile crane user.

Reasons for reduction of the interval between thorough examinations include the following:

- if the mobile crane frequently works above or near people, both personnel on site and members of the public outside the site;
- if the mobile crane might be used for lifting of persons in exceptional circumstances, including rescue, even if it is not initially planned;
- to take into account the intensity of use of the crane and the environment in which it is used;
- following a review by the competent person of the in-service lift plan (risk assessment, method statement and schedule of lifts) to ascertain the likely load spectrum and frequency of use of the crane.

8.3 Preparation for thorough examination

Prior to thorough examination the mobile crane should be cleaned by appropriate means, e.g. pressure washed, to remove all spoil/dirt that would otherwise conceal the structure or mechanisms and prevent an effective examination. The examination should be carried out in a logical sequence, for example from top to bottom, to ensure that nothing is overlooked.

8.4 Defined scope of thorough examination

8.4.1 General

The examination should be undertaken in accordance with a defined scope of thorough examination (see BS 7121-2-1:2012, **8.10**).

A defined scope of thorough examination should be drawn up in advance of the examination for each individual crane to be examined. The competent person undertaking thorough examination should regard this as the minimum scope of examination and add to the scope as appropriate. The scope should include details of any functional or supplementary testing that might be required and whether the tests need to be witnessed by the competent person undertaking thorough examination. The scope should also include details of any required non-destructive testing of the crane structure or mechanisms.

The defined scope of thorough examination for each crane should be reviewed on a periodic basis to check whether it is still appropriate and amended if necessary. A copy of the defined scope of thorough examination should be kept in the machine history file.

The scope should, as a minimum, include the components listed in **8.4.2**. These components should be assessed against the criteria listed in **8.4.3**, taking into account the path of the load through the crane's structure and mechanisms. It is essential that the scope is risk based and takes into account the consequences of failure of the crane.

8.4.2 Components to be included

The following components should be included in the defined scope of thorough examination for a mobile crane:

- tyres and wheels;

- axle locking system;
- crawler tracks;
- crane chassis;
- outrigger jacks and beams;
- chassis braking system;
- all bolts, pins and other fastenings (visual inspection);
- slew section structure, including fasteners and slew ring
- slewing mechanism (examination throughout its full range of movement with jib at maximum radius);
- all pipe work and connections (including rigid and flexible hoses)(visual inspection);
- all hydraulic cylinders (visual inspection);
- hydraulic cylinder fittings (visual inspection);
- oil and other fluids;
- superstructure and jib (visual inspection);
- fly jib and mounting attachment (visual inspection);
- all pivoting joints on the jib and attachments of the crane (visual inspection);
- telescoping extensions on the crane (operation and visual inspection);
- wire running and static ropes, including terminations;
- pulleys/sheaves and drums, including guards;
- access including ladders, walkways, guard rails and hand holds;
- cab, including controls, markings, indicators, seating, windows, heating, falling object protection structure (FOPS) bars, wipers and load charts;
- limiting and indicating devices including:
 - rated capacity system (measurement of load, moment and radius);
 - anemometer;
 - devices indicating:
 - over hoist and over lower limits;
 - luffing limits;
 - trolley limits;
 - slack rope limits;
 - rail travel limits;
- hook blocks, including sheaves, hook , safety catch and swivel bearing
- counterweights including, pendants, fasteners, lifting and locking mechanisms
- hoist and luffing winches and brakes, including hydraulic systems
- power and control cables and slip rings (visual inspection);
- control cabinets and wiring;
- markings, instructions and safety notices.

8.4.3 Assessment criteria

The following assessment criteria should be included in the defined scope of thorough examination for a mobile crane:

- Adjustment - As specified by manufacturer;
- Alignment - Within manufacturer's tolerance;
- Backlash - Within manufacturer's tolerance;
- Bearing play - Within manufacturer's tolerance;
- Brake performance - Within manufacturer's tolerance;
- Corrosion - Affecting strength or functionality;
- Cracks - Affecting strength or functionality;
- Cylinder creep - Within manufacturer's tolerance;
- Damage - Affecting strength or functionality;
- Distortion - Affecting strength or functionality;
- Fluid levels – Within manufacturer's limits;
- Functionality - As intended by the manufacturer;
- Guards - Presence and condition;
- Limit accuracy - As specified by the manufacturer;
- Leaks - Affecting strength, functionality and slips;
- Lubrication – Adequacy;
- Markings - Presence, accuracy and condition;
- Mode of operation - As intended by the manufacturer;
- Obstructions - Impeding safe access;
- Rope fit - As specified by manufacturer;
- Rope reeving - As specified by manufacturer;
- Rope specification - As specified by manufacturer;
- Security - Attachment of components and sub structures, fasteners, welds etc.;
- Seizure - Full or partial seizure of rotating components;
- Tidiness - General housekeeping;
- Wear - Affecting strength or functionality.

8.5 Rated capacity indicator/rated capacity limiter (RCI/RCL) calibration check and functional test

The thorough examination of a mobile crane should include a calibration check and functional test of the rated capacity indicator/rated capacity limiter (RCI/RCL) in accordance with BS 7121-2-1:2012, **10.15**.

8.6 Periodic dismantling prior to thorough examination

On telescopic jib mobile cranes at least once every 4 years, prior to the thorough examination the jib should be dismantled and an examination carried out of any hidden mechanism parts, for example rope and rope terminations, hydraulic cylinders.

On lattice jib cranes all of the jib sections should be included in the thorough examination of the crane.

9 Overload testing of mobile cranes

9.1 Four year test

In the past, mobile cranes in the UK have frequently been subjected to overload testing at four yearly intervals, in addition to the periodic thorough examinations required by LOLER 1998 [2]. This is a legacy from the requirements of the old Construction (Lifting Operations) Regulations, which were replaced by the introduction of LOLER in 1998. The Approved Code of Practice to LOLER 1998 [7] states that any testing is at the discretion of the competent person carrying out a thorough examination and that the competent person will decide on the nature of the test and the method of carrying it out.

The traditional routine overload testing of mobile cranes has a number of disadvantages and few benefits.

- Some manufacturers do not recommend overload tests, except in “exceptional” circumstances and severely limit the magnitude of the test load that may be applied.
- Repeated overloads can cause deterioration of the crane structure over time.
- Most structural failures are the result of fatigue and such defects will not be revealed by an overload test; fatigue cracking can be identified during thorough examination.
- If a crane fails during testing it could be dangerous and will certainly be expensive.
- Inspection bodies such as members of the Safety Assessment Federation do not recommend it, as there is no defined structural or mechanical benefit.
- A significant number of insurance policies do not provide cover for a crane that has been overloaded in any circumstances including overload testing.

In summary, where a defined scope of examination approach is used, four yearly overload testing is not required unless deemed necessary by the competent person.

9.2 Before testing

The competent person should seek advice from the manufacturer (or other suitable design authority) before deciding on the nature of the test and the method of carrying it out, including the magnitude of the overload to be applied.

A visual examination of the crane and the test area should be carried out prior to commencing the test.

Before the application of a load a thorough examination of the crane should be carried out, including verification that the crane is rigged in accordance with the manufacturer's instructions.

The competent person should check the rated capacity specified on the manufacturer's certificate of test, the load radius indicator, the table of rated capacities displayed in the operator's cab and those used by the RCI/L. The rated capacities should all be identical.

A functional test with no load applied should be carried out to determine whether the controls, switches, contactors and other devices operate correctly. The adjustments of the brakes and limit switches should be checked and tests carried out to determine whether they are operating correctly.

Mobile cranes have a large variety of support systems (for example crawler tracks, tyres and outriggers), jib configurations, counterweights and special attachments, all of which affect stability and strength of the crane. The competent person should take account of all the

support systems when determining the conditions for overload testing. (Further details are given in 9.3.)

9.3 Support systems to be taken into account in overload testing of mobile cranes

9.3.1 Outriggers

Certain manufacturers give duties for intermediate extension of outriggers. Before overload testing, the competent person should check that

- a) the intermediate extension position is clearly and durably marked on the outrigger;
- b) the manufacturer's duty chart indicates the correct rated capacities applicable to the outrigger extension;
- c) the duty charts supplied by the manufacturer give the specified intermediate extensions;
- d) provision is made in the RCI/RCL to accommodate the specified intermediate extensions.

9.3.2 Counterweight

Variations in the counterweight affects the stability of the crane. The manufacturer's duty charts specify the ratings applicable for each counterweight. Sometimes mobile cranes have additional weights to increase the mass of the counterweight and special rigs to enhance the lifting capacities.

Before overload testing, the competent person should check that the correct counterweight and any additional weights and special rigs are on the crane.

9.3.3 Jibs

Before overload testing the competent person should check that the jib is fitted to the crane in accordance with the manufacturer's instructions. Overload testing of cranes with jibs should be carried out in accordance with Clause 12.

9.3.4 Fly jibs

For overload testing, fly jibs should be erected in accordance with the manufacturer's instructions for the crane. Overload testing of cranes with fly jibs should be carried out in accordance with Clause 12.

9.3.5 Variable length jibs

Where jib lengths are increased by fitting intermediate sections it is required under LOLER 1998 [2] Regulation 7 that all jib sections are marked to indicate to which crane they belong. When carrying out an overload test, the identification of the jib sections tested should be recorded on the test certificate. Overload testing of cranes with variable length jibs should be carried out in accordance with Clause 12.

9.4 Levelling

The importance of levelling the crane cannot be over-emphasized. The crane should be level to $\pm 0.5\%$ slope. One method of determining the level of the crane is to use a spirit level. Alternatively, the hook block should be in the centre of the jib when viewed from the front with the jib fully extended at or near minimum radius and with the unladen hook block lowered to just above ground level. The procedure should then be repeated when the jib has been slewed 90° . This method of levelling can only be used when it has first been checked that the jib is correctly aligned. Any built-in levelling device should be checked at this time and reset if necessary. The levelling of the crane should be monitored throughout the tests; this is particularly important when testing cranes with long telescopic and lattice jibs. If the slope is found to exceed the limit given above, testing should be stopped, any load should be removed and the crane re-levelled.

9.5 Lifting free on wheels

Tyre pressures are a critical factor in retaining the necessary stability margin of mobile cranes. The tyres of cranes under test should be as specified in the crane manufacturer's instructions. Some crane manufacturers stipulate higher tyre pressure for free on wheels (static condition fully mobile) duties than for road travel as a vehicle. Where the manufacturer permits lift and travel duties these can differ from the free on wheels duties and both types of duty should be subjected to testing.

9.6 Lifting capacities

The load ratings marked on mobile cranes and shown on the manufacturer's rated capacity charts indicate the gross loads, i.e. the loads quoted include the loads imposed by the hook blocks, slings and lifting gear and often also have deductions, for example deduction of the load due to a stowed fly jib. This fact should be taken into account when the crane is being tested and an allowance should be made for the load imposed by suspended hook blocks, slings and lifting gear. The exact load imposed by these items should be ascertained. Certain cranes can become unstable when working with long jibs and fly jibs if the jib angle to the horizontal is reduced below the minimum angle given in the crane manufacturer's instructions. The hook block should always be rested on the ground before any lowering of the jib beyond the maximum operating radius commences.

9.7 Overload testing

The crane should be functionally tested without a load applied to determine whether it is working properly.

After the functional tests without a load applied, the efficiency of the crane's hoist brake(s) should be tested with the load that gives the maximum line pull on the hoist rope(s). The load should be lifted clear of the ground and the brake applied by returning the control to neutral. There should be no fall back or creep. The load should be re-hoisted and the brake reapplied to check the ability to re-hoist. The load should then be lowered and the control returned to neutral with the load still clear of the ground. There should be no overrun or creep.

At every configuration in the test programme the crane should be set up with the test load at a radius/angle within the rated capacity of the crane. The test load should then be raised just clear of the ground and the crane derricked out to the radius/angle where the test load is at the overload specified by the manufacturer. The load should be raised until every tooth in the train of the hoist gears has been subjected to the overload and then lowered to between 100 mm and 200 mm above the ground and held there for 10 min. There should be no overrun or creep. The load should be slewed at the lowest possible speed in both directions through a small arc to determine the ability of the structure to withstand lateral loadings. The test load should then be slewed through the maximum slew angle permitted by the design of the crane.

NOTE During raising of any load it might be necessary to derrick the jib in so that the radius is not exceeded. Similarly it might be necessary to jib out when lowering off a load at minimum radius (failure to do so can result in the jib falling backwards, particularly on a rope supported jib/fly jib).

9.8 Major repairs or modifications

Mobile cranes should be overload tested after major repairs or modifications.

9.9 Post test examination and certification

On completion of the overload test a thorough examination of the crane should be carried out, see BS 7121-2-1:2012, **8.12.**

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

NOTE Attention is drawn to LOLER 1998 [2] Regulation 9 regarding the certificate of test of lifting equipment.

10 Non-destructive testing (NDT) of mobile cranes

NDT of mobile cranes may be requested by the competent person carrying out the thorough examination, particularly when there is a suspicion that cracks or other damage might be present in structural parts of the crane (see BS 7121-2-1:2012, **10.13**).

11 Overload testing of mobile cranes mounted on water-borne craft

11.1 General

When a mobile crane is mounted on a water-borne craft (i.e. a barge or pontoon), LOLER 1998 [2] Regulation 9 (2) classes this as a major modification and requires the assembly of the crane and the vessel to be assessed, tested and thoroughly examined as a floating crane.

11.2 Information to be obtained

Information 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. In addition, information should be obtained from the crane manufacturer on how far the crane is derated from land based ratings whilst on the barge or pontoon. This is necessary to enable precautions to be taken to minimize any excessive loads on the crane structure which would be applied when any part of the barge or pontoon is at maximum list.

11.3 Verification of test conditions

Before testing is carried out on the mobile crane the following details should be verified:

- a) that the calculated angle of heel and trim of the vessel when the crane is in operation are in accordance with the allowable list and freeboard given in the information obtained in accordance with **11.2**;
- b) that the load on the crane structure while the crane is on the barge or pontoon does not exceed the crane manufacturer's allowable rated capacity taking into account the derating given in the information obtained in accordance with **11.2**;
- c) that the amount and position of any ballast required is as given in the information obtained in accordance with **11.2**;
- d) that the depth of water below the vessel's keel is as given in the information obtained in accordance with **11.2**;

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

- e) that the weather and sea state conditions do not exceed the limiting weather and sea state conditions allowed by the crane designer, certifying authority or other competent person.

11.4 Anchoring for testing

If it is not possible to anchor the vessel to the shore, the vessel should be anchored to a craft alongside. The anchorage should be sufficiently free to allow the vessel to take up a natural list in the water.

11.5 Rated capacity indicator/rated capacity limiter (RCI/RCL)

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

11.6 Thorough examination before testing

A thorough examination of the mobile crane should be made before the application of any loads. The examination should include verification that ties, supports, anchorages, ballast counterweight and load radius configuration for the type of crane under test are in accordance with the crane manufacturer's instructions. A functional test with no load applied should be carried out to check for correct operation of controls, switches, contactors and other devices. The operation and correct adjustment of the brakes and limit switches should be checked and tests carried out to determine whether they are operating correctly.

11.7 Stability margin

The required 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.

11.8 Overload testing

After the required stability margin has been calculated (see **11.7**) the crane should be tested to the maximum rated capacity that is within that margin.

With the jib set at its maximum working radius (i.e. minimum working load) a load equivalent to the rated capacity should be applied and the crane operated through all motions. The load should then be raised 100 mm to 200 mm and held on the brake. An overload should then be applied by increasing the load above the rated capacity by the amount specified by the manufacturer and again the crane operated through all motions, with the hoist and derrick brakes where applicable being proved to demonstrate whether they are capable of sustaining the load.

The overload should be handled through all motions at the lowest possible speeds.

The jib should be set at its maximum radius for the maximum load and the procedure repeated, first with the load equivalent to the maximum rated capacity and then the overload specified by the manufacturer.

The jib should be set at its minimum radius and the procedure repeated.

11.9 Post test examination and certification

On completion of the overload test a thorough examination of the crane should be carried out, see BS 7121-2-1:2012 **8.12**.

When the testing has been completed if the crane has passed the test the competent person should issue a test certificate which should be appended to the report of thorough examination.

NOTE Attention is drawn to LOLER 1998 [2] Regulation 9 regarding the certificate of test of lifting equipment.

12 Overload test for jib arrangements

12.1 General

All of the jib and mast/tower configurations given in Table 1, Table 2 and Table 3 should be tested with the overload specified by the manufacturer. Where the crane has duties on outriggers, free on wheels, crawler tracks, and lift and travel then the test should be repeated for each condition.

Table 1 – Test configurations for telescopic jib arrangements

Arrangement	Length of mechanized telescopic sections	Lengths of extended manual telescopic sections	Length of fly jib	
A) Mechanized telescopic jib	A.1 Shortest	—	—	
	A.2 Intermediate	—	—	
	A.3 Longest	—	—	
B) Mechanized telescopic jib with fly jib	B.1 Longest appropriate to maximum fly jib rating	—	B.1.1 At minimum offset	Shortest
				Longest
			B.1.2 At maximum offset	Shortest
				Longest
	B.2 Longest	—	B.2.1 At minimum offset	Shortest
				Longest
			B.2.2 At maximum offset	Shortest
				Longest
C) Mechanized telescopic jib with manual telescopic sections	C.1 Longest	C.1.1 Shortest	—	
		C.1.2 Longest	—	
D) Mechanized telescopic jib with manual telescopic section and fly jib	D.1 Longest	D.1.1 Shortest	D.1.1.1 At minimum offset	Shortest
				Longest
			D.1.1.2 At maximum offset	Shortest
				Longest
		D.1.2 Longest	D.1.2.1 At minimum offset	Shortest
				Longest
			D.1.2.2 At maximum offset	Shortest
				Longest

NOTE 1 If fly jib ratings for test configuration B.1 are similar to those for test configuration B.2, then B.1 is not applicable.

NOTE 2 If fly jib ratings at minimum offset are similar to those at maximum offset, then tests at minimum offset are not applicable.

Table 2 – Test configurations for strut jib arrangements

Arrangement	Length of jib	Length of fly jib	
A) Jib	A.1 Shortest	—	
	A.2 Intermediate	—	
	A.3 Longest	—	
B) Jib with fly jib	B.1 Longest appropriate to maximum fly jib ratings	B.1.1 At minimum offset	Shortest
			Longest
		B.1.2 At maximum offset	Shortest
			Longest
	B.2 Longest	B.2.1 At minimum offset	Shortest
			Longest
		B.2.2 At maximum offset	Shortest
			Longest

NOTE 1 If fly jib ratings for test configuration B.1 are similar to those for test configuration B.2, then B.1 is not applicable.

NOTE 2 If fly jib ratings at minimum offset are similar to those at maximum offset, then tests at minimum offset are not applicable.

Table 3 – Test configurations for mast/tower and jib arrangements

Arrangement	Length of mast/tower
A) Mast/tower with jib	A.1 Shortest
	A.2 Longest
B) Mast/tower with jib and fly jib	B.1 Shortest
	B.2 Longest

12.2 Long jib lengths

The crane should be set up with the longest jib configuration (see designation A.3 of Table 1 and Table 2).

The manufacturer's specified overload for maximum radius should be assembled at a reduced radius where it is less than the rated capacity of the crane and at a slew position where the stability of the crane is minimal. The load should be raised just clear of the ground and derricked out very slowly keeping the load just clear of the ground until the maximum radius is achieved.

A load equivalent to the maximum rated capacity for the jib given on the manufacturer's crane specific duty chart should then be assembled at the maximum radius of the jib and lifted just clear of the ground.

If the same rated capacity applies at a lesser radius, the load should be derricked in to the minimum permitted radius keeping the load just clear of the ground.

The load should then be lowered to the ground and increased to the overload specified by the manufacturer. The overload should be lifted clear of the ground and held for 10 min.

Where possible, the derricking motion should be checked by first derricking in the smallest practicable distance and then derricking out to the same position.

If the same rated capacity applies at a greater radius the test load should be derricked out to the maximum permitted radius keeping the load just clear of the ground.

The load should then be slewed at the lowest possible speed in both directions through a small arc to determine the ability of the structure to withstand lateral loadings.

These tests should be repeated for each configuration of the jib and mast/tower shown in Table 1, Table 2 and Table 3 except for the minimum length of jib in Table 1 and Table 2 and with the minimum tower height in Table 3 when this is appropriate.

12.3 Short jib lengths

For the minimum length of jib in Table 1 and Table 2 and the minimum tower height in Table 3 the crane should be set up either with the shortest jib or the shortest tower with the shortest jib.

The manufacturer's specified overload for the maximum radius should be assembled at a reduced radius where it is less than the rated capacity of the crane and at a slew position where the stability of the crane is minimal. The load should be raised just clear of the ground and derricked out very slowly keeping the load just clear of the ground until the maximum radius is achieved.

The load should be slewed at the lowest possible speed in both directions through a small arc to determine the ability of the structure to withstand lateral loadings and then slewed through 360° where the design permits.

A load equivalent to the maximum rated capacity for the jib should be assembled at the minimum radius and raised until each tooth of the train gear has been subjected to the load. The crane should then be operated through its permitted motions at the lowest possible speeds including full circle slew.

The load should then be lowered off and increased to the overload specified by the manufacturer to form an overload test load which should be hoisted until each tooth of the train of gears has been subjected to the overload, then lowered to 100 mm to 200 mm above the ground. The crane should be operated through its permitted motions at the lowest possible speeds.

NOTE 1 It is recognized that for certain types of crane the structure does not permit full slewing with the load just clear of the ground. In these cases the test load should be rested and the crane repositioned to ensure that as much of the crane structure as possible is subjected to the test load.

NOTE 2 For lengths of jib (telescopic or strut) and fly jib, see Table 1 or Table 2, as appropriate.

The derrick brakes should be tested with the overload specified by the manufacturer suspended no more than 100 mm above the ground by derricking in from the maximum load radius the smallest practicable distance and derricking out and applying the derrick brake immediately. Extreme care should be taken during this test.

Annex A (informative)

Examples of checklists for pre-use checking and in-service inspections of mobile cranes

A.1 Pre-use checking

The following is an example of a checklist for pre-use checking:

NOTE These checks are in addition to any checks needed in accordance with the crane manufacturer's instructions. This list is not exhaustive.

- a) check engine oil level;
- b) check fuel level;
- c) check coolant level;
- d) check torque converter level;
- e) inspect ropes for spooling and kinks;
- f) check jib pendant ropes and pins;
- g) check fly jib security;
- h) check operation of rated capacity limiter (if fitted);
- i) check operation of rated capacity indicator and check code is correct;
- j) check controls for correct operation;
- k) check cab gauges and warning lights;
- l) check operation of slew lock pin and slewing brakes;
- m) check operation of hoist/derrick brakes;
- n) drain air tanks;
- o) check tyre pressures and inspect tyres for damage;
- p) check wheel studs;
- q) check for debris between twin wheels;
- r) check cleanliness of crane and decking;
- s) check security of loose items e.g. lifting tackle;
- t) check security of all retaining pins;
- u) check security and condition of hook block and safety catches.

A.2 In-service inspections

The following is an example of a checklist for in-service inspections:

NOTE These checks are in addition to any checks needed in accordance with the crane manufacturer's instructions. This list is not exhaustive.

- a) check battery and water level;
- b) check windscreen washer reservoirs;
- c) check lubricant levels in transmission system;
- d) lubricate sheaves and active linkages;
- e) lubricate ropes;

- f) check hydraulic oil levels;
- g) check brake and clutch reservoir levels;
- h) check steering and throttle reservoir levels
- i) check hydraulic hose for leaks/damage
- j) check operation of boom;
- k) check outrigger operation;
- l) check lights, indicators and wipers;
- m) check slew ring path.

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