

BS 7121-2-5:2012



BSI Standards Publication

Code of practice for the safe use of cranes

Part 2-5: Inspection, maintenance and thorough examination –
Tower cranes

bsi.

...making excellence a habit.
AVA Documents™
Document Sharing Hub

Publishing and copyright information

The BSI copyright notice displayed in this document indicates when the document was last issued.

© The British Standards Institution 2012.

Published by BSI Standards Limited 2012

ISBN 978 0 580 78196 4

ICS 53.020.20

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

Committee reference MHE/3/11

Draft for comment 12/30259756 DC

Publication history

First published November 2012

Amendments issued since publication

Date	Text affected
------	---------------

Contents

Foreword *ii*

1	Scope	1
2	Normative references	1
3	Terms and definitions	1
4	General	1
5	Personnel carrying out pre-use checks, in-service inspections, maintenance and thorough examinations	1
6	Pre-use checks and in-service inspections	2
7	Maintenance of tower cranes	4
8	Thorough examination of tower cranes	10
9	Overload testing of tower cranes to supplement thorough examination	17
10	Non-destructive testing (NDT) of tower cranes	19
11	Rated capacity indicator/rated capacity limiter (RCI/RCL) test	19
12	Assessment of wire rope condition and discard criteria	20

Annexes

Annex A (informative) Examples of a checklists for pre-use checking of tower cranes 21

Annex B (informative) Example of a tower crane base pre-erection inspection report form 24

Annex C (informative) Example of a tower crane base approval/completion certificate 25

Annex D (informative) Example of a tower crane tie fabrication and pre-installation inspection report 26

Annex E (informative) Example of a tower crane tie approval/completion certificate 27

Annex F (informative) Example of a checklist for inspection during maintenance 28

Annex G (informative) Example of procedures for thorough examinations and supplementary testing of climbing frames 29

Bibliography 31

List of figures

Figure B.1 – Example of a tower crane base pre-erection inspection report form 24

Figure C.1 – Example of a tower crane base approval/completion certificate 25

Figure D.1 – Example of a tower crane tie fabrication and pre-installation inspection report form 26

Figure E.1 – Example of a tower crane tie approval/completion certificate 27

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 32, an inside back cover and a back cover.

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 30 November 2012. 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 7121-2-3, BS 7121-2-4 and BS 7121-2-7, this sub-part of BS 7121-2 supersedes BS 7121-2:2003, which will be withdrawn when all these 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 have been published or are 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, hoists, and their supporting structures;*
- Part 2-9: *Inspection, maintenance and thorough examination – Cargo handling and container cranes.*

When all sub-parts of BS 7121-2 have been published, it is intended that 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 7121-2-1.

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];
- Work at Height Regulations 2005 (as amended) [5].

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 [6] and Safe use of work equipment [7].

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 tower cranes. It covers self-erecting tower cranes, with the exception of vehicle mounted self-erecting tower cranes, which are covered by BS 7121-2-3.

This sub-part of BS 7121-2 is not applicable to permanently installed cranes on marine and other water-borne vessels.

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*

BS ISO 4309:2010, *Cranes – Wire ropes – Care and maintenance, inspection and discard*

3 Terms and definitions

For the purposes of this sub-part of BS 7121-2, the terms and definitions given in BS 7121-2-1:2012 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), 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 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 checks

Pre-use checks should be carried out at the start of each shift during which the crane is to be used. These are to test the functionality of the crane and visually check for any obvious defects. It is essential that these are carried out from a position of safety.

6.3 In-service inspection

A regular in-service inspection should be made to identify any defects which might not be detected by the pre-use checks. 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 [6]. It might be convenient to schedule the inspections concurrently with planned preventive maintenance (see BS 7121-2-1:2012, 7.2.2 and 7.2.3).

Steel structures suffer from fatigue, a process which can create cracks that propagate over time. If left unattended, cracks can cause serious failure of the crane structure, so the in-service inspection regime should include measures to detect cracks before the safety of the crane is affected.

The period between inspections should be decided on the basis the duty of the crane and the environmental conditions and might need to vary between 1 week and 6 months. The period should be kept under review and adjusted according to the results of the inspections.

6.4 Reporting of defects

Any defects found during pre-use checks and in-service inspections should be recorded and notified to the user. LOLER 1998 [2] requires that defects identified by in-service inspections which are, or could become, a danger to persons are notified to the employer (user) forthwith.

6.5 Records of pre-use checks and in-service inspections

6.5.1 General

Written records of all pre-use checks and in-service inspections should be kept.

6.5.2 Pre-use checks

The record of a pre-use check should include at least the following information:

- identity of the crane;
- date of the check;
- result of the check, i.e. whether or not the crane passed;
- name and signature of person carrying out the check.

This may be kept to a minimum by, for example, completing a single line of a pro-forma record card.

6.5.3 In-service inspections

The record of an in-service inspection should include at least the following information:

- date and location of the inspection;
- name of person carrying out the inspection;
- description and unique identification number of the equipment inspected;
- nature and extent of the inspection;
- results of the inspection, including details of the condition of critical components which need to be monitored, for example a wire rope showing signs of wear.

The record should be related to the crane's historical records and made available to the competent person responsible for the thorough examination (see Clause 8).

6.6 Inspection prior to reconfiguration or dismantling

Before an erected tower crane is reconfigured or dismantled it should be inspected to determine whether there are any defects which could affect the safety of the reconfiguration or dismantling operation. Any defects found during such an inspection should be recorded for inclusion in the machine history file and corrective action taken before the reconfiguration or dismantling operation is carried out. The details of these defects, together with any corrective actions, should be made available to the competent person at the time of the next thorough examination.

6.7 Inspection of second-hand tower cranes

When purchasing second-hand tower cranes their condition should be inspected and thoroughly assessed; nothing should be taken for granted. Where possible this assessment should include a review of maintenance records and previous reports of thorough examination.

Once the crane's condition has been fully assessed any necessary repairs should be carried out and appropriate inspection and maintenance intervals established.

7 Maintenance of tower 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.

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 tower 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 tower 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.

7.2 Pre-delivery inspection and maintenance of the crane and its components

Before a tower crane or its components are delivered to site, the crane and/or components should be inspected to identify any worn or faulty components and these should be replaced. The results of the inspection, and any maintenance carried out, should be recorded. This record might be required by the competent person carrying out thorough examination of the crane.

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 erected on site. It also enables parts that are not easily accessible on an erected crane to be examined. Work on an erected tower crane always involves work at height and presents difficulty in handling heavy components.

Pre-delivery inspection and maintenance provides a good opportunity for the completion of supplementary tests before the crane is erected. It is also strongly recommended that the tower crane's drive and control systems should be powered up and checked for correct functioning during pre-delivery inspection and maintenance.

The direct transfer of cranes between sites should be approached with extreme caution as it often leads to both delays in erection and time lost through the correction of faults. Best practice guidance is that direct transfers should not be undertaken and that cranes should be taken back to a depot for full pre-delivery inspection and maintenance before the next erection takes place. Where cranes are to be sent from site to site without returning to depot, special arrangements should be made and time allocated for inspection on the ground and for any necessary repairs to be carried out.

7.3 Post-delivery checks

Following delivery of the crane or crane components to site, the erection supervisor should check that the pre-delivery inspection and maintenance was completed at the depot prior to despatch and that the items have not been damaged in transit (see Construction Plant-hire Association publication, Tower Crane Technical Information Note 014, *Pre-erection component checks* [8]). The supervisor should also check that the correct components have been delivered in accordance with the build sheet and the manufacturer's manual.

7.4 Pre-erection checking and inspection of the base

Before a tower crane is erected on site it is essential that the design of the base on which it is to be erected is checked to ensure that the base, of whatever type, has been designed taking into account the loads expected to be imposed on it during installation of the crane, and both in service and out of service, once the crane has been commissioned. Following construction and/or installation of the base, an inspection should be carried out to check that the base has been constructed to the design specification. The results of the inspection should be recorded in writing. An example of a suitable form is shown in Annex B.

Once the base has passed the design check and post-construction inspection, the person responsible for the base construction should complete a permit to erect confirming that the tower crane base has been constructed to the designer's specification and that a post-construction inspection has been carried out. An example of a suitable form, which also provides space for design certification and design check certification, is shown in Annex C.

NOTE 1 Information on base design is given in CIRIA publication C654 Tower crane stability [9],

NOTE 2 Information on base design checking is given in Construction Plant-hire Association publication Tower Crane Technical Information Note 031, Tower crane bases and ties [10].

7.5 Checking and inspection of ties

Before a tower crane is erected on site it is essential that the design of any ties and tie attachment points connecting them to the supporting structure is checked to ensure that they have been designed taking into account the loads expected to be imposed on them during installation of the crane, and both in service and out of service, once the crane has been commissioned. Following fabrication and installation of the ties and tie attachment points, an inspection should be carried out to check that the ties and attachment points have been constructed and installed to the design specification. The results of the inspection should be recorded in writing. An example of a suitable form is shown in Annex D.

Once the ties have passed the design check and the post fabrication and installation inspection, the person responsible for the tie fabrication should complete a permit to erect confirming that the ties and tie attachment points to the supporting structure have been fabricated and installed to the designer's specification and that a post-installation inspection has been carried out. An example of a suitable form, which also provides space for design certification and design check certification, is shown in Annex E.

NOTE 1 Information on tie design is given in CIRIA publication C654, Tower crane stability [9].

NOTE 2 Information on tie design checking is given in Construction Plant-hire Association publication Tower Crane Technical Information Note 031, Tower crane bases and ties [10].

7.6 Verticality of the mast

The importance of the verticality of the tower crane mast cannot be over-emphasized. The mast should be vertical within the limits specified by the manufacturer [see also 8.3h)]. This should be checked by an engineer or surveyor with a theodolite at the following stages:

- a) after erection of the mast and prior to the slew section being installed;
- b) upon completion of the installation or reconfiguration of any mast ties;
- c) before and after mast climbing operations and after any other reconfiguration.

7.7 In-service maintenance interval

Once a tower crane has been erected on site it 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, long hoist ropes and excessive slewing, which might accelerate wear of all components.
- *Environment* – Corrosive environments, such as marine or industrial sites, which might accelerate corrosion of structural components, fasteners and wire ropes.
- *Feedback* – Feedback from maintenance records and thorough examination reports, which might indicate accelerated rates of wear and deterioration.

Once established, the 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.

7.8 Information for maintenance

The wide variation of designs and the increasing complexity of tower 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.

7.9 Inspection during maintenance

7.9.1 General

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

An example of a checklist for inspections during maintenance is given in Annex F.

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.

NOTE 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 7.11.2).