

Maintenance, Inspection and Thorough Examination of Mobile Cranes



Best Practice Guide



Maintenance, Inspection and Thorough Examination of Mobile Cranes

CPA Best Practice Guide



Working in Partnership

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Foreword

Every year, the construction industry is responsible for causing deaths and serious injury. In recent times the industry has done much to improve its performance which I welcome, but there is always room for more improvement.

Our construction industry relies on the use of mobile cranes to move materials on sometimes small, confined sites. Mobile cranes are an essential part of the construction process and can help resolve some of the safety problems on site arising from space constraints.

Mobile cranes are often used in close proximity to people. The transportation, set up and use of mobile cranes provide the potential for death and serious injury to occur and indeed tragically, both site workers and members of the public off site have been killed in mobile crane accidents. In addition to the terrible cost in human suffering, accidents have a financial cost. There is a very strong business case for improving safety performance.

The law relating on cranes is clear. There are requirements to ensure that cranes are inspected, examined and maintained to ensure they do not present a risk. However, investigations into recent accidents have shown that enhanced standards of maintenance and thorough examination could have reduced the chance of death or injury.

This guidance has been prepared to provide clarity about the practical elements of maintenance, inspection and thorough examination. The guidance is simple but comprehensive and easy to adopt. It represents best practice for mobile cranes used in the construction industry and is equally applicable to all mobile crane use across all industry sectors.

I thank those who have been involved in its preparation and commend the guidance to anyone who owns, supplies or controls the operation of mobile cranes. Please read the publication and turn the advice into action.



Phillip White

HM Chief Inspector of Construction
Chair of the Construction Industry Advisory Committee (CONIAC).

1.0 Introduction and Summary

The consequences of any failure of a mobile crane are likely to be extremely serious, with the potential for multiple fatalities. Mobile cranes, which include wheeled and crawler cranes, compact cranes and mobile tower cranes, are also often one of the primary means of material handling on a construction site and any breakdown will have a serious effect on the construction programme. It is therefore extremely important that mobile cranes are effectively maintained to ensure continued safe and efficient operation over time. In addition to the maintenance process, the thorough examination of mobile cranes, periodically and after exceptional circumstances is required to ensure that mobile cranes are safe to take into use and to continue in use.

Both the maintenance and thorough examination of mobile cranes are required by law and the purpose of this Best Practice Guide (BPG) is to set out, in clear and concise terms, both the requirements and the industry agreed Best Practice for meeting these requirements. The document is split into two sections – Maintenance and Thorough Examination, to emphasise that these are separate, although complementary, activities. The document is aimed primarily at mobile crane owners, and those managing and carrying out the maintenance and thorough examination of mobile cranes. However the document will also be of benefit to other groups such as mobile crane users.

Maintenance

The maintenance of work equipment is a fundamental requirement of the *Provision and Use of Work Equipment Regulations 1998* (PUWER). Regulation 5 of PUWER requires employers to ensure that mobile cranes are maintained in an efficient state, in efficient working order and in good repair. In the case of a hired-in mobile crane the actual undertaking of maintenance is often delegated to the crane owner by the user. The user however, retains the legal responsibility for ensuring that maintenance is carried out.

There are a number of equipment maintenance management techniques that can be employed, including “*Breakdown Maintenance*” where maintenance is only carried out after faults or failures have occurred, and “*Planned Preventive Maintenance*” which involves routine inspection replacing parts and consumables or making necessary adjustments at preset intervals, so that risks do not occur as a result of the deterioration or failure of the equipment. In the case of mobile cranes the “*Breakdown*” approach is inappropriate, as any failure presents an immediate risk. The Best Practice Guidance is therefore the “*Planned Preventive Maintenance*” management technique.

Maintenance of mobile cranes should be managed in the same way as any other business activity as, if not carried out effectively, it can have severe safety and financial implications for a business. An effective management structure is required to ensure that everyone involved in the maintenance activity is aware of their responsibilities, properly briefed on their duties and that systems are in place to enable effective feedback, including the monitoring of maintenance data. Mobile crane maintenance activities should be carried out, as a minimum, at the intervals specified in the mobile crane manufacturer’s maintenance manual. Varying circumstances on site and the crane's history may however require the frequency to be increased.

Once a mobile crane has been set up on a site, the user of the crane has a duty to ensure that it is adequately maintained. The actual undertaking of the maintenance is generally delegated to the crane owner by the user; the user however, retains the responsibility for ensuring that the maintenance is carried out.

Clear lines of responsibility for maintenance operations should be established from Board level downwards, ensuring that those appointed and responsible have sufficient knowledge and experience to carry out their duties in a way which will ensure that risks are properly controlled.

Each mobile crane should have a documented preventive maintenance schedule which is targeted at the parts of the equipment where failure or deterioration could lead to health and safety risks and which specifies the frequency of inspection and test of relevant

parts, taking account of the manufacturer's instructions, the age of the crane and its in-use history.

Mobile crane owners may not have access to expert professional engineering advice in-house. If this is the case arrangements should be made for securing such advice externally where this is necessary for the purposes of health and safety and clear guidelines should be established for when this advice should be sought.

For a preventive maintenance system to be fully effective it is essential that comprehensive records of daily checks, intermediate inspections, breakdown reports, maintenance work sheets (including details of parts replacement) and reports of thorough examination are kept. These should be filed in an individual machine history file which should be kept for the life of the crane.

An extremely important aspect of a planned preventive maintenance system is the continuous and systematic review of all maintenance records, inspection reports and reports of thorough examination to ensure that the maintenance is effective, defects are found and worn components are replaced well in advance of any possible failure. Should this review indicate that maintenance is not fully effective, the frequency may have to be increased and maintenance practices amended.

Maintenance should only be carried out by those who are competent and have adequate training and information to carry out the work required. A number of general maintenance training courses and qualifications are available for personnel carrying out and supervising maintenance operations. Training is offered by a number of training providers including the National Construction College, whilst qualifications are available through the NVQ/SVQ scheme.

All maintenance personnel should have received machine specific training, traceable to the mobile crane manufacturer, before carrying out maintenance tasks on any mobile crane.

Maintenance operations on mobile cranes require adequate facilities and equipment to enable them to be carried out effectively, efficiently and safely. The size and sophistication of the facilities will depend on the degree of maintenance tasks to be carried out.

When planning and carrying out maintenance activities on mobile cranes it should not be forgotten that when travelling on the road, the condition of the crane chassis will have a significant effect on the safety of the crane driver and other road users. The Road Vehicles (Construction and Use) Regulations (Reg. 100) require that mobile crane chassis are maintained so "..... *that no danger is caused or is likely to be caused to any person in or on the vehicle or on a road.*"

Thorough Examination

Thorough examination of lifting equipment is a fundamental requirement of the *Lifting Operations and Lifting Equipment Regulations 1998* (LOLER). Regulation 9 of LOLER requires employers to ensure that mobile cranes are thoroughly examined at prescribed intervals. In the case of a hired-in mobile crane the actual undertaking of thorough examinations is often delegated to the crane owner by the user. The user however, retains the legal responsibility for ensuring that thorough examinations are carried out.

The primary purpose of a thorough examination is to ensure that a mobile crane is safe to be taken into, or to continue in, use. It is in addition to any inspection carried out as a part of the maintenance regime and is a statutory requirement. Mobile cranes operate in a high risk environment which may include lifting loads over people in exceptional circumstances. These factors must be taken into account by the competent person when determining the scope and nature of the thorough examination.

As with maintenance, the thorough examination of mobile cranes should be managed effectively, irrespective of whether thorough examination is carried out in-house or by a third party. An effective management structure is required to ensure that everyone involved in the thorough examination activity is aware of their responsibilities, properly briefed on their duties and that systems are in place to enable effective feedback, including the monitoring of thorough examination outcomes. If thorough examination is

carried out by the organisation owning or supplying the mobile crane, steps must be taken to ensure that the competent persons carrying out the thorough examinations have, as LOLER requires *“the genuine authority and independence to ensure that examinations are properly carried out and that the necessary recommendations arising from them are made without fear or favour.”* This guidance describes a number of ways in which this requirement may be met.

Thorough Examination of mobile cranes should only be carried out by those who are assessed as competent and have adequate training and information to carry out the task. Competent persons should be selected through a formally documented assessment process and any shortfalls in their knowledge or ability addressed through formal or on the job training. All assessment and training must be recorded in an individual training record, together with the ongoing Continuing Professional Development that should be undertaken by all Competent Persons.

Competent Persons carrying out Thorough Examinations of mobile cranes should be provided with adequate information to enable them to carry out their duties effectively and safely. The Competent Person may specify supplementary tests to be carried out prior to or during the Thorough Examination. These may include such tests as:-

- Overload test following major repair;
- RCI/RCL calibration and functional test;
- Hoist brake test;
- Pre-delivery inspections;
- Non Destructive Examination of individual components.

The results of the thorough examination must be reported in writing as required by LOLER. This includes the reporting of safety critical defects to the Enforcing Authority (Normally the Health and Safety Executive).

Four Year Testing of Mobile Cranes

Mobile cranes in the UK are often subjected to overload testing at four yearly intervals. 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 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.

In drafting this guidance the CPA, HSE, SAFed and the other organisations involved have concluded that four yearly overload testing is **not** required where periodic thorough examinations are carried out to a defined scope, unless deemed necessary by the competent person. (See **14.0**)

Availability of Mobile Cranes for Maintenance and Thorough Examination

Mobile cranes, when on a construction site, are often pivotal to the construction process and Site Managers may be reluctant to release a mobile crane to the owner to allow maintenance or thorough examination to take place. It is essential that adequate downtime is built into the construction programme to allow effective maintenance and thorough examinations to be carried out and to ensure that personnel do not feel under pressure to skimp the work. The activities should always be carried out during the hours of daylight and the crane operator should be in attendance to operate the mobile crane as required.

Other Issues

In addition to the issues summarised above the guidance also addresses - site issues, management review of records, spare parts, work at height, safe systems of work and checklists for checks and inspections.

This Guidance may be used by Principal Contractors when undertaking vendor assessment as required by the CDM Regulations.

2.0 Definitions

competent engineer

person who has such theoretical knowledge of the design of the lifting equipment as enables them to assess the design of the item in order to establish appropriate criteria for a thorough examination

competent person

person who has such practical and theoretical knowledge and experience of the lifting equipment to be thoroughly examined which enables them to detect defects or weaknesses and to assess their importance in relation to the safety and continued use of the lifting equipment

competent trainer

person who has such practical and theoretical knowledge and experience of the training process, together with model specific training received directly from the crane manufacturer which enables them to provide effective technical product training

functional testing

operation of each motion of the appliance without a load applied in order to determine whether the equipment performs as the manufacturer intended

in-service

condition where the crane is handling loads up to and including the rated capacities within permissible wind speeds and other conditions as specified by the manufacturer during normal operation following thorough examination

maintenance

the process of ensuring that a mobile crane is kept in a safe state, in efficient working order and in good repair

mobile crane

a jib crane mounted on a wheeled or crawler chassis, which is capable of travelling without the need for fixed runways and which relies on gravity for stability

NOTE: This definition includes truck mounted, all terrain and rough terrain mobile cranes, truck mounted self erecting tower cranes, wheeled yard cranes, crawler cranes and mini cranes. Loader cranes are excluded from this definition.

non-destructive testing (NDT)

testing carried out on the structure of the appliance to establish the presence, location and extent of any defects that can affect the integrity of that structure

NOTE: The techniques employed for non-destructive testing are such that they do not damage or alter the material under test. NDT is also known as non-destructive examination (NDE).

overload testing (dynamic)

operation of each motion of the appliance with a load that exceeds the rated load applied in order to determine whether the appliance is stable, structurally sound and fit for the use for which it was designed

out-of service

condition where the crane is either not required for use or is out of use, without a load on the load lifting attachment and in conditions as specified by the manufacturer

NOTE: These conditions may include a higher wind speed than that permitted for the in-service conditions.

overload testing (static)

operation of the appliance with a load exceeding the rated load applied but without operating the full range of motions of the appliance in order to determine whether the appliance is stable, structurally sound and fit for the use for which it was designed

performance testing

operation of each motion of the appliance with the rated load applied in order to determine whether the equipment performs to the manufacturer's specification

supplementary tests

appropriate tests and/or examinations called for by the competent person where concerns regarding the condition of equipment arise from the thorough examination or where additional or more arduous use may be taking place

thorough examination

examination by a competent person in such depth and detail as the competent person considers necessary to enable them to determine whether the equipment being examined is safe to be taken into or continue in use

NOTE: *The thorough examination is not part of the maintenance regime for the equipment but provides owners with information which could be used to determine the effectiveness of the regime.*

user

person or organisation planning and managing a lifting operation

3.0 Legal Requirements

3.1 Introduction

The law places duties on persons concerned with mobile cranes, including those who supply, set up and maintain mobile cranes for use, those who undertake thorough examinations and those involved with the use of mobile cranes for lifting operations. This Section outlines those legal duties and points the reader towards further relevant guidance material.

3.2 The Law Outlined

Legislation relating to the use of mobile cranes at work includes the:-

- Health & Safety at Work etc Act 1974
- Management of Health & Safety at Work Regulations 1999/SI3242
- Workplace (Health, Safety & Welfare) Regulations 1992/SI3004
- Provision & Use of Work Equipment Regulations 1998/SI2306
- Lifting Operations & Lifting Equipment Regulations 1998/SI2307
- Personal Protective Equipment at Work Regulations 1992/SI2966
- Work at Height Regulations 2005/SI735
- Control of Substances Hazardous to Health Regulations 2002/SI2677
- Supply of Machinery (Safety) Regulations 2008/SI1597
- The Construction (Design and Management) Regulations 2007/SI320
- The Road vehicles (Construction and Use Regulations 1986/SI 1078 (As amended)
- The Road Vehicles (Authorisation of Special Types) (General) Order 2003/SI1998

3.3 Health & Safety at Work etc Act 1974 (HSWA)

HSWA places a duty on employers to ensure the health and safety of employees and others who may be affected by their work activities. Similar duties are placed on the self-employed and persons in control of premises. Employees, managers and directors also have responsibilities. The HSWA also places a duty on mobile crane owners and users, where their work activity involves mobile cranes being used where they could affect the general public.

3.4 Management of Health & Safety at Work Regulations 1999 (MHSWR)

Under MHSWR, employers and self-employed people are required to assess risks to health and safety from their undertaking. This includes risks from the use, repair and examination of mobile cranes on their premises, including the operation of the mobile crane. The risk assessment should identify what measures are needed to comply with health and safety requirements and control risk. The duty holder should then put in place the organisation and arrangements to ensure that those measures are properly implemented. MHSWR also requires employers on multi occupancy sites to co-operate with each other to ensure that all statutory provisions are complied with.

3.5 The Workplace (Health, Safety & Welfare) Regulations 1992 (WPR)

WPR places duties on employers to ensure, as far as is reasonably practicable, that their work places are safe and without risks to health. The WPR cover matters such as ventilation, temperature, lighting, electromagnetic radiation and cleanliness of the workplace as well as certain basic welfare provisions.

3.6 The Provision & Use of Work Equipment Regulations 1998 (PUWER)

PUWER is concerned with such matters as selection of appropriate work equipment, safeguarding of dangerous parts of machinery, provision of appropriate controls, and maintenance of work equipment including mobile cranes.

PUWER places duties on any person who has control to any extent of:

- work equipment;
- a person at work who uses, supervises or manages the use of work equipment or
- the way in which work equipment is used at work (including maintenance).

PUWER applies to employers in respect of work equipment provided for, or used by, their employees, self-employed persons in respect of work equipment they use and other persons, e.g. visitors.

3.7 The Lifting Operations & Lifting Equipment Regulations 1998 (LOLER)

LOLER deals with the specific risks arising from the use of work equipment (including lifting accessories) to lift loads. It builds upon PUWER and applies to the same groups of people. LOLER also introduces particular requirements for lifting equipment which is used to lift people, and a requirement for the thorough examination and reporting of thorough examination of mobile cranes.

3.8 Personal Protective Equipment at Work Regulations 1992 (PPE)

These Regulations impose health and safety requirements for the provision of, and use by, persons at work of personal protective equipment. The Regulations require employers to ensure suitable personal protective equipment is provided without charge, for their employees and also require self-employed persons to ensure suitable personal protective equipment is provided for them. Requirements are also imposed on employees and self-employed persons for the use, storage and maintenance of personal protective equipment. Employees are also required to report to their employer the loss of or any obvious defect in personal protective equipment.

3.9 Work at Height Regulations 2005 (WAH)

The Work at Height Regulations impose health and safety requirements for work at height. These include:-

- organisation and planning;
- hierarchy of control;
- competence and supervision;
- steps to be taken to avoid risk from work at height;
- selection of work equipment;
- inspection of work equipment.

The Regulations define work at height 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.*

3.10 Control of Substances Hazardous to Health Regulations 2002 (COSHH)

The Control of Substances Hazardous to Health Regulations require employers to control substances that are hazardous to health by:-

- finding out what the health hazards are;

- deciding how to prevent harm to health (risk assessment);
- providing control measures to reduce harm to health;
- making sure they are used ;
- keeping all control measures in good working order;
- providing information, instruction and training for employees and others;
- providing monitoring and health surveillance in appropriate cases;
- planning for emergencies.

3.11 Supply of Machinery (Safety) Regulations 2008 (SMSR)

The Supply of Machinery (Safety) Regulations are the UK's implementation of European Union Directive 2006/42/EC, the "*Machinery Directive*" which requires that all machinery (including lifting accessories) supplied into the European Union, meets the Essential Health and Safety Requirements detailed in Schedule 2 Part 1 of the Regulations. This include the provision of information for use, including maintenance. Each machine must be accompanied at time of supply by an "*EC Declaration of Conformity*" declaring that the machinery fulfils all the relevant provisions of the Regulations.

3.12 The Construction (Design and Management) Regulations 2007 (CDM)

The Construction (Design and Management) Regulations place duties on duty holders including clients, designers and contractors for the planning, management and monitoring of health, safety and welfare in construction projects and of the co-ordination of the performance of these duties by duty holders. These include a duty on every person working under the control of another to report anything that he is aware is likely to endanger health or safety. The Regulations impose additional duties on clients, designers and contractors where the project is notifiable, defined as likely to involve more than 30 days or 500 person days of construction work. These include the duty of the client to appoint a CDM coordinator and a Principal Contractor.

3.13 The Road Vehicles (Construction and Use) Regulations 1986 (As amended) (C & U)

The Road Vehicles (Construction and Use) Regulations specifies requirements for the construction and use of all road vehicles, including mobile cranes. Part of the requirements for use is a requirement (Regulation 100) that all vehicles, including mobile cranes, are maintained so that "... *no danger is caused or is likely to be caused to any person in or on the vehicle or on a road*".

3.14 The Road Vehicles (Authorisation of Special Types) (General) Order 2003 (STGO)

This Order authorises the use on the road of certain types of vehicle, including mobile cranes, which do not fully comply with the Construction and Use Regulations. The Order also specifies the requirements that must be met by such vehicles.

3.15 British, European and ISO Standards

Standards do not generally have the force of law: the application of a standard is almost always voluntary, although standards are very often used in support of legislation, and compliance with a standard is sometimes quoted in legislation as offering a route to discharging legal obligations. Good examples of this are the references to the BS 7121 series in the Guidance to LOLER.

British standards are generally restricted to Codes of Practice for safe use of equipment e.g. BS7121-3:2000 *Safe use of mobile cranes*, whilst European (EN) standards cover requirements for basic principles (Type A), common product requirements (Type B) and specific product requirements (Type C) e.g. *EN13000:2004 Mobile cranes*.

International Standards (ISO) cover both the safe use and specification of mobile cranes and components. They do not have any legal status by themselves but are often taken as good practice and when cited as normative references in some EN product standards have the same force as EN standards.

4.0 Approaches to Maintenance

4.1 Maintenance System Elements

The introduction to this Best Practice Guide has emphasised the need to ensure that equipment is maintained, as required by PUWER, so that its performance does not deteriorate to the extent that it puts people at risk. Many people have a part to play in this from the mobile crane operator carrying out daily and weekly checks, through the user reporting defects to the crane owner, to the maintenance personnel. Adequate maintenance can only be achieved by establishing an effective maintenance management system which should include

- A statement of maintenance policy (e.g. Planned Preventive Maintenance, backed up by breakdown repairs and supplemented by Predictive Maintenance or in combination);
- Definition of roles and responsibilities of persons involved in the maintenance activities;
- Systems for the delivery and assessment of individual competencies;
- A maintenance plan/schedule;
- Written maintenance procedures;
- Maintenance records;
- A review and audit plan to ensure that the maintenance is suitable and sufficient.

NOTE: *Thorough Examination is not part of maintenance and should never be viewed as a substitute for good maintenance.*

4.2 Types of Maintenance Management

There are three main types of maintenance management that may be applied to the maintenance of machines, including mobile cranes: breakdown maintenance, preventive maintenance and predictive maintenance. Not all of these are appropriate for the effective maintenance of mobile cranes, as explained below.

4.3 Breakdown Maintenance

Breakdown or “run-to-failure” maintenance management has a simple and straightforward logic. “If it ain’t broke, don’t fix it” is often seen as a way of limiting expenditure on maintenance and keeping costs low. The problem with this approach for mobile cranes is that any failure could present an immediate and unacceptable risk to persons. Additionally, repair costs may well be very high when the machine does break down, often at the most inconvenient moment, with considerable downtime whilst repairs are carried out.

4.4 Planned Preventive Maintenance

All planned preventive maintenance systems are time driven. In other words, maintenance tasks are carried out at intervals that are based on actual hours of operation or on an interval of time that equates to an average number of operating hours or number of operational cycles. The maintenance interval is based on experience of breakdowns or the mean-time to failure (MTTF) as illustrated in **Figure 1**. The MTTF or bathtub curve indicates that a newly purchased machine has a higher probability of breakdown due to teething problems in the first few weeks of operation. Following this initial period, the probability of failure is relatively low for an extended period, until wear and deterioration means that the probability of breakdown/failure increases sharply with elapsed time.

The problem with this approach is that machines wear at different rates over time depending on variety of factors such as environment, frequency of use and load spectrum. If maintenance intervals are too great the machine may breakdown anyway

and if they are too short maintenance costs may be unnecessarily high. Inappropriate or poor maintenance can also cause breakdowns.

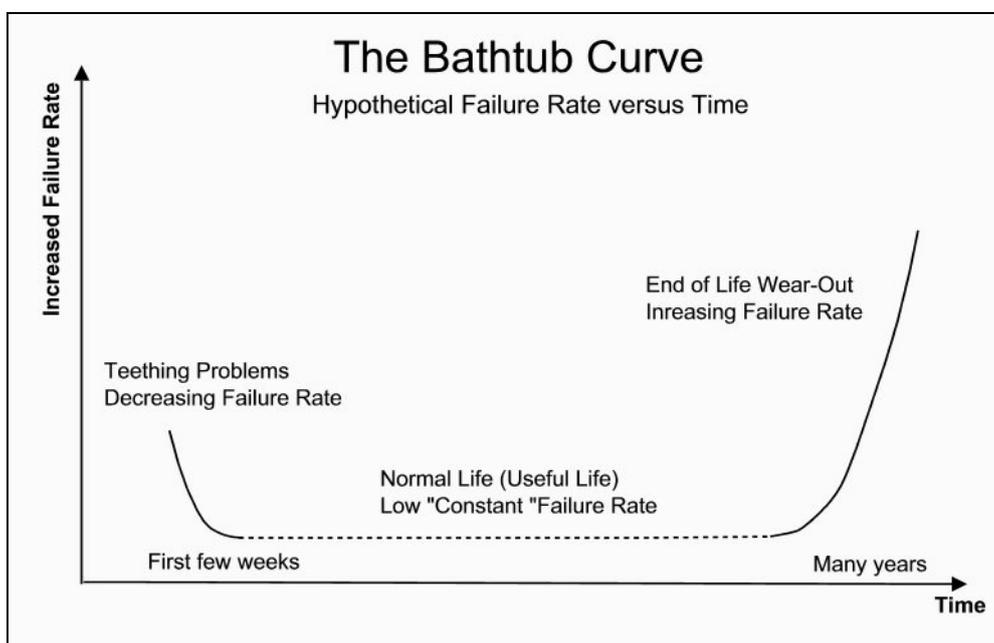


Figure 1. - The Bathtub Curve

4.5 Predictive Maintenance

Predictive maintenance is a condition driven preventive maintenance approach which instead of relying on industry average life statistics (i.e. mean time to failure) to determine maintenance intervals, uses direct monitoring of the machine. This may include mechanical and electrical condition, environmental factors and other indicators such as frequency of use and load spectrum. These are used to determine the actual mean time to failure for the individual machine and achieve the best balance between low maintenance costs and unplanned failures.

4.6 Best Practice Maintenance Regime For Mobile Cranes

In the case of mobile cranes, reliance on the "Breakdown" approach is totally inadequate, as any failure presents an immediate safety risk, whilst at the current stage of mobile crane technology a total "Predictive Maintenance" system would be difficult to implement. Current best practice is therefore "Planned Preventive Maintenance" backed up by repairs following breakdown. This involves replacing parts and consumables or making necessary adjustments, at preset intervals so that risks do not occur as a result of the deterioration or failure of the equipment. Some elements of Predictive Maintenance such as oil sampling and use of data logging records may well be able to be incorporated into the maintenance regime.

4.7 Investigation of Excessive Wear or Failure

Where maintenance activities identify excessive, unexpected or unusual wear, or failure of mobile crane components, this must be fully investigated and a solution sought. This may well require engineering assessment, involve the manufacturer and must be fully documented. The documentation must be made available to the competent person at the time of the next thorough examination as part of the machine history file.

4.8 Management Structure

The maintenance of mobile cranes should be managed in the same way as any other business activity as if not carried out effectively it can have severe financial and safety implications for a business. An effective management structure is required to ensure that everyone involved in the maintenance activity is aware of their responsibilities, properly briefed on their duties and that systems are in place to enable effective feedback, including the monitoring of maintenance data. A sample structure is shown in **Figure 2** below.

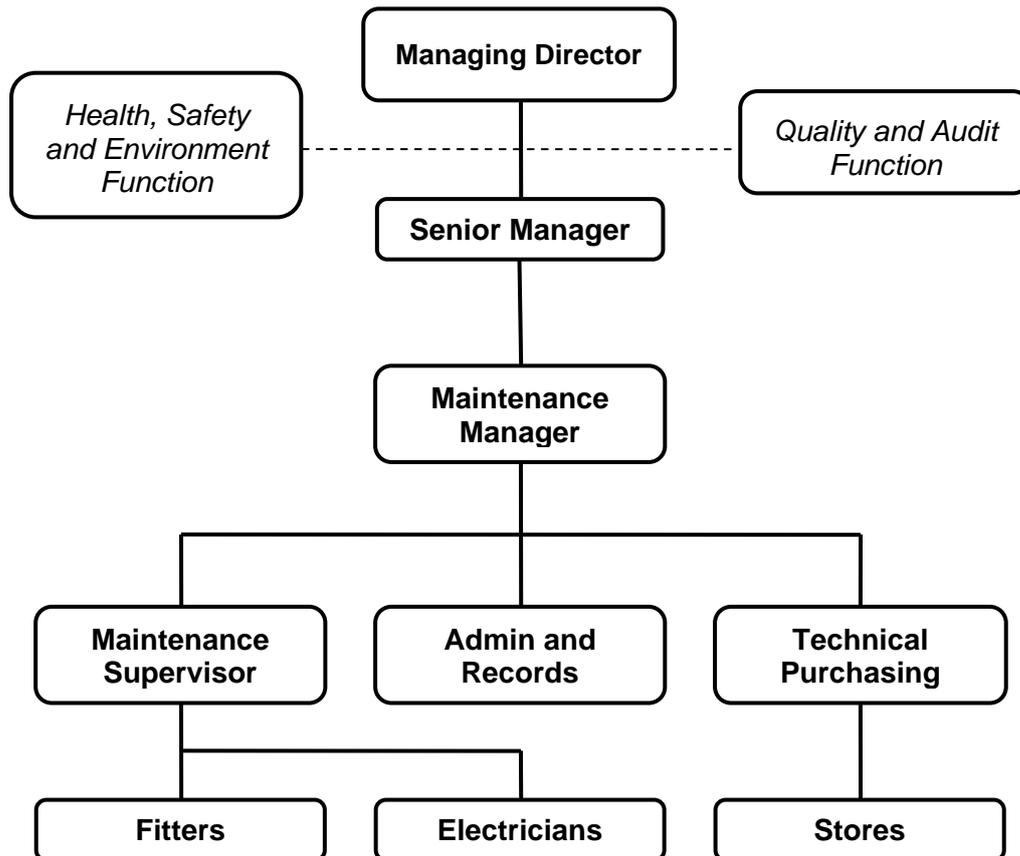


Figure 2. – Typical Maintenance Organisation

4.9 Auditing of Maintenance Systems

Once a maintenance system has been established, it is important that it is regularly audited to ensure that the system is being adhered to, that it is functioning correctly and objectives are being achieved. Auditing should be carried out by an auditor from outside the maintenance organisation with a sufficient degree of independence.

If a business has a formal quality management system such as an ISO 9001 accredited system the maintenance activity should be integrated into both that system and the scheduled audits.

4.10 Mobile Crane Users Responsibilities for Maintenance

The Health and Safety at Work etc. Act 1974 sets out a general duty requiring that work equipment is maintained so that it is safe. This requirement is reinforced by Regulation 5 of the Provision and Use of Work Equipment Regulations (PUWER) 1998 which requires that *“Every employer shall ensure that work equipment is maintained in an efficient state, in efficient working order and in good repair.”* In the case of a hired-in mobile crane the actual undertaking of the maintenance is often delegated to the crane owner by the user. The user however, retains the legal responsibility for ensuring that the maintenance, including the rectification of defects, is carried out. This point is of particular importance where cranes are on long term hire on a site, as is often the case with crawler cranes, mobile tower cranes and compact cranes.

4.11 Maintenance of the Mobile Crane Chassis

When planning and carrying out maintenance activities on mobile cranes it should not be forgotten that when travelling on the road, the condition of the crane chassis – brakes, suspension, steering, lights, wheels, tyres etc. will have a significant effect on the safety of the crane driver and other road users. Although mobile cranes are currently exempt from both the commercial vehicle Operators Licensing and Plating & Testing Regulations, the *Road Vehicles (Construction and Use) Regulations* (Reg. 100) require that they 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.”* As a mobile crane has the potential to cause as much damage in a road traffic accident as any other large vehicle, it is best practice to follow the recommendations set out in the manufacturer’s service manual. These normally set maintenance intervals based on both engine hours run and distance travelled, whereby the first parameter reached determines the need for maintenance.

Failure to maintain the chassis of a mobile crane adequately may put the crane operator and other road users at risk from issues such as:-

- Poor brake performance or failure leading to increased braking distances and an inability to stop in time;
- Insufficient tyre tread grip leading to increased braking distances;
- Hydraulic fluid leaks from the suspension system leading to contamination of the road surface and potential loss of control for other road users;
- Tyre blowouts leading to loss of control of the crane;
- Steering system failures leading to loss of control of the crane;
- Lighting failures leading to the operator not being able to see clearly and other road users not being able to see the crane;
- Wiper, washer and demister failures preventing the crane operator for seeing clearly;
- Failure of the vehicle suspension system;
- 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 to ensure that defects can be detected.

5.0 Maintenance Intervals

5.1 Introduction

It is essential that planned preventive maintenance is carried out at intervals which ensure that worn and damaged components are replaced before the mobile crane becomes unsafe, breaks down or fails. Breakdown will cause downtime and a consequent loss of production for the user, whilst a component failure may well result in a partial or total collapse of the crane with potentially fatal consequences for persons in the vicinity.

5.2 Pre-delivery Maintenance and Inspection Prior to Long Term Hires

Before a mobile crane, including crawler, mobile tower or compact cranes, is delivered to site for a long term hire, it is advisable that it is inspected by maintenance personnel to identify any worn or faulty components and that these are replaced. The results of the inspection must be recorded. This record may be required by the competent person carrying out the 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 set up on site. Work on a crane on site may involve work at height and presents difficulty in handling heavy components.

5.3 In-service Maintenance Interval

A mobile crane should be maintained at regular intervals to avoid breakdown, failure or collapse. The frequency at which 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 may require the maintenance interval to be reduced:-

- **Usage** – Double shifting, frequent lifting at or near the Rated Capacity, high cycling, long hoist ropes and excessive slewing may accelerate wear of all components;
- **Road Use** – Excessive travel on the highway;
- **Environment** – Corrosive environments such as marine or industrial sites may 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 may indicate accelerated rates of wear and deterioration.

Once established, the current maintenance interval should be recorded in the machine history file. Any variation from the manufacturer's recommended intervals must be 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.

5.4 Second-hand Mobile Cranes

When purchasing second-hand mobile cranes their condition should be thoroughly assessed, as nothing can be taken for granted. Second-hand cranes may contain latent defects which may only become apparent when the machine is put into service. They may have suffered significant damage and have been inadequately repaired. Second-hand cranes may also have been imported into the European Community without being modified to meet EU requirements, so called "Grey Imports" (See Annex12).

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 who may be able to provide details of any major repairs etc. Once the crane's condition has been fully assessed any necessary repairs can be carried out and an appropriate in-service maintenance interval established (See 5.3).

6.0 Maintenance Personnel - Attributes, Training and Assessment

6.1 Introduction

It is essential that the maintenance of mobile cranes is always carried out by personnel who have been assessed by their employer as competent and have adequate training and information to carry out the work required.

6.2 Attributes

Maintenance personnel should be:

- Physically fit;
- Comfortable working at height;
- Have a responsible attitude;
- Able to communicate clearly with other personnel on site;
- Able to demonstrate adequate literacy;
- Aware of their own limitations in knowledge and experience;
- Fully conversant with the machinery they are required to maintain and its hazards, including operation necessary for maintenance activities;
- Properly instructed and trained. Where special machinery is involved this should include attending appropriate courses given by the manufacturer/supplier of the equipment;
- Familiar with the procedures and precautions required for safe work at height;
- Fully conversant with the appropriate sections of the manufacturer's instruction manual;
- Familiar with the use of permit to work systems where they are required by the safe system of work, and able to operate them correctly;
- Familiar with site specific safety requirements (e.g. construction, process plant, nuclear, docks, airports, railways);
- Aware of their responsibilities under the Health and Safety at Work Act and supporting regulations;
- Trained and competent in the pre use inspection, correct wearing and limitations of their personal protective equipment.

6.3 Training

All mobile crane maintenance personnel should be trained in a set of basic skills to enable them to work safely and participate effectively in the maintenance process. They should not be required to undertake tasks for which they have not been trained and assessed as competent to carry out. These basic skills should include the following.

- Understanding basic health and safety requirements, including the risk assessment process, together with need for site specific safety;
- Slinging and signalling;
- Tool skills, including the selection and use of tools;
- Identification, selection and fitting of fasteners (including threaded fasteners);
- Use, inspection and maintenance of fall protection equipment (working at height);
- Interpretation of technical information, use of manuals;
- Basic assessment of weather and ground conditions;

- Generic skills in maintaining mobile cranes within a safe system of work;
- Product familiarity, including rigging and other relevant operational aspects, on all makes and models of crane on which maintenance is being carried out;
- Preparing equipment for use including isolation of power sources etc;
- Effective communication (including the use of radio equipment);
- Carrying out basic adjustments;
- Identifying and rectifying basic faults in equipment;
- Assisting with examinations and testing.

These basic skills may be augmented by the following as required:-

- Wire rope inspection and termination;
- Use of specialist tools and equipment appropriate to the work being carried out (including torque wrenches, multipliers and hydraulic tensioning equipment);
- Checking and setting limits, including RCI/RCL;
- Downloading data from data acquisition systems;
- Functional testing;
- Carrying out complex adjustments;
- Identifying and rectifying complex faults in equipment;
- Identifying proximity hazards;
- Welding and repair techniques.

NOTE: *Specialist activities such as structural repairs and identifying and rectifying complex faults are generally best carried out by the crane manufacturer, who should always be consulted before any such activities are contemplated.*

6.4 Training Plan

An individual training plan should be drawn up for each person carrying out maintenance on mobile cranes. This plan should take into account previous experience, qualifications and underpinning knowledge. Particular care should be taken where trainees fall into the category of Young Persons. Persons undergoing training should be closely supervised, where appropriate.

Achievement of this plan and continuing professional development should be monitored at frequent intervals as part of the management review process (See **10.0**) and included in the quality system (e.g. ISO 9001) auditing process.

The plan could include elements from the NVQ in Construction Plant Maintenance, Levels 1, 2 & 3.

6.5 Continuing Professional Development

Continuing professional development is the conscious updating of technical knowledge and the improvement of a maintenance person's skill throughout their working life. This is a joint responsibility between the maintenance person and their employer.

The employer should maintain a training, experience and development record for each maintenance person. The Record should include details of how ongoing development is being achieved and should include for example:

- Initial training (See 6.8 Training Records);
- Specific training towards enhancements/additions to skills;
- Familiarisation/re-familiarisation, coaching and training;
- Changes in legislation and working practices;
- Updating of product knowledge;

- Attendance at seminars and any refresher training courses.

6.6 *Manufacturer's Technical Product Training*

Before carrying out maintenance on a specific make and model of mobile crane all maintenance personnel must 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 must be carried out by a competent trainer who has received model specific technical training directly from the manufacturer. This ensures that the source of such training is only once removed from the manufacturer.

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

6.7 *Qualifications and Assessment*

It is important that all maintenance personnel are regularly assessed to ensure that they can carry out their duties safely and effectively. An in-house assessment should be undertaken of all maintenance personnel on appointment and at regular intervals thereafter. Assessment should form part of any training.

National Vocational Qualifications (NVQ) are available for construction plant maintenance. See **Annex 11**.

6.8 *Training Records*

A comprehensive individual training record should be established for all maintenance personnel. This should be updated as training is undertaken and as a minimum should include:

- When the training took place;
- Where the training took place;
- The scope of the training;
- The duration of the training;
- Who delivered the training;
- The result of any assessment;
- When refresher training is required.

7.0 Information for Maintenance

7.1 Introduction

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. Maintenance information comes in various forms and from several sources.

Mobile crane owners must ensure that a robust system is in place to provide adequate up to date information to maintenance personnel. This may be achieved in a number of ways including:-

- Provision of paper manuals using a system which will ensure frequent updating is taking place;
- Provision of electronic manuals using a system which will ensure frequent updating is taking place;
- A central technical information function which can be contacted for up to date information whenever maintenance is taking place.

NOTE: *It is essential that a system is in place to ensure that manual updates, safety alerts and other information are communicated speedily to those who need to know.*

7.2 Manufacturer's Information

Information supplied by the mobile crane manufacturer will be the main source of instructions and specifications when carrying out maintenance. The primary document will be the maintenance manual for the specific crane model (and in some cases serial number), supplemented by technical information bulletins.

Care should be taken to ensure that the information is up to date and relevant to the crane on which maintenance is being carried out.

Manufacturer's manuals are not always complete and in the case where a particular task is not covered, the manufacturer must be contacted for information **BEFORE** the task is undertaken. Manuals may not always contain an appropriate maintenance regime for older cranes, in which case the specific advice of the manufacturer should be sought.

When purchasing a second hand crane care should be taken to ensure that any manuals supplied with the crane are appropriate for the specific model of crane.

Some mobile crane manuals and other information are available to download from the manufacturer's web site.

If the mobile crane manufacturer is no longer in business a competent engineer should be consulted.

7.3 In-House Technical Information

Some mobile crane owners will have their own technical information dealing with specific issues relating to the cranes in their fleet. This can be a useful source of information for maintenance personnel but care should be taken to ensure that information is current and obsolete data has been withdrawn.

7.4 Method Statements and Work Instructions

Much maintenance work on mobile cranes is of a routine nature and can be covered by generic risk assessments, method statements and work instructions. On occasions however, unusual and potentially hazardous tasks, will have to be undertaken. Such tasks must be planned thoroughly and a job specific safe system of work (risk assessment, method statement and briefing) put in place. This planning must include consideration of falling object hazards (hand tools, components etc.).

This system of work must be described in a brief, focused job specific method statement on which all members of the maintenance team undertaking the task must be fully

briefed. This briefing, which should be recorded, should concentrate on the task to be undertaken and highlight any unusual features of the job.

7.5 Generic Information

Maintenance personnel may also need to refer to generic information such as standards and industry guidance. For example, for wire ropes there are BS ISO 4309: *Cranes – Wire Ropes – Care, maintenance, installation, examination and discard* and wire rope manufacturer's literature (See **Bibliography**).

Care should be taken to ensure that the information is up to date.

7.6 Machine History

The history of the repairs and maintenance carried out on a mobile crane is often very helpful when trying to diagnose faults and repeated failures. Maintenance personnel should be encouraged to contact their manager or supervisor to request relevant machine history details when appropriate.

7.7 Information Formats

Paper information such as manuals and bulletins is rapidly being replaced by electronic formats such as CD-ROM and website downloads. This has the advantage that physical storage space is kept to a minimum and, in the case of website downloads; information should be up to date at the point of access. However the use of electronic display devices, such as laptop computers, during maintenance is not always easy or practical. Information may therefore have to be printed out for use on site, in which case care should be taken that for any subsequent use the data is still current and relevant.

7.8 Management of Information

Information should be managed effectively if it is to be of maximum benefit to those involved in the maintenance process. Outdated information can at best waste time and at worst may well affect safety. It is therefore essential that organisations carrying out maintenance on mobile cranes ensure that they have robust systems and procedures to ensure that maintenance personnel are supplied with adequate information that is both up to date and accurate. The crane manufacturer should be consulted to ensure that information is current.

8.0 Inspection During Maintenance

8.1 Introduction

Inspection forms a very important part of the maintenance process and is required by the Health and Safety at Work Act (Section 2 (2) (a)); PUWER (Regulation 6) and LOLER (Regulation 9 (3) (b)).

The Guidance on Regulation 9 (3) (b) of LOLER says that:-

“You should arrange for suitable inspections to be carried out where the lifting equipment is of a type where its safe operation is dependent on its condition in use and deterioration would lead to significant risks to the operator or other persons. In determining the suitability and scope of the inspection you should refer to available information such as the manufacturer’s instructions. Examples of conditions which can be detected by inspection of the lifting equipment include:

(a) rapid wear arising from use in an arduous environment, e.g. construction;

(b) failure through repeated operation, e.g. [of a hoist winch brake];

(c) malfunction, e.g. of a rated capacity indicator; and

(d) tampering with safety devices, e.g. [overriding a luffing limit].”

8.2 Inspection Intervals

In-Service inspections of mobile cranes are normally of four types:-

Daily Pre-use Checks	Normally carried out by the mobile crane operator who should have been trained and assessed to carry out this task. Any defects found should be reported to his supervisor and formally recorded (See 8.3).
Weekly Inspection	Normally carried out by the operator if they have been assessed as trained and competent.
In-Service Maintenance Inspection	Normally carried out by maintenance personnel as part of the maintenance process (See 5.3).
Intermediate Inspection	An additional inspection required to monitor deterioration of a frequently failing or suspect component. (See 5.3)

These checks and inspections should only be carried out by personnel who have been adequately trained and assessed as competent to carry out the required tasks. It is essential that the results of all checks and inspections are recorded in writing to ensure that the requirements of LOLER and PUWER are met.

8.3 Reporting of Defects

There must be provision for the operator(s) of mobile cranes to make written reports of defects or observations immediately they are identified.

This facility must augment the normal verbal reporting that routinely takes place between operator and owner/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., and must be reported at least daily. ‘Nil Reports’ must also be submitted at least weekly.

All the defect reports, including the 'nil reports', should be forwarded to the crane owner, (or the delegated person), who is in a position to make an informed decision about a planned response to the report. A copy of the original report should be retained by the operator.

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

The 'un-cleared' and 'cleared' reports should be securely lodged within the crane owning company's maintenance management system and must be made accessible on demand to the operators of the crane as well as other authorised bodies.

8.4 Use of Checklists

The use of check lists is extremely useful when carrying out inspections, both as a reminder of the items to be checked and as a means of recording the results of the inspection. When inspections are being carried out as part of maintenance it is important that maintenance personnel do not succumb to the temptation not to record faults that are then rectified as part of the maintenance process. This masking of faults invalidates the machine history and hinders the review process (See **Section 10**). Examples of daily check and weekly inspection checklists are given at **Annex 6**. An example of a typical in-service maintenance schedule is given at **Annex 5**. These checklists should only be taken as a general guide and may well need additions for specific models of mobile crane.

NOTE: Additional information on inspection during maintenance is given in:-

BS 7121- 2:2003 - Code of practice for safe use of cranes — Part 2: Inspection, testing and examination

8.5 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 must 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 sites to allocate time for routine inspection and maintenance. It is unreasonable for a site 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 **Section 11**)

9.0 Maintenance Records

9.1 Introduction

Comprehensive maintenance records are essential to the safe, efficient and economical operation of mobile cranes. They provide a complete “cradle to grave” history of the individual crane giving the following benefits:-

- evidence of adequate maintenance as part of the management system;
- establishing breakdown trends over time and providing information for the review of maintenance frequency;
- identification of component failure trends for feedback to the manufacturer;
- evidence of adequate maintenance to the Enforcing Authorities in the event of an incident;
- enabling the performance of the crane to be reviewed over time to inform future purchases.

9.2 Maintenance Record Format

Maintenance records can be kept in either paper or electronic format. Paper records are often easier to update as the input will often be in paper format such as inspection reports or work sheets. Electronic records are however more secure against loss and damage, and the data is more readily analysed. There are many maintenance record software packages on the market but care should be taken when considering purchase to ensure that the system is flexible enough to accommodate changes in types of input and output.

9.3 Machine History Files

Each mobile crane should have its own machine history file, in either paper or electronic format, in which all records of maintenance activities are kept by the mobile crane owner. These should include (where applicable):-

- EC Declaration of Conformity;
- Special maintenance procedures;
- Service reports and worksheets;
- Breakdown reports and worksheets;
- Daily and weekly inspection reports;
- Records of component replacement;
- Records of major overhaul;
- Test reports;
- Wire rope and hook test certificates;
- Thorough Examination reports;
- Records of defect rectification;
- Data logger records;
- Records of supplementary tests;
- Record of modifications and upgrades;
- Safety Alerts from manufacturers;
- Records of extraordinary events (e.g. replacement or repair of significant load bearing components, severe overloading or wind loading)
- Records of unusual applications.

Where a mobile crane is on site for an extended period the user will need to be able to demonstrate that the crane has been adequately maintained (**PUWER** Reg. 5). The user should ensure that they obtain sufficient evidence from the crane owner to demonstrate this.

10.0 Management Review of Maintenance Records and Procedures

10.1 Introduction

A regular management review of mobile crane maintenance records and procedures is essential for the safe and efficient operation of a mobile crane fleet. It ensures that management can 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 and closed out appropriately and the maintenance schedule is being completed to plan;
- Checks to determine if the regime and frequencies are appropriate and to analyse trends.

10.2 Benefits

The benefits of regular management review of maintenance records are:-

- Confidence that the system is functioning correctly;
- Identification of extraordinary events and failures;
- Ensuring that there is evidence of adequate maintenance to the Enforcing Authorities in the event of an incident;
- Establishing breakdown trends over time and informing the review of maintenance frequency;
- Identification of component failure trends for feedback to the manufacturer;
- Providing breakdown trends to the manufacturer to inform future designs;
- Highlighting on-site maintenance access problems for feedback to the manufacturer to improve future designs;
- Monitoring the performance of individual cranes over time to provide information on future purchases.

10.3 Review Frequency

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.

10.4 Review Methodology

The review should aim to identify exceptional events such as occurrences of heavy expenditure and reoccurring faults. It should also measure achievement of maintenance activities against target. An example of the use of such Key Performance Indicators is given in **Annex 9**.

10.5 Review Records

It is essential that written records of the management review are made, both as evidence that the reviews have been undertaken and to evaluate long term trends.

11.0 Site Issues For Maintenance

11.1 Introduction

Maintaining a mobile crane (especially crawler cranes) on site presents a particular set of issues when compared with carrying out maintenance operations in a workshop or yard. These issues are best addressed at the planning stage before the crane is set up on site and taken into use. The effective maintenance of mobile cranes on site will require the cooperation of the user and an example of a document informing them of the issues they should consider when maintenance is being undertaken, is given at **Annex 4**.

11.2 Maintenance Downtime

The main purpose for a mobile crane being on site is to carry out lifting operations. Site managers are understandably reluctant to stop the crane whilst maintenance is carried out. If maintenance downtime is not scheduled into the programme, maintenance is pushed to the back of the queue and ends up being carried out hurriedly in unsafe conditions such as poor light.

It is therefore essential that mobile crane owners make clear to those hiring their cranes that maintenance is of paramount importance and that adequate maintenance downtime must be built into the programme. Hirers must be informed at the planning stage of the frequency and length of time required for maintenance operations. In certain circumstances it may 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 week ends and evenings. Such restrictions must 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.

11.3 Site Inductions

Maintenance personnel should have undertaken suitable and sufficient health and safety training applicable to their activity before arriving on site. Such training should be sanctioned by an appropriate industry body for the work function being carried out. (e.g. CPCS Health and Safety test). To supplement their trade specific health and safety training, visiting personnel must attend an appropriate site specific safety induction focused on the specific hazards that may be present in the vicinity of the intended work,

The induction must be of sufficient length to cover the relevant risks, however it is anticipated that it would normally take 20 – 30 min, and where necessary be specifically prepared by the Principal Contractor in control of the site. The time of the induction should be agreed in advance. If the maintenance work is programmed to commence at 8 am, there will be an automatic delay if the induction does not start until 9 or 10 am. The induction should be given by the Principal Contractor's Manager who will oversee the maintenance activity. This will help build relationships and a joint understanding. Where necessary the induction should be followed by a methods briefing talk given by the crane company supervisor to the maintenance team, but also attended by the Principal Contractors Management, and any other parties involved i.e. security guards, those arranging exclusion zones or traffic diversions etc. This is to help ensure all know what is to happen, when and by whom.

11.4 Communication

Those planning and carrying out maintenance on mobile cranes on site must ensure that they have effective lines of communication with the site for both routine maintenance and attending to breakdowns. Maintenance personnel must 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 will avoid much frustration and misunderstanding on both sides.

11.5 Availability of Operators

Many maintenance operations require the crane to be operated from the control cab whilst maintenance personnel are working on other parts of the crane. Arrangements should be made to ensure that an operator is available on such occasions and that a safe system of work is in place.

11.6 Availability of Site Facilities

When maintenance is being carried both during and outside normal working hours, arrangements must be made to ensure that site management, safety and welfare facilities are available to maintenance personnel.

11.7 Lone Working

Lone working should be avoided at all times by suitable liaison with the person in control of the site to ensure that site personnel are always in attendance.

The planning process for work at height on mobile cranes should take into account the particular hazards of lone working and maintenance at height by lone workers should not be undertaken.

If lone working at ground level is unavoidable suitable measures should be put in place to minimise risks to the lone worker. This might include:-

- Call in arrangements;
- Notification to a remote supervisor of entry and exit to premises;
- Provision of alarm and tracking systems.

NOTE: Additional advice on lone working is given in HSE publication INDG 73 - Working alone in safety

11.8 Work at Height

Some maintenance activities on mobile cranes will require competent persons to work at height outside edge protected areas on the mobile crane structure. The Work at Height Regulations 2005 set out a hierarchy of fall protection measures to be taken when planning work at height.

This means that those planning work at height on mobile cranes should:-

- Avoid work at height wherever possible and actively seek solutions to facilitate this;
- If this is not possible, use “collective” means of protection such as guardrails;
- If this is not possible, use “personal” means of prevention such as work restraint;
- If this is not possible, use a personal fall protection system such as a work positioning system or fall arrest system;
- Additionally provide training and instruction or take other measures to prevent any person falling a distance liable to cause personal injury.

Where a risk assessment indicates that a personal fall protection system is required a work positioning system should always be used in preference to a fall arrest system. Where the use of fall arrest personal fall protection systems are unavoidable there will be a risk of the wearer being left suspended following a fall and arrangements must be made to ensure that they can be rescued in a safe and timely manner (See **Annex 1**).

Where work is being carried out on mobile tower cranes suitable and sufficient arrangements must be put in place for the rescue of personnel from height. This matter is dealt with in the CPA Technical Information Note TIN 013 - *Rescue of Personnel from height on Tower Cranes* which may be downloaded from the CPA web site.

11.9 Isolation of Systems During Maintenance

To avoid the risk of trapping, crushing and shearing during the maintenance of mechanisms on mobile cranes, all systems should be isolated before work starts. Where this is not possible due to the need to have power to a system for fault diagnosis etc., a safe system of work should be put in place to mitigate the risks of trapping. Such a safe system of work may well involve a “permit to work” and adequate communication between the crane operator and other members of the maintenance team. If safety systems have to be bridged or over-ridden during the fault finding, checks must be made to ensure that all safety systems are functioning correctly before the crane is returned to service.

11.10 Exclusion Zones

Where maintenance is being carried out on site and there is a risk of falling objects, a suitable exclusion zone should be established and enforced around the crane to provide protection from falling objects.

11.11 Communication Equipment

Maintenance personnel should be provided with an adequate means of communication, often hand portable radios, to ensure that all members of the maintenance team can communicate effectively with each other, the mobile crane operator and personnel on the ground.

NOTE: *Additional advice on radio communications is given in the CPA Technical Information Note TIN 017 - Radio Communication for Lifting Operations*

12.0 Spare Parts

12.1 Introduction

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. This can only be achieved if a robust spare parts management system is in place. Ineffective management of spare parts will result in both direct and indirect costs and may well affect the safety of the mobile crane.

12.2 Availability and Sourcing

The two extremes of spare part sourcing are to stock every spare part that could ever be required in the crane owner's stores or to stock nothing, relying on the mobile crane manufacturer's stock with courier delivery. In practice a combination of the two is often used, avoiding a costly inventory whilst ensuring that fast moving items are readily available.

A list of critical items with long lead times should be identified by consultation with the manufacturer. Strong consideration should be given to stocking such items to ensure minimum crane downtime.

12.3 Spare Part Specification

Spare parts must always meet the crane manufacturer's specification. Ensuring that this is the case is often a complex process involving a full engineering assessment of the component to be replaced and it is often easier to purchase from the crane manufacturer. One of the benefits of purchase from the crane manufacturer is ensuring that parts are to the latest specification.

12.4 Stock Control

Spare parts must be controlled using a robust stock control system. This will allow stock levels to be maintained at economic levels and ensure that valuable stock is not "*misaid*". Too much stock will tie up capital unnecessarily, whilst too little will result in excessive downtime and repeat visits to site.

Stock levels should be periodically reviewed to ensure that levels are adjusted in the light of experience and that items with limited shelf life are identified and disposed of as required.

12.5 Storage and Identification

Spare parts must be stored in secure dry conditions to minimise deterioration and loss. Some form of storage system is essential in order that each part has unique location to ensure that parts can be easily located for issue and stock checks. Each individual part must be identifiable by part number and batch/purchase number (if applicable) to ensure that they are readily identifiable in storage, in the workshop and on site. Identification solely by comparison with the part being replaced is dangerous and could result in a component with the wrong material specification or dimension being fitted. Some parts such as hoses will have a limited shelf life and this must be taken into account in the storage system.

Spare parts can represent a considerable capital investment and should be treated as tangible business assets.

If spare parts are stocked in service vans for ready availability on site, this stock must be subject to regular audit to ensure that items are not misaid and that they are in "*as new*" condition. Care should be taken to ensure that maintenance personnel do not accumulate a personal stock of part worn components (See **12.6**).

12.6 Component Re-use and Refurbishment

There is always the temptation to store part worn components for re-use. This will be accompanied by safety risks as these components may contain hidden defects and may fail prematurely and without warning. Furthermore their source and previous utilisation can be confused or completely lost.

Refurbishment of previously-used parts must be undertaken with care, with thorough working quality management and process quality controls:

- All parts should carry a unique serial number or marking for traceability;
- The refurbishment of any parts should be undertaken to bring those parts back to the original manufacturer's specifications;
- The specification of component to be refurbished must be fully understood by the re-furbisher. This includes any subsequent changes to the original specification which may have been incorporated by the manufacturer in the light of service experience;
- Parts being considered for refurbishment must be inspected thoroughly including, where necessary, metallurgical examinations, to confirm their suitability for refurbishment and re-use;
- Where there is any doubt or uncertainty about the origin or previous utilisation of the part, for example if it might have previously taken a shock load, then the advice of the original manufacturer should be sought and suitable inspection and testing completed;
- The refurbishment must be carried out by companies with demonstrable competence in the type of work and operating robust quality management systems. An example being ISO9001;
- An audit trail of refurbishment documentation must be maintained by the crane owner.

Worn, failed and otherwise replaced parts that are to be further examined must be stored in controlled and quarantined area with full documentation. Once the decision has been to dispose of parts they should be destroyed before scrapping in a manner that precludes any repair that might make them suitable for re-use.

All other parts that become surplus after replacement should be immediately destroyed before scrapping in a similar manner.

12.7 Installation and Replacement of Spare Parts

Spare parts must always be installed in accordance with manufacturer's instructions by a competent and authorised person. If the competent person is unsure about procedure of fitting any new part, they should contact the manufacture for additional information. Instructions for the installation of spare parts are not normally given out with the supply of the parts, but are usually available from the manufacturer's service department upon request.

Special attention must be given to the replacement of parts that may be fitted to load-bearing components and pressurised components of the crane, as a dangerous occurrence could result from lack of knowledge or care.

In all cases of programmable components, installation should only be carried out by a manufacturer's field service engineer, as they will have access to all the data and equipment to ensure the component is installed and set up safely.

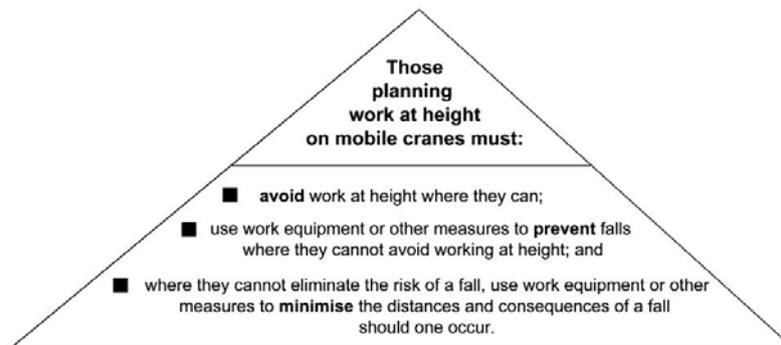
13.0 Maintenance Facilities and Equipment

13.1 Introduction

Maintenance operations on mobile cranes require adequate facilities and equipment to enable them to be carried out effectively, efficiently and safely. The size and sophistication of the facilities will depend on the degree of maintenance tasks to be carried out.

All tasks carried out during maintenance operations on mobile crane must only be undertaken following a suitable and sufficient risk assessment which identifies any control measures required to reduce risks to an acceptable level. The outcomes of the risk assessment should be used to put a safe system of work in place. This safe system of work should be documented in a method statement, which may be generic for frequently repeated tasks (See 7.4). Control measures will include the training, assessment and authorisation of all personnel required to carry out the tasks and may also include the provision of suitable Personnel Protective Equipment (PPE). If PPE is used personnel must be instructed in pre use checks, correct usage and maintenance.

Maintenance activities involving work at height must be planned and carried out in accordance with the following hierarchy.



Additional information on work at height is given in **Annex 1**.

13.2 Workshops

If maintenance and overhaul of mechanical, hydraulic and electrical components and assemblies is to be carried out successfully, an adequately sized workshop is essential. This should be weather tight with adequate heating, ventilation, lighting and lifting equipment; and provided with suitable services (power, air etc), work benches and adequate storage for tools and equipment.

If workshops are provided with pits for working under crane chassis they must be provided with adequate ventilation, edge protection and waste oil facilities.

13.3 Welfare Facilities

Suitable welfare facilities should be provided for the use of all employees and visitors. These should include:-

- Toilets;
- Washing facilities, including showers;
- Clothes storage and drying;
- Messing facilities;
- First Aid facilities and arrangements.

13.4 Washdown and Cleaning Area

A suitable area should be allocated to the washing down and cleaning of mobile cranes and components. This should be a concrete area with suitable drainage which includes interceptors to ensure that solids and oils are not discharged into the main drainage system and meet local environmental regulations. It is important that interceptors and other equipment in this area are regularly maintained and records of this kept. COSHH assessments should be carried out on any solvents, detergents etc used in this area.

Active consideration should be given to the recycling of washdown water.

13.5 Shot Blasting

If shot blasting of mobile crane components is to be undertaken at the maintenance facility adequate facilities must be provided to ensure that the requirements of noise, pollution control and COSHH regulations are not breached.

13.6 Spray painting

If spray painting of mobile crane components is to be undertaken at the maintenance facility adequate facilities must be provided to ensure that the requirements of noise, pollution control and COSHH regulations are not breached. In certain circumstances spray painting operations will require licensing by the Local Authority who should be consulted before any spray painting equipment is installed at the maintenance facility.

Spray painting activities may well fall into the scope of the *Dangerous Substances and Explosive Atmospheres Regulations 2002* (DSEAR). Further information is given in the HSE Information Document HSE 803/71 - *Guidance on the Application of DSEAR to Motor Vehicle Repair*.

13.7 Waste Disposal

Mobile crane maintenance operations may well produce various types of hazardous waste including waste oils, paint and thinners. These should be stored in appropriate containers and disposed of using a licensed waste contractor. Registration with the Environment Agency as a hazardous waste producer may also be required. Details can be found on the Environment Agency's website www.environment-agency.gov.uk.

Active consideration should be given to waste recycling.

13.8 Lubricating and Fuel Oil Pollution

Pollution of the ground and water courses from spilt or leaking lubricating and fuel oils and other risky materials is a prosecutable criminal offence which can attach up to 5 years imprisonment and/or an unlimited fine. Advice on storage, waste management, site drainage and dealing with pollution emergencies can be found on the Environment Agency's website www.environment-agency.gov.uk.

13.9 Hard Standing

In addition to covered workshops, maintenance facilities should be provided with adequate hard standing to enable mobile cranes and components to be moved, stored and handled safely. The hard standing should have adequate load bearing capacity for the loads to be imposed.

13.10 Test Area

Maintenance facilities should be provided with a suitable test area to enable mobile cranes to be tested for correct functioning. This area should be of sufficient size to enable segregation from other activities. Additional information on test site conditions, test weights etc. is given in BS 7121-2:2003.

13.11 Lifting Equipment

Maintenance facilities will require adequate lifting equipment and lifting accessories to ensure that mobile crane components can be handled safely both inside and outside the workshop. Internal craneage is often provided by the installation of an overhead travelling crane, whilst lifting outside a workshop is frequently carried out using forklifts or mobile cranes. Persons using any lifting equipment should be fully trained and assessed as competent.

It is essential that all lifting equipment and lift accessories are subject to pre-use checks, preventive maintenance, inspection and Thorough Examination.

13.12 Loading and Unloading of Components

The loading and unloading of components may involve work at height by the personnel carrying out these operations. Suitable risk assessments should be carried out to identify both the hazards and suitable control measures. Control measures may well include the provision of access gantries and loading bays with suitable edge protection.

NOTE: Further advice is given in the CPA Best Practice Guide on Work at Height Whilst Loading and Unloading Transport.

13.13 Wire Ropes

Facilities should be provided for the storage, cutting, tensioning and lubrication of wire ropes. Wire ropes should be stored and transported on suitable drums, not as loose coils and must be stored undercover in a well ventilated area. Work on wire rope should be undertaken with care using appropriate Personal Protective Equipment such as gloves and safety glasses.

NOTE: Further advice on the installation, inspection and maintenance of wire ropes is given in:

- Clause 22 of BS 7121-1:2006, Code of practice for safe use of cranes — Part 1: General;
- Clause 12 of BS 7121-2:2003, Code of practice for safe use of cranes — Part 2: Inspection, testing and examination;
- CPA Technical Information Note TIN 004 - Installing Wire Ropes on Winch Drums and Storage Reels.

13.14 Test and Measuring Equipment

Sufficient test and measuring equipment must be available to enable all testing and measurement to be carried out accurately. Such tests and measurements might include:-

- Function testing;
- Overload testing;
- Electrical testing;
- Fault diagnosis;
- Non destructive testing;
- Dimensional measurement;
- Torque measurement;
- Bearing play measurement;
- Pressure and flow measurement (hydraulic and pneumatic).

All test and measuring equipment should be marked with a unique identification number and entered on an asset register to ensure that the equipment can be monitored and tracked throughout its life. Equipment should be stored in a dry and secure location.

13.15 Calibration

All test and measuring equipment should be subjected to periodic calibration to nationally traceable standards, marked with the calibration expiry date and records kept of the calibration. The calibration interval should be set taking into account manufacturer's guidance together with the frequency and conditions of use.

13.16 Hand Tools

All hand tools should be checked and maintained by the user at regular intervals to ensure that they continue to function safely. Hand tools should also be checked at regular intervals by the supervisor.

13.17 Power Tools

Maintenance personnel should have access to adequate power tools to enable them to carry out maintenance tasks safely and efficiently. These tools should be checked and maintained at regular intervals to ensure that they continue to function safely. Electric power tools are required to be checked before each use by the user and more formally (PAT tested) at regular intervals to ensure that they remain safe. In general power tools used on construction sites should be PAT tested at a maximum of three monthly intervals, whilst those used in a workshop or permanent establishment should be tested every six to twelve months. This will include chargers and inverters for cordless tools.

NOTE: Further advice on the maintenance and testing of electrical power tools is given in HS(G) 107 - Maintaining portable and transportable electrical equipment.

13.18 Welding Facilities

Before undertaking welding on structural components, the crane manufacturer must be consulted,

Welding on structural components should only be carried out by trained competent personnel working to welding procedures approved by the mobile crane manufacturer or following a full engineering assessment by a competent engineer. Welding should be carried out in a workshop environment wherever possible and arrangements should be made to protect welders and other personnel from arc flashes and welding fumes. Where welding in a workshop environment is not possible, the environment must be controlled to ensure that drafts are avoided and temperature is controlled.

Welding equipment should be regularly checked, maintained and calibrated as appropriate. Consumables should be stored in a secure dry area.

Weld repairs should be subjected to full visual, and where appropriate NDT inspection.

NOTE: Further information is given in:-

- BS EN 287-1:2004 - Qualification test of welders. Fusion welding. Steels;
- BS EN 970:1997 - Non-destructive examination of fusion welds. Visual examination;
- BS EN ISO 15607:2003 – Specification and qualification of welding procedures for metallic materials. General rules;
- British Institute of Non-destructive Testing at <http://www.bindt.org>.

13.19 Hydraulic Presses

The maintenance of some mobile cranes requires the use of hydraulic presses. These items should be checked and maintained as with other power tools.

13.20 Job Control

It is essential that all refurbishment and repair of mobile cranes is carried out by competent personnel who are fully briefed and supplied with adequate information, equipment and facilities. Jobs should be monitored to measure progress against target

and to ensure that late delivery of spare parts, lack of resources etc. is not holding up the job.

13.21 Repair Records

It is essential that all work carried out as part of maintenance is recorded in the machine history file (See 9.3).

13.22 Maintenance Vehicles

Maintenance Personnel who are required to work on site should be provided with suitable vehicles for transport of themselves, tools, equipment and spare parts. Vehicles should have adequate carrying capacity and be fitted with racking to ensure that tools, equipment and parts can be stored securely during travelling and in the event of an impact. Racking systems should be correctly designed and fitted by an approved supplier.

Overall security of the vehicle should also be considered as the contents may well have a high value. Vehicles carrying oils, compressed gases and waste materials may need to comply with the requirements of the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2007*, depending on the type of goods and quantities carried. Vehicles should also be provided with first aid kits and fire extinguishers and their drivers trained to use them.

It should be remembered that although maintenance vehicles under 3500kg GVW are exempt from the EU Drivers Hours and Tachograph rules, anyone driving a company vehicle is “at work” and the requirements of the Working Time Regulations for rest breaks etc. apply.

13.23 Roadside Working

Working on a mobile crane at the roadside, carrying out repairs or rigging operations can be extremely hazardous with a significant risk of damage to persons and vehicles from live traffic. Such activities should be properly planned and those carrying out such work should be trained and briefed.

NOTE: Further information is given in:-

- BS 7121-12:1999, *Code of practice for safe use of cranes. Recovery vehicles and equipment.*
- PAS 43: 2008 *Safe Working of vehicle breakdown recovery and removal operations - Management system specification.* ICS 03.100.30; 43.160 Published by BSI
- *Guidance for Works on the Hard Shoulder and Road Side Verges on High Speed Dual Carriageways.* Published by the Road Workers' Safety Forum.

13.24 Tyre Maintenance

- Tyres are designed to maintain a cushion of air between the vehicle and road surface and provide the final link between the wheel and road. They must:-
- Cushion the vehicle, its load and the driver against road shocks;
- Transmit to the road surface, both traction and braking forces in all weather conditions;
- Control the vehicle by their influence upon braking, acceleration and cornering forces;
- Have a good resistance to abrasion in order to give good tyre wear;
- Have maximum resistance to impact blows.

In order for tyres to fulfil these requirements and perform safely, it is essential that the following care and maintenance procedures are employed at all times:-

13.24.1 Tyre Pressures

- Pressures should be checked weekly when the tyres are cold;
- Personnel inflating tyres should stand a minimum of 3 metres away from the tyre and outside the likely explosion trajectory to avoid injury in the event of a failure. This will require at least 3m of airline between the nozzle and airline trigger mechanism;
- Personnel should ensure that they stand to one side of the tyre facing the tread when inflating;
- Tyre valves should be checked to ensure that they are not leaking. High pressure valve caps should always be replaced.

13.24.2 Flat Tyres

- Any tyre found to be severely under inflated or deflated must be removed from the rim and checked out by an authorised dealer.

13.24.3 Visual inspection

- The tread and side walls should be checked for bulges and separation;
- The tread and side walls should be checked for cuts;
- All foreign objects caught in tread pattern should be removed;
- Tread depths should be measured as part of a routine inspection programme. The minimum legal tread depth for a wheeled mobile crane is 1mm. Any crane tyre found to be at or below this limit must be replaced or re-grooved in accordance with the manufacturer's requirements.

13.24.4 Equipment Required for Tyre Maintenance

- A compressor capable of achieving the maximum operating tyre pressure.
- An inline filter should be fitted to ensure all moisture is removed from the airline, thus preventing internal corrosion of the wheel rim and eventual sealing problems and/or loss of pressure.
- A tyre pressure gauge which is certified accurate for the purpose of maintaining the tyres at the correct pressure.

NOTE: Further information is given in:-

- ECE Regulation 54 – *Uniform provisions concerning the approval of pneumatic tyres for commercial vehicles and their trailers*. Tyres fitted to vehicles first used after 01.04.1991 must be approved to this regulation
- BS AU 159f:1997 - *Specification for repairs to tyres for motor vehicles used on the public highway*
- BS AU 144f:1988 – *Specification for retreaded car and commercial vehicle tyres*
- *The Road Vehicle (Construction and Use) Regulations 1986* (as amended)

13.25 Working Time

The Working Time Regulations limit the maximum number of hours that an employee aged 18 or over can be required work in one week to 48. However, most workers can agree in writing to work longer than the 48-hour limit. The agreement must be signed by the worker.

Working time includes travelling if part of the job, working lunches and job-related training. It does not include travelling between home and work, lunch breaks, evening classes or day-release courses.

Workers can cancel the opt-out agreement whenever they want, although they must give their employer at least seven days' notice.

The regulations also require employees to take rest breaks during the working day. It is important that breaks are taken to ensure that employees can maintain concentration and combat fatigue.

Detailed guidance the Working Time Regulations is given at:-

<http://www.businesslink.gov.uk/bdotg/action/layer?r.l1=1073858787&topicId=1073858926&r.lc=en&r.s=t>

14.0 Approaches to Thorough Examination

14.1 Introduction

The primary purpose of thorough examination is to ensure that a mobile crane is safe to be taken into, or to continue in, use. It is in addition to any inspection carried out as a part of the maintenance regime and is a statutory requirement.

Mobile cranes operate in a high risk environment in close proximity to people. These factors must be taken into account by the competent person when determining the scope and nature of the thorough examination.

NOTE: *The thorough examination is not part of the maintenance regime for the equipment but provides owners with information which could be used to determine the effectiveness of the regime. The competent person may require supplementary tests as part of thorough examination. See BS 7121-2 and BS 7121-3.*

NOTE: *The legal requirements covering thorough examination are set out in HSE publication L113 - Approved Code of Practice and Guidance to LOLER. It is essential that anyone undertaking thorough examinations of mobile cranes or the management of the thorough examination of mobile cranes obtains and familiarises themselves with this document.*

14.2 Types of Thorough Examination

There are three situations where thorough examination is required by Regulation 9 of LOLER:-

- Before being put into use for the first time, LOLER Regulation 9(1);
- Periodically whilst in service, LOLER Regulation 9(3)(a)(i)&(ii);
- After exceptional circumstances have occurred, LOLER Regulation 9(3)(a)(iv).

14.3 Initial Thorough Examination

Before being put into use for the first time a mobile crane must be thoroughly examined to ensure that it is safe to use. The only exception to this is if the crane is new and the owner has an EC Declaration of Conformity that was made not more than twelve months prior to the crane being used for the first time. In this case the Declaration of Conformity will cover the use of the crane for the first six or twelve month period.

14.4 Periodic Thorough Examination

A mobile crane must be thoroughly examined periodically to ensure that it is safe to continue in use. LOLER specifies that the maximum statutory intervals between thorough examinations are six months for mobile cranes that lift people and twelve months for mobile cranes that lift goods only.

14.5 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:-

- Mobile cranes frequently work above or near people, both personnel on site and members of the public outside the site;
- Mobile cranes will be used for lifting of persons in exceptional circumstances, including rescue, even if it is not initially planned;
- The intensity of use and the environment in which they are used;

- Following 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.

14.6 Thorough Examination After Exceptional Circumstances

If the mobile crane is subjected to exceptional circumstances it should be removed from service and subjected to a thorough examination to ensure that it is safe to be returned to service. Exceptional circumstances may include an overload, jib clash, use for particularly arduous duties, failure of a structural component or being subjected to weather in excess of design parameters.

14.7 Examination Schemes

As an alternative to the maximum intervals of twelve and six months for periodic thorough examination LOLER allows a competent person to draw up an “examination scheme” for an item of lifting equipment such as a mobile crane. This scheme must take account of the condition of the equipment, maintenance and previous thorough examination history, the environment in which it is to be used, the number of lifting operations to be carried out and the magnitude of the loads to be lifted. As a result of this detailed analysis of the equipment’s condition and use the competent person will specify the intervals at which periodic thorough examinations must be carried out. These intervals may be shorter or longer than the six or twelve month intervals and will reflect the anticipated rate of deterioration and likelihood and consequences of failure.

Examination schemes are a useful approach where lifting equipment is used in well defined circumstances and a consistent environment, such as a manufacturing plant. Lifting equipment such as mobile cranes used in the construction industry are however, used in ever changing circumstances with arduous duties and lifting over people. In addition, examination schemes require significant time to draw up, validate and administer.

Best Practice guidance suggests that the examination scheme approach is totally unsuitable and periodic thorough examinations using a defined scope should be used for all mobile cranes.

14.8 Defined Scope for Periodic Thorough Examination

Mobile cranes are sophisticated and complex machines and as such, the competent person carrying out a thorough examination should work to a defined scope of examination for each mobile crane they are required to examine.

The defined scope of examination should be drawn up in advance of the examination by a competent person and identify those parts of the mobile crane that should be thoroughly examined, together with required supplementary supporting reports and tests. The defined written scope of examination should specify the intervals at which the mobile crane (or individual parts thereof) should be thoroughly examined (within the statutory maximum periods specified by LOLER of 6 and 12 months) and, where appropriate, intervals for specific reports and tests. A non-exhaustive list of supplementary supporting reports and tests is provided in **Annex 10**

The competent person who draws up the scope of examination should be formally appointed. The competent person may be employed by the user, owner, manufacturer or some other independent party provided they have the necessary competence. The competent person could also carry out the thorough examinations, supplementary reports and tests of the mobile crane. However in practice it is likely that these will be undertaken by other competent persons who are suitably knowledgeable and trained. The defined written scope of examination should detail who, or which organisation, should undertake thorough examinations including any supporting supplementary reports and tests and the extent to which they should be witnessed.

The defined written scope of examination must take account of manufacturer's information (which may include a scope of examination), maintenance history, previous thorough examination history, the environment in which it is to be used, the number of lifting operations to be carried out and the magnitude of the loads to be lifted. As a result of this detailed analysis of the mobile crane's history and use, the competent person will specify the intervals at which periodic thorough examinations, supporting supplementary reports and tests must be carried out. These intervals should reflect the anticipated rate of deterioration and likelihood and consequences of failure.

It is likely that generic scopes of examination, supported by crane specific information, can be written for specific makes and models of mobile crane. This may need to be supplemented by the competent person carrying out the thorough examination in the light of the findings of the thorough examination.

The defined written scope of examination should be capable of being reproduced as a written copy when required; it should be secure from loss or unauthorised modification and it should be authenticated by the competent person preparing the written scope. The competent person should periodically review the defined written scope of examination to take account of changes in usage of the equipment, findings of previous thorough examinations, supporting supplementary reports and tests together with any information from maintenance activities, manufacturers or other sources.

Best Practice guidance suggests that a defined written scope of examination approach should be used for all mobile cranes with thorough examinations undertaken at defined intervals within the statutory maximum periods. Supporting supplementary reports and tests may be undertaken at longer intervals at the discretion of the competent person.

It is essential that the defined scope of examination includes all components that may be used with the crane in different configurations, such as luffing jibs, strut jib sections and counterweights, together with any dedicated fixings or lifting accessories.

An example of a typical defined written scope of examination is shown in **Annex 3**.

14.9 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. 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 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 may have a deteriorating effect on the crane structure over time;
- Most structural failures are the result of fatigue and such defects will not be highlighted by an overload test;
- Fatigue cracking should be identified during thorough examination;
- If a crane fails during testing it could be dangerous and will certainly be expensive;
- Inspection bodies such as the engineering insurers 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 written scope of examination approach is used four yearly overload testing is **not** required unless deemed necessary by the competent person.

14.10 Mobile Crane Users Responsibilities for Thorough Examination

Regulation 9 of the *Lifting Operations and Lifting Equipment Regulations 1998 (LOLER)* requires employers to ensure that mobile cranes have a current report of thorough examination before the crane is used. (See **14.2**). In the case of a hired-in mobile crane the actual undertaking of thorough examinations is often delegated to the crane owner by the user. The user however, retains the legal responsibility for ensuring that thorough examinations are carried out.

15.0 Management of Thorough Examination

15.1 Introduction

LOLER permits thorough examination to be carried out by competent persons from third party in-service inspection organizations or by “in-house” examiners. All competent persons are required to have *“such appropriate practical and theoretical knowledge and experience of the lifting equipment to be thoroughly examined as will enable them to detect defects or weaknesses and to assess their importance in relation to the safety and continued use of the lifting equipment.”* It is also *“essential that the competent person is sufficiently independent and impartial to allow objective decisions to be made.”*

15.2 Use of a Third Party Inspection Body

Many third party inspection bodies who carry out thorough examinations of mobile cranes, such as full members of the Safety Assessment Federation, will hold accreditation to ISO 17020.

In order to satisfy such accreditation requirements the following must be included:-

- Verification of an organisation’s independence for the function of inspection/thorough examination. (There should be no conflict of interest between the inspection function and activities such as potential sales of cranes, design, supply of parts, maintenance or repair See 15.4);
- Identification and stipulation of the limiting scope of activity for the organisation (i.e. defining the inspection competencies of the organisation);
- Sufficiently documented processes and procedures (Procedural, Quality and Health & Safety) supporting the thorough examinations undertaken;
- Evidence that documentation has been periodically reviewed and relevant information provided to the competent person (e.g. defined scope of examination, processes and procedures);
- The auditing of these processes and procedures on a periodic basis, by a recognised accreditation body;
- The performance assessment, by the accreditation body, of the organisation’s in-house audit schedule and that non-conformity action has been suitably completed;
- The auditing, by the accreditation body, of the competent person’s training records;
- The auditing, by the accreditation body, of the thorough examinations carried out by competent persons;
- The auditing, by the accreditation body, of the reporting process to ensure that enforcing authority reports are issued as appropriate without fear or favour and within required timescales. This will also include report format compliance with legislative requirements;
- Adequate time is allowed for each examination

The benefit of a third party inspection body is that the competent person will, by definition, be independent from all aspects of the maintenance and operational management of the mobile crane. They may, however, not have the detailed product knowledge that an in-house competent person might possess but they will have been comprehensively trained and assessed in thorough examination techniques and will know when to ask for product specific information. They will look at a crane from a different perspective than someone regularly involved in the maintenance of that type or model of crane.

Third party inspection bodies should be selected with care, as not all bodies will have the required level of generic and specific product knowledge required for the effective thorough examination of mobile cranes.

Use of a third party body will require management input from the crane owner and user in terms of making the mobile crane available, providing details of crane configuration, maintenance carried out, preparation of the crane for thorough examination, supplementary tests and management of thorough examination reports. Both parties must also be prepared to take a crane out of service if the third party competent person carrying out a thorough examination identifies defects which immediately affect the safety of persons.

It is essential that the mobile crane owner and the competent person, or his employer, agree and periodically review, the programme and information requirements for thorough examinations, including the specific supplementary test reports that will be provided prior to each thorough examination. This is especially important when a new external provider has been appointed.

NOTE: The United Kingdom Accreditation Service (UKAS) is the sole UK body authorised by The Department for Business, Innovation and Skills (BIS) to carry out accreditation to ISO 17020.

15.3 Carrying Out Thorough Examination In-house

As noted above, LOLER permits the use of in-house competent persons. Their employer must, however, ensure that they *“have the genuine authority and independence to ensure that examinations are properly carried out and that the necessary recommendations arising from them are made without fear or favour.”* This can only be demonstrated by means of a clearly defined autonomous management structure with built in checks and balances to ensure that the necessary degree of independence is achieved. One means of demonstrating this is accreditation to ISO 17020.

15.4 In-house Thorough Examination Management Structure

If thorough examination of mobile cranes is being undertaken in-house an effective management structure should be put in place to ensure that everyone involved in the activity is aware of their responsibilities, properly briefed on their duties and that systems are in place to demonstrate independence and enable effective feedback including the monitoring of thorough examination. A sample structure is shown in **Fig. 3**.

A number of measures can be taken which will help establish the independence of the competent persons:-

- A fully documented, detailed and independently audited quality system such as ISO 9001;
- The thorough examination function reporting straight to the Managing Director or equivalent;
- An undertaking that the competent person will never examine their own maintenance work, be involved in the operational management of the mobile crane or be involved in any other conflicting activities;
- A statement that in the case of any conflict, the Managing Director will always back the competent person against commercial pressures from other parts of the organisation;
- The competent person has the authority to stop the operation of any mobile crane owned or operated by the company;
- The competent person has the authority to send reports of examination where there is an imminent danger of serious personal injury to the enforcing authority (HSE or Local Authority);
- The pay and rewards of competent persons should not depend on the number of thorough examinations completed in a given period or the findings of those examinations.

From this it is also clear that in-service thorough examinations, where a member of the maintenance team examines his own work would not have the required degree of

independence. Members of the maintenance team may undertake supplementary inspections, tests and reports requested by the competent person.

15.5 Auditing of In-house Thorough Examination Management Systems

Once an in-house thorough examination system has been established it is important that it is regularly audited to ensure that the system is being adhered to and that it is functioning correctly. Auditing should be carried out by an auditor from outside the thorough examination department with a sufficient degree of independence.

If a business has a formal quality management system such as an ISO 9001 accredited system the thorough examination activity should be integrated into that system and the scheduled audits.

Strong consideration should also be given to obtaining UKAS accreditation to ISO 17020 as an in-service inspection body.

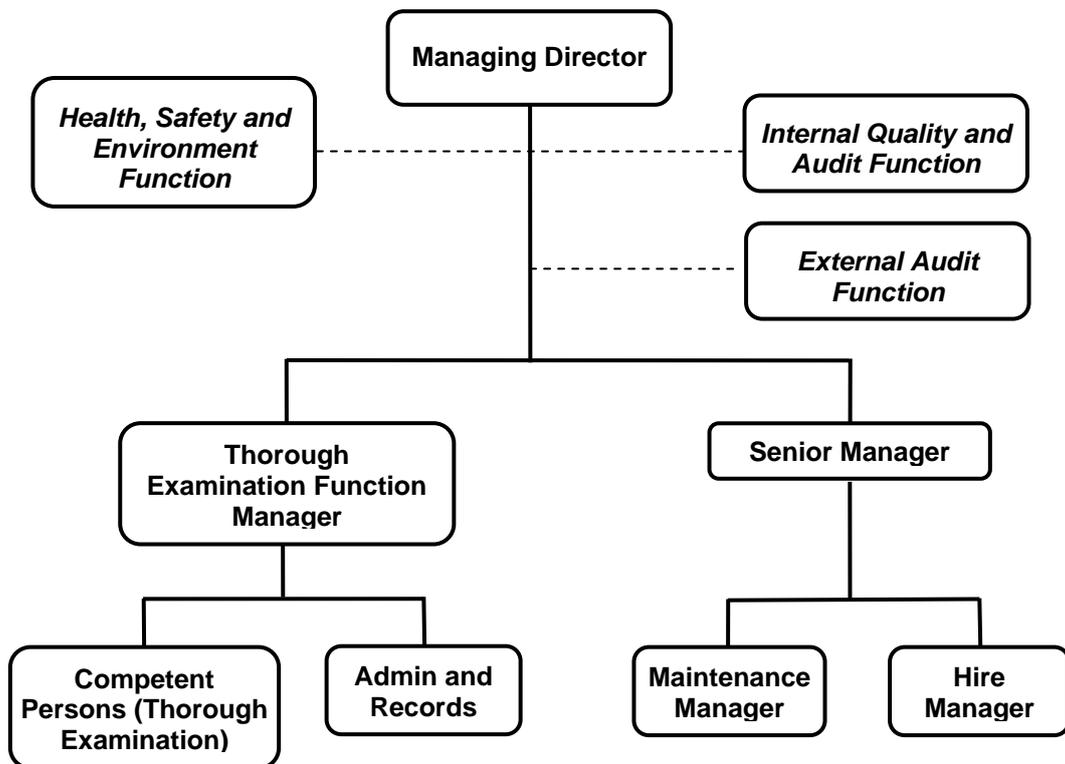


Figure 3. – Typical In-house Thorough Examination Organisation Structure

16.0 Competent Persons – Attributes, Training and Assessment

16.1 Introduction

It is essential that the thorough examination of mobile cranes is always carried out by persons who have been assessed as competent and have adequate training, information and independence to carry out the work required.

16.2 Attributes

Competent persons carrying out the thorough examination of mobile cranes should have the following attributes:

Personal Attributes

- Be physically fit;
- Be comfortable working at height;
- Have a responsible attitude;
- Be able to communicate clearly with other personnel on site;
- Be familiar with working on construction sites and site specific safety requirements;
- Be aware of their responsibilities under the Health and Safety at Work Act and supporting regulations;
- Be trained in the use, pre-use checks and maintenance of their personal protective equipment and capable of using it correctly.

Knowledge Base

- Have an understanding of the legislative requirements for thorough examination;
- Have an understanding of the mobile crane design Standards and codes of practice for the selection and use of mobile cranes, together with the applicable inspection/examination criteria;
- Have an understanding of the safety rules and associated codes of practice that are applicable to mobile cranes;
- Have an understanding of the inspection and maintenance requirements of mobile cranes;
- Have knowledge of appropriate test procedures which may be employed and the interpretation and limitations of those techniques;
- Have an understanding of drawings and manufacturing literature relevant to the mobile cranes to be inspected or examined;
- Have knowledge of the materials and techniques used in the manufacture and assembly of the mobile cranes;
- Be aware of their own limitations.

Practical Skills

- Be capable of detecting defects or weaknesses in mobile cranes which could compromise the safety of the mobile crane;
- Have sufficient knowledge and experience to assess the importance of defects or weaknesses in the mobile crane and identifying what actions need to be taken in order to rectify them. In particular they should be able to:-
 - verify that the mobile crane is operating as intended;
 - specify the appropriate time-scales within which identified defects or weaknesses need to be rectified;
 - establish that defects identified in the previous report of thorough examination have received attention;

- assess the correct function of all safety devices;
- check that warning notices are correctly fixed and legible; and where necessary specify any limitations on the use of the mobile crane;
- witness any testing required as part of thorough examination;
- report on the findings of the thorough examination.

16.3 Qualifications and Experience

Competent persons should have both appropriate recognised formal qualifications and a relevant level of practical experience in a related engineering field.

The following are examples of those with the cumulative attributes necessary to support competence:

- Engineering Technician as defined by the Engineering Council or equivalent (e.g. appropriate HNC with relevant experience) having a minimum of 5 years experience within a relevant discipline of which at least one year shall have been spent working within an engineering discipline related to lifting equipment;
- Person trained in a relevant engineering discipline with a recognised and documented engineering apprenticeship (in lieu of an academic qualification) with a minimum of 5 years experience within a relevant discipline of which at least one year shall have been spent working within an engineering discipline related to lifting equipment;
- Level 4 (Engineer Surveyor National Vocational Qualifications (NVQ) are available for competent persons carrying out thorough examination of mobile cranes.

Employers must determine competence of each individual person, both existing employees and new entrants, based on the attributes listed above together with formal qualifications. A shortfall on attainment level does not preclude employment in this role but such shortfalls must be addressed before the person is allowed to carry out unsupervised thorough examinations of mobile cranes.

16.4 Competent Person Selection

Competent persons should be selected through a formally documented assessment process.

The purpose of the assessment, which must include a sufficiently robust technical interview and other elements, is to determine whether or not the interviewee has the general aptitude and appropriate level of relevant underpinning knowledge and understanding to perform the intended duties of a competent person when combined with the training provided by the employer.

16.5 Training Plan

An individual training plan should be drawn up for each person who is to carry out the thorough examination of mobile cranes. Achievement of this plan and continuing professional development should be monitored at frequent intervals as part of the management review process (See Section 19) and included in the quality system (e.g. ISO 9000) auditing process.

16.6 Training Courses

Training courses covering both the management and practice of thorough examinations are available from training organisations such as the National Construction College at:- <http://www.cskills.org/supportbusiness/ncc/index.aspx/ncc/index.aspx>

16.7 Technical Product Awareness

Before carrying out the thorough examination of a specific make and model of mobile crane all personnel should receive technical information from the crane manufacturer or the employer. This may be carried out in-house by a trainer who has received model specific technical training directly from the manufacturer.

16.8 Assessment

It is important that all competent persons are assessed on appointment, within 12 months and at regular intervals (not exceeding four years) thereafter. Assessment should form part of any training.

16.9 Continuing Professional Development

Continuing Professional Development (CPD) is the conscious updating of professional knowledge and the improvement of a competent person's competency throughout their working life. This is a joint responsibility between the competent person and their employer.

The competent person's employer should maintain a training, experience and development record for each competent person. The record should include details of how CPD is being achieved and should include for example:-

- Initial training towards achievement of competency;
- Specific training towards enhancements/additions to competency;
- Familiarisation/re-familiarisation, coaching and training;
- Any alterations and/or withdrawals of competency;
- Enhancements to qualifications;
- Membership of professional bodies/institutions;
- Attendance at seminars and any refresher training courses;
- Visits to manufacturers and trade shows.

16.10 Training Records

A comprehensive individual training record should be established for all personnel carrying out thorough examinations. This should be updated as training is undertaken and as a minimum should include:

- When the training, refresher training, assessment or reassessment took place;
- Where the training took place;
- The scope of the training including types and models of mobile crane;
- The duration of the training;
- The outcome of the training;
- Who delivered the training;
- When refresher training is required.

17.0 Developing the Defined Scope of Thorough Examination

17.1 Introduction

It is important that a defined scope of thorough examination is drawn up before a thorough examination is undertaken on a mobile crane. This should cover at least the following:-

- What is to be looked at;
- How often;
- Examination methods to be employed including special tools, equipment or procedures;
- Details of any supplementary reports and tests;
- Anticipated duration.

The defined scope of thorough examination for an individual crane will comprise of generic elements applicable to most cranes, supplemented by crane specific elements derived from consideration of information including:-

- Crane specific details
- Maintenance and repair data
- Manufacturer's information (alerts and technical bulletins)
- In-service history
- Proposed future use

This process is shown in **Figure 4**. below.

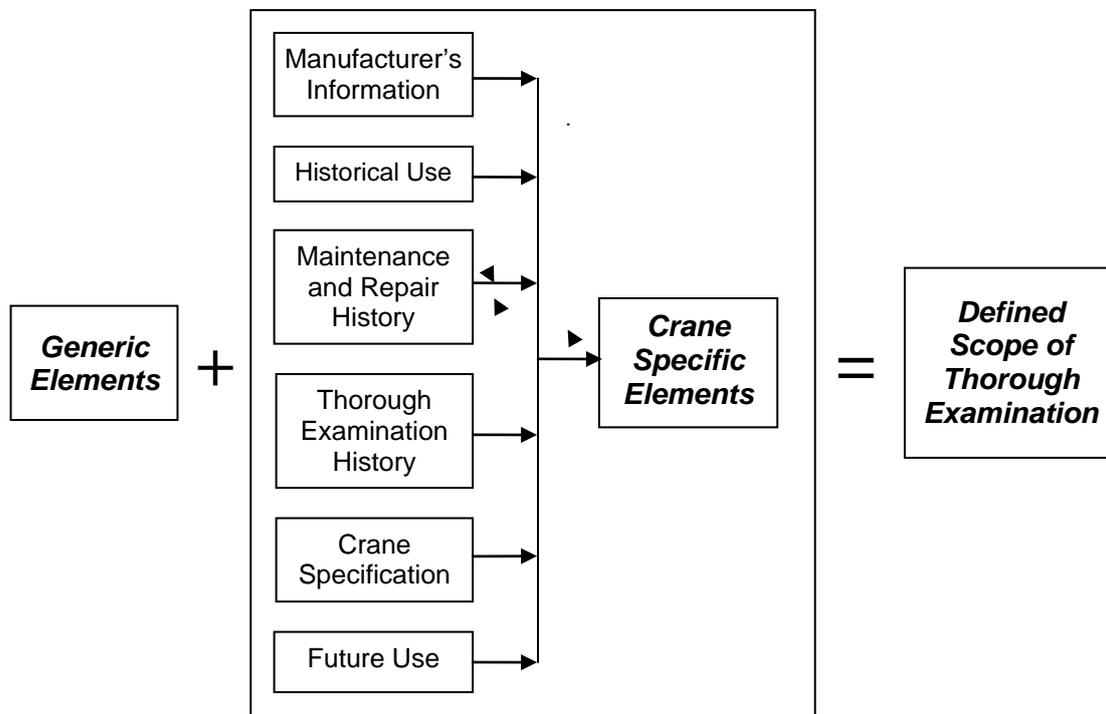


Figure 4 – Elements of a Defined Scope of Thorough Examination

17.2 Compiling the Defined Scope of Examination

The generic elements of the defined scope of examination should be drawn up by a competent person within the inspection body. This document should be authorised by the competent person and periodically reviewed for continued relevance.

The supplementary elements for the specific crane to be examined should be defined in advance of the examination by a competent person within the inspection body.

These elements should be verified for relevance to the crane being examined and amended as necessary, by the competent person carrying out the thorough examination before starting the examination.

It is essential that the defined scope of examination includes all components that may be used with the crane in different configurations, such as luffing jibs, strut jib sections and counterweights, together with any dedicated fixings or lifting accessories.

17.3 Information

The wide variation of designs and the increasing complexity of mobile crane technology make it essential that all competent persons carrying out thorough examination are supplied with adequate information to enable them to carry out their duties effectively and safely. Information comes in various forms and from several sources.

17.3.1 Manufacturer's Information

Information supplied by the mobile crane manufacturer or another competent source will be the main source of instructions and specifications when carrying out thorough examination. The primary document will be the maintenance manual for the specific crane model (and in some cases serial number), supplemented by technical information bulletins.

Care should be taken to ensure that the information is up to date and relevant to the crane on which the thorough examination is being carried out.

Manufacturer's manuals are not always complete and in the case where particular information is not covered, the crane owner or manufacturer must be contacted for information **BEFORE** the thorough examination is undertaken. Manuals may not always contain an appropriate maintenance regime for older cranes, in which case the specific advice of the manufacturer should be sought.

When purchasing a second hand crane care should be taken to ensure that any manuals supplied with the crane are appropriate for the specific model of crane.

Some mobile crane manuals and other information are available to download from the manufacturer's web site.

17.3.2 In-House Technical Information

Some mobile crane owners will have their own technical information dealing with specific issues relating to the cranes in their fleet. This can be a useful source of information for thorough examination personnel but care should be taken to ensure that circulation is controlled to ensure that information is current and that outdated data has been withdrawn.

17.3.3 Generic Information

Competent persons may also need to refer to generic information such as standards and industry guidance. Examples of these are BS ISO 4309:2004, *Cranes. Wire ropes. Care, maintenance, installation, examination and discard*, and wire rope manufacturer's guidance.

Care should be taken to ensure that the information is up to date.

17.3.4 Machine History

The history of the repairs and maintenance carried out on a mobile crane is essential to a competent person carrying out a thorough examination. Details of any structural repairs, welding and any non-routine maintenance must be presented to the competent person at the time of the next thorough examination.

17.3.5 Supplementary Reports and Tests

The purpose of the supplementary tests is to support the thorough examination in order to establish the equipment's suitability for continued safe use. These supplementary tests may be specified by the competent person and can cover a wide range of techniques, not just overload testing. They will need to be undertaken, completed by the date specified and documented, in order to enable the subsequent thorough examination to be completed. Failure to complete the supplementary tests may preclude the completion of the subsequent thorough examination. In some circumstances the competent person may wish to witness the 'supplementary tests'.

The results of any tests not witnessed by the competent person should be forwarded to the competent person, for review, without delay

Supplementary tests and corresponding reports on mobile cranes may include:-

- Anemometer calibration and functional test;
- ATEX equipment (spark arrestor);
- Boom extension system;
- Electrical/electronic control system;
- Hoist brake test and examination;
- Hoist/luffing winch;
- Hook blocks;
- Hydraulic system;
- Load test following major repair;
- Maintenance records;
- Non Destructive Examination of individual components;
- RCI/RCL calibration and functional test;
- Sheaves;
- Slew brake;
- Slew ring condition and clearances;
- Stowage for transport;
- Wire ropes.

Additional information on supplementary tests is given in **Annex 10**.

In practice the mobile crane owner and the competent person may wish to agree and periodically review the specific supplementary test reports that will be provided prior to each thorough examination. These should at least include functional test and confirmation of calibration of RCI/RCL and hoist brake test. Additional supplementary tests will be requested by the competent person as circumstances demand.

17.3.6 Previous Reports of Thorough Examination and Supplementary Tests

Where a mobile crane has been previously examined, the reports of the most recent thorough examination and any supplementary tests carried out should be made available to the competent person before they carry out the current thorough examination. Best practice guidance is that all reports of thorough examination are kept for the life of the mobile crane.

17.3.7 Information on Clearance of Defects

Where a previous thorough examination report has identified defects requiring rectification, evidence of clearance of those defects should be made available to the competent person before they carry out the current thorough examination.

17.3.8 Information Formats

Paper information, such as that found in manuals and bulletins, is rapidly being replaced by electronic formats such as CD-ROM and website downloads. This has the advantage that physical storage space is kept to a minimum and information should be up to date at the point of access. However the use of electronic devices during thorough examination is not always easy or practical. Information may therefore have to be printed out for use on site, in which case care should be taken that for any subsequent use the data is current and relevant.

Facilities should be available on site to print any document required by the competent person. Any print out should be marked "uncontrolled".

17.3.9 Management of Information

Information should be managed effectively if it is to be of maximum benefit to those involved in the thorough examination process. Outdated information can at best waste time and at worst may well affect safety. It is therefore essential that organisations carrying out thorough examination of mobile cranes ensure that they have robust systems and procedures to ensure that personnel are supplied with adequate information that is both up to date and accurate. The crane manufacturer should be consulted to ensure that information is current.

18.0 Reports of Thorough Examination

18.1 Introduction

LOLER requires that the competent person carrying out a thorough examination of a mobile crane makes a report of that thorough examination in writing to the employer for whom the thorough examination is being carried out and to the person from whom the crane has been hired. In the case of mobile cranes this is often the same person.

The report must be authenticated by the competent person, or on his behalf, and must contain the information specified in Schedule 1 to LOLER.

On completion of the thorough examination the competent person should also make a verbal report to employer for whom the thorough examination is being carried out. This is particularly important where a defect is discovered which is or could become a danger to person.

18.2 Categorisation of Defects

Where defects are found during the thorough examination of a mobile crane the competent person will make a judgement on the severity of the defect and its potential to affect the safety of persons. To assist this process defects are divided into three categories:-

- Defects that are or could become a danger to persons;
- Defects affecting the safety of persons that are to be remedied within a specified period of time;
- Observations/recommendations which may require planning for resolution and may be outside the strict scope of the thorough examination.

18.3 Required Level of Detail

Defects should be reported in a sufficient level of detail to enable the crane owner to identify the exact location and nature of the defects, and decide on a course of appropriate action to rectify those defects. Reports should be clear and readily understood by crane users. The use of abbreviations should be avoided.

18.4 Distribution of Reports

Generally mobile crane thorough examinations are carried out on behalf of, or by, the mobile crane owner. The thorough examination report is therefore sent to the crane owner who should then immediately send a copy to the mobile crane user as the user has a duty to ensure that the crane is safe to use.

18.5 Report Completion Timescale

Where defects are found during a thorough examination which are or could become a danger to persons then the competent person must inform both the user and the owner, so that the crane can either be prevented from being put into service or is taken out of service until the defects have been satisfactorily rectified. This is often accomplished by leaving an interim, hand written, report on site and making contact with the crane owner. In the case of an in-house competent person they will often have the authority to take the crane out of service immediately.

Where the competent person identifies defects which need to be made good within a specified time scale and could become a danger to persons, they should submit the report promptly to allow the mobile crane owner to take the necessary action within the required period.

In normal circumstances, the competent person should complete the report of thorough examination and forward it within a maximum of 28 days.

18.6 *Inclusion of Cleared Defects*

On occasions the competent person carrying out the thorough examination will be accompanied by the mobile crane owner's maintenance personnel and as defects are discovered they may be immediately rectified. In this case all defects **MUST** be reported even if they have been cleared. Failure to report defects is contrary to the requirements of LOLER, will give a false picture of the condition of the crane and invalidate both the machine history and the review process.

18.7 *Notification to the Enforcing Authority*

Where, in the opinion of the competent person, the thorough examination identifies a serious defect in the mobile crane which involves an existing or imminent risk of serious personal injury arising from failure of the crane which may occur at the next use or a short time thereafter, the competent person must send a copy of the report to the local office of the relevant enforcing authority. In most cases this will be the local office of the Health and Safety Executive.

19.0 Management Review of Thorough Examination Records

19.1 Introduction

A regular management review of mobile crane thorough examination records is essential for the safe and efficient operation of a mobile crane fleet. It ensures that management can be confident that robust maintenance and thorough examination systems are in place and will rapidly highlight any shortcomings and the need for corrective action. It may be beneficial to include competent persons or the employer of third party competent persons in this process.

19.2 Benefits

The benefits of regular management review of thorough examination records are:-

- Confidence that the system is functioning correctly;
- Identification of extraordinary defects, events and failures;
- Ensuring that there is evidence of adequate maintenance and thorough examination to the Enforcing Authorities in the event of an incident and a subsequent investigation;
- Establishing trends over time and informing the review of the examination frequency;
- Feedback to the maintenance activity;
- Identification of component failure trends for feedback to the manufacturer;
- Highlighting on-site thorough examination access problems for feedback to the manufacturer to improve future designs;
- Monitoring the performance of individual cranes over time to provide information on future purchases;
- Ensuring that defects are rectified in a timely manner.

19.3 Review Frequency

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.

19.4 Review Methodology

The review should aim to identify exceptional events such as occurrences of heavy expenditure and reoccurring faults. It should also measure achievement of maintenance activities against target. An example of the use of such Key Performance Indicators is given in **Annex 9**.

19.5 Review Records

It is essential that written records of the management review are made, both as evidence that the reviews have been undertaken and to evaluate long term trends.

20.0 Practical Issues for Thorough Examination in a Depot

20.1 Introduction

When a thorough examination of a mobile crane is to be carried out in the owner's depot or other off site premises it is essential that there is effective liaison between the competent person carrying out the thorough examination and the person in charge of the premises. Before starting the thorough examination both parties must recognise each others requirements and agree the method by which these requirements will be met.

The person in charge of the premises must make the competent person aware of any site specific hazards and arrange for the provision of the facilities required by the competent person.

20.2 Lines of Communication

Those planning and carrying out the thorough examination of mobile cranes on site must ensure that they have effective lines of communication with the site for initial, periodic and exceptional thorough examinations including preparation. This will avoid much frustration and misunderstanding on both sides.

20.3 Availability of Operators

Thorough examination will require the crane to be operated from the control cab whilst the competent person is examining other parts of the crane. Arrangements must be made to ensure that a trained and competent operator is available on such occasions.

20.4 Availability of Maintenance Staff

If the competent person carrying out the thorough examination requires the removal of covers and guards to facilitate the through examination of concealed parts, the owner of the crane should ensure that suitable personnel are available.

20.5 Thorough Examination Area

The area in which the thorough examination is being carried out should be of adequate size and cordoned off to prevent access by persons not directly involved in the examination.

20.6 Test Area

Careful consideration should be given to the condition of any area where tests are to be conducted. The recommendations provided in the operating instructions for the crane relate to operations within the rated capacity and more stringent requirements apply when loads are being applied for the purpose of testing.

The ground should be level, well consolidated and capable of withstanding the loads applied to it. There should be no hidden dangers such as cable ducts, drains, pipes, back-filled areas, cellars or other subterranean weaknesses. Cranes should not be tested in the vicinity of overhead power lines.

The test site should be of sufficient size with unrestricted overhead clearance to allow the unobstructed movement of the crane and load throughout its test movement, for example slewing, derricking and travelling.

It is preferable that tests are not conducted over high risk areas, for example a public highway, railway, occupied buildings, or in the flight path of airports. If due to the requirements of usage this is unavoidable, arrangements should be made with the appropriate authorities.

If load testing is being carried out it must be borne in mind that the crane might not withstand the loading. All personnel not essential to the test should be kept away from the area. The test area should be cordoned off and notices posted prohibiting

unauthorized entry. The site adjacent to the test area should be clear of plant and property which could inhibit the test.

20.7 Availability of Facilities

Arrangements should be made to ensure that management, safety and welfare facilities are available to the competent person and any personnel assisting them both within and outside normal working hours. Facilities should include office space for the review of documentation.

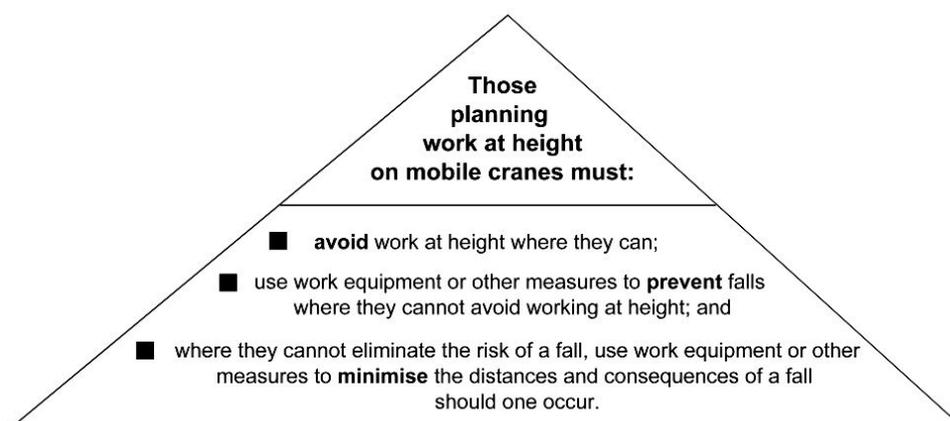
20.8 Lone Working

Lone working should be avoided at all times by suitable liaison with the person in control of the premises to ensure that site personnel are always in attendance.

The planning process for work at height on mobile cranes should take into account the particular hazards of lone working and thorough examination at height by lone workers should not be undertaken.

20.9 Work at Height

Some thorough examination activities on erected mobile cranes may require competent persons to work at height outside edge protected areas on the mobile crane structure. The Work at Height Regulations 2005 set out a hierarchy of fall protection measures to be taken when planning work at height.



This means that those planning work at height on mobile cranes should:-

- Avoid work at height wherever possible and actively seek solutions to facilitate this;
- If this is not possible, use “collective” means of protection such as guardrails;
- If this is not possible, use “personal” means of prevention such as work restraint;
- If this is not possible, use a personal fall protection system such as a work positioning system or fall arrest system;
- Additionally provide training and instruction or take other measures to prevent any person falling a distance liable to cause personal injury.

Where a risk assessment indicates that a personal fall protection system is required a work positioning system should always be used in preference to a fall arrest system. Where the use of fall arrest personal fall protection systems are unavoidable there will be a risk of the wearer being left suspended following a fall and arrangements must be made to ensure that they can be rescued in a safe and timely manner (See **Annex 1**).

Where work is being carried out on mobile tower cranes suitable and sufficient arrangements must be put in place for the rescue of personnel from height. This matter is

dealt with in the CPA Technical Information Note TIN 013 - *Rescue of Personnel from height on Tower Cranes*, which may be downloaded from the CPA web site.

20.10 Isolation of Systems During Thorough Examination

To avoid the risk of trapping, crushing, shearing or electrocution during the thorough examination of mechanisms on mobile cranes, all systems should be provided with a means of isolation. Where power is required to a system during examination, a safe system of work should be put in place to mitigate the risks of trapping. Such a safe system of work may well involve a “permit to work” and adequate communication between the crane operator and other members of the thorough examination team.

20.11 Communication Equipment

Personnel carrying out thorough examinations should be provided with an adequate means of communication, often hand held portable radios, to ensure that all members of the thorough examination team can communicate effectively with each other, the mobile crane operator and personnel on the ground.

NOTE: *Additional advice on radio communications is given in the CPA Technical Information Note TIN 017 - Radio Communication for Lifting Operations.*

21.0 Practical Issues for Thorough Examination on Site

21.1 Introduction

The thorough examination of mobile cranes is most effective when carried out in a workshop or depot yard.

Carrying out a thorough examination of a mobile crane away from a depot presents a particular set of issues when compared with carrying out a thorough examination in a workshop or depot yard. These issues are best addressed at the planning stage before the crane arrives on site and is taken into use. The effective thorough examination of mobile cranes on site will require the cooperation of the user and an example of a document informing users of the issues they should consider when a thorough examination is being undertaken is given at **Annex 4**.

21.2 Downtime During Thorough Examination

The main purpose for a mobile crane being on site is to carry out lifting operations as part of the construction process. Site managers are understandably reluctant to stop the crane whilst a thorough examination is carried out. If thorough examination downtime is not scheduled into the construction programme it is pushed to the back of the queue and may end up being carried out hurriedly in unsafe conditions such as poor light.

It is therefore essential that mobile crane owners make clear to those hiring their cranes that thorough examination is the user's legal obligation and that adequate downtime must be built into the site programme. Hirers must be informed at the planning stage of the frequency of thorough examination and probable time required. In certain circumstances it may be of benefit to substitute another crane to allow thorough examination to be carried out off site.

Construction projects in built up areas often have environmental restrictions imposed on them which severely limit working time and such restrictions must be taken into account when planning thorough examinations.

21.3 Site Inductions

Competent persons should have undertaken suitable and sufficient health and safety training applicable to their activity before arriving on site. Such training should be sanctioned by an appropriate industry body for the work function being carried out. (e.g. SAFed Safety Passport for Engineers undertaking thorough examinations). To supplement their trade specific health and safety training, visiting personnel must attend an appropriate site specific safety induction focused on the specific hazards that may be present in the vicinity of the intended work,

The induction must be of sufficient length to cover the relevant risks, however it is anticipated that it would normally take 20 – 30 min, and where necessary be specifically prepared by the Principal Contractor in control of the site. The time of the induction should be agreed in advance. The induction should be given by the Principal Contractor's nominated personnel who will oversee the thorough examination activity. This will help build relationships and a joint understanding.

21.4 Lines of Communication

Those planning and carrying out the thorough examination of mobile cranes on site must ensure that they have effective lines of communication with the site for initial, periodic and exceptional thorough examinations including preparation. This will avoid much frustration and misunderstanding on both sides.

21.5 Availability of Operators

To assist the competent person in carrying out the thorough examination of certain parts of the crane an operator is required to actuate the cab controls. Arrangements must be made to ensure that a trained and competent operator is available on such occasions.

21.6 Availability of Maintenance Staff

If the competent person carrying out the thorough examination requires the removal of covers and guards to facilitate the through examination of concealed parts, the owner of the crane should ensure that suitable personnel are available.

21.7 Thorough Examination Area

The area in which the thorough examination is being carried out should be of adequate size and cordoned off to prevent access by persons not directly involved in the examination.

21.8 Test Area

Careful consideration should be given to the condition of any area where tests are to be conducted. The recommendations provided in the operating instructions for the crane relate to operations within the rated capacity and more stringent requirements apply when loads are being applied for the purpose of testing.

The ground should be level, well consolidated and capable of withstanding the loads applied to it. There should be no hidden dangers such as cable ducts, drains, pipes, back-filled areas, cellars or other subterranean weaknesses. Cranes should not be tested in the vicinity of overhead power lines.

The test site should be of sufficient size with unrestricted overhead clearance to allow the unobstructed movement of the crane and load throughout its test movement, for example slewing, derricking and travelling.

It is preferable that tests are not conducted over high risk areas, for example a public highway, railway, occupied buildings or in the flight path of airports. If due to the requirements of usage this is unavoidable, arrangements should be made with the appropriate authorities.

If load testing is being carried it must be borne in mind that the crane might not withstand the loading. All personnel not essential to the test should be kept away from the area. The test area should be cordoned off and notices posted prohibiting unauthorized entry. The site adjacent to the test area should be clear of plant and property which could inhibit the test.

21.9 Availability of Site Facilities

Arrangements should be made to ensure that site management, safety and welfare facilities are available to the competent person and any personnel assisting them both within and outside normal working hours. Facilities should include office space for the review of documentation.

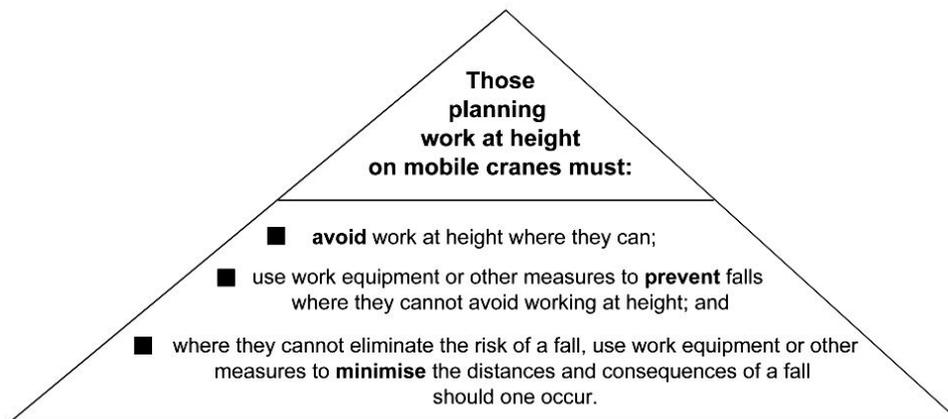
21.10 Lone Working

Lone working should be avoided at all times by suitable liaison with the person in control of the site to ensure that site personnel are always in attendance.

The planning process for work at height on mobile cranes should take into account the particular hazards of lone working and thorough examination at height by lone workers should not be undertaken.

21.11 Work at Height

Some thorough examination activities on erected mobile cranes may require competent persons to work at height outside edge protected areas on the mobile crane structure. The Work at Height Regulations 2005 set out a hierarchy of fall protection measures to be taken when planning work at height.



This means that those planning work at height on mobile cranes should:-

- Avoid work at height wherever possible and actively seek solutions to facilitate this;
- If this is not possible, use “collective” means of protection such as guardrails;
- If this is not possible, use “personal” means of prevention such as work restraint;
- If this is not possible, use a personal fall protection system such as a work positioning system or fall arrest system;
- Additionally provide training and instruction or take other measures to prevent any person falling a distance liable to cause personal injury.

Where a risk assessment indicates that a personal fall protection system is required a work positioning system should always be used in preference to a fall arrest system. Where the use of fall arrest personal fall protection systems are unavoidable there will be a risk of the wearer being left suspended following a fall and arrangements must be made to ensure that they can be rescued in a safe and timely manner (See **Annex 1**).

Where work is being carried out on mobile tower cranes suitable and sufficient arrangements must be put in place for the rescue of personnel from height. This matter is dealt with in the CPA Technical Information Note TIN 013 - *Rescue of Personnel from height on Tower Cranes*, which may be downloaded from the CPA web site.

21.12 Isolation of Systems During Thorough Examination

To avoid the risk of trapping, crushing, shearing or electrocution during the thorough examination of mechanisms on mobile cranes, all systems should be provided with a means of isolation. Where power is required to a system during examination, a safe system of work should be put in place to mitigate the risks of trapping. Such a safe system of work may well involve a “permit to work” and adequate communication between the crane operator and other members of the thorough examination team.

21.13 Communication Equipment

Personnel carrying out thorough examinations should be provided with an adequate means of communication, often hand held portable radios, to ensure that all members of the thorough examination team can communicate effectively with each other, the mobile crane operator and personnel on the ground.

NOTE: Additional advice on radio communications is given in the CPA Technical Information Note TIN 017 - *Radio Communication for Lifting Operations*.

22.0 Lifting Accessories

Lifting Accessories used with mobile cranes fall into two categories:-

- Slings, shackles etc supplied with the crane and used solely for the rigging or maintenance of the crane.
- Slings, shackles etc used with the crane for attaching loads to the crane hook.

Those in the first category are considered to part of the crane's equipment and should be thoroughly examined with the crane at the appropriate interval required by LOLER (not exceeding six months if lifting persons or not exceeding twelve months if only goods are being lifted). It is best practice to tag these items to ensure that they are only used for their intended purpose.

Those in the second category are defined by LOLER as "lifting accessories" and must be thoroughly examined at intervals not exceeding six months.

Lifting points that are permanently attached to the load (e.g. welded or cast-in) are considered to be part of the load, whereas those which can be detached (e.g. screwed in or bolted on) are considered to be lifting accessories and are subject to thorough examination.

All lifting accessories should be marked with their Working Load Limit (Safe Working Load) and before each use; pre-use checks should be carried out to ensure that they are in good condition and that a current report of thorough examination is available. It is good practice to adopt a tagging system for lifting accessories to indicate if a lifting accessory has a current report of thorough examination. This will enable the person carrying out the pre-use check to immediately ascertain whether or not the equipment is "in date".

Lifting accessories carried on a mobile crane should be stored in a secure weather tight box or compartment and should be listed in a lifting accessory register (see **Annex 7**).

Annex 1 – Work at Height

A1.1.0 Introduction

On average there are five fatalities in the workplace each year due to falls from height from vehicles, including mobile cranes, with a yearly average of 775 non-fatal major injuries from the same cause. Where working at height is required as part of the rigging, use, maintenance and thorough examination of mobile cranes, it should be carried out by trained personnel, following careful planning, which includes adequate assessment of the risks involved. This document provides guidance on the issues involved.

Health and Safety legislation requires that safe systems of work are in place for all work activities. The particular references for the requirement to provide safe access, egress and a means of safe rescue are:-

- Health and Safety at Work etc. Act 1974. - Sections 2 & 3
- Work at Height Regulations 2005
- Provision and Use of Work Equipment Regulations (PUWER) 1998 – Regulation 17
- Lifting Operations and Lifting Equipment Regulations (LOLER) 1998 – Regulation 3
- Management of Health and Safety Regulations 1999 – Regulation 3
- Construction Design and Management Regulations 2007

A1.2.0 Responsibility for Planning of Work at Height and Provision of Rescue Resources

The primary duty for ensuring that work at height on a mobile crane is effectively planned and that there are adequate resources for carrying out rescue of persons from height, rests with the organization in control of the premises on which any mobile crane is sited. In the case of a construction site this will be the Principal Contractor, as defined by the *Construction (Design and Management) Regulations 2007*. The Principal Contractor has a responsibility to assess, approve the method of work and monitor that work is carried out in accordance with the method statement.

Location	Responsibility for Planning Work at Height
Construction Sites	Principal Contractor
Industrial Premises	Person in control of the site
Retail Premises	Person in control of the site
Airports, Docks and Railways	Person in control of the site
Petrochemical Plants	Person in control of the site
Domestic Premises	Sole responsibility of the crane supplier if hiring directly to a consumer.

In practice it is likely that:-

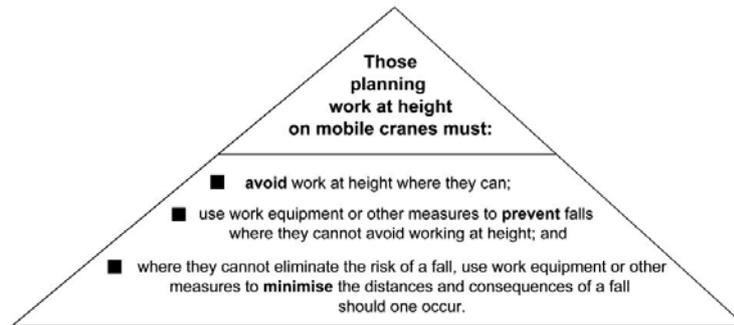
- Arrangements for work at height during rigging and de-rigging will be made by the mobile crane supplier;

- Arrangements for rescue during rigging and de-rigging, maintenance and thorough examination on site, or other activities associated with the mobile crane will be made by the person in control of the site. The mobile crane supplier should, however, also ensure that adequate arrangements are in place;
- Arrangements for work at height during use and the carrying out of daily checks by the operator will be made by the mobile crane supplier;
- Arrangements for work at height during maintenance and thorough examination will be made by the crane supplier in cooperation with the employer of the competent person (e.g. An Insurance Company);
- Arrangements for rescue during maintenance and thorough examination will be made by the crane supplier in cooperation with the employer of the competent person (e.g. An Insurance Company).

NOTE: It is vital that there is effective communication between all parties involved.

A1.3.0 Guidance for Work at Height

The Work at Height Regulations 2005 set out a hierarchy of fall protection measures to be taken when planning work at height.



This means that those planning work at height on mobile cranes should:-

- Avoid work at height wherever possible and actively seek solutions to facilitate this;
- If this is not possible, use “collective” means of protection such as guardrails;
- If this is not possible, use “personal” means of prevention such as work restraint;
- If this is not possible, use a personal fall protection system such as a work positioning system or fall arrest system;
- Additionally provide training and instruction or take other measures to prevent any person falling a distance liable to cause personal injury.

A1.3.1 *Elimination of work at height*

As a primary aim, all tasks associated with work at height on mobile cranes should be reviewed to see if they can be fully or partially completed at ground level.

Manufacturers should be encouraged to ensure that new designs of mobile crane are developed to reduce the need for work at height to a minimum. Where work at height cannot be eliminated the following hierarchy should be employed.

A1.3.2 *Collective measures*

Permanent collective fall prevention measures such as guard rails currently have a limited application on mobile crane structures. They are sometimes used on roofs of

crawler crane machinery housings and on the working platforms of some wheeled mobile cranes.

When purchasing new mobile cranes, consideration should be given to the collective measures provided by the manufacturers as part of the purchase evaluation process. Manufacturers should be strongly encouraged to incorporate collective measures into new designs of mobile crane to enable rigging, use and maintenance to be carried out safely, with a minimal need for the use of personal fall protection systems.

Other collective measures that can be employed include the use of other equipment such as access gantries, tower scaffolds and MEWPs. Care needs to be taken, particularly in the case of MEWPs where the operation should be adequately planned and operators must be adequately trained and familiarised with the specific model of MEWP to be used.

Detailed guidance on the safe use of MEWPs is given in *BS8460:2005 – Safe use of MEWPs – Code of practice*

A1.3.3 Personal Fall Prevention

Collective fall prevention is often difficult to provide when accessing mobile crane structures. Therefore some of the work will be carried out using personal fall prevention equipment. This will normally fall into one of two types:-

- Work restraint systems
- Work positioning systems

A1.3.3.1 Work restraint systems



Figure 1 - Work Restraint System

Work restraint systems are designed to prevent personnel from reaching an unprotected edge and falling. By definition they restrain the wearer by restricting movement and may be of limited value when working on the crane structure.

A1.3.3.2 Work positioning systems

Work positioning systems can provide full or partial support to personnel and prevent them from falling whilst carrying out tasks in one location. They allow the wearer to work safely with both hands. Work positioning systems used on mobile cranes should always be combined with a fall arrest system to provide protection at the location where the work

positioning system will be used. The fall arrest system will provide protection whilst the wearer is moving to and from, the location where the work positioning system will be used.



Figure 2 - Work Positioning System

A1.3.4 Collective Fall Protection

There are a number of proprietary collective fall protection systems, such as nets or airbags on the market. These should be carefully evaluated to ensure that they are appropriate and effective solutions for the particular issues associated with working at height on mobile cranes.

A1.3.5 Personal Fall Protection

If it is not possible or appropriate to use collective or personal fall prevention or collective fall protection systems, personal fall protection should be used to mitigate the effects of any fall. This will generally be the use of personal fall arrest systems



Figure 3 - Fall Arrest System

Suspension trauma can occur even if a person has only been suspended at height for a short period of time, particularly if they are motionless (See Section 9.1).

When using fall arrest systems it is important that the anchor point is as high as possible to ensure that the “fall factor” which provides an indication of the length and severity of a fall, is kept as low as possible. The “fall factor” can also be reduced by the use of a proprietary shortening device (See Figure 4).

Reducing fall factors is vital where personnel using fall arrest systems are working at low heights above the ground, as is often the case with mobile cranes. If an anchor point is level with the feet of the wearer the minimum free space required above the ground with a 1.5m energy absorbing lanyard is 5.75m, according to Table F1 of BS 8437.

Further information on “fall factors” is given in Clause 9.1.3.1 of BS 8437:2005 - *Code of practice for selection, use and maintenance of personal fall protection systems and equipment for use in the workplace.*



Figure 4 - Lanyard Shortening Device

A1.3.6 Anchor Points

All personal fall protection systems require connection to an anchor point. It is essential that all anchor points have an adequate margin of strength and stability to withstand the dynamic and static forces that could be applied to them in service. Anchor points for fall arrest systems will require a greater capacity than those for work restraint or work positioning systems. Manufacturers should be consulted on the designation of suitable & sufficient anchor points.

Single person anchor points for fall arrest systems should be designed to resist a minimum static force of 12kN. This includes a safety factor of 2 to allow for the dynamic and static forces that could be applied to them in service. If two or more users are to be connected to the same anchor the minimum static strength of the anchor should be increased to 14kN for two persons and 16kN for three person use.

Specifications for the installation and testing of anchors are given in:-
BS 7883:2005 - *Code of practice for application and use of anchor devices conforming to BS EN 795.*

Where personal fall protection systems are required, manufacturers should be encouraged to provide and designate suitable & sufficient anchor points to which lanyards etc. can be fastened. On new machine purchases the provision of anchor points should be made a condition of order and manufacturer’s advice should be sought on the availability of anchor point kits for retrofitting on existing cranes.

With all types of personal fall protection equipment it is essential that the following points are considered during planning for work at height:-

- Correct equipment for the application is selected;
- Personnel are trained and assessed as competent in the correct adjustment, use, care and recorded checking of fall protection equipment;

- Suitable anchor points on the structure are identified;
- Arrangements are made for the inspection and maintenance of the equipment.

Detailed guidance is given in BS 8437:2005 - *Code of practice for selection, use and maintenance of personal fall protection systems and equipment for use in the workplace.*

A1.3.7 Ladders

The basic configuration of mobile cranes means that it may not be possible to provide means of access to parts of the crane with collective fall protection, particularly when a crane is on site, rather than in a depot. Consequently fixed ladders (attached to the crane structure) and portable ladders are often used.

Where portable ladders are used they should be of sound construction, with a broad base and fixed to provide effective restraint against slipping. Research has shown that “footing” of ladders by a second person is of limited value. Where personnel are transferring from a ladder to the crane structure there must be sufficient projection of the ladder (at least 1m or three rungs) beyond the landing level to provide adequate handholds during transfer.



Suitable Ladder



Automatic Ladder Latch with Anchor Point

Personnel using ladders must be adequately trained in the selection, use and pre-use checking of ladders. See **Sections 11 and 13.**

Additional guidance is given in the following HSE publications:-

- INDG402 - Safe use of ladders and stepladders: An employers' guide
- INDG403 - A toolbox talk on leaning ladder and stepladder safety
- INDG405 - Top tips for ladder safety(Pocket Card)

A1.4.0 Guidance for Rescue From Height on Mobile Cranes

Typical methods and items for consideration in the planning for rescue from height on mobile cranes are as follows:-

A1.4.1 Recovery from Suspension During Rigging or De-rigging

If the work at height during rigging or de-rigging only involves low level working it may be adequate to utilise other members of the rigging team to support the suspended person. This must however be carefully evaluated at the planning stage, taking into account the potential height of the suspended person above the rescuers and the number and physique of the rescuers.

Where rescue by other members of the rigging team is not practicable other means must be employed. This could include:-

- A system provided by the Principal Contractor;
- A MEWP;
- A telehandler with a non-integrated platform;
- A crane with a man riding cage;
- A proprietary rescue system.

In planning for rescue from height, reliance should not be placed on the use of the Emergency services without first consulting those services

Suspension in a harness for a period of time (often as little as ten minutes) without moving may give rise to “suspension trauma” which leads to pooling of blood in the veins of the lower limbs. This can cause disturbance to the circulatory system leading to damage of the vital organs. When rescuing a suspended person care must be taken to avoid moving them into a horizontal position as this can cause a massive flow of venous blood to the heart, which cannot cope, and this can cause potentially fatal cardiac abnormalities.

Additional information on suspension trauma is given in Annex D of *BS 8437:2005 - Code of practice for selection, use and maintenance of personal fall protection systems and equipment for use in the workplace.*

A1.4.2 During Maintenance and Thorough Examination of the Mobile Crane

In this situation the method described in **9.1** can also be used, it does however rely on having a trained person on site at all times whilst fall arrest systems are being used.

A1.4.3 Injury or Medical Crisis

In this situation the injured person should be lowered to a suitable position where first aid can be administered in accordance with the site emergency plan.

Annex 2 - Example of a Typical Safe System of Work for Thorough Examination Activities

A2.1.0 Introduction

This safe system of work considers the hazards and risks when undertaking the examination of mobile and crawler cranes. As a necessity of examination, the plant will have to be manoeuvred to prove satisfactory function and operation. This creates added risks such as falling from plant, being trapped, crushed or struck by plant movement. The safe system is to raise awareness of the hazards and therefore reduce the risks involved, so far as is reasonably practicable.

A2.2.0 Scope

The guidance covers work associated with the examination of all types of mobile and crawler crane and lifting accessory.

A2.3.0 Legislation and other publications

A2.3.1 Legislation

- The following is a summary of relevant legislation, including:
- Health and Safety at Work Act 1974;
- The Supply of Machinery (Safety) Regulations 2008;
- Provision and Use of Work Equipment Regs (PUWER 98) 1998;
- Lifting Operations and Lifting Equipment Regulations (LOLER) 1998;
- Management of Health and Safety at Work Regulations 1999;
- Work at Height Regulations 2005 (as amended).

This list is not exhaustive and reference may need to be made to other Legislation as applicable.

A2.3.2 Other relevant guidance includes:

- Safe use of Cranes: BS 7121 Pts 1, 2 & 3;
- Safe use of ladders, step ladders & trestles, INDG 402;
- In-house procedures and instructions;
- Personal Protective Equipment.

This list is not exhaustive and reference may need to be made to other documents.

A2.4.0 Hazards

A2.4.1 Anticipating the Consequences of Actions

Many accidents occur because of a lack of planning and/or consideration of what could happen as a result of actions on site.

A2.4.2 Known Hazards

Examples of how injury can occur when undertaking the examination of mobile and crawler cranes:

- Trapping / Crushing;
- Falling;
- Being struck;

- Electrical shock.

A2.4.3 Hazard details

A1.4.3.1 Trapping and Crushing points:

There are many trapping points to consider when undertaking the examination of mobile and crawler cranes. Trapping hazards are present at following areas:

- Slewing of cranes: Trapping can occur between slew ring and its attachments (ladders, underside of jibs, counterweight attachments, etc.) and also between adjacent plant and building structure. At slew ring drive systems;
- Luffing/derricking of cranes: At rope drums and divertor sheaves (hands or clothing being caught between ropes and rope drums and divertor sheaves); in machinery housings or apex assemblies. At jib pivot and articulating points. Moving counter balance systems;
- Telescoping Jibs: At jib entry points and jib attachments;
- Hoisting/lowering of ropes: At rope drums and rope divertor sheaves, open gears and pulley systems. Rotating machinery ie. brake drums, couplings, shafts, winches, etc;
- With mobile and crawler cranes: Along travel routes - being trapped by wheels or track drives. Being trapped against plant and machinery and adjacent building or plant structures;
- Between plant and site buildings or ground in the event of plant overturning during examination.

A1.4.3.2 Falling

Generally falls can occur at any time when undertaking the examination of mobile and crawler cranes. By virtue of their construction, climbing and access to areas above ground are a necessity. The risk from falling is present when:-

- Climbing jibs, machine structures and slipping from ladders and plant structure;
- Using ladders and other means of access;
- Slipping on oil/grease on plant structure and ground, unstable or uneven ground conditions;
- Tripping over obstacles on items of plant being examined, and items at ground level on site;
- Deteriorating weather conditions. i.e. ice, rain and wind present.

A1.4.3.3 Being struck

- By moving parts of plant undergoing examination ie jib structures, slew arrangements, outrigger movement, etc;
- By load hooks and suspended loads on cranes;
- By wheels and track drives on mobile plant;
- By other plant, and mobile systems in operation at site;
- By chain slings and lifting beams and frames suspended from cranes;
- By failure of plant under examination ie. loads being dropped, failure of plant structures;
- From projections on machinery and buildings.

A1.4.3.4 Other hazards include:

- Risk of electrical shock from live equipment and poorly maintained systems; Cranes being examined striking overhead electric power lines;
- Fumes and dust from site work;
- Catch points - clothing or rings being caught on protrusions;
- Noise - from plant being examined and adjacent work processes;
- Vibration - from cranes being examined;
- Burns - hot surfaces on cranes being examined;
- Injection of hydraulic fluid under pressure into the skin.

A2.5.0 **Safe working on cranes - general**

Prior to examination of cranes:-

A2.5.1 ***Access & Egress***

The Competent Person shall make their presence known to a responsible person at the location. At the end of his visit the Competent Person shall advise that person that they are leaving the site.

A2.5.2 ***Unoccupied Premises***

Under no circumstance shall the Competent Person work alone at unoccupied premises or carry out any examination at premises where no member of the clients staff (or other responsible person) is present.

A2.5.3 ***Appropriate Clothing***

Competent Persons shall wear suitable protective clothing and equipment eg. Safety helmet, boiler suit, gloves, suitable safety boots or shoes, and safety harness. All shall be maintained in good condition and properly worn.

A2.5.4 ***Personal Protection & Safety Equipment***

Other personal protection and safety equipment shall be worn according to the site conditions and client's site safe systems of work. eg. eye protection, hearing protection, high visibility clothing, personal buoyancy equipment, and respiratory protective equipment.

A2.5.5 ***Inspection Plan***

Competent Persons shall plan the sequence of their examination prior to commencement. This is essential when undertaking the examination of mobile and crawler cranes, with regard to health and safety.

Planning should include the following:

- Suitable and satisfactory on site procedures must be in place and capable of being initiated, in the event of an accident.
- Briefing of the responsible person on site and plant driver/operator as to the sequence of examination.
- Banksman (where used) and plant driver/operator must fully understand the examination procedure and the system of hand signals to be used where applicable. All personnel must understand the emergency signals and procedures.
- Examinations of mobile plant should be away from regular site traffic and site

routes. This will reduce the risk from being struck by, and striking, other site traffic and site personnel.

- Ensure ground conditions are sound and will fully support the plant to be inspected in all examination positions, without risk of overturning due to ground instability.
- Position of plant being examined to be well away from edges of excavations, and overhead electric power lines.
- Ensure adequate clearance, and sufficient operating space, between plant being examined and adjacent fixtures to prevent trapping and crushing hazard.
- When a lifting machine with a travelling or slewing motion is used, an obstructed passageway at least 600mm (2ft) wide must be maintained between the moving parts of the machine and any nearby fixture. This standard should be applied to the inspection of all lifting machines with a travelling or slewing motion.

A2.5.6 Isolation

Where plant and machinery needs to be isolated for inspection purposes the Engineer Surveyor shall ensure power is isolated from the plant. This should consist of switching off power where required and displaying warning notices at the isolation points.

A2.5.7 Operation of Plant

Operation of cranes should be carried out by the competent operators except where it is necessary for the Competent Person to do so as part of his examination.

A1.5.7.1 Unrestricted View

The driver/operator of the crane must have a clear view of operations. Where this is not possible a banksman must be used.

A1.5.7.2 Competent Person Restrictions

Competent Persons should not drive or operate motions of plant for any other purpose than the minimum amount strictly necessary to carry out the examination.

Where it is necessary for the Competent Person to operate cranes themselves they should:

- obtain prior permission.
- take all reasonable care during the operation of the plant.
- satisfy themselves that all reasonable safety precautions have been taken.
- ensure the crane is left in a safe condition at the end of the examination.

A1.5.7.3 Client Responsibility

Under no circumstance shall a Competent Person operate any crane if they have any doubt as to their own ability to do so or the authority of the person giving them permission to do so. In all such cases the Competent Person should request the client provides a competent operator.

A2.5.8 Notification of Appropriate Authorities

If a crane is to slew over a public highway, river or railway the Competent Person should ensure that the client has notified the appropriate authority.

A2.5.9 Water Borne

With cranes on water borne craft information should be obtained regarding the amount of list and freeboard allowable under both safe working load and overload conditions, from a competent person or authority experienced in crane design and stability of craft plus how far the crane is derated from land based ratings whilst on the barge or pontoon.

A2.5.10 Environmental Conditions

Careful attention should be given to cranes operating in situations where they are likely to be affected by the weather. Certain weather conditions such as strong wind, heavy rains, ice or snow can impose loads on a crane and adversely affect the safety of crane operations. Never undertake examinations when the crane or load cannot be easily seen due to limitations on visibility or when coated with ice or snow. The crane should not be operated in wind speeds in excess of those specified in the operating instructions for the equipment.

A2.5.11 Outriggers

Cranes fitted with outriggers are not fully stable until the outriggers are set in accordance with the manufacturers instructions. When used, always ensure outriggers are fully extended to their maximum position.

A2.6.0 During examinations

A2.6.1 Safe Access

Always use a safe means of access to reach parts of the crane requiring examination above ground level, i.e. properly secured ladders or access platforms. When working above ground level a safety harness should be worn by the Competent Person where there is an identifiable risk of falling.

A2.6.2 Climbing Precautions

Keep a good foot and handhold when climbing crane structures. Watch for obstacles, protrusions, oil and grease deposits, ice and water which may cause a tripping or slipping hazard.

A2.6.3 Ladders

If long, extension or step ladders are used during the course of an examination they must be in good condition and free from defects and damage. Wooden ladders must not be painted as the paint may hide defects. Always ensure ladders are stable and securely fixed. When using long or extension ladders they must be securely fixed or supported and be on a level firm surface. They must extend at least 1 metre above the highest level to be accessed. Step ladders must be long enough to enable the Competent Person to examine the crane and have an adequate handhold. Three points of contact should always be maintained when working on ladders and two points of contact when working on stepladders.

A2.6.4 Other Hazards

Competent Persons should not position themselves close to open excavations, pits or waters edge during the course of examination.

A2.6.5 Moving Plant & Parts

When a crane is being moved during an examination the Competent Person should position themselves clear of all moving parts and have a clear view of the driver/operator. Where this is not possible a banksman should be used to relay the

Competent Person's signals to the driver/operator.

A2.6.6 *Wheels & Tracks*

Stand well clear of wheels and tracks when the crane is being moved.

A2.6.7 *Other Plant*

Be aware of other plant moving on site adjacent to the crane being examined.

A2.6.8 *Rope Inspections*

Always wear gloves when inspecting hoist ropes, etc. If it is necessary to examine ropes when they are moving ensure they are moving at slow speed and away from hoist and winch drums. Moving ropes must not be passed through the hands.

A2.6.9 *Suspended Loads*

Never stand beneath suspended loads or parts of the crane which could descend.

A2.6.10 *Buoyancy Aids*

Buoyancy aids/life jackets must be worn when undertaking examinations on waterborne cranes, situated on barges, boats or pontoons, or where adjacent to waters edge.

A2.6.11 *Trapping*

Competent Persons should always position themselves where they will not be trapped between adjacent fixed structures and the crane being examined.

A2.6.12 *Crushing*

Keep hands, arms, feet and head clear of any potential trapping or crushing points, i.e. crane pivot and articulating points, sliding and telescoping components, open rotating parts.

A2.6.13 *Pendant Controls*

When working at height on a crane, ensure that any pendant or remote controls are not within reach of anyone who could inadvertently operate the crane during examination.

A2.6.14 *Securing Ladders*

Ensure that when resting ladders against cranes, the mechanisms upon which the ladders are resting are not capable of movement (i.e. braking applied, mechanism chocked, etc), during that part of the examination.

A2.7.0 *Permit to work*

Some clients operate a "Permit to Work" system when work is required on certain cranes. The permit to work system is an extension to the safe system of work when written authorisation is required before a particular job can be started.

A2.8.0 *Summary*

The preceding sections outline the main considerations to achieve a safe system of work when undertaking examinations of mobile and crawler cranes. Physical layout and operational facilities vary considerably depending on client's premises and the crane being examined. Therefore, the safe system of work must be adapted to take into account the particular characteristics and situation of the crane being examined and the working environment in which it is operating.

Annex 3 – Example of a Defined Scope of Thorough Examination for Mobile Cranes

Generic Element

Resources		
Regulations (ACOP and Guidance)	Provision and Use of Work Equipment Regulations 1998 Lifting Operation and Lifting Equipment Regulations 1998 BS 7121 Parts 1, 2 & 3	
Documentation	Health & Safety Technical Documentation <ul style="list-style-type: none"> • Safe systems of work • Risk assessments 	
Tools	Torch Rope Gauge Vernier Calliper Mirror Hand Tools Engineers Tape/Rule Sheave Gauge Dial Test Indicator	
Requirements	Crane Location Crane Description Crane Identification Safe Working Load Crane Operator Authority/Permit to Work	

Examination Areas		
Area	Element	Requirement
Jib (Strut)	Identification Section Assembly and Identification Jib Length/RCI/RCL Match Structural Integrity Welds, Fixings and Fastenings Heel Pins/Bushes Jib Stops Back Stays and Mountings	Correct Markings Correct Markings Correct Markings Assessment of Construction Security and Assessment of Connections Wear, Cracking, Lubrication Conditions Security and Assessment of Connections
Jib (Telescopic)	Jib Length/RCI/RCL Match Radius/Load Indicator Structural Integrity Welds, Fixings and Fastenings Heel Pins/Bushes Wear Pad Jib Stops Extension Chains/Ropes/Sheaves Hydraulics:- <ul style="list-style-type: none"> • Cylinders • Retention Pins/Bushes • Pipes, Unions, Couplings • Reservoir Oil Levels 	Correct Markings, Extension Markings Correct Markings Assessment of Construction Security and Assessment of Connections Wear, Cracking, Lubrication Condition Condition Condition and Wear Wear and Leakage Wear, Cracking, Lubrication Security, Corrosion, Leakage Correct Levels
Jib (Fly)	Structural Integrity Welds, Fixings and Fastenings Pins/Bushes	Assessment of Construction Security and Assessment of Connections Wear, Cracking, Lubrication
Sheaves	Size Condition Pins/Bushes	Correct Sizes Wear, Damage Wear, Cracking, Lubrication
Ropes (Running and Static)	Condition Terminations	Damage, Broken Strands Security of Terminations
Hoist and Luffing Mechanism	Drums Clutches and Brakes Bridle Assembly	Condition Damage, Wear Condition
Hook Block	Fixings and Fastenings Hook Swivel Bearing Safety Clip Markings – SWL, ID	Security of Connections Wear, Cracking Wear, Cracking, Lubrication Security of Clip Correct Markings
Slew Mechanism	Driving Motor Mounting Gear Integrity Fixings and Fastenings Brake Condition Slew lock (travelling) Slew bearing	Assessment of Conditions Wear, Cracking, Lubrication Security of Connections Wear Function and condition Wear, lift and lubrication

Structures	Structural Integrity Welds, Fixings and Fastenings	Assessment of Construction Security of Connections
Counterweight	Counterweights Locking and handling system Markings Integrity	Security and Adequacy Function and Condition Visible and Adequate Assessment of construction
Chassis	Structural Integrity Welds, Fixings and Fastenings	Assessment of Construction Security of Connections
Outriggers	Structural Integrity Welds, Fixings and Fastenings Outrigger foot pads and spreader mats Wear Pads Markings (outrigger beam, hazard warnings etc) Hydraulics:- <ul style="list-style-type: none"> • Rams • Retention Pins/Bushes • Pipes, Unions, Couplings • Reservoir Oil Levels 	Assessment of Construction Security of Connections Condition Condition Visible and Adequate Wear and Leakage Wear, Cracking, Lubrication Security, Corrosion, Leakage Correct Levels
Running Gear (Wheeled and Tracked)	Tyres Axle Mountings Fixings and Fastenings Track Pads Track Tension Drive Sprockets Steering Drive Motor:- <ul style="list-style-type: none"> • Fixings and Fastenings • Drive Chain 	Damage, General Condition Assessment of Construction Security of Connections Condition Condition Wear, Damage Condition Security of Connections Condition
Running Gear (Road Going)	Wheels Axles, Suspension and Locks Bearings and Bushes Fixings and Fastenings	Wear, Damage Function, Wear, Cracking Wear, Lubrication Security of Connections
Super Structure	Body Panels <ul style="list-style-type: none"> • Cab • Doors • Windows • Seat Running Boards:- <ul style="list-style-type: none"> • Deck • Fixings and Fastenings STGO Plate	Condition Functional Damage Assessment of Construction Condition Security of Connections Secure and Legible

Operation	Power Unit:- <ul style="list-style-type: none"> • Guarding/Covers • Cables Controls:- <ul style="list-style-type: none"> • Markings • Function and Operation Brakes:- <ul style="list-style-type: none"> • Operation Horn Lights Windscreen Wipers	Condition Damage, Security of Connection Correct Markings Correct Functioning Correct Operation and Effectiveness Function Function and Condition Function and Condition
RCl	Condition Boom Angle Radius Boom length Load and Capacity Warnings (audible and visual) Display	Security Accuracy and Orientation Accuracy Accuracy Accuracy Function and Condition (approach and limit) Function and Condition (legibility)
RCL	Condition Operation (Test) Setting Override Switches Limiting Devices:- <ul style="list-style-type: none"> • Over hoist • Over lower 	Assessment of Construction Correct Operation and Accuracy Correct Setting Function and Condition Function and Condition Function and Condition
SWL	Load Chart Markings	Present and Correct Present, Correct and Legible
Manufacturer's Plate	CE Mark Serial Number Model Number Manufacturer	Present and Correct Present and Correct Present and Correct Present and Correct
Complete Crane	Functional and Operational Testing	Crane Functions and Operation Through Full Range

Supplementary Element

Crane Specific Requirements		
Basic Data	Crane Location Crane Description Crane Identification Safe Working Load Crane Owner Authority/Permit to Work	<i>Canal Street Depot</i> <i>Miracle XM50</i> <i>Serial No. 123456</i> <i>50 tonne</i> <i>Krafty Krane Hire</i> <i>N/A</i>
Tools	Sheave Gauge Dial Test Indicator	
Examination Areas		
<i>Area</i>	<i>Element</i>	<i>Feature</i>
Jib (Strut)	<i>N/A</i>	
Jib (Telescopic)	<i>Structural Integrity</i> <i>Wear pads</i>	<i>Use inspection diagram on page 1221 of manual</i> <i>Maximum wear 8.5 mm</i>
Jib (Fly)	<i>Structural Integrity</i>	<i>Use inspection diagram on page 1228 of manual</i>
Sheaves	<i>Upper cathead sheave</i>	<i>Bearing play on limits at last TE</i>
Ropes (Running and Static)	<i>Discard Criteria</i>	<i>23 mm dia. Lang Lay – 2 broken wires over a length of 6 diameters (138 mm) and 4 broken wires over a length of 30 diameters (690 mm)</i>
Hoist and Luffing Mechanism	<i>Hoist Winch</i>	<i>Obtain and review latest oil sample report</i> <i>Determine used portion of theoretical life (manual page 1237)</i>
Hook Block	<i>Hook opening distortion</i> <i>Thread corrosion and wear</i>	<i>Check opening against initial measurements marked on hook. Limit = 10% of initial.</i> <i>Examine as specified in Miracle Service Bulletin No. 09/32</i>
Slew Mechanism	<i>Bearing play</i> <i>Slew ring bolts</i> <i>Lubrication</i>	<i>Bearing clearance limit 2.0 mm. Check using procedure on 1019 of manual</i> <i>Obtain evidence of bolt torque check</i> <i>Ensure evidence of correct lubrication (lack of lubrication at last TE)</i>

Structures	<i>Slew section structural integrity</i>	<i>Use inspection diagram on page 1219 & 1220 of manual</i>
Counterweight	<i>Structural Integrity</i>	<i>NDT of attachment lugs as specified in Service Bulletin 08/04</i>
Chassis	<i>Structural Integrity</i>	<i>Use inspection diagram on page 1216 of manual</i>
Outriggers	<i>Structural Integrity Hose protection</i>	<i>Use inspection diagram on page 1217 of manual See Service Bulletin 08/42</i>
Running Gear (Wheeled and Tracked)	<i>N/A</i>	
Running Gear (Road Going)	<i>Wheel rim integrity Brake system</i>	<i>Use inspection procedure on page 1231 of manual Use inspection procedure on page 1277 of manual</i>
Super Structure	<i>No additions to generic requirements</i>	
Operation	<i>No additions to generic requirements</i>	
RCI	<i>Boom angle sensor</i>	<i>See Service Bulletin 08/36</i>
RCL	<i>Over lower limit</i>	<i>See Service Bulletin 07/38</i>
SWL	<i>No additions to generic requirements</i>	
Manufacturer's Plate	<i>No additions to generic requirements</i>	
Complete Crane	<i>No additions to generic requirements</i>	

Annex 4 – Sample Document Covering Maintenance and Thorough Examination Issues for Mobile Crane Users

The effective maintenance and thorough examination of mobile cranes on construction site depends of a significant degree of cooperation between the mobile crane supplier/owner and the Principal Contractor. Mobile crane users (including Principal Contractors) are frequently unaware of the part they have to play and the intention of this document is to provide mobile crane suppliers/owners with a means of making users aware of their responsibilities and the need for effective cooperation.

A4.1.0 Introduction

An important part of the safe use of mobile cranes on construction sites is ensuring that they cranes are effectively maintained and subject to thorough examination at the appropriate intervals. This is normally undertaken by the mobile crane owner and it is essential that mobile crane users fully appreciate the need to allocate sufficient time in the construction programme to allow these tasks to be carried out effectively, particularly where a crane is on long term hire and will not be returned to the owner's depot for maintenance .

This document identifies the maintenance and thorough examination issues that must be agreed between the mobile crane owner and user before a mobile crane arrives on site for a long term hire.

A4.2.0 Responsibility for Maintenance and Thorough Examination

Both the *Provision and Use of Work Equipment Regulations 1998* (PUWER) and the *Lifting Operations and Lifting Equipment Regulations 1998* (LOLER) are very clear that the responsibility for ensuring that the maintenance and thorough examination of mobile cranes is carried out, lies with the user of the mobile crane. In the case of a hired-in mobile crane the actual undertaking of maintenance or thorough examination is often delegated to the crane owner by the user. The user however, retains the legal responsibility for ensuring that both maintenance, including the rectification of defects, and thorough examinations are carried out.

A4.3.0 Downtime During Maintenance and Thorough Examination

The main purpose for a mobile crane being on site is to carry out lifting operations as part of the construction process. Site managers are understandably reluctant to stop the crane whilst maintenance or thorough examination is carried out. If maintenance or thorough examination downtime is not scheduled into the construction programme it is pushed to the back of the queue and may end up being carried out hurriedly in unsafe conditions such as poor light.

It is therefore essential that mobile crane users understand that both maintenance and thorough examination are a legal requirement and that adequate downtime must be built into the site programme. Mobile crane owners should inform those hiring their cranes of the frequency and expected time required for maintenance and thorough examination at the planning stage, well before the crane arrives on site.

Construction projects in built up areas often have environmental restrictions imposed on them which severely limit working time at week ends and such restrictions must be taken into account when planning maintenance and thorough examinations.

A4.4.0 Lines of Communication

It is essential that effective lines of communication are established between the user and those planning and carrying out both maintenance and thorough examination of mobile cranes. This will avoid much frustration and misunderstanding on both sides.

A4.5.0 Availability of Operators

Maintenance and thorough examination will require the crane to be operated from the control cab whilst maintenance personnel are carrying out their tasks or the competent person is examining other parts of the crane. Arrangements must be made to ensure that a trained and competent operator is available on such occasions.

A4.6.0 Thorough Examination Area

The area in which any maintenance or thorough examination is being carried out should be of adequate size and cordoned off to prevent access by persons not directly involved in these tasks.

A4.7.0 Test Area

Careful consideration should be given to the condition of any area where tests are to be conducted. The recommendations provided in the operating instructions for the crane relate to operations within the rated capacity and more stringent requirements apply when loads are being applied for the purpose of testing.

The ground should be level, well consolidated and capable of withstanding the loads applied to it. There should be no hidden dangers such as cable ducts, drains, pipes, back-filled areas, cellars or other subterranean weaknesses. Cranes should not be tested in the vicinity of overhead power lines.

The test site should be of sufficient size with unrestricted overhead clearance to allow the unobstructed movement of the crane and load throughout its test movement, for example slewing, derricking and travelling.

It is preferable that tests are not conducted over high risk areas, for example a public highway, railway, occupied buildings or in the flight path of airports. If due to the requirements of usage this is unavoidable, arrangements should be made with the appropriate authorities.

Where load testing is being carried it must be borne in mind that the crane might not withstand the loading. All personnel not essential to the test should be kept away from the area. The test area should be cordoned off and notices posted prohibiting unauthorized entry. The site adjacent to the test area should be clear of plant and property which could inhibit the test.

A4.8.0 Availability of Site Facilities

Arrangements should be made to ensure that site management, safety and welfare facilities are available to any personnel carrying out maintenance or thorough examination both within and outside normal working hours. Facilities should include office space for the review of documentation.

A4.9.0 Access For Deliveries

Maintenance operations, particularly the rectification of breakdowns often require spare parts to be delivered to site. Care must be taken to ensure that there is adequate access for delivery and that adequate acceptance procedures are in place to ensure that the parts are available when required by maintenance personnel and are not lost on site.

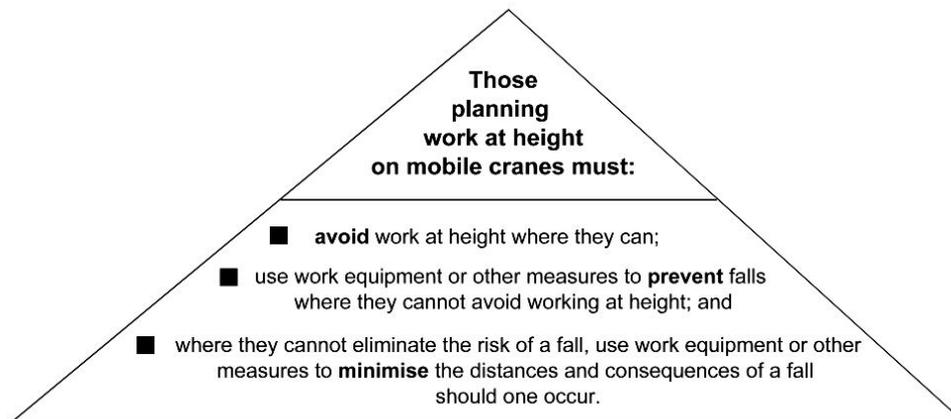
A4.10.0 Lone Working

Lone working should be avoided at all times by suitable liaison with the person in control of the site to ensure that site personnel are always in attendance.

The planning process for work at height on mobile cranes should take into account the particular hazards of lone working and thorough examination at height by lone workers should not be undertaken.

A4.11.0 Work at Height

Some maintenance and thorough examination activities on mobile cranes may require maintenance personnel or competent persons to work at height outside edge protected areas on the mobile crane structure. The Work at Height Regulations 2005 set out a hierarchy of fall protection measures to be taken when planning work at height.



This means that those planning work at height on mobile cranes should:-

- Avoid work at height wherever possible and actively seek solutions to facilitate this;
- If this is not possible, use “collective” means of protection such as guardrails;
- If this is not possible, use “personal” means of prevention such as work restraint;
- If this is not possible, use a personal fall protection system such as a work positioning system or fall arrest system;
- Additionally provide training and instruction or take other measures to prevent any person falling a distance liable to cause personal injury.

Where a risk assessment indicates that a personal fall protection system is required a work positioning system should always be used in preference to a fall arrest system. Where the use of fall arrest personal fall protection systems are unavoidable there will be a risk of the wearer being left suspended following a fall and arrangements must be made to ensure that they can be rescued in a safe and timely manner.

A4.12.0 Isolation of Systems During Maintenance and Thorough Examination

To avoid the risk of trapping, crushing, shearing or electrocution during the maintenance or thorough examination of mechanisms on mobile cranes, all systems should be provided with a means of isolation. Where a system requires power for maintenance or thorough examination, a safe system of work should be put in place to mitigate the risks of trapping. Such a safe system of work may well involve a “permit to work” and adequate communication between the crane operator and other members of the maintenance or thorough examination team.

A4.13.0 Communication Equipment

Personnel carrying out maintenance or thorough examinations should be provided with an adequate means of communication, often hand held portable radios, to ensure that all members of the thorough examination team can communicate effectively with each other, the mobile crane operator and personnel on the ground.

NOTE: Additional advice on radio communications is given in the CPA Technical Information Note TIN 017 - Radio Communication for Lifting Operations.

A4.14.0 Additional Information

Provision & Use of Work Equipment Regulations 1998/SI2306

L22 *Safe use of work equipment*, HSE Books.

Lifting Operations & Lifting Equipment Regulations 1998/SI2307

L113 *Safe use of lifting equipment*, HSE Books.

BS 7121-1:2006, *Code of practice for safe use of cranes — Part 1: General*

BS 7121-2:2003, *Code of practice for safe use of cranes — Part 2: Inspection, testing and examination*

BS 7121-3:2000, *Code of practice for safe use of cranes — Part 3: Mobile cranes*

Best Practice Guide for the Maintenance, Inspection and Thorough Examination of Mobile Cranes, Construction Plant-hire Association

Annex 5 – Typical In-service Maintenance Schedule

Maintenance work on the CARRIER: monthly / after approx. 2 000 km	M 1	
	Oil / lubricant	
	Amount (l)/ quantity	Designation ☛ p. 6 - 1
Diesel engine – Details in the Diesel Engine Operating Instructions and in the Diesel Engine Maintenance Booklet. Special notes for the maintenance group and for rapeseed oil operation; ☛ p. 7 - 5.		
Axle lines – Axle centre drive – check oil level; ☛ p. 7 - 23. – Final drive – check oil level; ☛ p. 7 - 27. – Lubricate the cardan shafts on the axle lines; ☛ p. 7 - 29 for additional equipment, 6 x 6 x 6 drive.	12 18	E 3 E 3 K K
Wheels – Check tightness of wheel nuts; ☛ p. 7 - 34. Tightening torque; ☛ <i>Special tightening torques</i> , p. 10 - 2.		
Suspension – Check oil level in the suspension cylinders; ☛ p. 7 - 39. – Check retaining bolts of the suspension cylinders; Tightening torque; ☛ <i>Special tightening torques</i> , p. 10 - 2.		H
Steering – Lubricate the drag link bearing; ☛ p. 7 - 44.		X
Carrier electrical system – Check the acid level in the batteries; ☛ p. 7 - 63.		
Trailer coupling (additional equipment) – Lubricate the trailer coupling; ²⁾ ☛ p. 7 - 69.	2	J
Carrier air conditioning system (additional equipment) – Check the moisture and level of the refrigerant; ☛ p. 7 - 65. – Clean capacitor disks; ☛ p. 7 - 66.		
Other maintenance work – Check for correct operation of the auxiliary heater (additional equipment); ☛ p. 7 - 75. – Lubricate the outrigger beam ¹⁾ ; ☛ p. 7 - 75. – Lubricate door hinges. – Lubricate retaining and socket pins. ¹⁾	8 4 div.	J J J / M

¹⁾ after 100 oh

²⁾ lubricate the trailer coupling after every high pressure cleaning.

Maintenance work on the SUPERSTRUCTURE: monthly / after 100 oh	M 1	
	Oil / lubricant	
	Amount (l)/ quantity	Designation ☛ p. 6 - 1
Hook blocks – Lubricate; ☛ p. 8 - 73.	div.	J
Hydraulic system of the superstructure – Bleed the telescoping cylinders GMK 3055; ☛ p. 8 - 23, GMK 3050-1; ☛ p. 8 - 35. – Bleed the derricking cylinder; ☛ p. 8 - 16.		
Central lubrication system on the superstructure – Lubricate; ☛ p. 8 - 71 (not fitted when central lubrication pump is fitted as additional equipment).	1	K
Other maintenance work – Lubricate derricking cylinder piston rods; ☛ p. 8 - 19. – Check for correct operation of the auxiliary heater (additional equipment); ☛ p. 8 - 77. – Lubricate tread rollers of cab door. – Lubricate retaining and socket pins.	3 div.	Y M J / M

Annex 6 - Daily Pre-use Checks and Weekly Inspections

The daily checks that must be carried out at the start of every shift should include everything in the following list. Weekly inspections must be made in addition to the daily checks. Additional checks may be required by the mobile crane owner, based on advice given to them by the manufacturer of the crane.

WHEELED CRANE - OPERATOR DAILY CHECKS AND WEEKLY INSPECTIONS

Copy of this report form must be handed in with driver's time sheet each week.

Name:	Depot or Site Address	Fleet No:	W/E:
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DAILY PRE-USE CHECKS

M T W T F S S

1. Engine oil level						
2. Fuel level						
3. Coolant level						
4. Torque converter level						
5. Inspect ropes for spooling and kinks						
6. Check jib pendant ropes and pins						
7. Check fly jib security						
8. Operation of over-hoist limit (if fitted)						
9. Operation of ASU and correct code						
10. Correct operation of controls						
11. Cab gauges and warning lights						
12. Operation of slew lock pin and slewing brakes						
13. Operation of hoist/derrick brakes						
14. Drain air tanks						
15. Tyres for pressure and damage						
16. Wheel studs						
17. Debris between twin wheels						
18. Cleanliness of crane and decking						
19. Security of loose items, eg. Lifting tackle etc.						
20. Security and condition of all Retaining Pins						
21. Security and condition of Hook Block and Safety Catches						
22.						

WEEKLY SERVICING CHECKS

A. Battery and water level	
B. Windscreen washer reservoirs	
C. Grease and lubricate	
D. Lubricant levels in transmission	
E. Lubricate sheaves and active linkages	
F. Lubricate ropes	
G. Hydraulic oil levels	
H. Brake and clutch reservoir levels	
I. Steering and throttle reservoir levels	
J. Check hydraulic hose for leaks/damage	
K. Check operation of boom	
L. Check outrigger operation	
M. Check lights, indicators and wipers	
N. Check slew ring path	
O.	
P.	
Q.	
R.	
S.	
T.	
U.	
V.	
W.	

WEEKLY SAFETY INSPECTIONS

The crane has been thoroughly examined as required by LOLER. The operator must also inspect the crane before use on a new site and every week thereafter as required by PUWER. Please report results below.

RESULTS OF SAFETY INSPECTIONS	Date:
Details of defects or state "No defects"	

RESULTS OF ASLI INSPECTION			
Boom Length	Radius	SWL	Correct Operation

Further checks to meet the needs of manufacturer's instructions.

DEFECTS REPORT (All defects must be reported. Those affecting safe operation must be repaired immediately.)

Description:	Description:	Engine: Hrs
Reported to:	Reported to:	Super Structure: Hrs
Date:	Date:	Chassis: Miles

Operator's comments, requirements for oil, grease etc:	Repairs Completed or Comments:
Operator's Signature: _____	Fitter's Signature: _____
Date: _____	Date: _____
	Manager's Signature: _____
	Date: _____

Daily and weekly checks listed in this form meet the requirements of BS 7121 Part 1.

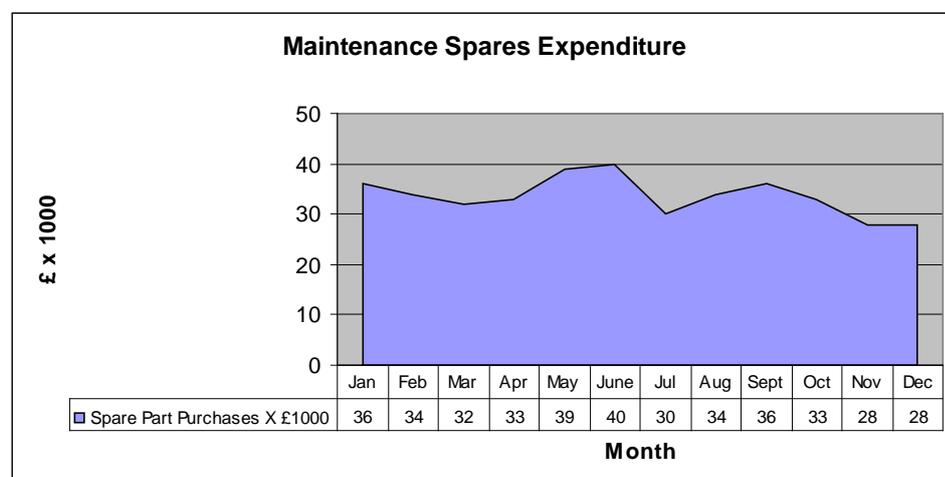
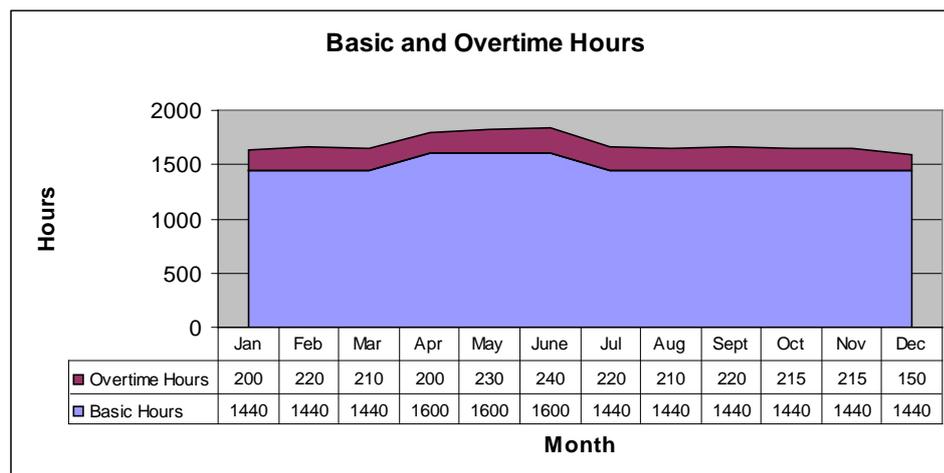
Annex 7 – Example of a Lifting Accessory Register

Lifting Accessory Register							
Vehicle	OY06 OYS	Employing Organisation	BB Crane Hire	Appointed Person	F Bloggs	Contact Telephone No	0161 953 8765
	Description	SWL	Weight	Ident. No.	Location	Date of Last Thorough Examination	Date of Next Thorough Examination
1.	Violet web sling 2m long with choker hooks	1400 kg	4 kg	W22228	Storage Locker	23.01.09	23.07.09
3.	2 leg 8mm chain sling 2 m leg length	2000 kg	7.5 kg	K26977	Storage Locker	19.12.09	19.05.10
4.	4 leg 10mm chain sling 2.5m leg length	4750 kg	31 kg	K17396	Storage Locker	19.12.09	19.05.10
5.	6 tonne D shackle	6000 kg	4.5 kg	B1289	Storage Locker	19.12.09	19.05.10

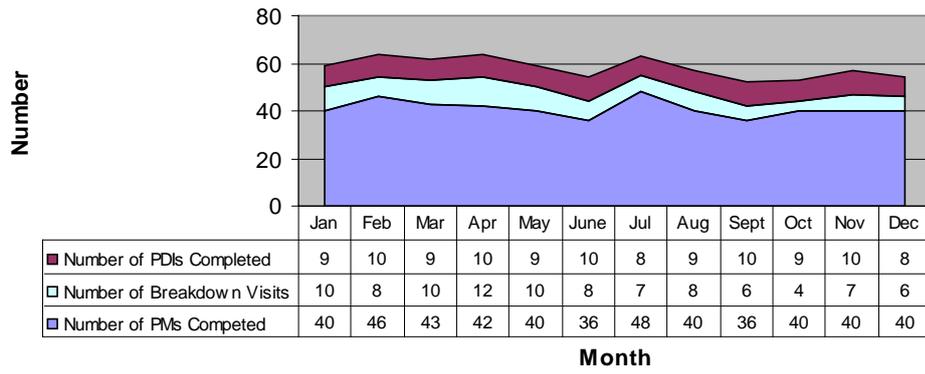
Annex 8 – Example of the Use of Key Performance Indicators for Maintenance

Basic Data

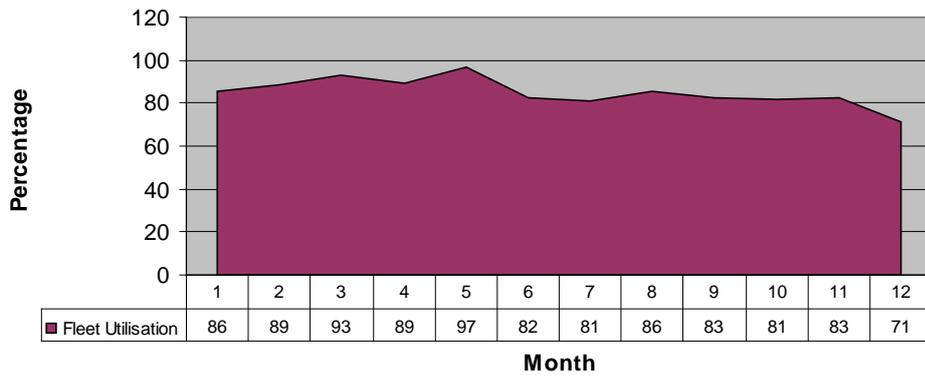
KPI	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec
No. of Cranes in the fleet	70	70	70	72	68	68	69	69	70	70	70	70
Spare Part Purchases X £1k	36	34	32	33	39	40	30	34	36	33	28	28
No. of Tradesmen	9	9	9	10	10	10	9	9	9	9	9	9
Basic Hours	1440	1440	1440	1600	1600	1600	1440	1440	1440	1440	1440	1440
Overtime Hours	200	220	210	200	230	240	220	210	220	215	215	150
Total Hours	1640	1660	1650	1800	1830	1840	1660	1650	1660	1655	1655	1590
PMs Completed	40	46	43	42	40	36	48	40	36	40	40	40
PDIs Completed	9	10	9	10	9	10	8	9	10	9	10	8
No. of Breakdown Visits	10	8	10	12	10	8	7	8	6	4	7	6
Fleet Utilisation	86	89	93	89	97	82	81	86	83	81	83	71



Number of PDIs, PMs & Breakdowns Completed



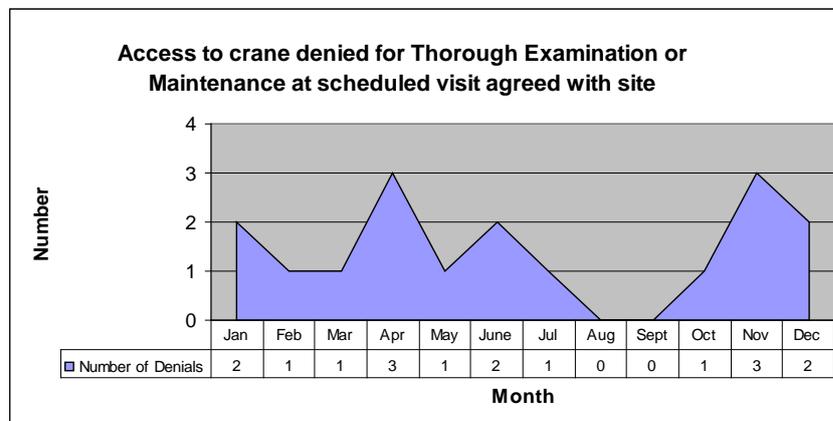
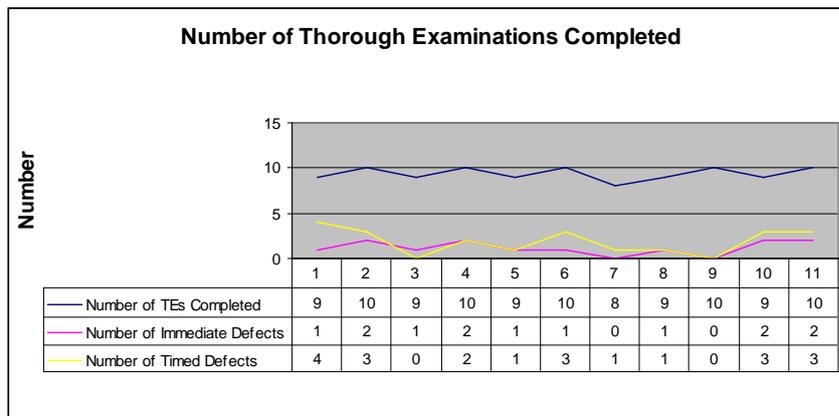
Fleet Utilisation



Annex 9 – Example of the Use of Key Performance Indicators for Thorough Examination

Basic Data

KPI	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec
No. of TEs Completed	9	10	9	10	9	10	8	9	10	9	10	8
No. of Immediate Defects	1	2	1	2	1	1	0	1	0	2	2	2
No. of Timed Defects	4	3	0	2	1	3	1	1	0	3	3	3
% Immediate Defects	11	20	11	20	11	10	0	11	0	22	20	25
% Timed Defects	44	30	0	20	11	30	13	11	0	33	30	38
No. of hire days lost due to Immediate Defects	3	4	1	7	1	2	0	2	0	3	1	2
Access denied to crane for TE or Maintenance	2	1	1	3	1	2	1	0	0	1	3	2



Annex 10 - Supplementary Reports and Tests Supporting Thorough Examination

A10.1 Anemometer Functional Test and Calibration Report

This is a report recording the results of a functional and calibration check of an anemometer. The report should include confirmation of:-

- Suitable location and function of the wind speed sensor;
- Function and calibration check of the indicating system;
- Function and setting of any warning indicators or alarms;
- The make, serial number and calibration details of the hand held anemometer, or other test device, used to verify the calibration of anemometer mounted on the crane.

The appointed person responsible for the in-service lifting operations should specify the setting values for the anemometer warning indicators and alarms.

A10.2 ATEX equipment (spark arrestor)

Spark arresters should be tested by running the engine in a safe environment and examining the exhaust discharge in darkness for any sparks. If the engine is being run in an enclosed space adequate precautions must be taken to avoid the effects of exhaust fumes, in particular carbon monoxide poisoning.

A10.3 Boom extension system

The boom extension of most mobile cranes is an enclosed system which will require full or partial dismantling, at intervals prescribed by the competent person, in order that components such as telescoping and retracting ropes, end fastenings and sheaves may be examined for damage, wear and deterioration. A report of condition and any items replaced should be provided to the competent person.

In setting out the scope of inspection of the boom extension system the competent person should indicate whether they wish to be present at the inspection.

A10.4 Electrical/Electronic control system

Many mobile cranes are fitted with sophisticated microprocessor based control systems with inbuilt diagnostic capability including detailed test programs. The competent person may require these test programs to be run and the results made available for his inspection.

Data downloads from control systems should only be completed by fully trained staff bearing in mind that the data is subject to the Data Protection Act.

If the person completing the download is a third party, it is suggested that a written agreement is in place to protect the two parties under the Data Protection Act and that within this agreement the handling and recording of data is clear.

A10.5 Hoist Brake Test and Examination

This is a test of the operational efficiency of the hoist brakes. This test should also be completed following major overhaul of the braking system, replacement of brake shoes or pads, or in the event that the brake has failed to arrest or hold a load.

The operational test should include:-

- Dynamic testing to confirm that the brake can bring to rest a moving load being lifted or lowered at the normal maximum operational speed;
- Dynamic testing to confirm that the brake can bring to rest a moving load being lifted or lowered at the normal maximum operational speed following operation of the emergency stop;
- Static testing to confirm that the brake can hold without slippage a static load.

A10.6 Hoist/luffing winch

Hoist and luffing winches are designed on the basis of a theoretical service life taking into account a number of factors including the power unit group, load spectrum and collective service factor. This theoretical service is not the same as the real (actual) service lift. At least every year an assessment of the proportion of the theoretical service lift left must be made to determine when the next major overhaul of each winch must be carried out. This is carried out using the information supplied by the crane manufacturer, together with the effective operating hours for the winch and an assessment of load spectrum for the winch over the period.

A10.7 Hook blocks

The inspection of hook blocks should assess the general condition of the assembly and in particular the condition of bearing and fasteners. The mouth of the load hook should be checked for deformation by measuring between the marked datum points and comparing the value obtained with the original dimensions marked on the hook data plate. The increase should not exceed the value specified by the manufacturer (normally 10%).

The threads on the hook retaining nut and the shank of the hook should be checked at regular intervals for signs of fretting and wear.

A10.8 Hydraulic System

The competent person may request reports and tests on various aspects of the crane's hydraulic system including:-

- Hydraulic oil sampling and analysis for contaminants to aid assessment of component wear;
- Cylinder lock valve holding capability;
- Accumulator integrity;
- Filter replacement intervals;
- Pressure testing of components.

A10.9 Load Test Following Major Repair

This test would normally be completed shortly after an major repair of a mobile crane at a new location to confirm the structural integrity of the crane following repair and to detect any weaknesses. The magnitude of the test load should be as specified by the crane manufacturer.

The report should include:-

- Date the test and subsequent examination was completed;
- The configuration of the crane at time of test;
- The unique serial number or identifying mark of the crane;
- Test weights and radii tested;
- Details of any defects or deformation observed.

A10.10 Maintenance Records

The competent person may request a copy of the maintenance log/reports for the crane. This information may be provided as individual records or in summary form.

A10.11 Non Destructive Examination of Individual Components

Non-destructive examination may be requested by the competent person to supplement any visual examination. Where requested, such information should be made available to the competent person. The report should include:-

- Date the tests were completed;
- Name, qualifications and position of the person completing the tests;

- Serial number or identifying mark of the components examined;
- Details of the test method employed and reference to appropriate standards;
- Calibration details of any test equipment used;
- Results of the examination.

It is important that the chassis is prepared for structural thorough examination by pressure washing to remove dirt, debris and grease so that any defects can be clearly identified.

A10.12 RCI/RCL Functional Test and Calibration Report

This is a report of the results of a functional and calibration check on the rated capacity system. The report should include confirmation of correct function of:-

- Visual displays and read outs;
- Warning lights advising of the approach to, and reaching of, an overload condition (hoist and moment systems);
- Audible alarms internal and external to the cab;
- Prevention of dangerous crane movements when an overload condition has been reached;
- Override keys (i.e. spring loaded);
- Self test on first power up.

Calibration of the unit would normally include:-

- Calibration completed with a test load of a known value close to the maximum lifting capacity of the crane;
- Radius calibration at minimum and maximum radius;
- Pre-Overload and Overload warning
- Calibration check at various loads and ranges with the cranes duties to include any attachment (fly jibs/luffer and auxilliary boom nose equipment).

A10.13 Sheaves

Sheaves should be checked frequently to ensure that they rotate freely and that any play in the bearings is within limits. The radius at the bottom of the sheave groove should be checked with a set of sheave gauges to ensure that it is within limits. These are normally no smaller than nominal rope diameter + 5% and no greater than nominal rope diameter +15%.

A10.14 Slew brake

This is a test of the operational efficiency of the slew brake. This test should also be completed following major overhaul of the braking system, replacement of brake shoes or pads, or in the event that the brake has failed to arrest or hold a load. The operational test should include dynamic testing to confirm that the brake can bring to rest a moving load being slewed at the normal maximum operational speed.

When testing the slew brake, the slew gearbox and pinion should also be inspected and a sample taken of the gearbox oil for analysis.

A10.15 Slew Ring Clearances and Condition Report

This is a report detailing the clearances measured at the slew ring bearing. Slew ring bearing clearance measurements are most effectively made in a workshop environment. The frequency of examination should be in line with the manufacturer's recommendations, at an increased frequency if the crane has been subjected to arduous service conditions or at the request of the competent person completing thorough examination. Measurements should be made in accordance with the manufacturer's instructions

The condition and function of greasing systems, grease lines, nipples and lip seals should be ascertained.

An indication of slew ring bearing clearance may also be obtained on a mobile crane without disassembly. In this case measurements should be taken using a dial test indicator (DTI) mounted on the centreline of the bearing track. The DTI should be zeroed with no load on the hood (back moment condition). A load should then be lifted at such a radius that a forward moment condition is created and the bearing moves to the other extent of its play. The process can then be repeated with the crane slewed through 45° increments.

The slew ring should also be checked dynamically and noted for noise and smooth operation, condition of teeth and pinion gear (mesh and backlash).

Measurement of slew ring bearing play on an assembled crane will not give result that is as accurate as axial loading in workshop conditions, but will give a good indication of excessive wear and the need for any corrective action.

The report should include:-

- Date the examination was completed;
- Unique serial number or identifying mark of the slew ring;
- Measurements taken and relative geometric index position;
- Manufacturers specifications;
- Previous recorded values;
- Assessment as to the condition of the bearing faces and rolling elements;
- Confirmation of the function of the grease nipples and lubrication systems.

It is good practice to measure the slew bearing clearance on new acquired cranes at before first use to provide a reference value against which all subsequent measurements can be assessed.

A10.16 Stowage for transport

This is a functional test and examination to confirm that the cranes superstructure can be stowed for transport in accordance with the manufacturer's instructions. Specific checks should be made to ensure that;

- The boom rests correctly in the transport position
- The slew locking system can be applied and is effective
- Counterweights either attached to the slewing structure or chassis are secure
- Fly jib, where fitted, is secure

A10.17 Wire ropes

The examination of wire ropes as part of the thorough examination of a mobile crane should be based on the principles and requirements set out in BS ISO 4309:2004, *Cranes. Wire ropes. Care, maintenance, installation, examination and discard*

This document stresses the importance of examining critical areas of the rope such as:-

- The termination points of both moving and stationary ropes;
- That part of the rope which passes through the block or over sheaves;
- In the case of cranes performing a repetitive operation, any part of the rope which lies over sheave(s) while the crane is in a loaded condition;
- That part of the rope which lies over a compensating sheave;
- Any part of the rope which may be subject to abrasion by external features.

Annex 11 – Qualifications and Assessment of Maintenance and Thorough Examination Personnel

Role	Qualifications (minimum)	Additional Competencies	Location of Additional Competencies
Maintenance Manager	C&G/NVQ Level 3, Introduction to the Management of Thorough Examination, The Management of Mobile Cranes	Product specific knowledge	Available from crane and component manufacturers
Depot/Workshop Mechanics	C&G/NVQ Level 2 in Plant Maintenance, CPCS Slinger/Signaller <i>NOTE: A CPCS Crane Supervisor qualification is also desirable</i>	Product specific knowledge, Introduction to the Thorough Examination	Available from manufacturers and others including NCC
Field Service Maintenance Personnel	C&G/NVQ Level 2 in Plant Maintenance and NVQ Level 3 in Plant Maintenance, CPCS Slinger/Signaller <i>NOTE: A CPCS Crane Supervisor qualification is also desirable</i>	Product specific knowledge	Available from manufacturers and others.
Operator	CPCS Mobile Crane (S/NVQ)	Product specific knowledge including operator maintenance activities	Available from manufacturer and others
Competent Person (thorough examination)	a) Engineering Technician as defined by the Engineering Council or equivalent (e.g. appropriate HNC with relevant experience) having a minimum of 5 years experience within a relevant discipline of which at least one year shall have been spent working within an engineering discipline related to lifting equipment or b) Person trained in a relevant engineering discipline with a recognised and documented engineering apprenticeship (in lieu of an academic qualification) with a minimum of 5 years experience within a relevant discipline of which at least one year shall have been spent working within an engineering discipline related to lifting equipment or c) Introduction of Thorough Examination or SAFed equivalent	Product specific knowledge	Available from manufacturer and others including mobile crane owner

NOTE: Employers must determine competence of each individual person, both existing employees and new entrants, based on the attributes listed above together with academic qualifications. A shortfall on attainment level does not preclude employment in this role but such shortfalls must be addressed before the person is allowed to carry out the role.

Annex 12 – “Grey” Imports

This annex is based on guidance and advice given by the HSE to their inspectors on the controversial issue of “grey import” machines coming from outside the EU. This advice is reproduced, (apart from a few changes to clarify the meaning,) to help readers understand the standards that the inspectors look for when inspecting any mobile cranes imported from outside the EEA (European Economic Area – EU States plus Norway, Iceland and Liechtenstein), in particular those that do not meet EU requirements.

Introduction

There is concern in the UK about the safety of machines manufactured and imported from outside the EU, that were not originally designed and constructed to meet European standards.

These machines, some of which are mobile cranes, should meet the same essential health and safety requirements (EHSRs) as any other machine under the Supply of Machinery (Safety) Regulations 2008 (SM(S)R).

Under SM(S)R all new mobile cranes are presumed to comply with the EHSRs if they have been made to the European Standard BS EN 13000 or equivalent standards, and are safe to use. The design and material specification for the machine has to be kept in a technical file that is normally held by the manufacturer, and is required by whoever carries out the conformity examination.

In order to meet the standards of safety under SM(S)R, the Provision and Use of Work Equipment Regulations 1998, and the Noise at Work Regulations 1989, machines must comply with the following requirements:

- (1) All mobile cranes should be supplied with operator and routine maintenance instructions in English. Operating instructions are needed for routine maintenance and all written directions in the cab must also be in English.
- (2) Controls must be appropriately marked to indicate their function and mode of operation, and must be positioned, and protected so that the desired effect, where a risk is involved, cannot occur without intentional operation.
- (3) Any mobile crane that can lift loads in excess of one tonne must have a rated capacity indicator/limiter fitted to it, providing visual warning to the driver before the safe working load (SWL) is reached, with both visual and audible warning to the driver and anyone else in the vicinity of the machine, when the SWL is reached. The rated capacity limiter must prevent the crane from supporting a load outside the limits of the permitted radii, and outside the positions and loads shown and/or described on the rated capacity chart and current test certificate or the permissible working load of the ropes.
- (4) Any mobile crane must meet the noise levels laid down by the Outdoor Noise Directive 200/14/EC (as amended). A noise decal is also required by the Noise at Work Regulations 1989.

There are also a large number of requirements in EN13000 such as stability, mandatory limiters and indicators, control systems, braking systems, guards, access, hydraulic, pneumatic and electrical systems, visibility, noise and lighting, which may well not be met by cranes imported from countries outside the EEA.

Declaration of Conformity

New mobile cranes supplied under SM(S)R are required to be CE marked, have a declaration of conformity, be supplied with instructions for use, and fitted with a range safety features. Grey imports may look similar to other machines but information on their construction, use and maintenance may not be made available by the manufacturer to others.

A declaration of conformity is required to be supplied with the machine in accordance with SM(S)R, regulation 7.(2)(e). This does not have to be kept with the machine on site, but it should be retained by the purchaser.

The declaration of conformity should refer to the relevant standards used in the construction of the mobile crane and be capable of being cross-referenced with other design information. It is of value because it may be used to compare design standards with the guidance given in BS EN 13000.

The manufacturer does not have to use the European Standards, whose use is voluntary, but may instead satisfy the relevant EHSRs.

CE Mark

The CE marking is required to be fixed to the mobile crane in accordance with SM(S)R, regulation 7.(2)(f).

The lack of a CE marking, or an inappropriate CE mark, would indicate that the mobile crane had not been made to SM(S)R. It would not necessarily indicate that the mobile crane was unsafe but it increases the likelihood, and information may be required to justify any claim that the machine meets the EHSRs and is safe to use.

Advice

If a mobile crane is being purchased from outside the EU the purchaser will be treated as the importer and must take suitable steps to ensure that the crane meets the requirements of SM(S)R, regardless of the age of the machine. This will normally involve the purchaser engaging the services of a specialist to undertake the assessment of the build standard of the crane against the EHSRs and relevant European standards, identifying those areas which do not comply. Any non-compliant areas **must** be addressed **before** the crane is taken into use. Records of this assessment and any rectification must be kept.

Upon completion the crane must be CE marked in accordance with SM(S)R and a Declaration of Conformity issued.

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