Developing Professionals for the Lifting Equipment Industry

Mobile Crane Examination

Advanced Programme

Course Study Materials

INSTRUCTOR LED TRAINING ONLY

LEEA Learning and Development Agreement

In the interests of all parties and to ensure the successful achievement of the LEEA Mobile Crane Examination Advanced Programme, the following arrangements are to be confirmed:

Student:

I agree to:

- Always follow instructions from my LEEA trainer
- Follow all rules and procedures regarding health and safety matters whilst on site
- Respect the tidiness and cleanliness of training areas and rest area facilities
- Notify my LEEA trainer immediately if I have any concerns
- Inform my LEEA trainer of any learning difficulties at the soonest opportunity (this may be done privately between you and your LEEA training facilitator)
- Keep to agreed session times and return quickly from rest breaks and lunchtime periods
- Keep my mobile phone on 'silent' for the duration of all training sessions and to leave the class if I have to make or receive an urgent call, for the benefit of my fellow students
- Provide feedback to the LEEA trainer regarding the training I have received
- Respect the opinions of my fellow students and to actively engage in group discussion
- Follow the rules regarding LEEA Assessments

Signed _____ Date _____

LEEA Trainer:

Your LEEA Trainer agrees to:

- Safeguard the health, safety and welfare of my students throughout the training programme
- Provide my students with quality training, maintaining the highest of professional standards throughout
- Always maintain confidentiality for all students
- Provide regular feedback to students on their progress, identifying areas which may need additional study
- Keep appropriate records of any assessments conducted
- Ensure that all students can discuss any issues or concerns which arise during the training course

Disclaimer

These Course Study Materials are a useful and authoritative source of information for the LEEA Mobile Crane Examination Advanced Programme student.

Whilst every effort has been made to achieve the highest degree of accuracy in the generation of the data and information supplied, ultimate responsibility remains with the student and their employer to ensure that current legal requirements are followed.

First Edition.....November 2019

Operative training for all the equipment covered in these course study materials should always take the manufacturer's information and instructions for use into account.

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Digital Navigation

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1. LEGISLATION

Moral, Legal and Financial Reasons for Health and Safety Legislation

- Employers have a moral responsibility to ensure appropriate working conditions are provided
    - This is known as a common law duty of care

- Unsafe working conditions are likely to have an impact on production
    - Loss of output leading to lowering of morale and motivation
    - Loss of sales turnover and profitability

- Society and customer expectations of a company's approach to managing safety - health and safety culture
    - Negative public relations would have a damaging effect on any business

- Financial cost from loss of output
    - Fines, damages, legal costs, insurance etc.

The Legislative Framework

Health and Safety at Work etc. Act 1974 (UK)

- The Act is general in nature
- There is no reference to specific articles or substances
- The Act applies to all sectors

Specific duties of care for:

- Manufacturers/suppliers of articles or substances
- Employers
- Employees

The **Health and Safety at Work Act (HSWA)** is an enabling Act for specific regulations.

Status in UK: legal requirement.

Status internationally: adopted as best practise and requested by customers and authorities.

The Main Purpose of the HSWA

The Health and Safety at Work Act covers nearly all occupations. It is designed to protect people at work including staff, visitors, contractors and members of the public. The HSWA supersedes nearly all previous health and safety laws in the UK.

The main purposes of the Act are set out in section 1 as follows:

- To secure the health, safety and welfare of persons at work
- To protect other people from hazards arising from work
- To control the keeping and use of dangerous substances and materials, including explosives and highly flammable materials
- To control the emission of noxious substances from certain premises

It sets out a framework of general duties, primarily on employers, but also on employees and the controllers of premises, and on designers, manufacturers, importers and suppliers in relation to articles and substances used at work.

Regulations from the HSWA

Regulations are one form of delegated legislation made possible by Section 15 of HSWA which gives powers to the Secretary of State (UK) to make regulations for matters concerned with health and safety at work.

Regulations are not Acts of Parliament but do have the support of the law and therefore must be complied with.

Regulations are increasingly drafted by reference to European Directives (these will be discussed at a later stage in this module).

There are many sets of regulations applying to health and safety. Some apply to all places of work and others are specific to particular industries, operations, substances, materials or premises.

Here are some examples of Regulations:

- The Manual Handling Operations Regulations
- The Control of Substances Hazardous to Health Regulations

Notes:

Health and Safety at Work Act Section 2

Duties of the Employer

"Duty to ensure so far as is reasonably practicable, the health, safety and welfare at work of all his/her employees"

- Safe plant and systems of work
- Safe use, handling, storage and transportation of articles and substances
- Information, instruction, training and adequate supervision
- Safe place of work and a safe means of access and egress
- Safe working environment and adequate welfare facilities

Health and Safety at Work Act Section 6

Duties of Designers, Manufacturers, Importers and Suppliers

- To ensure, so far as is reasonably practicable, that articles they design, construct, make, import, supply etc. are safe and without risk to health at all times e.g. when it is being set up, cleaned, used or maintained by someone at work
- To carry out or arrange such testing and examination necessary to perform the duties above
- To ensure that those supplying the item have adequate information about its designed and tested use. This includes essential conditions for dismantling and disposal
- Take steps to ensure, so far as is reasonably practicable, that those supplied are given updated information where it becomes known that the item gives rise to serious risk to health and safety

Health and Safety at Work Act Section 7

Duty of Employees

- States that employees must not endanger themselves, or others, by their acts or omissions
- Also, they must co-operate with their employers; as long as this does not lead to an increased risk to health and safety, or is an illegal act; so that employers can comply with their statutory duties

This makes responsibility for safety a joint employer/employee effort

Health and Safety at Work Act Section 8

Misuse and interference of any provisions:

No person shall intentionally or recklessly or interfere or misuse anything provided in the interests of health, safety and welfare in pursuance of any of the relevant statutory provisions.

Management of Health and Safety at Work Regulations 1992 (Revised 1999)

In addition to Section 2 (2) c of the HSWA, The Management of Health and Safety at Work Regulations 1999 require employers to ensure the effective planning, organisation, control, monitoring and review of preventive and protective measures. All these arrangements must be recorded and made known to employees. This is usually accomplished by the design of a company health and safety policy.

- MHSWR underlines the requirements for employers to provide instruction and training
- Employers must ensure that their personnel are properly trained to use any equipment necessary in the course of their work, but the regulations also place an obligation on employees to undergo such training and follow the instructions given by their employer
- Operatives are required to only use equipment for which they are trained and to use it in the manner and for the purpose for which they have been trained

LEEA Definition of a Competent Person

The term 'Competent Person' has long been used in legislation. Current legislation uses it for a variety of duties to describe a person with the necessary knowledge, experience, training, skill and ability to perform the specific duty to which the requirement refers. There can therefore be several 'Competent Persons', each with their own duties and responsibilities, i.e. competent for the purpose.

The term has never been fully defined in law but, for the purpose of thoroughly examining lifting equipment, the LEEA definition of a Competent Person is a person having such practical and theoretical knowledge and experience of the equipment which is to be thoroughly examined that will enable him/her to detect defects or weaknesses which it is the purpose of the examination to discover and assess their importance to the safety of the equipment.

The Competent Person should have the maturity to seek such specialist advice and assistance as may be required to enable him/her to make necessary judgements and be a sound judge of the extent to which he/she can accept the supporting opinions of other specialists. He/she must be able to certify with confidence whether it is free from patent defect and suitable in every way for the duty for which the equipment is required. It is the view of LEEA that competency can be a corporate responsibility.

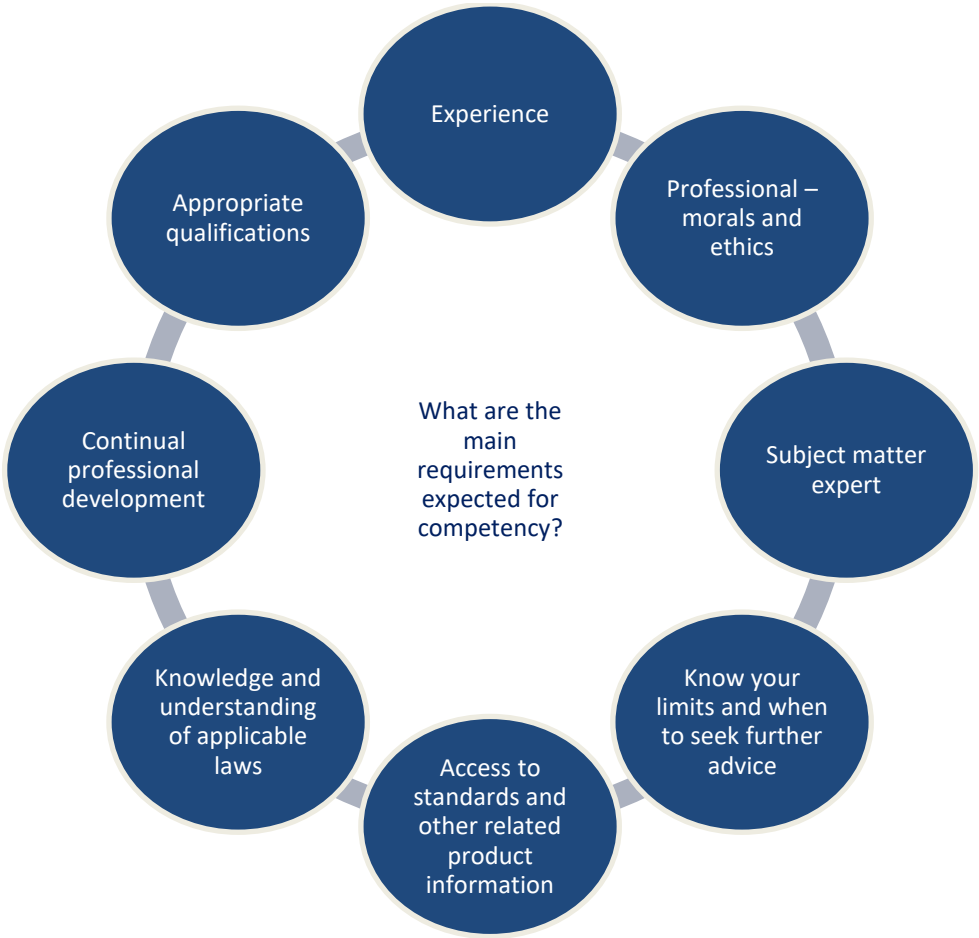
Notes:

Primary Elements of Competency

Note: LEEA training course certificates and Advanced Programme qualifications are not evidence, declaration or proof of competency.

Employers must ensure that their personnel are properly trained to use any equipment necessary in the course of their work. To ensure the personnel are correctly trained, Risk Assessment processes will be carried out to decide on the level of training to be provided to the employees based on their duties.

What are the Required Elements of Competency?



The European Machinery Directive

European Directives

- A need for common requirements throughout Europe
- European Directives implemented
- Main Directives are already regulations in the UK
- Most countries in the European Free Trade Area have similar laws

2 types of Directives:

- Those that remove barriers to trade
- Those that concern health and safety

Lifting equipment legislation addresses:

- Requirements for design
- Condition of the equipment
- The manner in which it is used

Machinery Directive 2006/42/EC
Provides the harmonisation of the **Essential Health and Safety Requirements (EHSRs) for machinery**.

It applies only to products that are intended to be placed on or put into service in the market for the first time.

Machinery is "an assembly, fitted with or intended to be fitted with a drive system other than directly applied human or animal effort, consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application".

The manufacturer is responsible for verifying whether a product falls within the scope of the Machinery Directive.

Supply of Machinery (Safety) Regulations 2008 – SM(S)R

Machinery Directive is implemented in the United Kingdom under the Supply of Machinery (Safety) Regulations 2008:

- Manufacturers to issue information for care and safe use of lifting equipment
- Coefficients of Utilisation (Factor of Safety)
- Static and dynamic loads that the equipment must withstand
- No requirement for a test certificate to be issued
- Certain safety information must be placed on the equipment
- Compliance can be achieved through working to Harmonised European Standards
- Implements the European Machinery Directive within the UK
- Mandatory on member states of the European Union
- Designed to prevent barriers to trade

Under the Supply of Machinery (Safety) Regulations 2008, machinery needs:

- A Declaration of Conformity (DOC)
- To be “CE” marked
- A “technical file”

An **EC Declaration of Incorporation (DOI)** is a device to legally market machinery which can function but is not complete and may not be safe. Such machinery is not to be used until incorporated into an assembly for which a DOC has been issued – in doing so you assume the obligations of the manufacturer of the finished assembly.

Definitions

WLL – Working Load Limit
The maximum load or mass that an item of lifting equipment is designed to sustain, i.e. raise, lower or suspend. This is the load required to be marked on an item by the product standards.

SWL – Safe Working Load
The maximum load or mass (as certified by a competent person) that an item of lifting equipment may raise, lower or suspend under particular service conditions. It is the SWL which is required to be marked on the item by LOLER and which appears on any report of thorough examination.

MBL – Minimum Breaking Load
The minimum breaking load is the calculated load at below which the item will not break or fail due to distortion.

Coefficient of Utilisation/Factor of Safety/Working Coefficient
It is a factor which is applied to the MBL to determine the WLL. It varies with the product to take account of the susceptibility to damage and considers the type of stresses the item will meet in normal use.

Mode Factor
A factor applied by the user (slinger or rigger) that takes into account the geometry of a sling assembly to obtain the maximum load it may lift for a particular mode of use.

Lifting Accessory
Any device such as a sling, shackle, eyebolt, clamp, spreader beam etc used to connect the load to a lifting appliance but which is not itself part of the load or the appliance.

Lifting Appliance
A device or mechanism, such as a crane, winch, pulley block, gin wheel, chain block, which does the work in lifting the load or provides the means of movement, or the supporting structure and anchoring devices for such a mechanism, e.g. runway, gantry etc., which may also permit a suspended load to be moved in the horizontal plane.

Static Test
Lifting machinery or a lifting accessory is first inspected and subjected to a force corresponding to the maximum working load multiplied by the appropriate static test coefficient. The load is released and the machinery/accessory is inspected again to ensure that no damage has occurred.

Dynamic Test
Lifting machinery is operated in all its possible configurations at the maximum working load multiplied by the appropriate dynamic test coefficient, taking into account the dynamic behaviour of the lifting machinery, in order to check that it functions properly.

Supply of Machinery (Safety) Regulations 2008

Lifting equipment must be designed and built to sustain a static overload of:

Manually operated machines	1.5	x WLL
Other machines	1.25	x WLL
Lifting accessories	1.5	x WLL

Machinery must be capable of sustaining a dynamic overload of:

1.1 x WLL

PUWER and LOLER

PUWER: Provision and Use of Work Equipment Regulations 1998
Applies to all work equipment

LOLER: Lifting Operations and Lifting Equipment Regulations 1998
Applies to lifting equipment in addition to PUWER

Both LOLER and PUWER apply to all sectors of industry

Status of PUWER and LOLER
These are **legal requirements** in the UK.

Internationally, these are **good practice** demanded by customers and local authorities. They are integral to the **LEEA Code of Practice**.

The Essentials of PUWER

PUWER places duties on the employer to ensure that:

- Work equipment coming into their undertaking meets with any EHSRs and in the case of lifting equipment, this would be according to directive 2006/42/EC.
- Work equipment is suitable for the purpose for which it is to be used
- The working conditions and risk to health and safety of personnel in which the work equipment is used is to be considered
- Equipment is suitably maintained and a log kept up to date
- Equipment is inspected on a regular basis (ref. LOLER)
- All inspection and maintenance records are kept and recorded
- All persons using work equipment have sufficient information pertaining to its use, e.g. operating manuals and guides to safe use

PUWER requires employer to address risks or hazards of equipment from all dates of manufacture and supply.

Equipment first provided for use after 31st December 1992 must comply with any 'essential requirements'.

Equipment may still present a hazard or risk if:

- Application is different from that originally envisaged
- Safety depends upon the way it is installed
- Technical mismatch between the supply side and user side legislation

Employers can ensure compliance by checking:

- CE Marking
- EC Declaration of Conformity

When providing equipment for use at work PUWER requires that the purchaser obtains equipment complying with the relevant European Directives.

Provision and Use of Work Equipment Regulations (PUWER)

Regulation 4	Suitability of Work Equipment
Regulation 5	Maintenance
Regulation 6	Inspection
Regulation 7	Specific Risks
Regulation 8	Information and Instructions
Regulation 9	Training

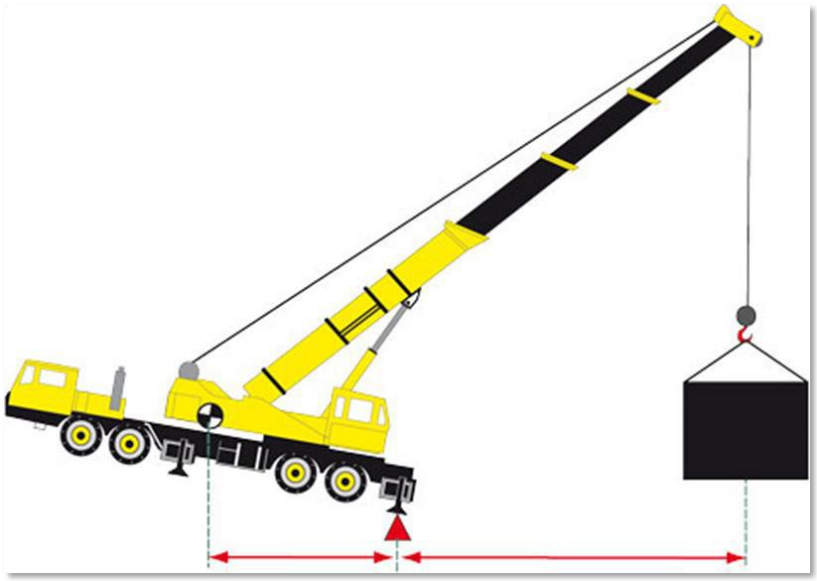
Lifting Operations and Lifting Equipment (LOLER)

Regulation 4	Strength and Stability
Regulation 5	Lifting Equipment for Lifting Persons
Regulation 6	Positioning and Installation
Regulation 7	Marking of Lifting Equipment
Regulation 8	Organisation of Lifting Operations
Regulation 9	Thorough Examination and Inspection
Regulation 10	Reports and Defects
Regulation 11	Keeping of Information

Notes:

Regulation 4: Strength and Stability

Employers must ensure that Lifting equipment is of adequate strength and stability for each load, particularly when stress may be induced at mounting or fixing points. Every part of a load and anything attached to it and used in lifting is of adequate strength.



Regulation 5: Lifting Equipment for Lifting Persons

Every employer shall ensure that lifting equipment for lifting persons –

(a) is such as to prevent a person using it being crushed, trapped or struck or falling from the carrier;
(b) is such as to prevent so far as is reasonably practicable a person using it, while carrying out activities from the carrier, being crushed trapped or struck or falling from the carrier;
(c) has suitable devices to prevent the risk of a carrier falling;
(d) is such that a person trapped in any carrier is not thereby exposed to danger and can be freed.

A mobile crane used for lifting people should

- be adequate and suitable for the task
- have a freefall capability lock-out
- be equipped with appropriate devices such as a hoisting limiter, lowering limiter, rated capacity indicator and rated capacity limiter.

The carrier should be adequately attached to the crane (e.g. by a shackle or a hook with a latch).

The crane and carrier should be inspected every day by someone competent to do so (e.g. trained operator, person in charge of the lift, etc.). If it is not regularly used, then inspect it before it is first used each time it is put into service and every day it is used.

The crane and associated equipment should be suitably de-rated (by 50%) and the crane should be operated in accordance with the recommendations in the BS 7121 series of standards.

Regulation 7: Marking of Lifting Equipment

All lifting equipment to be marked with its SWL and information that gives the items characteristics, e.g. boom length, radius, capacity (load charts) etc.

Regulation 8: Organisation of Lifting Operations

Each lifting operation must be

- planned by a competent person
- supervised
- carried out in a safe manner

Regulation 9: Thorough Examination and Inspection

Every employer shall ensure that before lifting equipment is put into service for the first time by them, it is thoroughly examined for any defect unless:

- The lifting equipment has not been used before
- An EC Declaration of Conformity should have been drawn up, the employer has received such declaration and;
- The equipment is no older than 12 months before the lifting equipment is put into service.

Maximum fixed periods for thorough examinations and inspection of lifting equipment as stated in regulation 9 of LOLER are:

Lifting Accessories	6 months
Lifting Equipment	12 months
Lifting equipment for lifting persons	6 months

The information to be contained in the report of thorough examination is given in **schedule 1 of LOLER.** LEEA also makes it available in LEEA Members templates for ROTE.

Examination Scheme

An examination scheme may specify periods of time between in-service thorough examinations different **(longer or shorter)** to the periodic examination intervals stated in the Regulations. But a longer period must be based on a rigorous assessment of the risks based on how and where the equipment will be used.

This should be included in the information provided to the competent person where the thorough examination is conducted by someone other than the competent person who agreed the longer/shorter examination periods. The examination scheme should be regularly reviewed, especially where circumstances change.

The examination scheme can be drawn up by the user, owner, manufacturer or some other independent party provided they have the necessary competence.

The examination scheme drawn up by the competent person should identify and specify those parts of the lifting equipment that should be thoroughly examined. It should specify the intervals at which the lifting equipment (or individual parts thereof) should be thoroughly examined and, where appropriate, those parts that should be tested.

Any examination scheme for lifting equipment should take account of:

(a) its condition;
(b) the environment in which it is to be used; and
(c) the number of lifting operations and the loads lifted.

Different items or parts of the lifting equipment may be thoroughly examined at different intervals, taking into account the degree of risk associated with each item or part.

Regulation 10: Reports and Defects
A person making a thorough examination for an employer under regulation 9 shall:

- Notify the employer immediately of any defect in the lifting equipment which in his opinion is or could become a danger to persons

- As soon as possible make an examination report in writing authenticated by him or on his behalf by signature or equally secure means and containing the information specified in Schedule 1 to the employer

- **Where there is, in his opinion, a defect in the lifting equipment involving an existing or imminent risk of serious personal injury, send a copy of the report as soon as is possible to the relevant enforcing authority**

Every employer who has been notified shall ensure that the lifting equipment is not used before the defect is rectified.

Regulation 11: Keeping of Information
An employer obtaining lifting equipment shall:

- Keep the EC Declaration of Conformity for so long as they operate the lifting equipment
- Ensure that the information contained in every report is kept available for inspection

	Declaration of Conformity	Reports of Thorough Examination
Lifting Appliances/ Machines	As long as the employer operates the equipment	Until the employer ceases to own the equipment
Lifting Accessories	As long as the employer operates the equipment	For a minimum of 2 years after the report is made

Notes:

Notes:

2. STANDARDS AND CODE OF PRACTICE

What are Standards?

Standards are a published specification that sets a common language and contains a technical specification or other precise criteria. They are designed to be used consistently, as a rule, a guideline, or a definition.

Standards are applied to many materials, products, methods and services helping to make life simpler and increase the reliability and effectiveness of goods and services.

Standards are designed for voluntary use and do not impose any regulations, but laws may refer to a specific standard, making compliance with them compulsory.

Reference is made in legislation to Standards and Codes of Practice and we must refer to these for further information and guidance.

Manufacturing standards detail dimensions, materials and safe working loads.

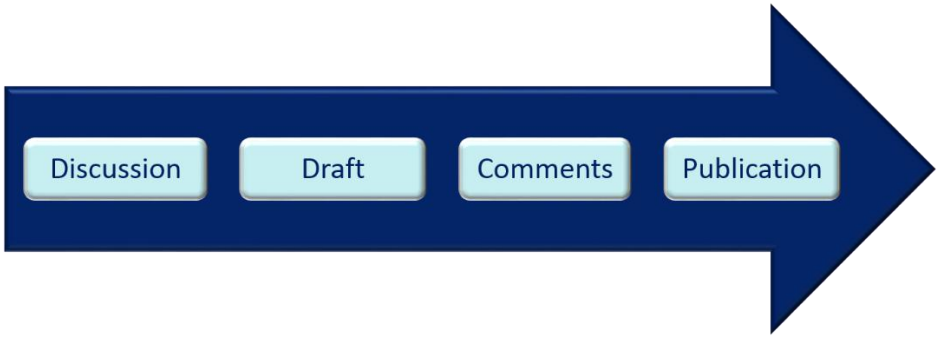
- E.g. BS EN 14492 (Winches and Hoists)

Performance standards offer a range of criteria that the final product must meet.

- E.g. BS EN 13001 – Cranes (General Design)

Creating Standards

Standards are usually created by a collective of appropriately experienced and qualified people who function together as a committee. Details of proposed standards are agreed and a draft of the standard is released for anyone who has an interest in the standard to make comments about the contents. When the reviews have finished, the standard may be published.



Notes:

British Standards

Modern standards are written as safety standards for new products.

Older standards are more detailed, covering materials, workmanship, design, test and examination requirements.

Some standards take the form of recommended Codes of Practice, covering the use, maintenance or application of specific products or the conduct of certain processes.

Harmonised European Standards (Transposed)

For lifting equipment, these standards are made through the European Standards body CEN. The standards bodies of the member states (BSI in the UK) are then required to withdraw any conflicting standards and publish the Harmonised Standard as their national standard. A manufacturer can demonstrate compliance with the requirements of a Directive by working to Harmonised Standards since the standards address the requirements.

CEN standards carry the prefix EN. In practice the standards bodies of the member states publish the standards with the additional prefix used for their national standards, e.g. in the UK they are published with the prefix BS EN and in Germany as DIN EN. The number of the standard and its content is then identical throughout Europe. However, not all EN standards are Harmonised and it is necessary to refer to the standard to establish its relationship with Directives.

Transposed Harmonised European Standards are intended to remove technical barriers to trade and to be recognised throughout Europe and beyond. They have a quasi-legal status under the European Directives and working to them is the easiest way for a manufacturer to demonstrate compliance with the 'essential safety requirements' addressed by the standard.

ISO Standards

ISO (or International Standards) are generally performance standards which are agreed internationally by a majority vote.

Their use is optional, but they are often used as the basis for writing national standards.

Where the UK accepts these as written, they are published as British Standards.

A new practice has been adopted in recent years of using the ISO number and adding the prefix BS, for example ISO 4301- Cranes Classification -General-2016 is published as BS ISO 4301-1-2016

Approved Codes of Practice

The Regulations which provide the detailed requirements of the general duties set out in HSWA do not specify how employers and others should meet those requirements. This is the role of the Approved Codes of Practice (ACoPs). They detail how to comply with the legal requirements.

ACoPs are issued by the Health and Safety Executive with the consent of the relevant government minister and following consultation with government departments, employers' and employees' organisations, and expert opinion in the subject area.

There are ACoPs accompanying some of the health and safety regulations which have particular significance beyond providing guidance on how to comply with the requirements of the regulations. This is because contravention of the advice in a code of practice is admissible in evidence to prove a breach of the statutory provisions as set out in HSWA itself and the associated regulations.

The introduction to ACoPs contains the following statement:

> *"Although failure to comply with any provision of the code is not actually an offence, such a failure may be used in criminal proceedings as evidence that a person has contravened a regulation to which the provision relates. In such a case, however, it will be open to that person to satisfy the court that he has complied with the regulation in some other way."*

It is important not to confuse Regulations with Approved Codes of Practice (ACoPs). ACoPs do not state legal requirements and, therefore, you cannot be prosecuted for failing to comply with any guidance contained in them. However, if you do not comply with them, this may be used as evidence of non-compliance with the Regulations, unless you can prove otherwise.

Examples of Approved Codes of Practice are:

- ACoP L113 - LOLER ACoP (Lifting Operations and Lifting Equipment Regulations)
- ACoP L22 - PUWER ACoP (Provision and Use of Work Equipment Regulations)

Codes of Practice and Guidance

- Approved Codes of Practice (e.g. L113 LOLER ACoP 2014)
- Recommended CoP (e.g. LEEA COPSULE)
- Trade or Professional Code of Practice (e.g. LEEA Technical requirements)
- Technical publications (e.g. Manufacturer's specifications)
- Safety information sheets

Status of the Approved Code of Practice (ACOP) is quasi-legal

- An ACOP is a step down from the regulations
- The requirements are not absolute
- Normally be expected to follow them
- Provide a benchmark against which a court may judge alternatives

Status of Guidance

- Guidance is another step down in status
- Does not have a special status in law
- The guidance is not compulsory
- If you follow the guidance you will normally do enough to comply with the law

Health and safety inspectors seek to secure compliance with the law and may refer to this guidance as illustrating good practice. (Section 20, 21 and 22 of HSWA)

Notes:

3. ON SITE SAFETY

A Few Essential Rules

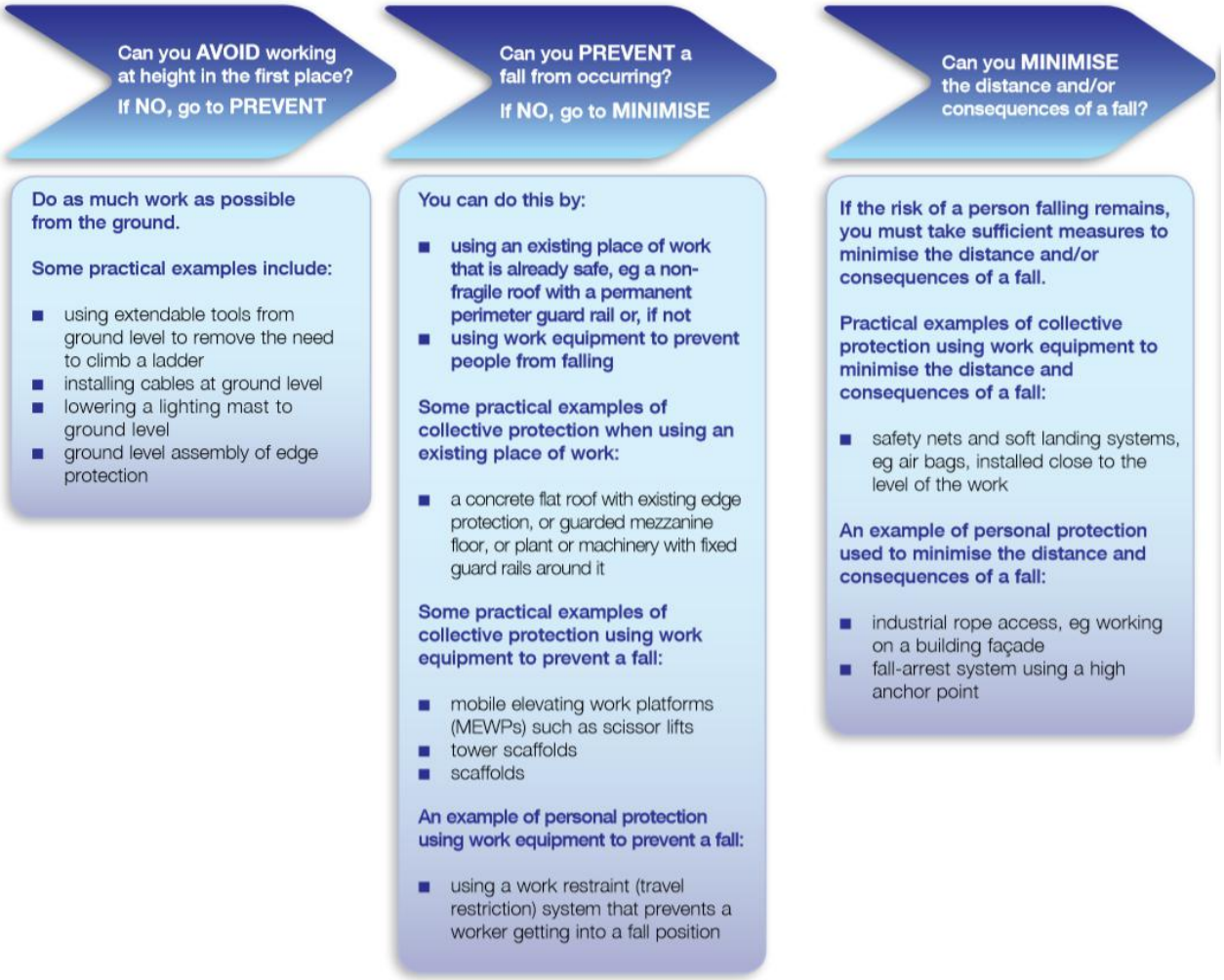
- Do not take shortcuts in the planning of safety for the work to be done
- Do not take risks
- If your job cannot be done safely, your employer will not want you to do it
    - Always talk to your line manager if you have concerns
- Report unsafe conditions or unsafe working behaviour immediately

Working at Height

Thorough examination activities carried out on mobile cranes outside of edge protected areas are required to comply with the Work at Height Regulations 2005, which prioritise the fall protection measures which should be used.

Duty holders must:

Notes:



Working Above Ground Level

Hierarchy of Control Measures

1. Working Platforms (crane walkways etc.)
2. Scaffolding
3. MEWPs
4. Controlled Zones
5. Safety Nets and Air bags
6. Work Positioning
7. Horizontal and Vertical Lifelines
8. Fall Arrest Equipment

Rescue Plan

A Rescue Plan must be developed whenever fall-arrest systems are in use and when personnel may not be able to perform a self-rescue should a fall occur.

Before requesting a Rescue Kit (which is the last resort), you must first consider whether ladders, stepladders, MEWPs, controlled decent devices or other equipment can be used to perform a rescue.

If all else fails, then a Rescue Kit should be used.

Other Things to Consider for a Rescue Plan

- You must never rely on the emergency services as a primary rescue plan
- What obstructions may be in the way of reaching a suspended worker?
- How will the rescue be assured within 10 minutes of the fall to minimise the risk of further injury or suspension trauma?
- How will the safety of the rescuers be assured as well as the suspended worker?
- What communications will be used between the suspended worker and the rescue team?

Risk Assessment

When identifying sensible measures to control risks, concentrate on real risks - those most likely and those which will cause most harm.

Consider particular control measures as part of overall assessment.

Hazard	•An object or situation that has the potential to cause harm
Danger	•A liability or exposure to harm; something that causes peril
Likelihood	•How likely is it that someone could be harmed by the hazard?
Severity	•If the potential for harm occurs, how severe would the incident be?
Risk	•The likelihood that the harm from the hazard is realised

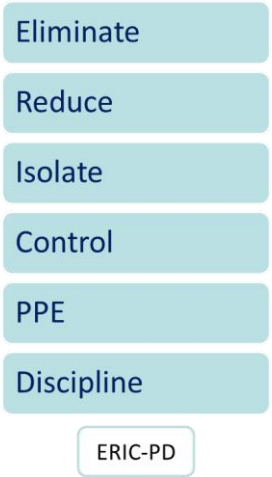
Notes:

5 Steps to Risk Assessment

Example of Risk Assessment

What are the hazards?	Who might be harmed and how?	What are you already doing?	Do you need to do anything else to control the risk?	Action by who	Action by when
Slips, trips and falls	All personnel present Broken bones	Good housekeeping procedures Correct PPE Barriers Toolbox talk	Monitor personnel and traffic accessing the area	Site supervisor Crane supervisor Competent person	Prior to and during thorough examination

Hierarchy of Control Measures



ERIC-PD

Monitor and Review

"Ensure control, measure compliance"

Note any changes during operations such as:

- additional hazards presented
- traffic, pedestrians etc.
- changes in production activity

Record your findings and change the risk assessment as necessary. This may result in the requirement for additional control measures.

Safe System of Work

So far. you have reviewed how to implement a safe system of work.

A safe system of work is a best practice that will allow you to minimise the risks.

When you follow a safe system of work:

- ✓ You have identified the hazards
- ✓ You have decided who may be harmed
- ✓ You have evaluated risks and implemented the control measures required (ERIC PD)
- ✓ You have recorded your findings
- ✓ You have reviewed and monitored the situation when required

Method Statements and Work Instructions

- Generic risk assessments will normally suffice
- Unusual or potentially hazardous tasks may require specific risk assessment
- Always follow a 'Safe system of work'
- Toolbox talk
  - All team members are fully briefed
  - Focussed
  - Discuss the 'job specific' method statement
  - Briefings should be recorded
  - Unusual features of the job to be highlighted

Notes:

4. PERSONAL PROTECTIVE EQUIPMENT

Making the workplace safe includes providing instructions, procedures, training and supervision to encourage people to work safely and responsibly.

Before starting a thorough examination or test, the competent person will have completed a site risk assessment and so will be able to select the appropriate safety equipment to wear.

Even where engineering controls and safe systems of work have been applied, some hazards might remain. For example,

Injuries to	Hazard	Suitable PPE
Lungs	Breathing contaminated air	Respirators
Head and feet	Falling materials	Hard hats and safety boots
Eyes	Flying particles or splashes of corrosive liquids	Safety glasses
Skin	Contact with corrosive materials	Overalls or gloves
Body	Extremes of heat or cold	Overalls

PPE is required to protect from these hazards as a control measure.

What do the PPE Regulations Require?

PPE as a control measure is one of the least preferred methods. Wherever there are risks to health and safety that cannot be adequately controlled in other ways, the Personal Protective Equipment at Work Regulations 1992 require PPE to be supplied.

The Regulations also require that PPE is:

- Properly assessed before use to make sure it is fit for purpose
- Maintained and stored properly
- Provided with instructions on how to use it safely
- Used correctly by employees

Key Points

Are there other ways to adequately control the risk? e.g. by using engineering controls.

If not, check that:

- Suitable PPE is provided
- It offers adequate protection for its intended use
- Those using it are adequately trained in its safe use
- It is properly maintained, and any defects are reported
- It is returned to its proper storage after use.

Ensure all site safety procedures are followed always!


Wear boots
Eye protection must be worn
Wear gloves
HEAD PROTECTION MUST BE WORN IN THIS AREA
Wear ear protectors
Wear protective clothing

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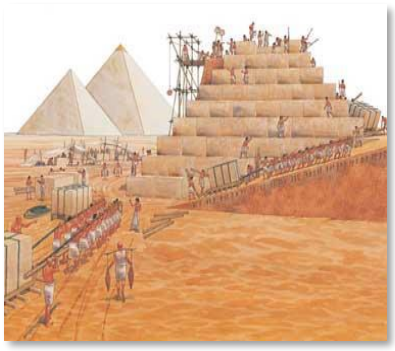
Notes:

5. ORIGINS OF MOBILE CRANES

Democracy and Devotion: Greeks Invent the Crane
Traditional methods like ramps for moving and lifting the enormous building stones of massive monuments like the Parthenon just weren't going to get the jobs done.



Meet the crane: at first a simple winch and pulley system and then later a compound pulley system credited to Aristotle.

Today, you can see the difference in the ways buildings were constructed in different time periods.

Pre-cranes, building blocks tended to be much larger, because so much effort was required to push each one up a ramp, it was less labour-intensive to use bigger and fewer blocks.

Origins of Mobile Cranes

Post-cranes, blocks were smaller but stacked higher, in more complicated and advanced structures, and quicker.

In the end, the Greeks proved just how much more ambitious projects could be, with the help of a crane. Rome wasn't built in a day, but without the introduction and improvement of the Greek cranes, construction would have taken much, much longer than it did.

In fact, the Romans were the first to use multiple cranes for cooperative lifting tasks, as is evident by the massive cornerstone blocks used in some of the famous structures.

But beyond the beautiful, historic, crane-built city still very visible today, perhaps the most impressive aspect of Roman crane use was the way they were used far from their home.

Again—necessity drives innovation. The Roman Empire stretched further and further away from Rome and conquering armies became more and more ambitious, so mobility and versatility in their cranes became key.

The Roman army needed cranes that could move quickly, be assembled and torn down quickly, and perform a variety of tasks—all without losing their powerful lifting capabilities.

Today, you can see that influence in how mobile cranes are used all over the world. You find them on boats, docks, trains, and trucks, often able to be quickly adapted for difficult and unusual tasks.

The lifting capacity in mobile cranes has skyrocketed, up to 1,500 tonnes. In the end, the Romans proved just how much mobility and versatility has increased construction capabilities.

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6. THE THOROUGH EXAMINATION

In accordance with LOLER and PUWER 1998, a thorough examination must be:

- A systematic and detailed examination of the equipment and safety-critical parts
- Carried out at specified intervals
- Undertaken by a competent person
- Used to determine whether the equipment under examination is safe to take into use or safe to continue in use
- Documented in a written report.

When planning the examination, also consider the operating environment – is it hazardous and/or populated?

The owners/users may use report information to plan maintenance based on trends of breakdowns and repairs – reducing incidents – and to determine the effectiveness of maintenance schedules.

Thorough Examinations of Mobile Telescoping Cranes and Intervals

Periodic Thorough Examination - LOLER Reg. 9(3)(a)(i) and (ii) and BS 7121-2-1 (8.7)

LOLER specifies intervals of:

- 6 months maximum for mobile cranes used to lift personnel
- 12 months for mobile cranes that only lift goods

The maximum intervals may be reduced by a competent person, the mobile crane user or the mobile crane owner if they decide that environmental factors, the age or the condition of the mobile crane warrant it or if the frequency and likely load schedule justify it.

Thorough Examination after Exceptional Circumstances

LOLER 1998 requires that if the crane is subjected to exceptional circumstances, it must be removed from service and subjected to a thorough examination to determine whether it is safe to be returned to service.

Exceptional circumstances include:

- overload
- jib clash
- collision
- use for particularly arduous duties
- failure of a structural component or
- being subjected to weather in excess of design parameters

The scope of the thorough examination should be proportional to the nature of the exceptional circumstances and the extent of any repairs, It should consider the reports of previous thorough examinations, where applicable.

Scope of Periodic Thorough Examination

The competent person carrying out a periodic thorough examination should work to a defined scope of thorough examination that has been drawn up specifically for the crane they are required to examine. Different scopes might be required for individual cranes of the same type and model to reflect different thorough examination requirements resulting from differing service histories, past use and intended future use.

It is recommended that a defined scope of thorough examination approach should be used for all cranes. It is likely that generic scopes of thorough examination, supported by crane specific information, can be written for specific makes and models of crane.

The defined scope of thorough examination should be drawn up in advance of the examination and should identify those parts of the crane that should be thoroughly examined, together with required supplementary supporting reports and tests and the extent to which they should be witnessed.

E.g. ISO 4309 for wire rope discard criteria.

The defined scope of thorough examination should specify the intervals at which the crane (or its individual parts) should be thoroughly examined and, where appropriate, intervals for specific supplementary supporting reports and tests. These intervals should reflect the anticipated rate of deterioration and the likelihood and potential consequences of failure.

The defined scope of thorough examination should be drawn up by a formally appointed competent person. The competent person may be employed by the user, owner or manufacturer of the crane or by some other independent party, provided they have the necessary competence. This competent person could also carry out the thorough examinations, supplementary reports and tests of the crane. However, in practice, it is likely that these will be undertaken by other competent persons who are suitably knowledgeable and trained.

Supplementary Testing in Support of Thorough Examination
Supplementary testing in support of thorough examination can include:

- Anemometer functional test and calibration check
- Spark arrestor test
- Electrical system inspection and tests
- Electrical/electronic control system test program run
- Function testing
- Hoist brake operational test
- Hoist/luffing winch assessment
- Hook blocks inspection
- Hydraulic system tests
- Overload testing
- Maintenance log/reports check
- Non-destructive testing of individual components
- Performance testing of the crane
- RCI/RCL calibration checks and functional tests
- Sheaves check
- Slew brake, test of operational efficiency
- Slew ring bearing clearance measurement and condition assessment
- Stowage of the crane's superstructure for transport, functional test

Note: This list is not exhaustive.

Scope of Periodic Thorough Examination
The defined scope of thorough examination should take account of…

- the crane manufacturer's information (which may include a scope of thorough examination)
- the maintenance history of the crane
- previous thorough examination history
- the environment in which it is to be used
- the number of lifting operations to be carried out
- the magnitude of the loads to be lifted
- recurring defects

The competent person carrying out the thorough examination may add to the defined scope but is not permitted to reduce it. The competent person should highlight any concerns about the scope to the competent person who prepared the defined scope.

The defined scope of thorough examination should be documented and kept in a way so that it cannot be lost or modified without authorization and can be reproduced as a paper copy if required. The competent person who prepared the defined scope of thorough examination should periodically review it 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.

It is essential that the defined scope of thorough examination includes all components that may be used with the crane in different configurations, together with dedicated ancillary equipment. Pay attention to wire ropes.

Components that are regularly used with the crane should be included in every thorough examination of the crane. Other components should be thoroughly examined prior to use. Take precautions like quarantining to ensure that such components are not used unless there is a current through examination report for the component.

Examination Schemes

As an alternative to the maximum intervals of 6 months or 12 months for periodic thorough examination, LOLER 1998 allows a competent person to draw up an "examination scheme" for an item of lifting equipment such as a crane.

These intervals may be shorter or longer than the 6 month or 12 month intervals and should reflect the anticipated rate of deterioration and likelihood and consequences of failure. This is to ensure that the examination scheme will identify defects of a serious nature in good time and before they become a danger to persons.

The benefit of an examination scheme is that, by focusing on the most safety critical areas, the examinations can be carried out the most cost effective way. This may provide a means of reducing examination costs, however, it may also provide a means of enhancing safety without increasing costs.

Notes:

Information for Examination Schemes

The examination scheme should contain at least the following information:

a) name and address of the crane owner

b) name, qualifications and address of the person drawing up the scheme and certifying that it is suitable and sufficient. If the competent person is not working on their own account, the name of their employing organization and their position in that organization

c) make, model and unique identification number of the crane

d) references of any information used in drawing up the scheme. This might include the manufacturer's instructions and/or specific information from the designer on the design life of the structure and mechanisms

e) details of any data logging system fitted, including a listing of the parameters monitored and the means by which data retrieval, monitoring and storage is achieved

f) details of the environment in which the crane is to be used during the period covered by the scheme

g) identification of those parts of the crane requiring thorough examination and the probable modes of deterioration, for example wear and corrosion

h) frequency of thorough examination for those parts of the crane identified. This frequency might be time based, or based on loading or duty cycle limits and might vary for different parts of the crane

i) method of thorough examination of those parts of the crane identified as requiring thorough examination, which might include the degree of dismantling required, any preparation to be carried out by the user prior to the examination, NDT techniques and timed component renewal

j) an indication of the resources required to carry out the thorough examination. This might include qualified personnel, workshop facilities, specialist NDT and metallurgical facilities

k) any changes to crane condition, operational or environmental parameters that would require a review of the scheme by the competent person. These might include damage to the structure, change of use from general use to heavy duty work, or moving from an inland location to a marine environment

l) the date of drawing up the scheme and the date on which the next routine review of the scheme is required

The examination scheme should determine whether all mechanisms function correctly and are free from defects and whether the crane is safe for further use.

Notes:

Overload Testing

Under LOLER there is no requirement for 4 yearly overload testing

Disadvantages of overload testing include:

- Damage over time to the crane structure
- Structural failures are usually a consequence of fatigue, defects of this type will not be shown by an overload test
- The result of cranes that fail during testing can be both hazardous and costly
- Inspection organisations and most manufacturers do not advocate overloading as there are no mechanical or structural benefits
- Some insurance contracts will not insure a crane that has been overloaded even if the overload was only carried out for testing purposes
- It gives a false sense of security to both owners and users

The requirement for any testing and the types of test are at the discretion of the competent person and the crane manufacturer should be contacted for guidance if load testing is necessary.

Verification Tools and Inspection Aids

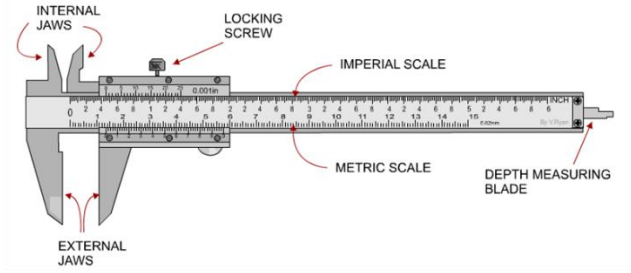
When carrying out thorough examination and/or testing of a mobile telescoping crane it will be necessary to verify calculations, dimensions, measurements, radii, weights or angles.

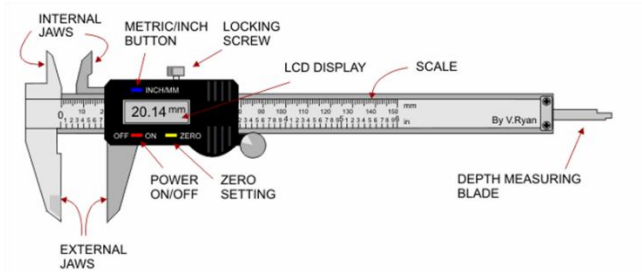
To do this requires using some of or all the following instruments:

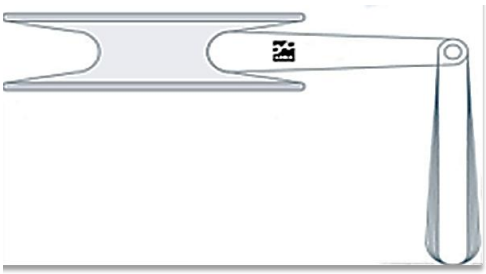
- Vernier gauges
- Rope and sheave gauges +5%
- Tape measures
- Load cells
- Angle indicator / inclinometer
- Spirit level
- Calculator and notebook
- Tyre pressure gauge
- DTI gauge
- Torch / supplementary lighting
- Inspection mirrors
- Engineers chalk / liquid chalk or paint

This list is not exhaustive.

Vernier gauges measure the diameter of a rope







Sheave gauges measure wear on a sheave

Steel tape for measure and dimensional check

Load cells verify the actual load shown

Spirit levels or crane level gauges on outriggers

Tyre gauges for tyre pressures

Angle indicators/ inclometers for boom angle

Telescoping inspection mirrors to see behind bumpers

Test Weights

Use test weights which have been proven to be accurate within ±1.0% of their nominal value by a weighing device which has been calibrated within the previous 12 months.

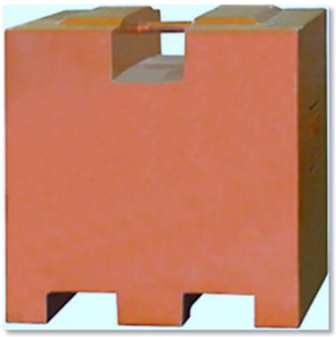
The accuracy of the weighing device should be such that the sum of the possible calibration error and the indicated load error do not exceed ±1.0% of the required test load.

Concrete Test Weights

- Cheap to make
- Easy to use
- Easily damaged
- Verified annually because of damage or erosion

Steel Test Weights

- Initially weighed for verification
- Expensive - require heavy transport
- Easy to use, compact
- More secure lifting points



Water bags

- Easy to transport
- Awkward to handle
- Requires disposal of water after use
- No requirement for verification but…….

The LEEA recommendation is in **LEEA Guidance Document 051 – Guidance on Design, Inspection, and Use of Water Bags as Test Weight in the Offshore Industry**. To meet PUWER and LOLER, all bags and associated lifting accessories should be inspected by a competent person at least at 6 monthly periods, as the beam or shackle that comes with it, for example, are accessories and fall under LOLER's inspection regime. An examination before each use is also recommended.

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7. TYPES OF CRANE

There are many types of mobile crane. In this module, you will find some common types that you are likely to encounter during examinations.



Rough Terrain Crane

This crane is ideal for rough terrain and is capable of “free on rubber” duties.

When function testing “free on rubber” duties, as safety precautions in the event of the tyres failing, it is advisable to have the outriggers extended and the jacks sufficiently clear of the ground to allow loading.

Truck Mounted Crane

If not fitted with a 5th or front jack, this type of crane may have restricted or no duties in the front quadrant. Always refer to the rated capacity chart.

All Terrain Crane

This crane is designed to be used under different ground conditions. Outrigger controls allow the operator from the upper cab to raise and stow the jacks and outriggers. A steering wheel and brake pedal are also fitted in the upper cab to allow travel around the site to a new position.

When examining this type of crane it is essential that both sets of steering and braking systems are shown to operate.

City Crane

The city crane has a very short boom with more sections than a normal mobile crane to allow greater manoeuvrability while still retaining boom length. It is all-wheel steering and the boom is kept low to avoid overhead obstructions prevalent in an urban area.

Yard Crane

This type of crane is designed for use in yards where it is not always convenient or possible to deploy outriggers and where a rough terrain crane is too large. The yard crane has “free on rubber” capabilities and a strong platform where rated loads (e.g. pumps, motors, valves) as per the rated capacity chart may be transported.

Crawler Mounted Telescopic Crane

Telescoping cranes mounted on tracks are usually used for on-site work and can be examined in the same manner as wheeled cranes with the exception, obviously, of the undercarriage. It is easier nowadays to inspect the tracks as the drive system is hydraulic rather than mechanical so you do not have to worry about drive chains, gears etc.

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8. RATED CAPACITY CHARTS

Rated Capacity Charts provide critical information to enable Rated Capacity Limiters (RCLs) to be calibrated correctly and lifting operations to be planned and carried out safely.

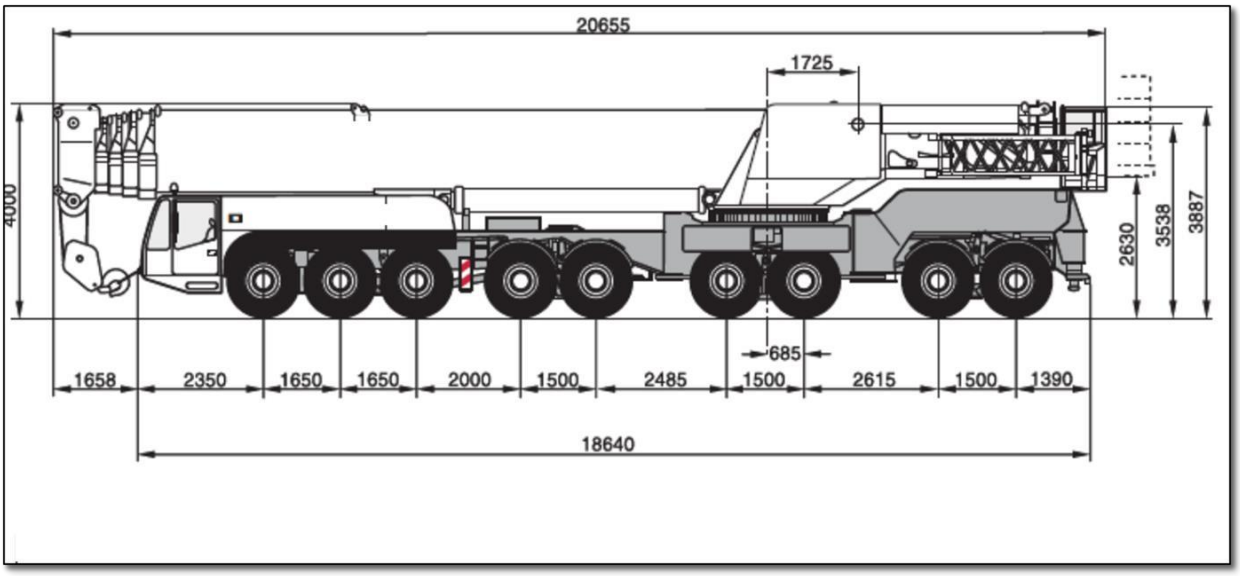
Rated Capacity Charts are essential to the crane operator to enable them to input the correct information into his RCL so they can operate safely and within the design parameters of the crane.

The technical information contained in Rated Capacity Charts is important to the competent person(s) when carrying out their examinations.

In this module are examples of Rated Capacity Charts which shows the type of the information that the competent person may use to carry out a complete thorough examination and functional test of a mobile crane.

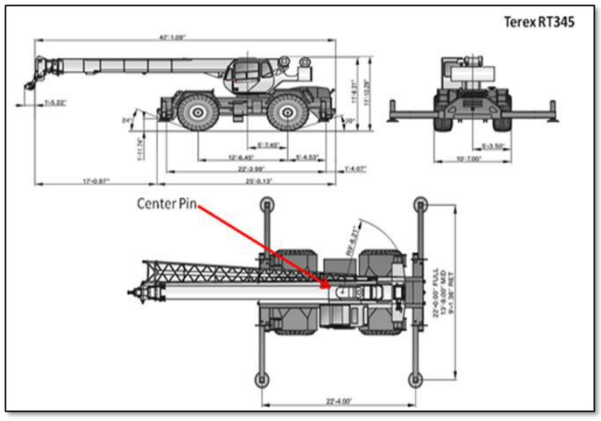
Crane Dimension

Knowing the dimensions of the mobile crane allows a lift planner and the examiner to determine whether the crane can access the required area for the lift or test.



Knowing the weight of the crane ensures it can safely travel to its location without exceeding weight restrictions for roads, bridges, crossings or recent excavations.

With rough terrain cranes, the weight is required to ensure appropriate heavy transport is available to relocate the crane from site to site.



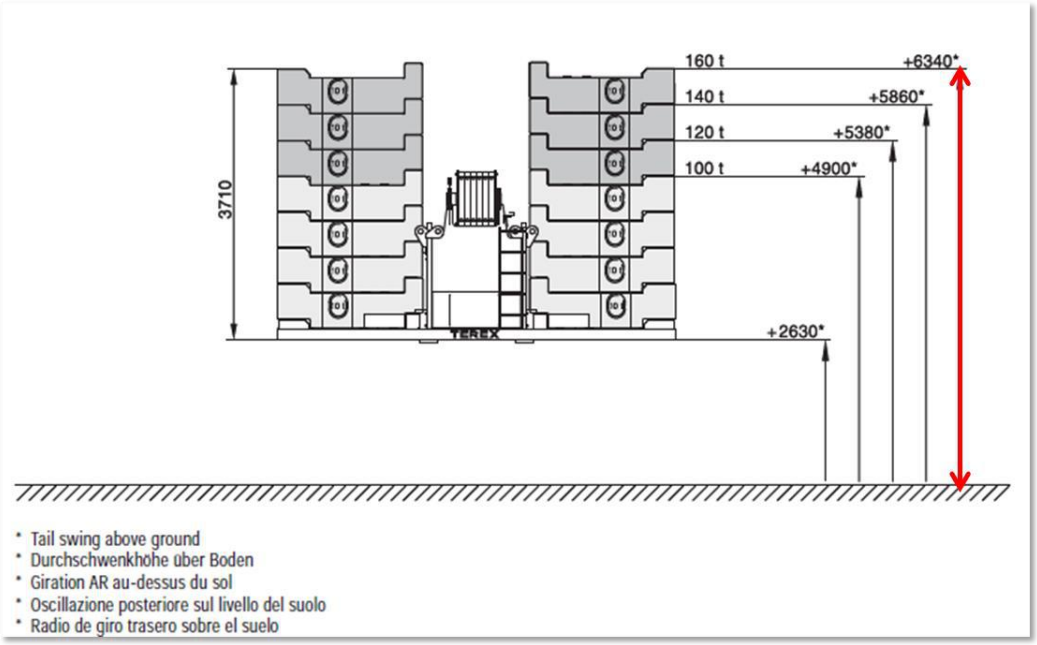
Crane Weights

The transport weight determines the trailer to be used, how to load the crane on the trailer, the route to take, and what permits are required to get the crane to the jobsite.

T 340-1 XL Boom in front travel position		GVW Gross Vehicle	Front max. 22,000 lb	Rear max. 45,000 lb
Configuration:				
	1/4 tank fuel 200 lb Operator seated in cab Front Tires: 445/65 R22.5-20PR Rear Tires: 11R22-14PR 105 ft Boom/No Jib 11,000 lb total counterweight	60,053	16,515	43,528
Add / subtract for options with 105 ft boom:				
	32 ft swing-on jib	+ 1,368	+ 1,117	+ 251
	32 ft to 49 ft extendable swing-on jib	+ 1,789	+ 1,343	+ 446
	Auxiliary boom head	+ 100	+ 170	- 70

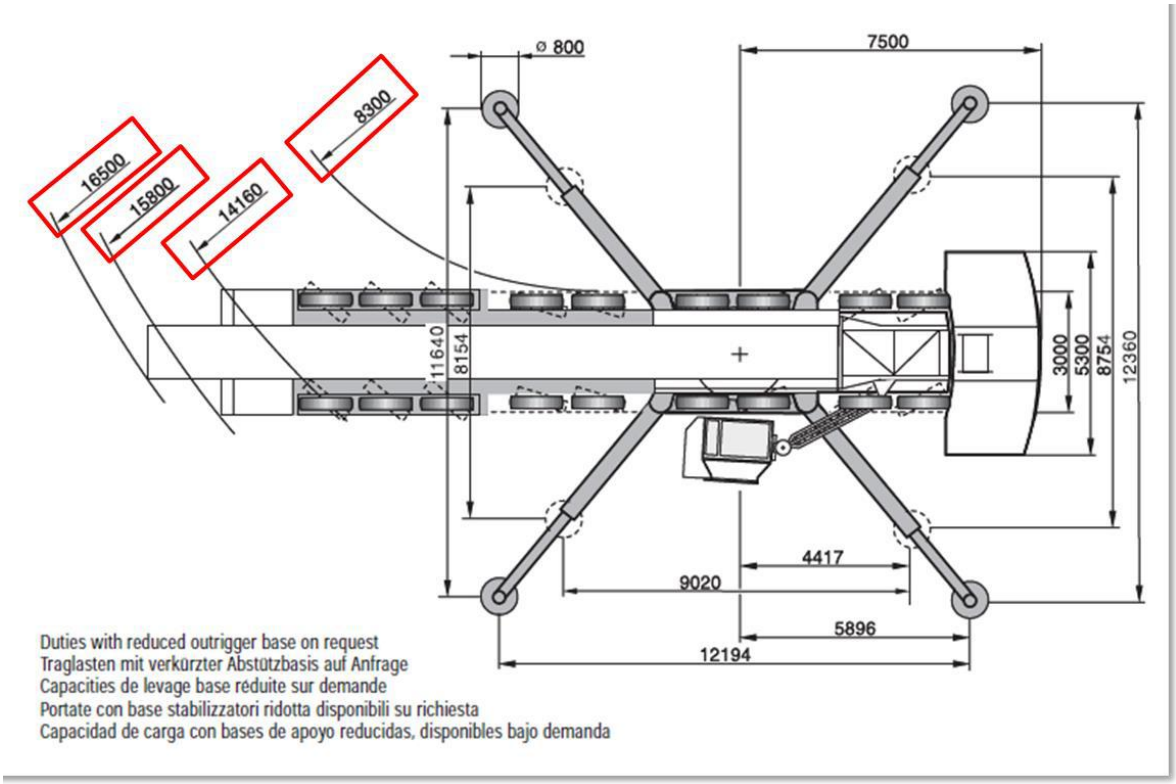
Along the top axis is the gross vehicle weight. In the other two columns, the arrows indicate the weight load for each axel, depending on what additional accessories are loaded.

Counterweights, Installation and Tail Swing



Knowing the height of the counterweight configuration allows the crane to be set up in a location that does not interfere with overhead or protruding obstructions such as scaffolding.

Outrigger Configuration



Because different cranes have different configuration of outriggers, it is important to know the outrigger setup, whether X pattern as shown or H pattern where the outriggers extend straight out from the chassis, and also the length of the outriggers. This allows the crane to be set up so the outrigger pads do not sit on underground utilities or recent excavations.

Knowing the turning circle confirms that the crane can actually access the site at the required location. There have been cases of cranes arriving at a site and being unable to enter because of the width of road restricts the turning circle of the crane and prevents it entering the gates.

Notes:

Hoists and Wire Rope

WORKING SPEEDS (INFINITELY VARIABLE) · ARBEITSGESCHWINDIGKEITEN (STUFENLOS REGELBAR) · VITESSES DE TRAVAIL (RÉGLABLES SANS PALIERS) · VELOCITÀ DI LAVORO (A REGOLAZIONE VARIABILE) · VELOCIDAD DE TRABAJO (INFINITAMENTE VARIABLE)			
Mechanisms Antriebe Mécanismes Funzioni Mecanismos	High speed Schnellgang Marche rapide Velocità rapida Velocidad rápida	Max. permissible line pull Max. zulässiger Seilzug Effort max. admis sur brin Tiro max. sulla fune Carga máx. por reenvío	Rope diameter / Rope length Seil ø / Seillänge Diamètre du câble / Longueur du câble Diametro / lunghezza fune Diam. cable / long. cable
Hoist I Hubwerk I Treuil de levage I Argano I Cabrestante I	max. 143 m/min	134 kN	26 mm 550 m
Hoist II Hubwerk II Treuil de levage II Argano II Cabrestante II	max. 151 m/min	134 kN	26 mm 770 m
Slewing · Drehwerk · Orientation · Rotazione · Unidad de giro			max. 1,0 1/min
Telescoping speed · Ausleger-Teleskopieren · Vitesse de télescopage · Velocità di sfilamento · Velocidad de telescopaje			15,4 – 60,0 m: ~ 480 s
Boom elevation · Ausleger-Winkelverstellung · Relevage de flèche · Angolazione braccio · Elevación de pluma			–0,5° – +83° 120 s
CARRIER PERFORMANCE · FAHRLEISTUNGEN · PERFORMANCE DU PORTEUR · PRESTAZIONI DEL CARRO · PRESTACIONES DEL VEHÍCULO			
Travel speed · Fahrgeschwindigkeit · Vitesse sur route · Velocità su strada · Velocidad de traslación			0 . . 63 km/h

51 The information shown here assists the examiner for a number of reasons.

The left hand boxes highlighted show the number of hoists.

The middle box shows the line pull for a single line.

The boxes on the right show firstly the diameter of the hoist wire rope and secondly the length of the wire rope. You may notice there are 2 different wire rope lengths. The shorter length is for the auxiliary hoist and is usually a single fall configuration. The longer length is required for the main hoist - as it will require multiple reeving to achieve the maximum capacity.

The box in the bottom right is the maximum and minimum boom elevation and is also shown in degrees, which allows boom limit switches to be verified.

Notes:

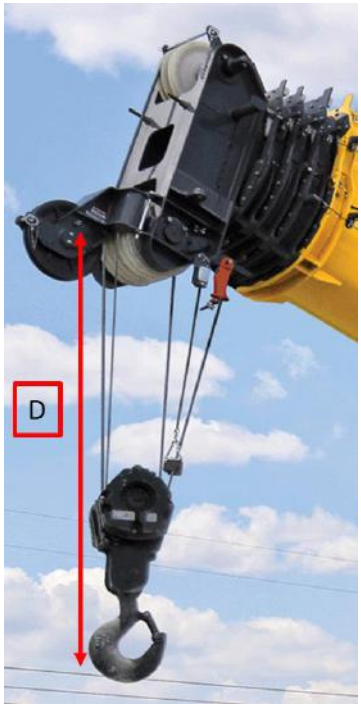
Hook Block

HOOK BLOCK / HEAVY-LIFT ATTACHMENT · UNTERFLASCHE / SCHWERLASTEINRICHTUNG · CROCHET-MOUFLE / EQUIPEMENT LEVAGE LOURD · BOZZELLO / EQUIPAGGIAMENTO PESANTE · GANCHO / EQUIPO DE CARGAS PESADAS

Type Typ Type Tipo Tipo	Possible load Mögliche Traglast Charge possible Portata possibile Carga permitida	Number of sheaves Anzahl der Rollen Nombre de poulies Nº di pulegge No de poleas	Weight Gewicht Poids Peso Peso	„D"	Number of lines Strangzahl Nombre de brins Nº max avvolgim. Reenvíos máx.	Heavy-lift attachment Schwerlasteinrichtung Equipement levage lourd Equipaggiamento pesante Equipo de carga pesada
320	312,0 t	13	4000 kg	4,50 m	26	2 add. sheaves / Zusatzrollen / poulies suppl. / puleggie suppl. / poleas adicionales
250	235,0 t	9	2800 kg	4,50 m	19	
200	189,0 t	7	2600 kg	3,00 m	15	
160	141,0 t	5	2200 kg	3,00 m	11	
100	92,0 t	3	1800 kg	3,00 m	7	
40	40,0 t	1	1200 kg	2,70 m	3	
13,5	13,5 t	Single line hook / Hakengehänge / Boulet / A palla / Gancho de tiro directo	650 kg	2,00 m	1	

The above shows types of hook blocks for specific maximum loads, their actual weight, number of sheaves and the reeving required to achieve maximum load lift.

The 'D' circled refers to the minimum distance where the hook block activates the anti two block. This ensures that the hook block does not contact the boom at its maximum elevation.



Rated Capacity Chart (Load Chart – Over Rear)

37 - 90 ft. (11.2 - 27.4 m) | 6,000 lbs. (2722 kg) | 100% | OVER REAR

Pounds

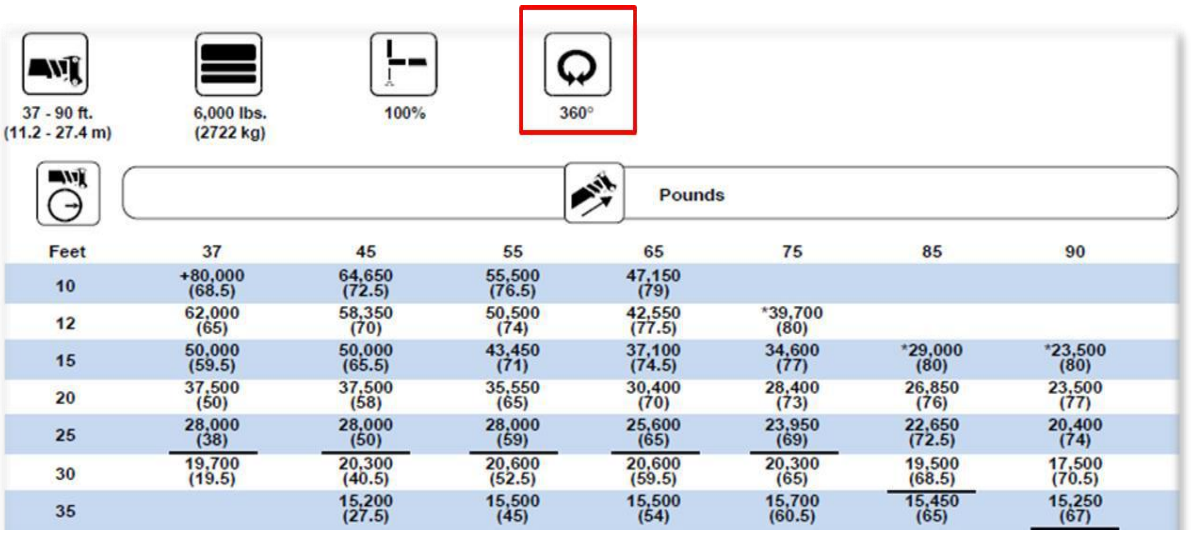
Feet	37	45	55	65	75	85	90
10	+80,000 (68.5)	64,650 (72.5)	55,500 (76.5)	47,150 (79)			
12	62,000 (65)	58,350 (70)	50,500 (74)	42,550 (77.5)	*39,700 (80)		
15	50,000 (59.5)	50,000 (65.5)	43,450 (71)	37,100 (74.5)	34,600 (77)	*29,000 (80)	*23,500 (80)
20	37,500 (50)	37,500 (58)	35,550 (65)	30,400 (70)	28,400 (73)	26,850 (76)	23,500 (77)
25	28,000 (38)	28,000 (50)	28,000 (59)	25,600 (65)	23,950 (69)	22,650 (72.5)	20,400 (74)
30	20,850 (19.5)	21,000 (40.5)	21,000 (52.5)	21,000 (59.5)	20,550 (65)	19,500 (68.5)	17,500 (70.5)
35		16,250 (27.5)	16,600 (45)	16,850 (54)	17,000 (60.5)	17,000 (65)	15,250 (67)
40			13,100	13,450	13,650	13,900	13,450

This chart shows the area of operation over the rear only. Over the rear means that the crane is only rated for these capacities between the arc formed by the rear outriggers when they are extended.

5th Jack being deployed-

Notes:

Rated Capacity Chart (Load Chart – 360°)



37 - 90 ft. (11.2 - 27.4 m) | 6,000 lbs. (2722 kg) | 100% | 360°

Pounds

Feet	37	45	55	65	75	85	90
10	+80,000 (68.5)	64,650 (72.5)	55,500 (76.5)	47,150 (79)			
12	62,000 (65)	58,350 (70)	50,500 (74)	42,550 (77.5)	*39,700 (80)		
15	50,000 (59.5)	50,000 (65.5)	43,450 (71)	37,100 (74.5)	34,600 (77)	*29,000 (80)	*23,500 (80)
20	37,500 (50)	37,500 (58)	35,550 (65)	30,400 (70)	28,400 (73)	26,850 (76)	23,500 (77)
25	28,000 (38)	28,000 (50)	28,000 (59)	25,600 (65)	23,950 (69)	22,650 (72.5)	20,400 (74)
30	19,700 (19.5)	20,300 (40.5)	20,600 (52.5)	20,600 (59.5)	20,300 (65)	19,500 (68.5)	17,500 (70.5)
35		15,200 (27.5)	15,500 (45)	15,500 (54)	15,700 (60.5)	15,450 (65)	15,250 (67)

This chart shows 360° capacity. By deploying the front jack, the crane rated capacities shown are applicable through the full 360° rotation.

Rated Capacity Chart (Load Chart)

This rated Capacity Chart clearly outlines the areas of operation with and without the 5th jack being deployed.

■RATED LIFTING CAPACITY

10.6 m — 34.0 m Boom

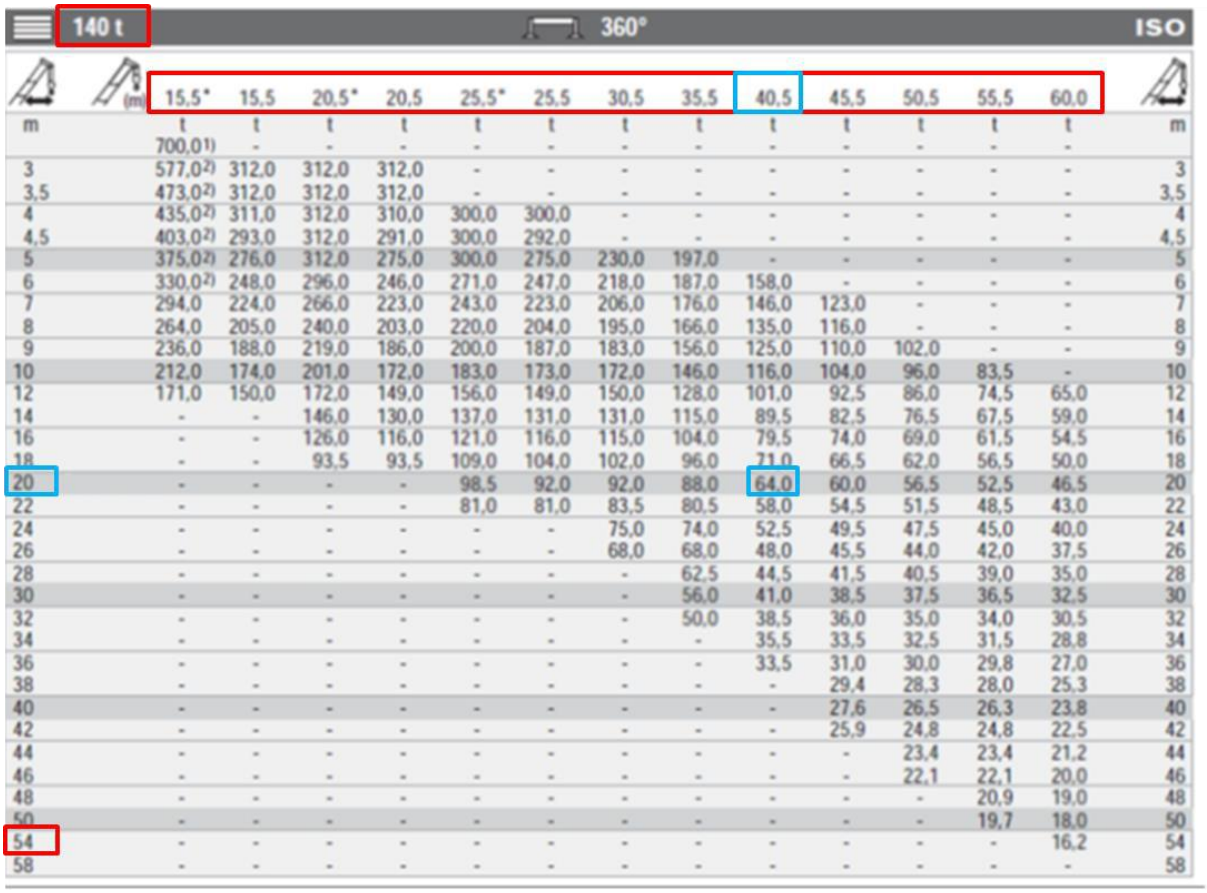
Outriggers fully extended with front jack -360° full range
Outriggers fully extended without front jack -over side and over rear

Working radius (m)	10.6 m Boom	14.5 m Boom	18.4 m Boom	22.3 m Boom	26.2 m Boom	30.1 m Boom	34.0 m Boom
2.5	30.00	23.00	16.00				
3.0	30.00	23.00	16.00				
3.5	26.50	23.00	16.00	12.00			
4.0	24.00	23.00	16.00	12.00	12.00		
4.5	22.00	21.50	16.00	12.00	12.00		
5.0	20.10	19.80	16.00	12.00	12.00	9.50	
6.0	16.50	16.10	15.00	12.00	12.00	9.50	7.50
7.0	13.70	13.20	13.10	12.00	12.00	9.50	7.50
8.0	11.40	11.10	11.00	11.00	10.55	9.50	7.50
8.5	10.30	10.30	10.20	10.25	9.95	8.95	7.50
9.0		9.40	9.30	9.50	9.40	8.40	7.50
10.0		7.60	7.50	8.00	8.30	7.50	6.90
12.0		5.30	5.10	5.60	5.90	6.10	5.70
14.0			3.65	4.05	4.30	4.50	4.70
16.0			2.65	3.00	3.30	3.45	3.60
18.0				2.25	2.50	2.70	2.80
20.0				1.65	1.90	2.10	2.20
22.0					1.45	1.60	1.70
24.0					1.05	1.25	1.35
26.0						0.90	1.00
28.0						0.65	0.75
30.0							0.55
31.0							0.45
Standard hook	for 30 ton						
Hook mass	300 kg						
Parts of line	10	8		4			
Critical boom angle	—	—	—	—	—	—	—

(Unit: Metric ton)

Load Chart

Simple load chart showing required counterweight, range of swing, radius and boom length.



140 t — 360° — ISO

m	15.5* t	15.5 t	20.5* t	20.5 t	25.5* t	25.5 t	30.5 t	35.5 t	40.5 t	45.5 t	50.5 t	55.5 t	60.0 t	m
	700,0[1]	-	-	-	-	-	-	-	-	-	-	-	-	
3	577,0[2]	312,0	312,0	312,0	-	-	-	-	-	-	-	-	-	3
3,5	473,0[2]	312,0	312,0	312,0	-	-	-	-	-	-	-	-	-	3,5
4	435,0[2]	311,0	312,0	310,0	300,0	300,0	-	-	-	-	-	-	-	4
4,5	403,0[2]	293,0	312,0	291,0	300,0	292,0	-	-	-	-	-	-	-	4,5
5	375,0[2]	276,0	312,0	275,0	300,0	275,0	230,0	197,0	-	-	-	-	-	5
6	330,0[2]	248,0	296,0	246,0	271,0	247,0	218,0	187,0	158,0	-	-	-	-	6
7	294,0	224,0	266,0	223,0	243,0	223,0	206,0	176,0	146,0	123,0	-	-	-	7
8	264,0	205,0	240,0	203,0	220,0	204,0	195,0	166,0	135,0	116,0	-	-	-	8
9	236,0	188,0	219,0	186,0	200,0	187,0	183,0	156,0	125,0	110,0	102,0	-	-	9
10	212,0	174,0	201,0	172,0	183,0	173,0	172,0	146,0	116,0	104,0	96,0	83,5	-	10
12	171,0	150,0	172,0	149,0	156,0	149,0	150,0	128,0	101,0	92,5	86,0	74,5	65,0	12
14	-	-	146,0	130,0	137,0	131,0	131,0	115,0	89,5	82,5	76,5	67,5	59,0	14
16	-	-	126,0	116,0	121,0	116,0	115,0	104,0	79,5	74,0	69,0	61,5	54,5	16
18	-	-	93,5	93,5	109,0	104,0	102,0	96,0	71,0	66,5	62,0	56,5	50,0	18
20	-	-	-	-	98,5	92,0	92,0	88,0	64,0	60,0	56,5	52,5	46,5	20
22	-	-	-	-	81,0	81,0	83,5	80,5	58,0	54,5	51,5	48,5	43,0	22
24	-	-	-	-	-	-	75,0	74,0	52,5	49,5	47,5	45,0	40,0	24
26	-	-	-	-	-	-	68,0	68,0	48,0	45,5	44,0	42,0	37,5	26
28	-	-	-	-	-	-	-	62,5	44,5	41,5	40,5	39,0	35,0	28
30	-	-	-	-	-	-	-	56,0	41,0	38,5	37,5	36,5	32,5	30
32	-	-	-	-	-	-	-	50,0	38,5	36,0	35,0	34,0	30,5	32
34	-	-	-	-	-	-	-	-	35,5	33,5	32,5	31,5	28,8	34
36	-	-	-	-	-	-	-	-	33,5	31,0	30,0	29,8	27,0	36
38	-	-	-	-	-	-	-	-	-	29,4	28,3	28,0	25,3	38
40	-	-	-	-	-	-	-	-	-	27,6	26,5	26,3	23,8	40
42	-	-	-	-	-	-	-	-	-	25,9	24,8	24,8	22,5	42
44	-	-	-	-	-	-	-	-	-	-	23,4	23,4	21,2	44
46	-	-	-	-	-	-	-	-	-	-	22,1	22,1	20,0	46
48	-	-	-	-	-	-	-	-	-	-	-	20,9	19,0	48
50	-	-	-	-	-	-	-	-	-	-	-	19,7	18,0	50
54	-	-	-	-	-	-	-	-	-	-	-	-	16,2	54
58	-	-	-	-	-	-	-	-	-	-	-	-	-	58

On this chart, the box in the top left corner shows the counterweight required- in this case, 140 tonnes.

The highlighted box underneath shows the boom length ranges – in this case, 15.5 metres to 60 metres.

The box in the bottom left corner shows the maximum radius – in this case, 54 metres.

In this example, the counterweight required is 140 tonnes. With 40.5m boom length set out at 20m radius, it would give a rated capacity of 64 tonnes according to the chart.

Notes:

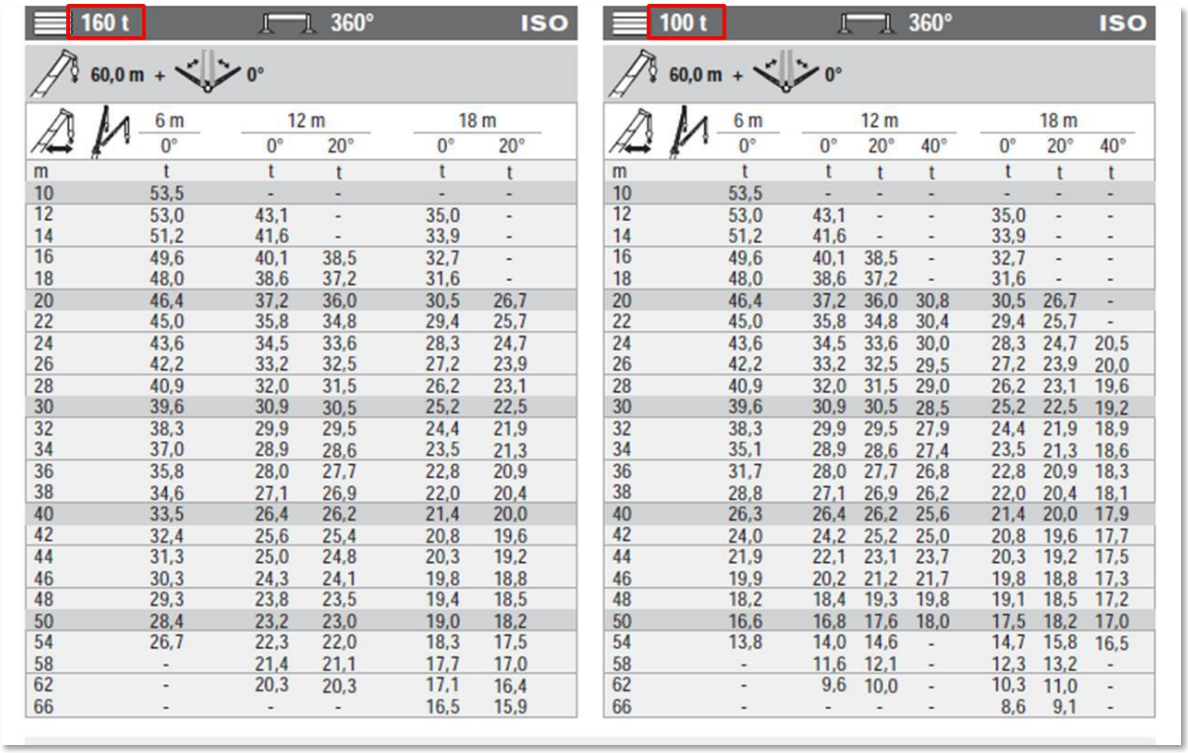
The next charts show the effect of different configurations of counterweights.

The first chart shows 160 tonnes of counterweight.

The second chart shows 100 tonnes of counterweight.

Initially with short boom and minimum radius there is no appreciable difference.

However, with the increase in boom length and radius - the difference in Rated Capacity is almost halved. This underlines the importance of the crane being configured according to the Rated Capacity Charts.



160 t 360° ISO

60,0 m + 0°

	6 m	12 m		18 m	
	0°	0°	20°	0°	20°
m	t	t	t	t	t
10	53,5	-	-	-	-
12	53,0	43,1	-	35,0	-
14	51,2	41,6	-	33,9	-
16	49,6	40,1	38,5	32,7	-
18	48,0	38,6	37,2	31,6	-
20	46,4	37,2	36,0	30,5	26,7
22	45,0	35,8	34,8	29,4	25,7
24	43,6	34,5	33,6	28,3	24,7
26	42,2	33,2	32,5	27,2	23,9
28	40,9	32,0	31,5	26,2	23,1
30	39,6	30,9	30,5	25,2	22,5
32	38,3	29,9	29,5	24,4	21,9
34	37,0	28,9	28,6	23,5	21,3
36	35,8	28,0	27,7	22,8	20,9
38	34,6	27,1	26,9	22,0	20,4
40	33,5	26,4	26,2	21,4	20,0
42	32,4	25,6	25,4	20,8	19,6
44	31,3	25,0	24,8	20,3	19,2
46	30,3	24,3	24,1	19,8	18,8
48	29,3	23,8	23,5	19,4	18,5
50	28,4	23,2	23,0	19,0	18,2
54	26,7	22,3	22,0	18,3	17,5
58	-	21,4	21,1	17,7	17,0
62	-	20,3	20,3	17,1	16,4
66	-	-	-	16,5	15,9

100 t 360° ISO

60,0 m + 0°

	6 m	12 m			18 m		
	0°	0°	20°	40°	0°	20°	40°
m	t	t	t	t	t	t	t
10	53,5	-	-	-	-	-	-
12	53,0	43,1	-	-	35,0	-	-
14	51,2	41,6	-	-	33,9	-	-
16	49,6	40,1	38,5	-	32,7	-	-
18	48,0	38,6	37,2	-	31,6	-	-
20	46,4	37,2	36,0	30,8	30,5	26,7	-
22	45,0	35,8	34,8	30,4	29,4	25,7	-
24	43,6	34,5	33,6	30,0	28,3	24,7	20,5
26	42,2	33,2	32,5	29,5	27,2	23,9	20,0
28	40,9	32,0	31,5	29,0	26,2	23,1	19,6
30	39,6	30,9	30,5	28,5	25,2	22,5	19,2
32	38,3	29,9	29,5	27,9	24,4	21,9	18,9
34	35,1	28,9	28,6	27,4	23,5	21,3	18,6
36	31,7	28,0	27,7	26,8	22,8	20,9	18,3
38	28,8	27,1	26,9	26,2	22,0	20,4	18,1
40	26,3	26,4	26,2	25,6	21,4	20,0	17,9
42	24,0	24,2	25,2	25,0	20,8	19,6	17,7
44	21,9	22,1	23,1	23,7	20,3	19,2	17,5
46	19,9	20,2	21,2	21,7	19,8	18,8	17,3
48	18,2	18,4	19,3	19,8	19,1	18,5	17,2
50	16,6	16,8	17,6	18,0	17,5	18,2	17,0
54	13,8	14,0	14,6	-	14,7	15,8	16,5
58	-	11,6	12,1	-	12,3	13,2	-
62	-	9,6	10,0	-	10,3	11,0	-
66	-	-	-	-	8,6	9,1	-

Notes:

Load Chart (Iron Fairy)

MAIN BOOM DUTIES TRAVEL BALLAST 360° BS / DIN

BOOM LENGTH IN METRES

RADIUS METRES	6.8			6.8-11.64			11.64-16.5		
	BLOCKED 360°	FREE ON WHEELS 360°	OVER FRONT	BLOCKED 360°	FREE ON WHEELS 360°	OVER FRONT	BLOCKED 360°	FREE ON WHEELS 360°	OVER FRONT
2.50	12.15	7.50	8.00						
2.75	12.15	7.00	7.75	12.15	7.00	7.75			
3.00	12.15	6.50	7.40	10.80	6.50	7.40	6.20		
3.25	11.00	6.00	6.90	9.90	6.00	6.90	6.20		
3.50	10.00	5.45	6.30	9.00	5.45	6.30	6.20	5.45	6.30
3.75	9.00	4.85	5.60	8.20	4.85	5.60	6.10	4.85	5.60
4.00	8.25	4.40	5.10	7.55	4.40	5.10	6.00	4.40	5.10
4.50	7.00	3.65	4.25	6.50	3.65	4.25	5.80	3.65	4.25
5.00	6.00	3.10	3.60	5.60	3.10	3.60	5.60	3.10	3.60
5.50				4.80	2.65	3.10	5.10	2.65	3.10
6.00				4.25	2.30	2.70	4.60	2.30	2.70
7.00				3.35	1.75	2.05	3.70	1.75	2.05
8.00				2.75	1.30	1.60	3.00	1.30	1.60
9.00				2.25	1.00	1.25	2.50	1.00	1.25
10.00				1.90	0.75	0.95	2.00	0.75	0.95
11.00							1.70	0.60	0.75
12.00							1.45	0.45	0.60
13.00							1.20		
14.00							1.00		
15.00							0.85		

LIFT CAPACITY IN TONS

THE WEIGHTS OF THE HOOK BLOCK, SLINGS AND ANY LIFTING ATTACHMENTS MUST BE ADDED TO THE WEIGHT TO BE LIFTED WHEN DETERMINING THE SUSPENDED LOAD

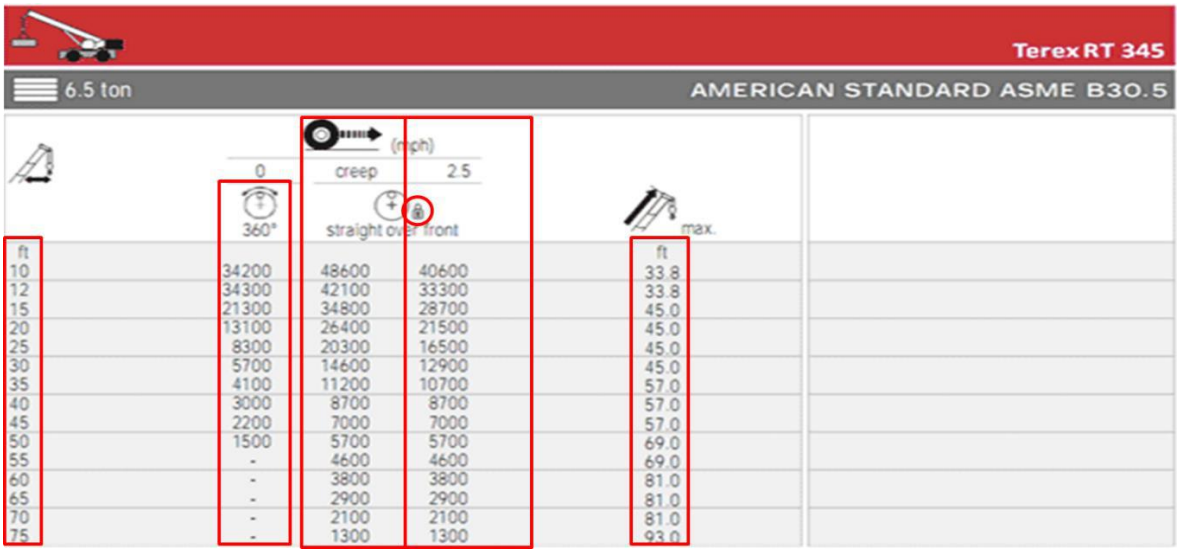
CAPACITIES SHOWN IN THE SHADE AREA ARE BASED ON FACTORS OTHER THAN STABILITY. FOR THIS REASON STABILITY MUST NOT BE RELIED UPON TO INDICATE CAPACITY

Note the differences in performance between “on stabilisers” and “free on wheels” duties.

This is a good illustration of the difference in capacities when using free on wheels duties. A quick explanation of “free on wheels” means the ability to lift loads with a stationable crane without the use of outriggers or stabilisers.

Notes:

Rated Capacity Chart



Terex RT 345

6.5 ton — AMERICAN STANDARD ASME B30.5

ft	0 (mph) 360°	creep straight	2.5 straight over front	max. ft
10	34200	48600	40600	33.8
12	34300	42100	33300	33.8
15	21300	34800	28700	45.0
20	13100	26400	21500	45.0
25	8300	20300	16500	45.0
30	5700	14600	12900	45.0
35	4100	11200	10700	57.0
40	3000	8700	8700	57.0
45	2200	7000	7000	57.0
50	1500	5700	5700	69.0
55	-	4600	4600	69.0
60	-	3800	3800	81.0
65	-	2900	2900	81.0
70	-	2100	2100	81.0
75	-	1300	1300	93.0

This chart illustrates the lift capacity for a pick and carry task.

The first column indicates the radius of the lift.

The second column shows the rated capacity allowed to be lifted with 360-degree rotation, but no movement.

The ratings in Column 3 are for a pick and carry with the crane locked over the front, which is indicated by the padlock symbol and allows movement at a “creep” which is a slow roll.

These capacities are further reduced if the crane will roll at 2.5 miles per hour as shown in Column 4.

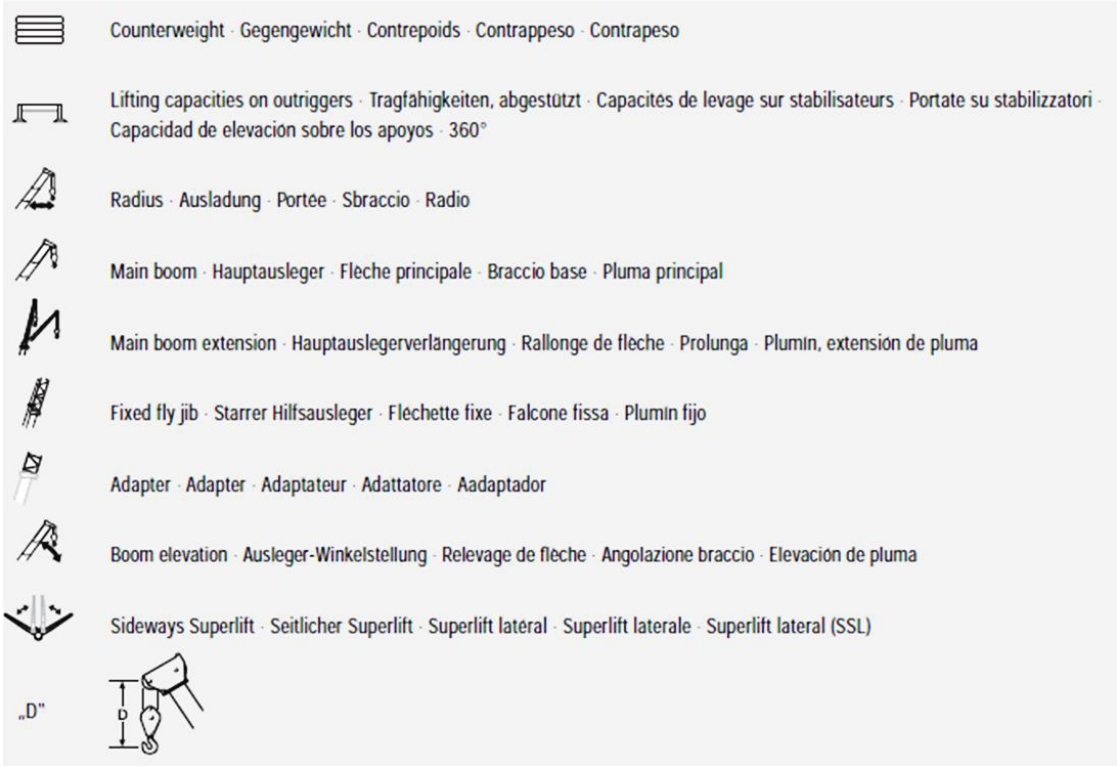
Column 5 on the right states the maximum boom length.

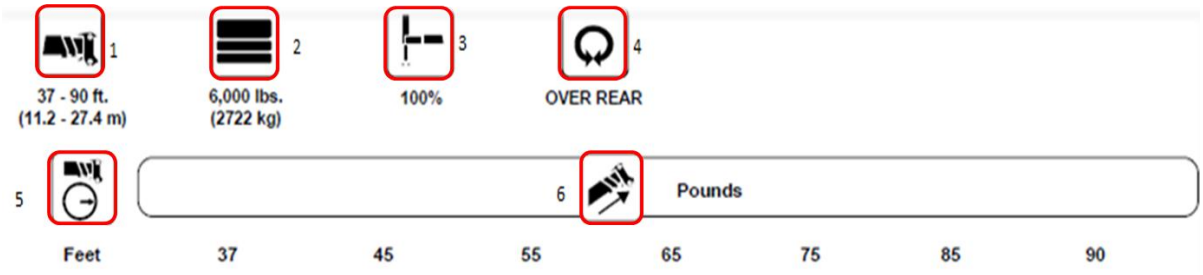
For example, with a radius of 40ft and a boom length of 57ft and allowing movement at “creep” speed, the rated capacity would be 8700lbs.

Notes:

Key to Symbols

Example of the symbols used within Rated Capacity Charts:



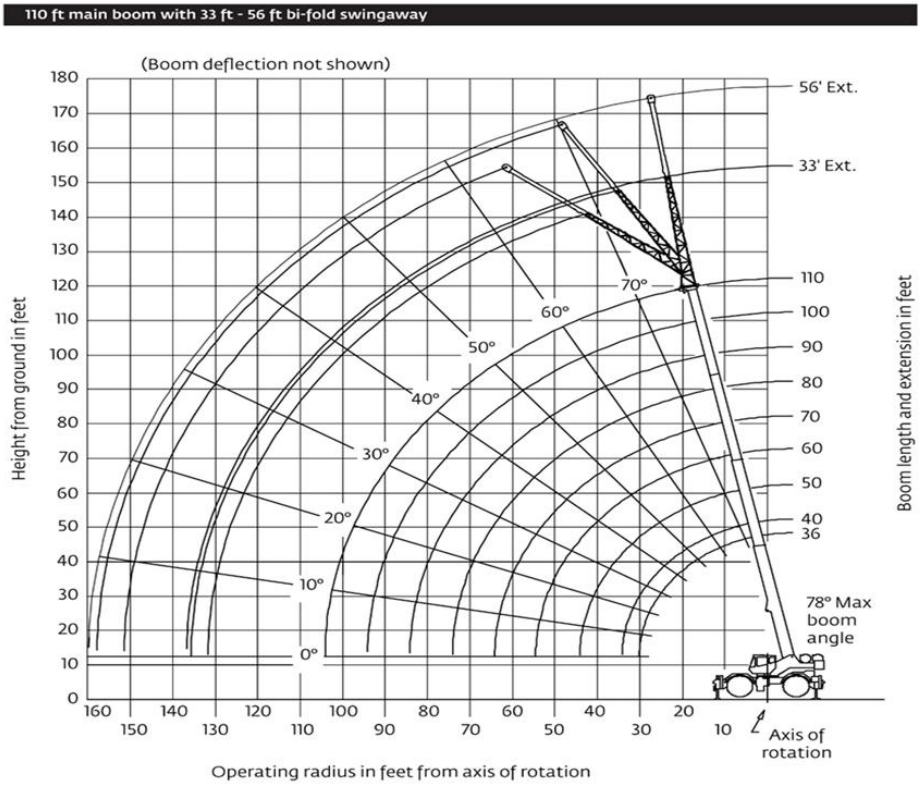


Basic symbols shown above are:

1 - Available boom length
2 - Counterweight
3 - Outrigger extension
4 - Area of operation or working area
5 - Radius
6 - Actual boom length

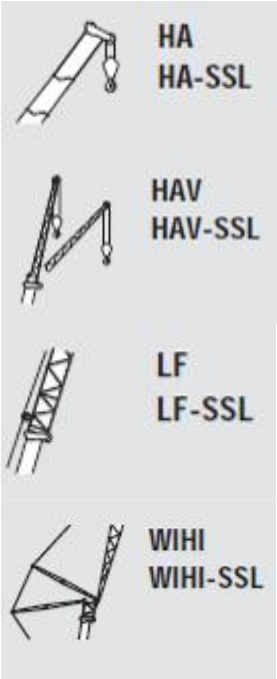
Range Diagram

Range diagrams are useful to lift planners and rigging supervisors as they set out the boom lengths and angles required to reach specific heights and radii, allowing correct positioning of the crane.



Configuration Acronyms

Here is an example of configuration acronyms for a specific crane. (These are not in general use).



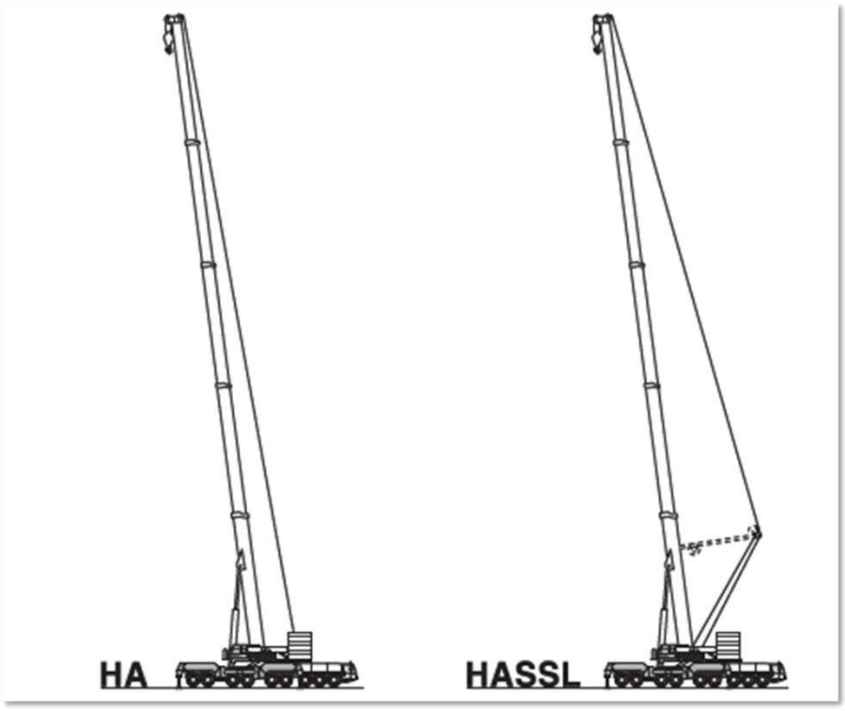
Main Boom
Main Boom with SSL

Main boom extension
Main boom extension with SSL

Fixed fly jib
Fixed fly job with SSL

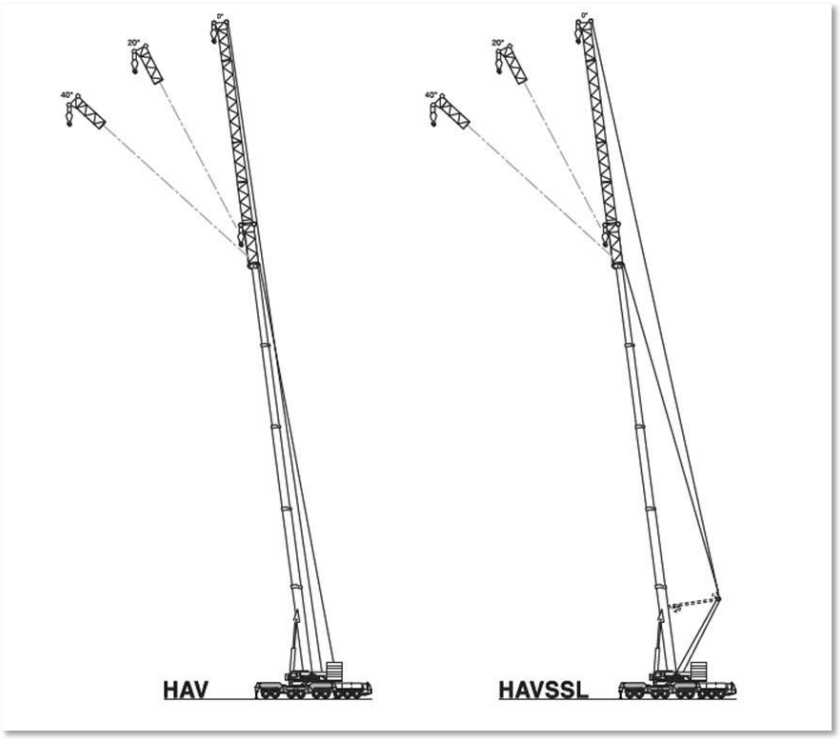
Luffing fly jib
Luffing fly jib with SSL

Boom Configurations



The above illustrates various boom configuration that should be recognised. Examiners should be familiar with all configurations of the equipment under examination.

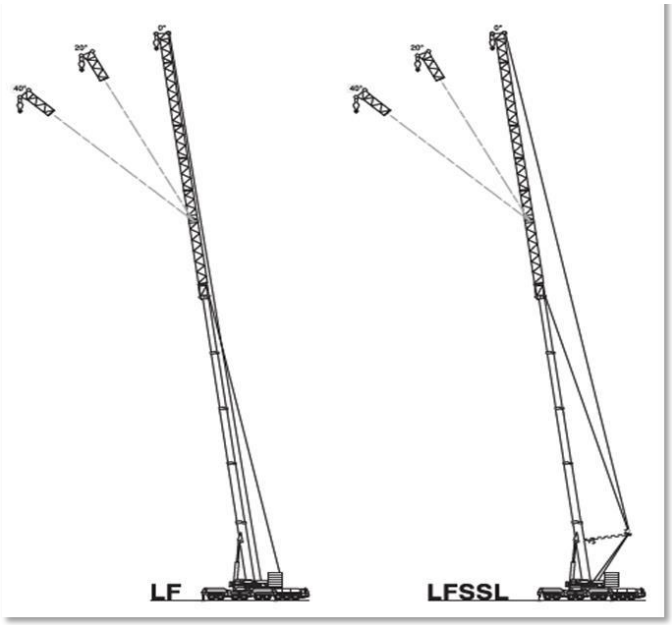
61 HA shows crane main boom without the side supported lift and HASSL with the side supported superlift.



This configuration shows a main boom fitted without a fixed jib and then with a side supported Superlift.

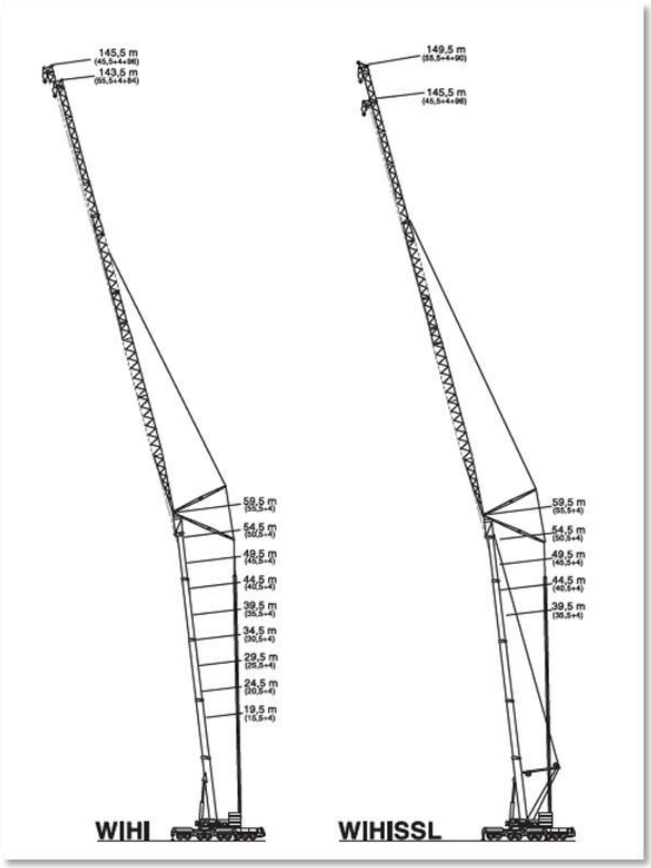
Fly Jib

Additional jib fitted to the main boom tip to extend or offset the reach. In the illustration below, there is an example of without and with Superlift attachment.



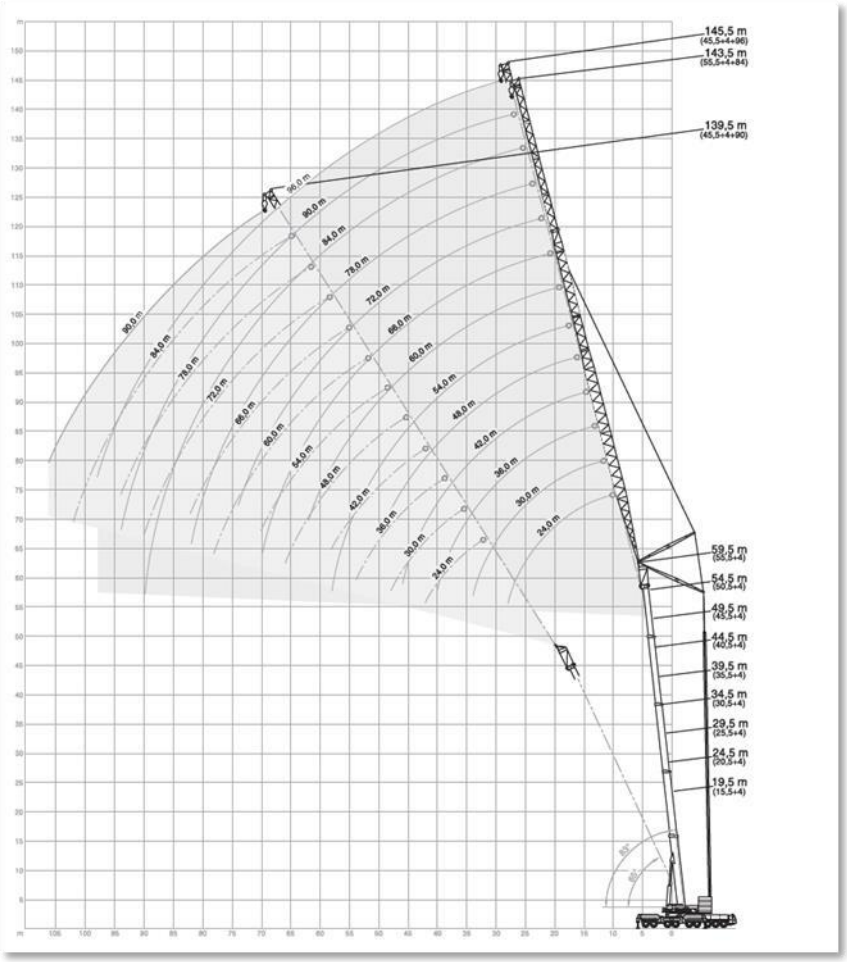
Luffing Jib

In the illustration below, there are examples of luffing jibs without and with Superlift attachment.



Range Diagram

This range diagram illustrates the main boom length with a fixed jib extension and then sets out the duties for the jib length at different jib angles.



Lift Angle for Fixed Jib

6.5 ton | 22 ft x 22.3 ft | 360° | AMERICAN STANDARD ASME B30.5

105 ft

	32 ft			49 ft			
	0°	15°	30°	0°	15°	30°	
ft							ft
50	8693	-	-	-	-	-	50
55	8005	-	-	-	-	-	55
60	7563	7991	-	-	-	-	60
65	7144	7420	6254	4908	3147	2514	65
70	6734	7070	6101	4176	3027	2460	70
75	6343	6772	5896	3859	2916	2409	75
80	5716	6493	5638	3636	2812	2360	80
85	5101	5840	5328	3448	2716	2314	85
90	4499	5054	4967	3277	2628	2269	90
95	3910	4328	4393	3077	2547	2226	95
100	3334	3661	3745	2974	2451	2185	100
105	2770	3052	3133	2843	2448	2145	105
110	2219	2499	2557	2684	2404	2087	110
115	1680	2003	2016	2497	2320	2140	115
120	1153	1563	1510	2282	2195	2102	120
125	639	1178	-	2041	2032	1972	125
130	-	-	-	1773	1828	1752	130
135	-	-	-	1478	1586	1444	135
140	-	-	-	1157	1304	-	140

This chart illustrates the various angles of lift if a fixed jib is used.

The highlighted areas in the centre of the chart show jib lengths of 32 feet and 49 feet.

The highlighted box in the top left shows with a boom extension of 105 feet.

With higher angles of lift (15° and 30°), the maximum load capacity decreases.

With a fixed jib, the angle remains fixed.

Summary

Each crane has a load chart that specifies the crane's capabilities—detailing its features and how its lift capacity varies when considering distance and angle.

These values are critical for the crane examiner/inspector as initially, they are the values they have to verify the Rated Capacity Limiter (RCL) against. Comparing the values shown on the Rated Capacity Chart against the RCL allows the examiner to confirm that they match. The examiner can then use the chart to select different configurations to verify the structural integrity and stability of the crane.

It is vital that the examiner uses the specific manufacturer's charts for the specific crane being examined.

You can identify rated capacity charts easily by the crane serial number. Otherwise, use the model designation and number to find the correct rated capacity chart.

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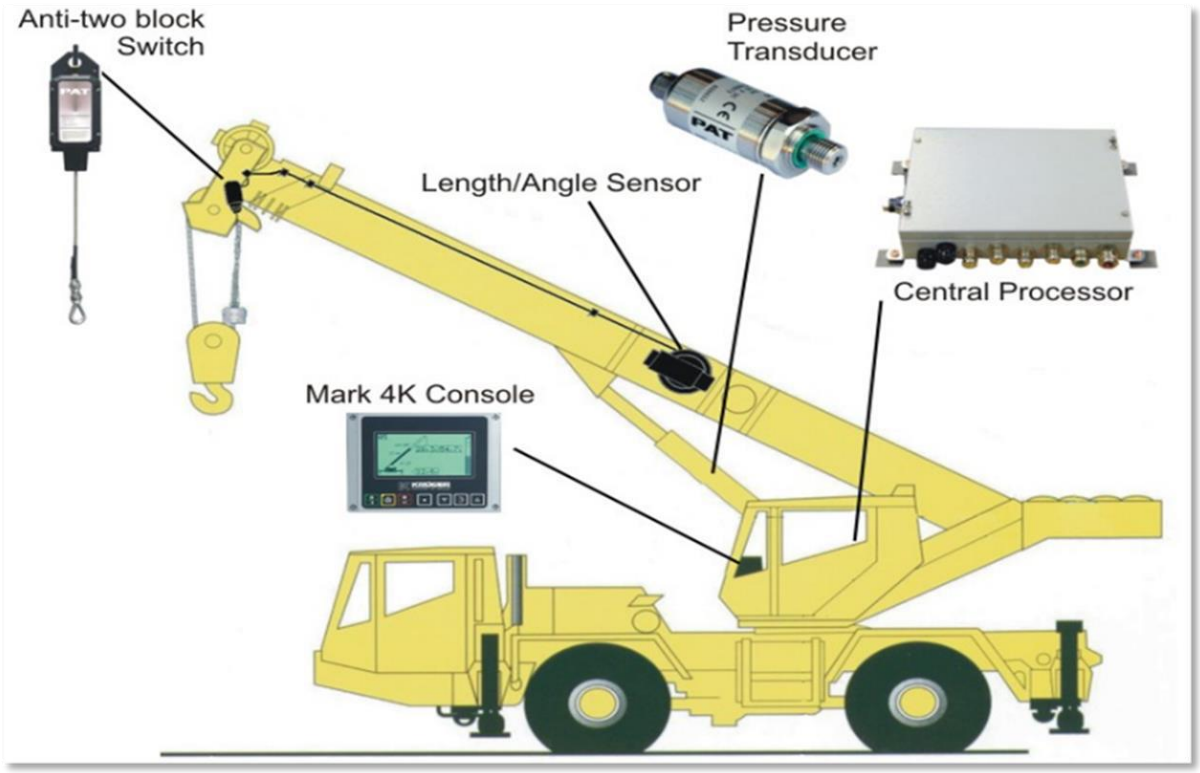
9. LOAD INDICATORS



Some of the indicators and limiters that the competent person may come across are:

RCL Rated Capacity Limiter

RCI Rated Capacity Indicator

SLI Safe Load Indicator

ASLI Automatic Safe Load Indicator

All these indicators/limiters aid the equipment operator by sensing (directly or indirectly) the overturning moment on the equipment, i.e. load multiplied by radius. They compare the lifting condition to the equipment's rated capacity, and when the rated capacity is reached, warn the operator that an increase in the load or radius will result in the rated capacity being exceeded. This, of course, could result in serious consequences.

Rated Capacity Limiters

A **Rated Capacity Limiter** is a device designed to lock out various functions if it considers the equipment is exceeding the manufacturers rated capacities.

It can shut off elements of the crane's systems to prevent an increase in the severity of the loading on the equipment, e.g. hoisting, telescoping out, or luffing out.

Functions which decrease the severity of the loading on the equipment usually remain operational, e.g. lowering, telescoping in, or luffing in.

In some crane models the device informs the operator of the configuration of the boom, confirms that all the locking devices are in place and aids the operator in installing the counterweights.

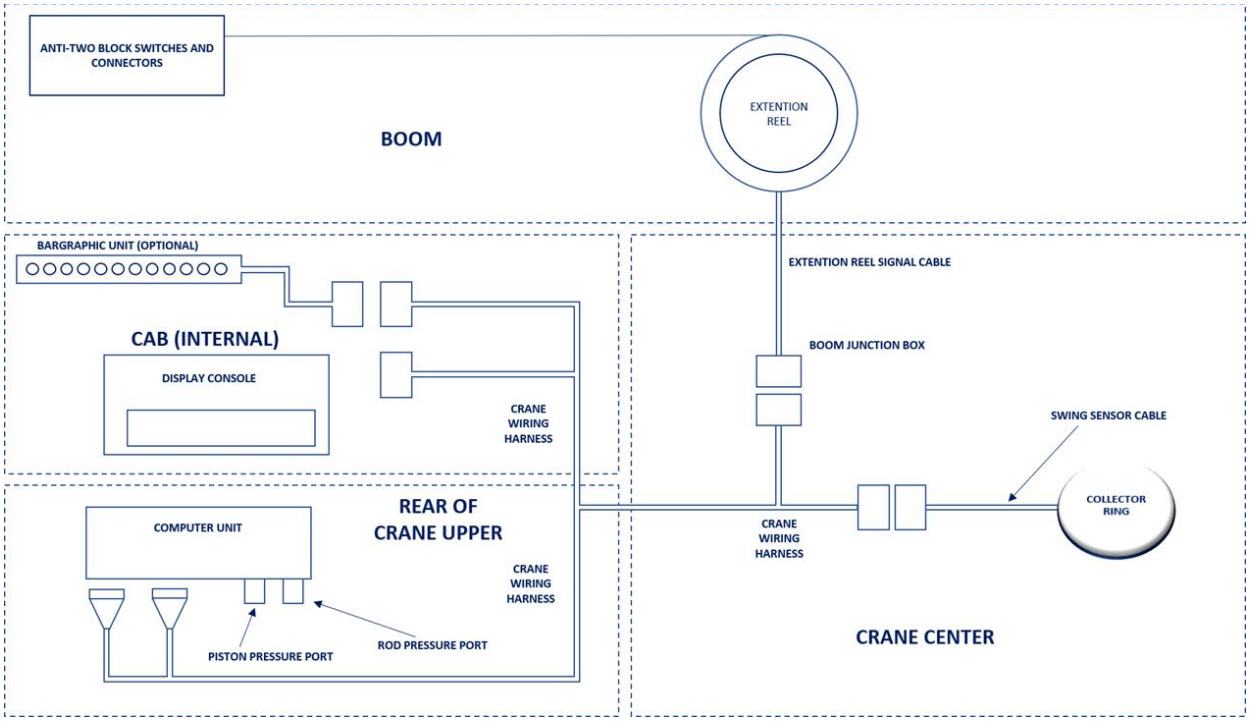
A **Rated Capacity Indicator** will inform the operator with an audible or visual warning only, e.g. a horn or flashing beacon.

Rated Capacity Limiter systems are usually composed of a microprocessor connected to various sensors on the crane itself. The RCL measures the angle and extension of the boom along with the load weight and compares this with the manufacturer's specifications to determine if the lift is safe.

The RCL has the capability of detecting the angle, weight of load lifted, and ground radius of any lifting device. It controls the lifting equipment to keep the machinery functioning as per the manufacturer's suggested safety charts.

The crane is fitted with sensors for each of the measured parameters, which are displayed in the operator's cabin.

RCI - Schematic Representations



Notes:

Anti-Two Block Assembly

Part of the Rated Capacity Limiter system is the anti-two block assembly or cut out. This normally consists of a weight wrapped round the dead line of the crane hoist wire and suspended from a micro switch by a chain or small wire.

If a hook block travels past the limit of the chain or wire, the weight is lifted and the micro switch is activated. This sends a signal to the rated capacity limiter and cuts out any further hoisting movement but may allow lowering.

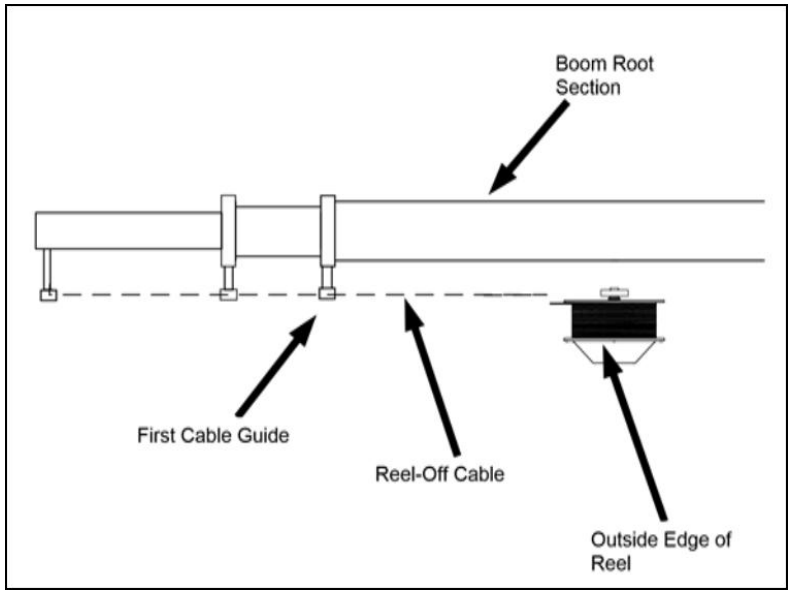
Reel Off Cable Drum

The extension reel is designed to provide accurate measurement of boom extension when the reel off cable forms a single flat layer across the surface of the extension reel as the boom is telescoped in and out. Any stacking of the cable will cause extension errors as the boom retracts.

To check the reel-off cable, telescope the boom fully out and then fully in. Check that the reel-off cable forms a flat single layer across the surface of the extension reel, with each successive turn of cable lying next to the last.

If any stacking or build-up of the cable occurs, make sure that the first cable guide at the top of the boom root section is correctly aligned with the outside edge of the extension reel, as shown in the illustration below.

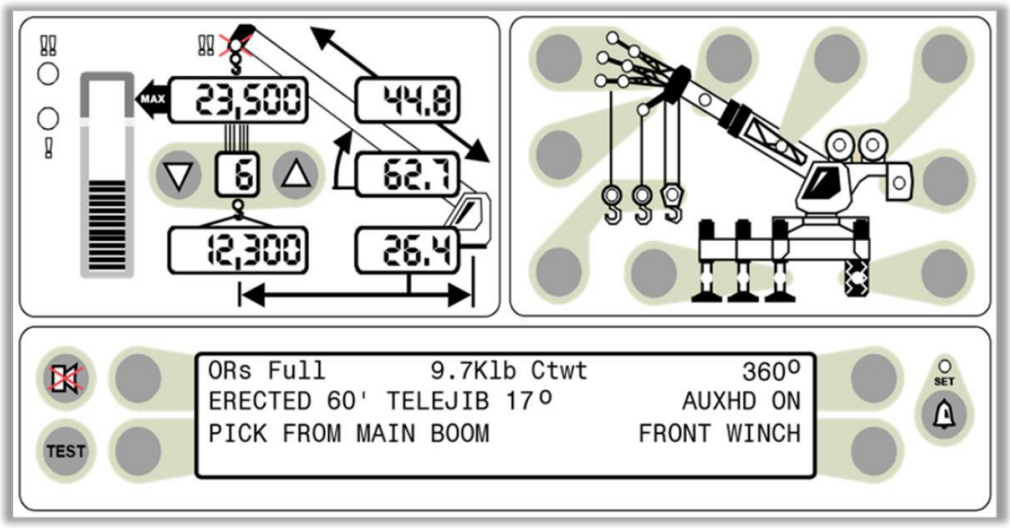
Clean the reel-off cable; then lubricate it with a silicone oil.

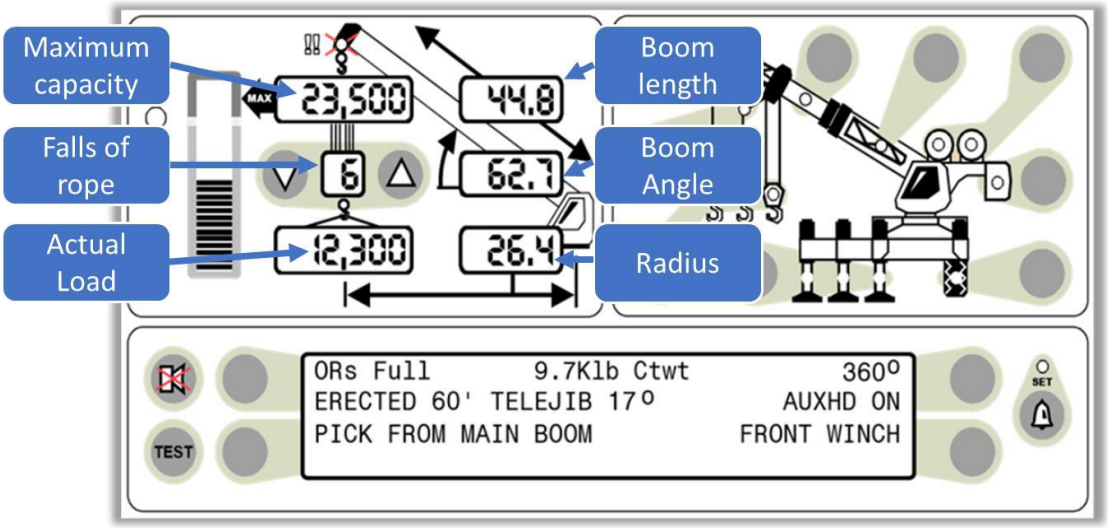


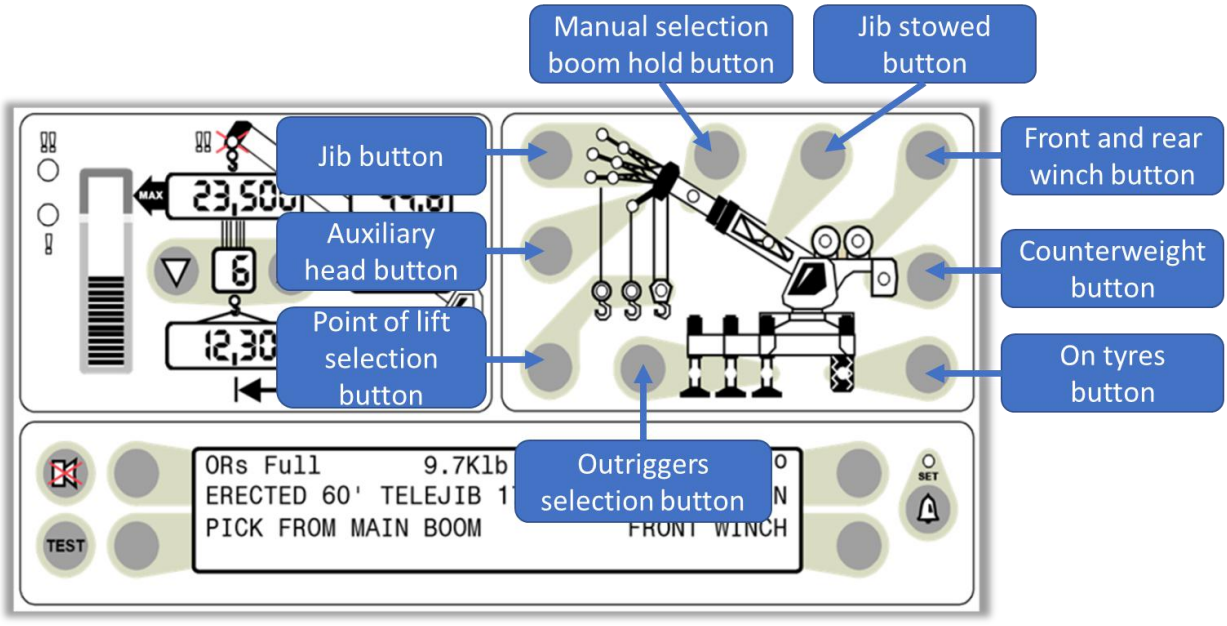
Notes:

Load Indicator Display

Example of a load indicator display -







Remote Bar Graph Overview

The Remote Bar Graph, shown below, displays the percentage of rated capacity of the crane. The remote bar graph is mounted at the top of the cab front window, in the operator's line of sight.

User selectable levels of brightness are available on the device, which is designed for reading under all lighting conditions. Defective remote bar graphs cannot be serviced.

The remote bar graph is optional and is not used on all cranes.

Notes:

Example of RCL System

Liebherr cranes have their own crane computer called Liccon – stands for Liebherr Computer Controlling.

Liccon allows the crane operator to enter information depending on the crane's configuration so the computer can calculate what the crane can safely lift at all possible distances and heights with different boom angles and lengths.

Basically:

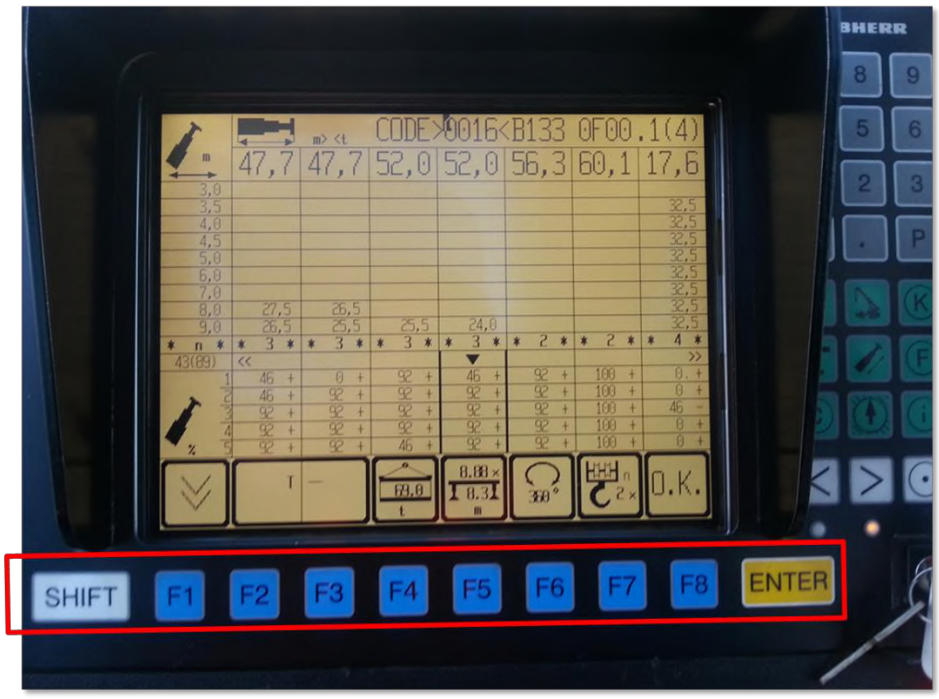
- Every crane configuration entered into the computer is given a unique code
- The crane operator can enter the code directly into the computer for a given crane configuration without going through the steps of adjusting all the data separately.

Warning: Always refer to the particular manufacturer for the operating instructions and readings of rated capacity limiters as they change from manufacturer to manufacturer.

Information that is typically entered into the system computer are:

- Type of boom and boom extension
- Amount of counterweight on crane
- Lengths of outriggers used
- Working area or area of operation
- Reeving of main hook block

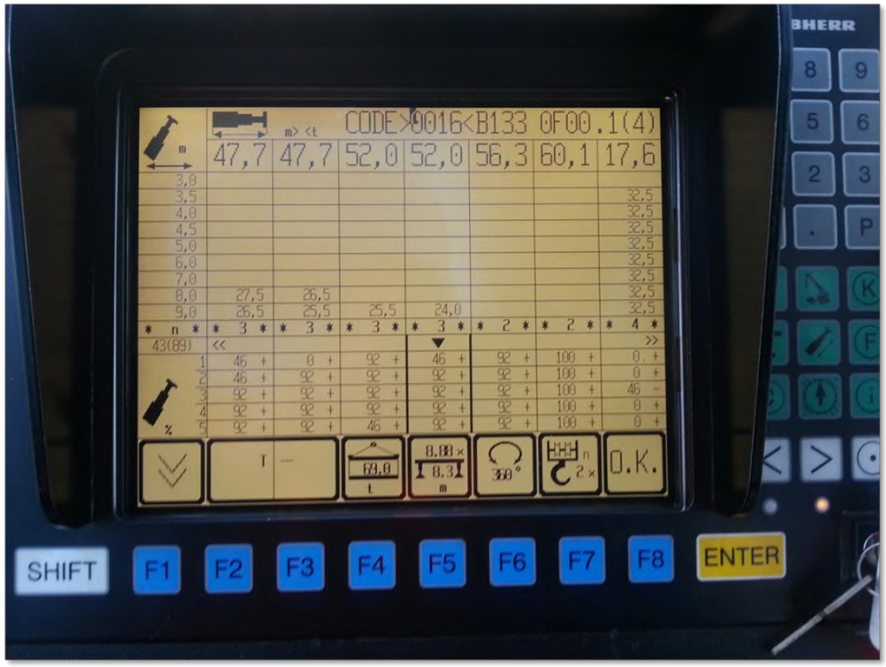
All data is entered via corresponding "F" keys directly located under each data value.

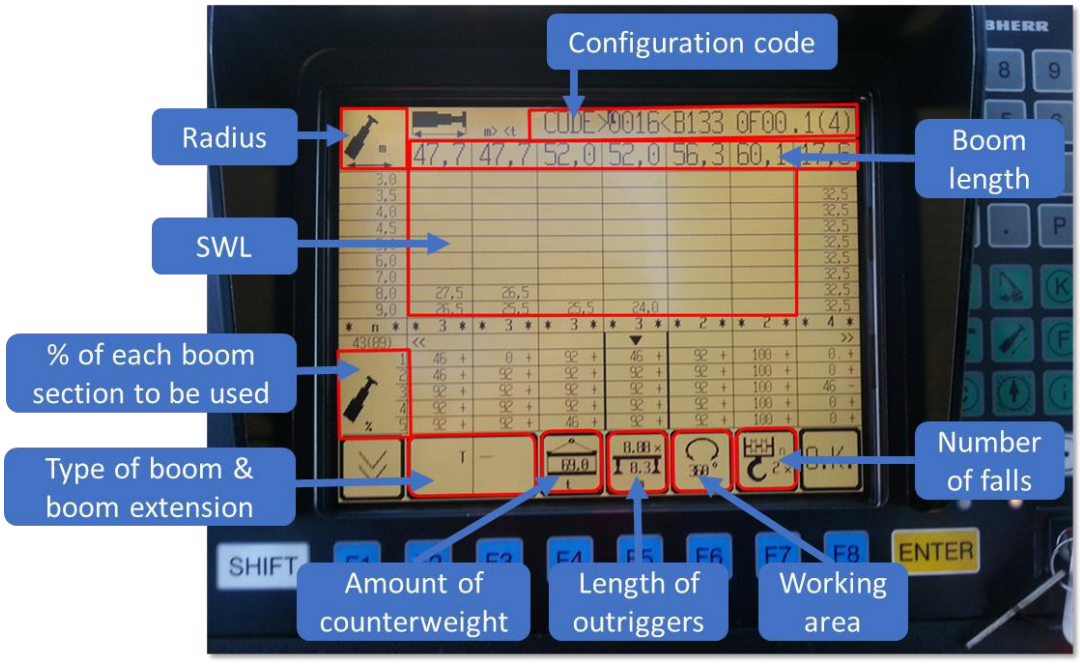


Example of RCL System – Data Input

The example of rated capacity limiter below displays:

- Configuration code
- Radius
- SWL
- Boom lengths
- Number of falls
- Percentage of each boom section to be used for chosen crane configuration
- Type of boom and boom extension
- Amount of counterweight on crane
- Length of outriggers
- Working area or area of operation



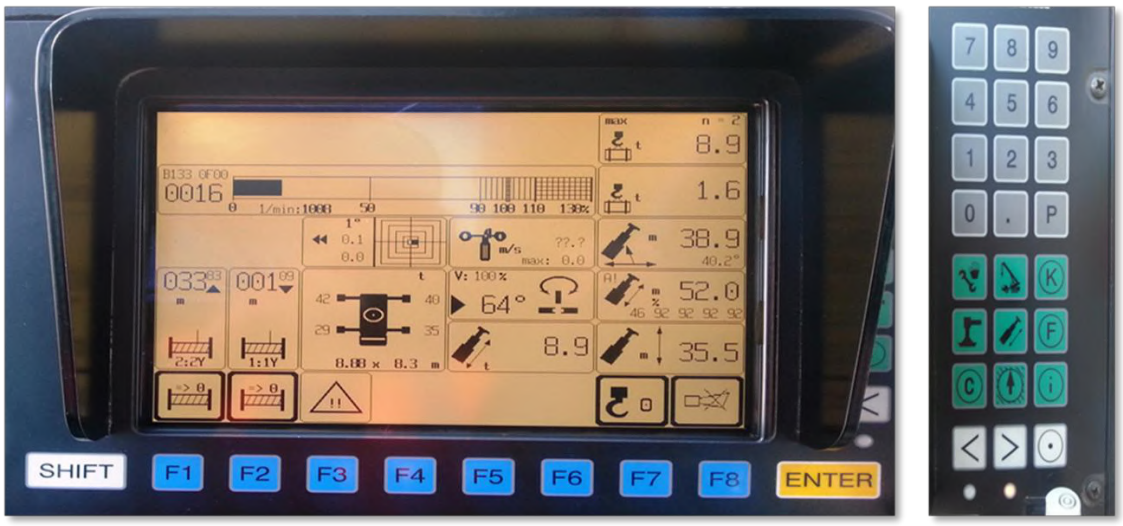


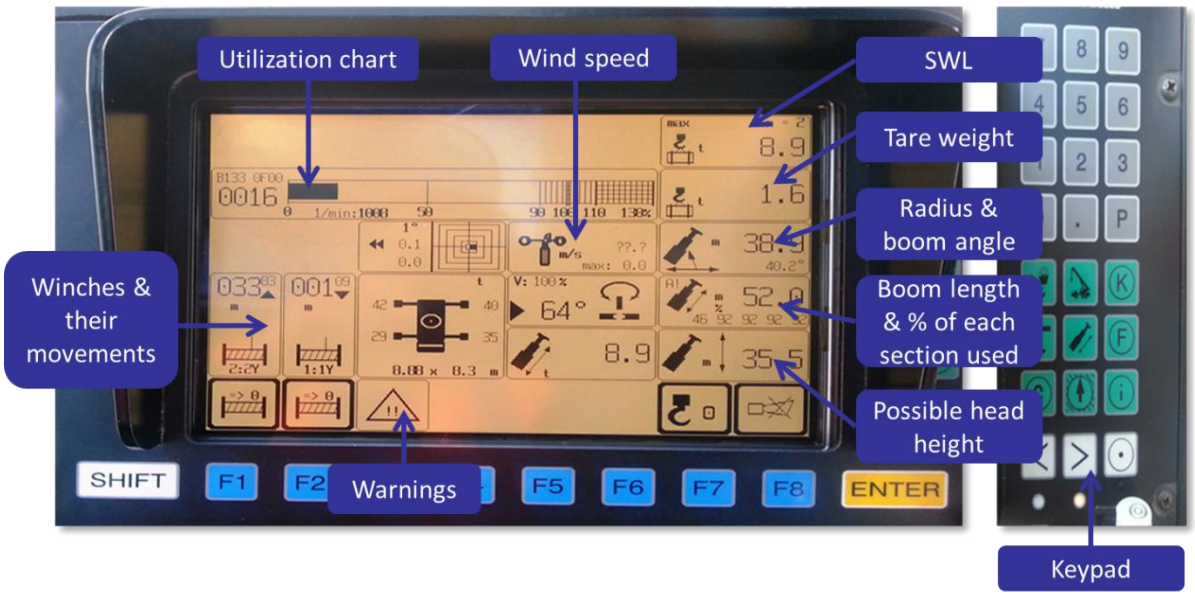
Example of RCL System – Working Screen

The Rated Capacity Limiter working screen may display:

- Utilization chart
- Winches and their movements
- Warnings
- Wind speed (if anemometer is installed)
- SWL
- Tare weight
- Radius and boom angle
- Boom length with current percentages of each section used,
- Possible head height and options

To the right of the screen there is a keypad for entering more adjustments.

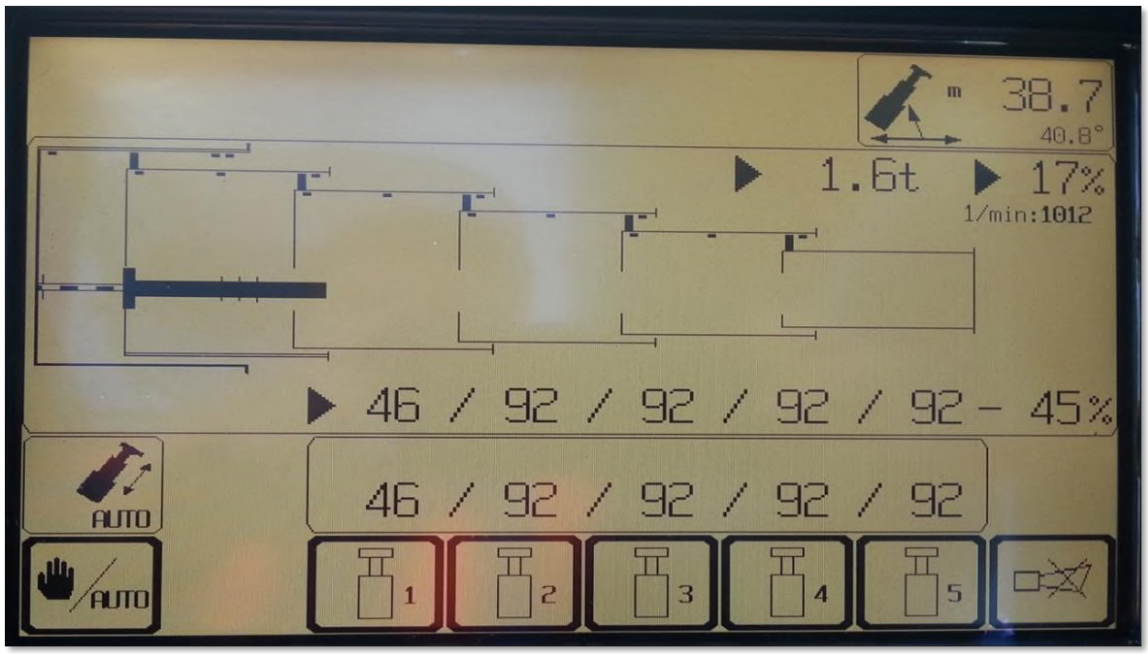


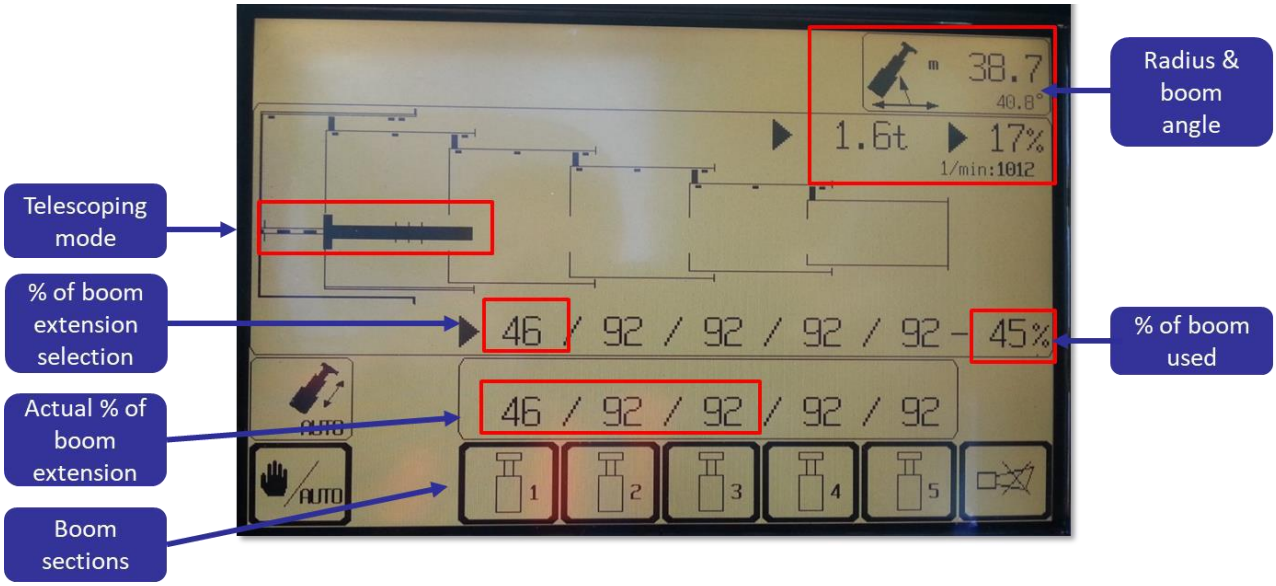


Example of RCL System – Function screen for boom telescoping configurations and percentages

Via the keypad, the crane operator can access more functions of the RCL System. These can include:

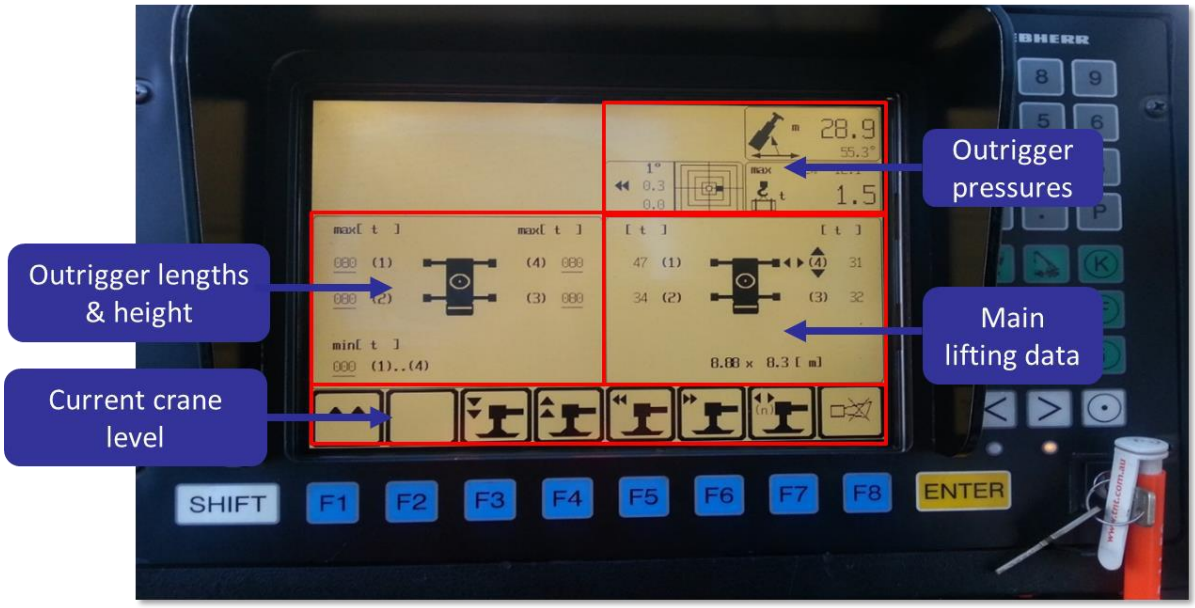
- Go to the setup/load chart screen
- Retrieve information about outrigger pressures or adjust outriggers
- Go directly into telescoping mode
- Enter the configuration code
- Adjust speed of movements
- and more



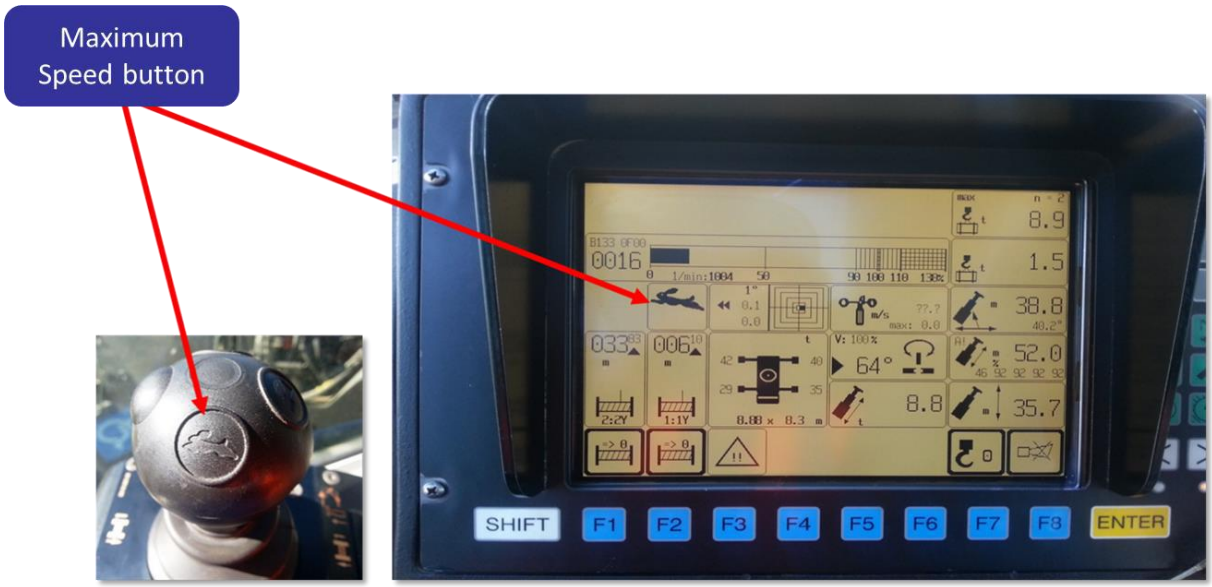


Example of RCL System – Function screen for outriggers
From the key pad, the crane operator can display the outriggers screen.

Here the crane operator can see all outrigger pressures, adjust outrigger lengths and height, see current crane level and main lifting data.



Example of RCL System – Maximum Speed
Maximum speed can also be altered via joystick directly by pressing the high speed (rabbit) button. After pressing the high speed button, this change is displayed on the main working screen with a rabbit symbol.



Important Note on RCL

Although all the systems shown display the same basic information, for example;

- Boom Length
- Boom Angle
- Radius
- Capacity
- Actual Load

They do require some input from the operator.

Unforeseen and tragic consequences can result from inputting the wrong code, number of falls or amount of counterweight

RCL - A Tale of Two Misfortunes

After successful completion of a full main boom and fly jib test, it was decided that a crane should undergo a maximum boom test.

The owner of the crane did not have the facility to carry out this test, however there was a testing area which did have this facility.

To allow the crane to access the testing area, the fixed jib was removed and the 112 tonnes of counterweight was transferred with trucks for relocation.

Because of a delay in accessing the testing area, the crane owner, who had recently purchased the crane second-hand from another company, decided to have the name of the previous owner removed from the boom and to replace it with his name.

To facilitate this task, the operator extended the boom sufficiently to allow the name change and started booming down.

Unfortunately, he had forgotten to change the configuration of the crane on the RCL. Therefore, the crane "thought" that there was still 112t of counterweight attached.

As a result, the RCL allowed the downward motion of the boom, the crane lost stability and tipped over. The RCL performed as if there were still 112t of counterweight attached.

Two misfortunes happened here:

1. The crane had zero counterweight duties- this had to be inputted but wasn't!
2. The owner had just finalised the payment transaction of the crane when he got the incident call!

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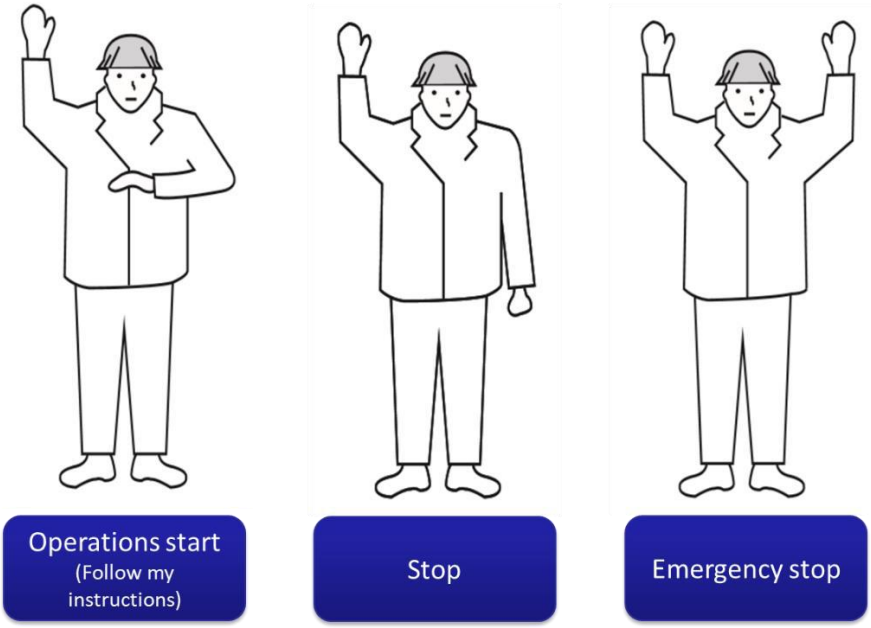
10. CRANE SIGNALS

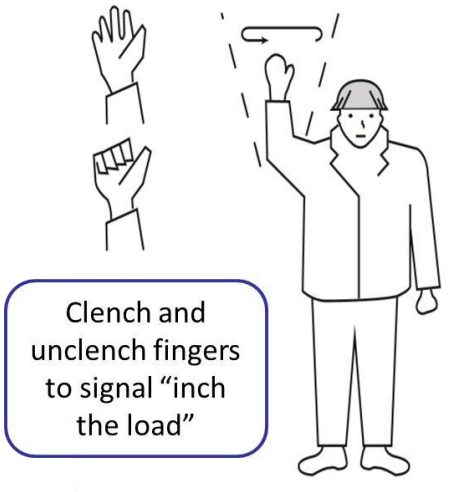
Confusion can be caused by riggers, banksmen or labourers working with cranes who have evolved their own method of signaling in unconventional ways with various body parts including feet or heads.

To counter this potentially dangerous trend, an internationally recognised set of signals as per those illustrated in BS 7121-1 has been developed to allow communication between riggers, banksman, signallers and crane operators. These should be used by all competent persons when performing a thorough examination or test on a mobile crane.

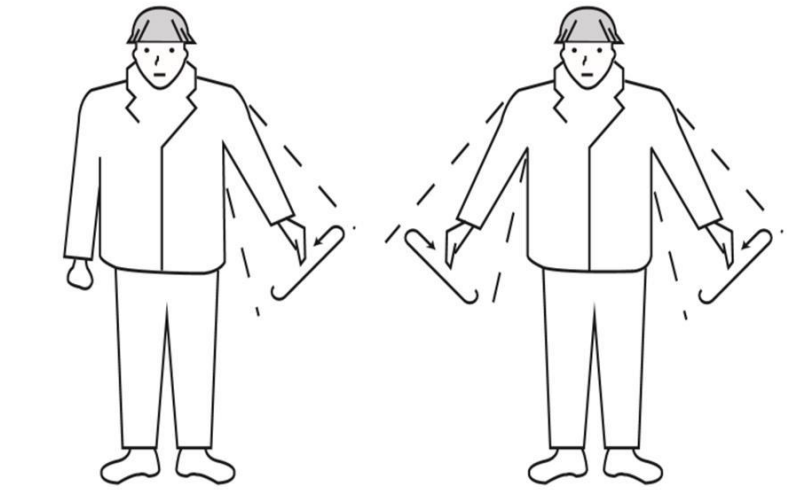
This module gives examples of these signals.

Crane Signals as per BS 7121-1



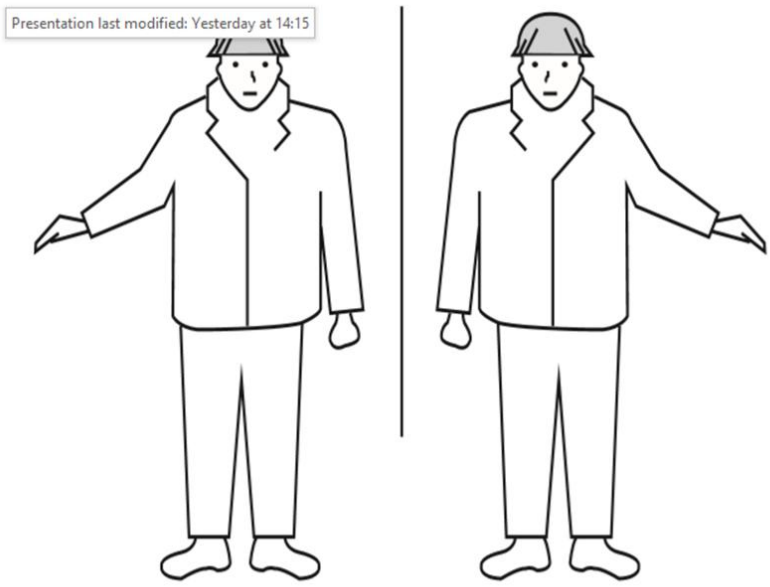


Hoist

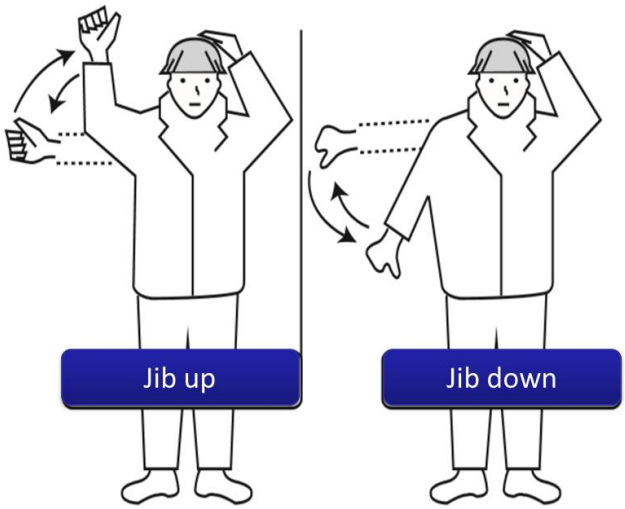


Lower

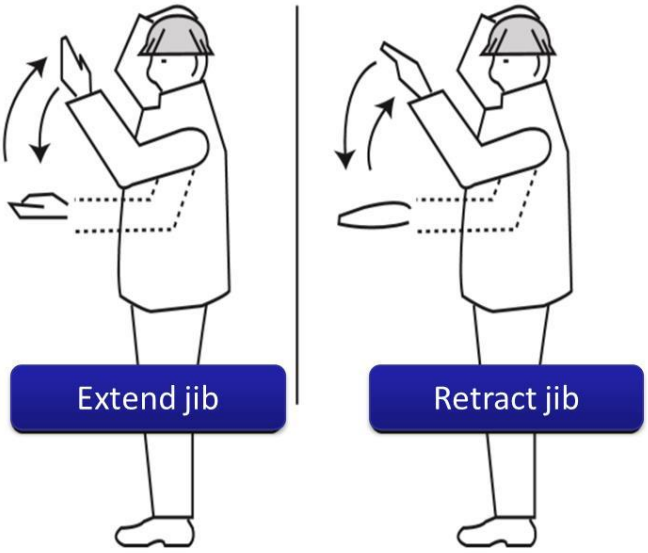
Lower Slowly



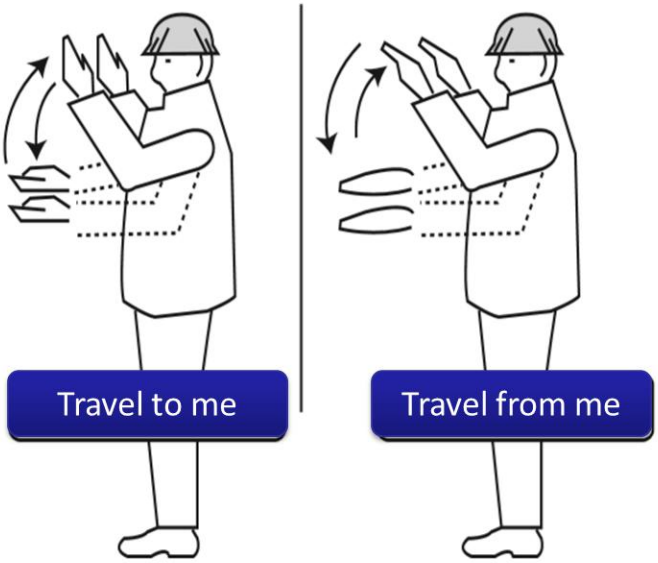
Slew in direction indicated



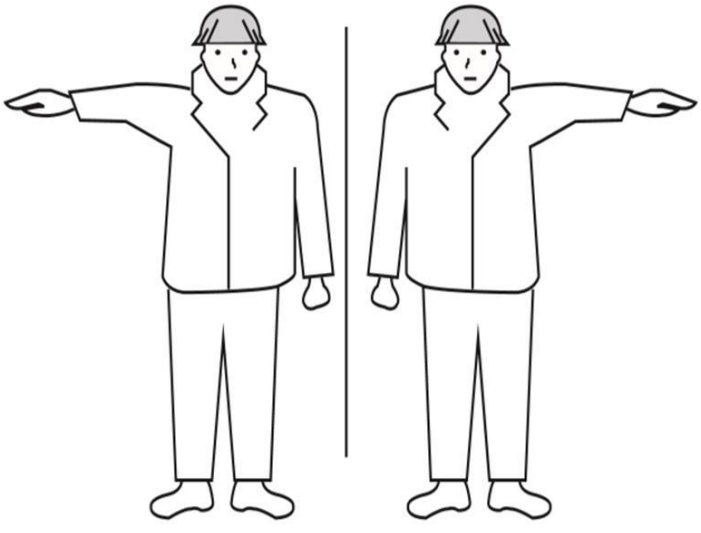
Signal with one hand, whilst other hand is on head



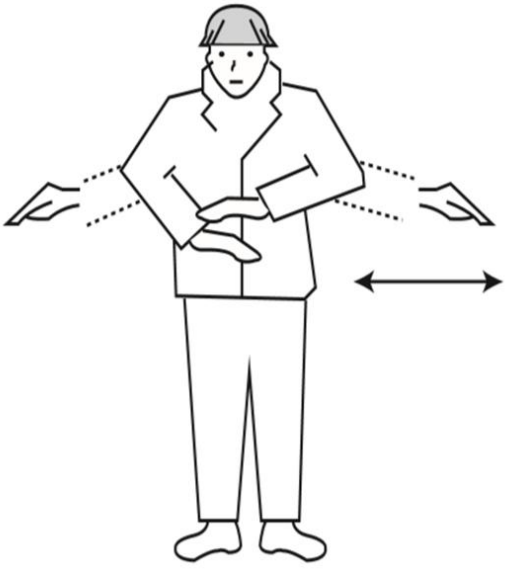
Signal with one hand, whilst other hand is on head



Signal with both hands



Travel in direction indicated



Operation cease
(or Cease to follow my instructions)

Regarding crane signals, the competent person should always remember the following points:

- Always have a clear view of the crane operator and the load
- Beware of people working around the area of lifting; the load should never go above people
- There should be only one designated signaller at any one time
- The emergency stop signal can be given by any person on site
- Discuss signals with the crane operator and all personnel prior to the lift
- If you use handheld radios, they must be reliable, secured and must have a hands-free option for the crane operator.

Always ensure that everyone is informed of the particular signals that are being used before commencement of a lift!

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11. MOBILE CRANE HYDRAULIC SYSTEMS BASICS

The operating system for mobile telescoping cranes is a hydraulic pump powered by a power take off (PTO) shaft or a dedicated engine to drive the pump. It is therefore essential that the competent person performing the examination has a basic knowledge of this type of system.

A hydraulic crane works on the same principle as the human body as far as fluid, circulation and pressure are concerned.

The heart is a pump that pumps blood round the system. The hydraulic oil in the system is like the human blood and if we don't get enough blood circulating through the system, the system will get weak and ultimately break down (flow).

If our blood pressure is not correct, we will also be weak and tired (pressure).

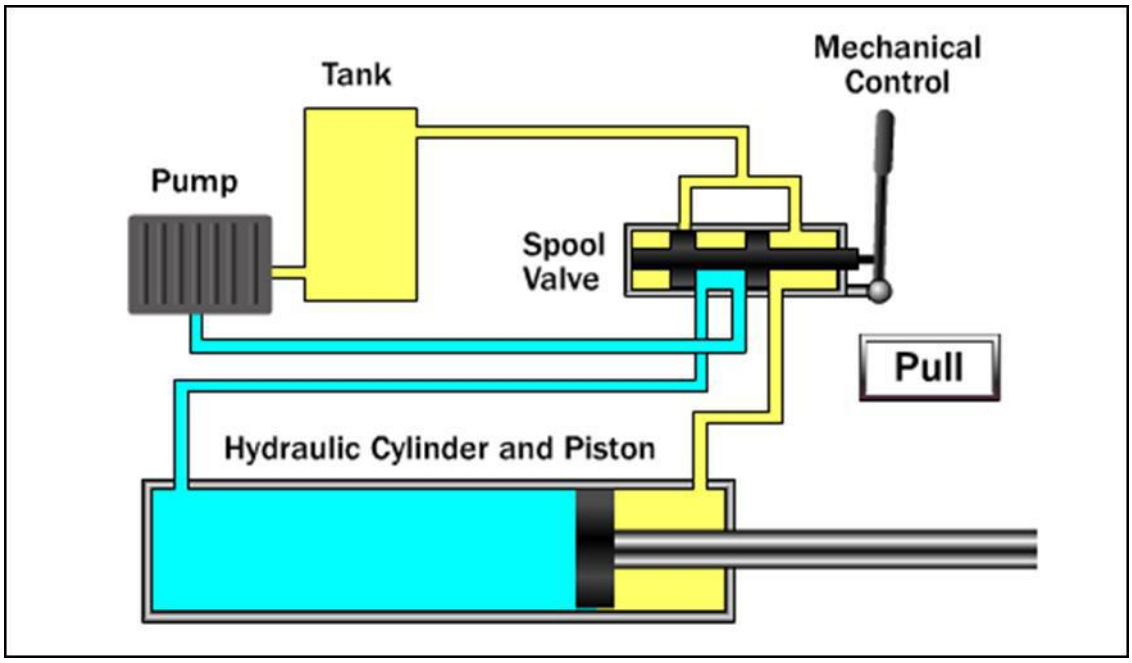
The crane also has a brain, (spool valves) the same as the human body, which gives it instructions on what part of the body to move.

If we want to run or exercise vigorously our heart pumps faster to allow us to do this (accelerator).

Hydraulic Systems Basic Components

Mobile Crane systems have the following same basic components of any hydraulic system:

- A power source
- A hydraulic oil reservoir
- A pump
- Directional control valves and actuators



Most hydraulic truck cranes use two-gear pumps that have a pair of inter-meshing gears to pressurize the hydraulic oil.

When speed needs to increase, the operator pushes the foot throttle to run the pump to give the maximum flow rate (approx. 1600 rpm).

In a gear pump, the only way to get full flow is to run the engine at recommended rpm as per the pump specification.

Example
A typical 70-ton hydraulic truck crane uses a 12.7-L diesel engine that generates up to 365 horsepower. The engine is connected to three two-gear pumps, including:

Main pump - This pump operates the piston rod that raises and lowers the boom, as well as the hydraulic telescoping sections that extend the boom. The main pump is able to generate 3,500 pounds per square inch (psi) of pressure. It generates more pressure than the other two pumps because it is responsible for moving much more weight.

Pilot pressure counterweight pump - A hydraulic truck crane uses counterweights on the back of the cab to keep it from tipping over. These may be added and removed by a hydraulic lift that has its own pump. The counterweight gear pump can generate 1,400 psi.

Steering/outrigger pump - One pump controls the steering and the outriggers. The outriggers are used to stabilize the truck during lifting operations. Because steering and outrigger operation are not performed simultaneously, they can run off of the same pump. This pump generates 1,600 psi.

Mobile Crane Operator Cab

A mobile crane has two basic types of controls for manoeuvering a load:

Joysticks - There are a minimum of two joysticks in the cab. Most mobile crane joysticks are configured so that one will control hoist and boom motions and the other will control boom telescoping and swing motions.

Foot pedals - One pedal controls the amount of pressure being generated by the pump, but ancillary pedals can be responsible for retracting and extending the telescoping sections of the boom or as a swing brake, a change over from main winch to auxiliary or as a means of booming up and down.

Joy sticks and foot pedals are connected to hydraulic hoses that connect various hydraulic rams to spool valves.

The spool valve is connected to the hydraulic pump via a third hose that is placed between the two hoses that run from the spool valve to the hydraulic ram. When a joystick is pushed in one direction, it causes the valve to direct the oil through the spool valves to operate the function as required.

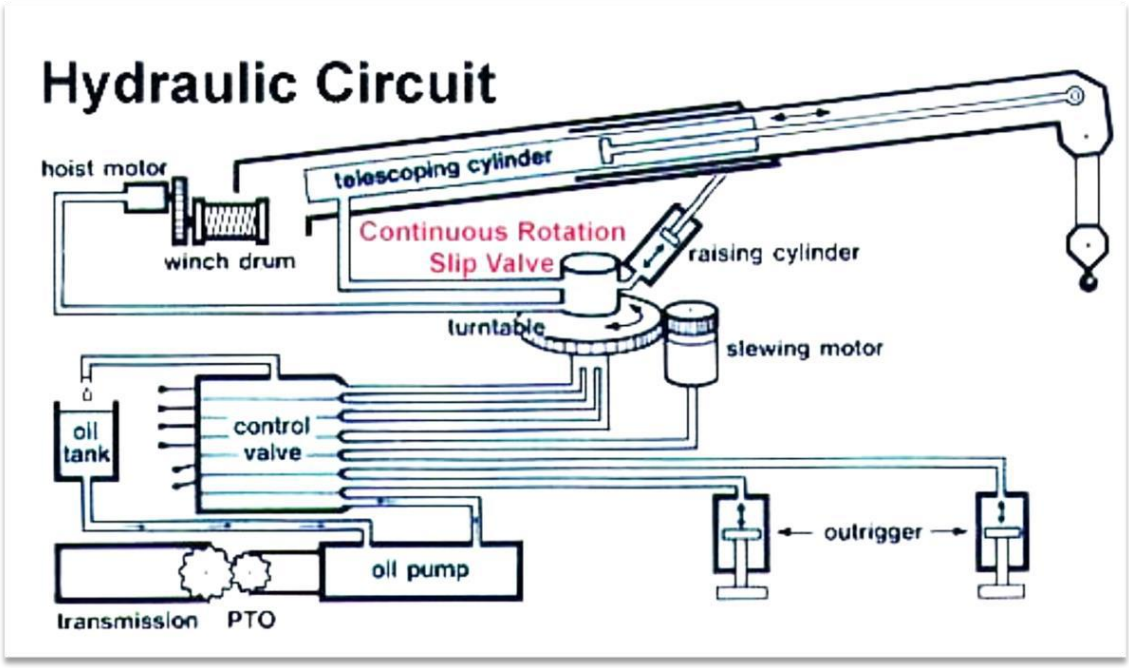
Some older style cranes may still be equipped with mechanical levers that use direct linkages to spool banks rather than electronic signals.

Hydraulic Circuit

The crane's engine powers a hydraulic pump via a rotating shaft, (PTO – Power Take Off) or a dedicated engine that drives the hydraulic pump. This then applies pressure to the oil, which is then directed through spool valves to either a cylinder or a motor. This is converted back to mechanical power, which then activates the relevant motion of the crane such as hoist, boom, swing, telescoping.

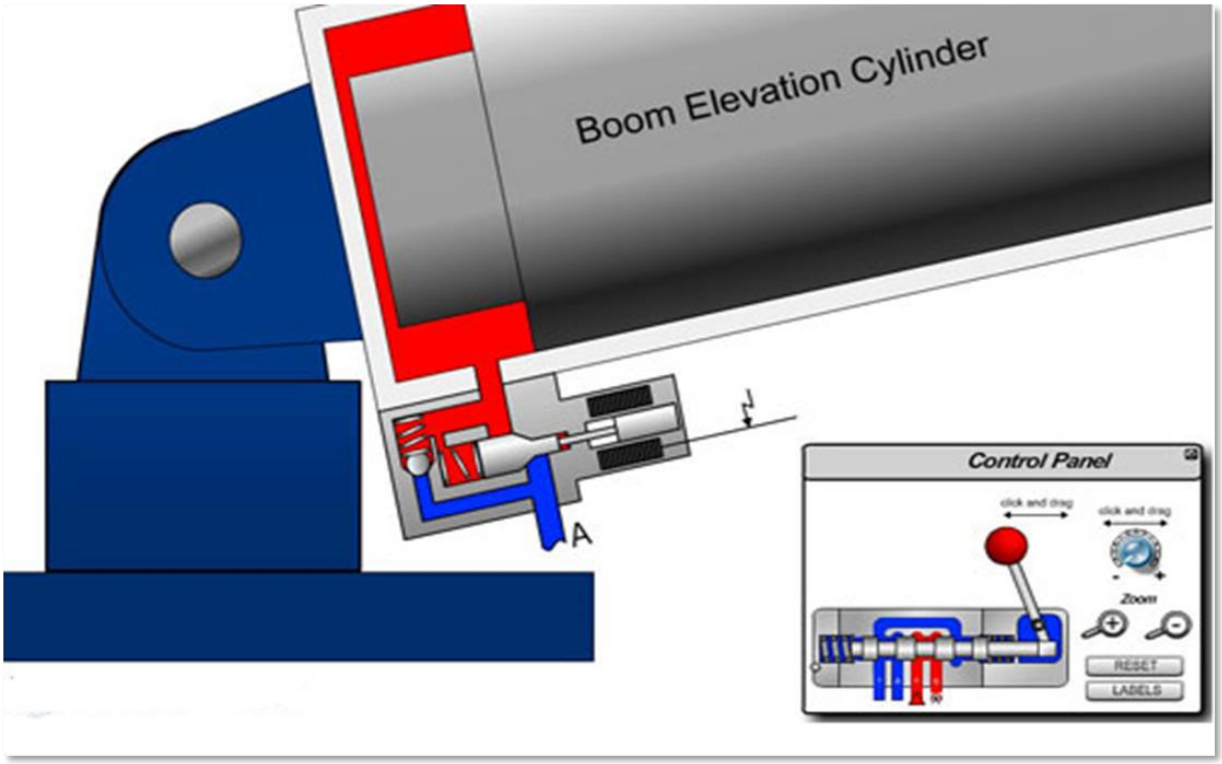
The system is protected by pressure relief valves which are set to protect the main components of the crane and to prevent overloading.

Here is an example of a typical hydraulic circuit.



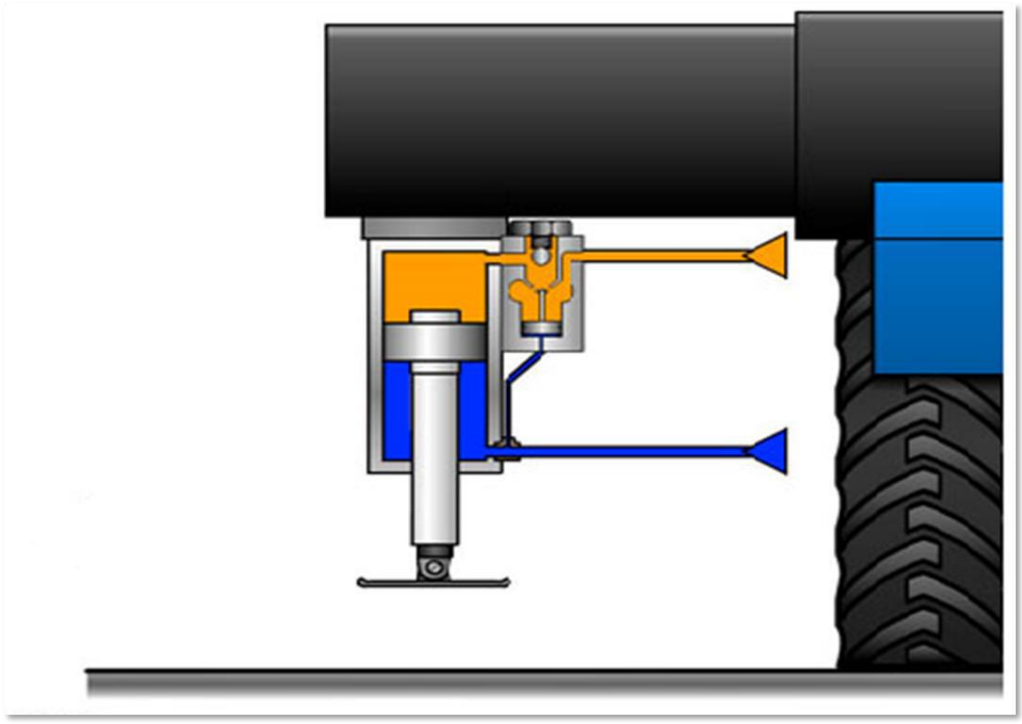
Boom Circuit

Typical boom hydraulic circuit



Outriggers

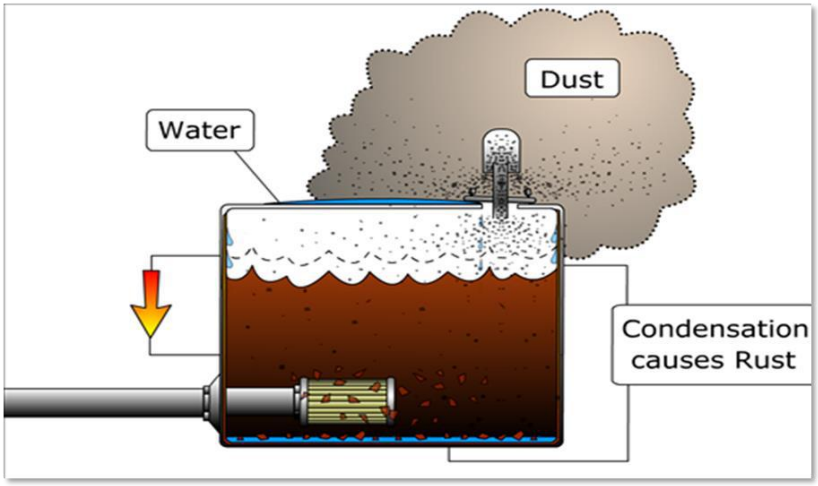
Typical outrigger hydraulic circuit



Hydraulic System Performance

Hydraulic system performance can be affected by:

- Insufficient oil/no oil/contaminated oil in the system
- Dirty or clogged filter
- Excess loads
- Presence of air in the system
- Engine speed



Safety Warning

Anything under pressure is a potential hazard

Hydraulic fluid injection injury is a very serious hazard for anyone who works with hydraulic equipment.

Other dangers with hydraulic fluid may include-fire, explosion, slips, trips, environmental effect, whipping hoses, mechanical failure and burns.

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12. THOROUGH EXAMINATION OF MOBILE CRANE CARRIER/CHASSIS

Modern mobile telescopic cranes are complex pieces of equipment which are constantly developing and a competent person should take every opportunity to keep up to date with advancements.

Manufacturer's public relation releases often provide updated product information.

To ensure that a thorough examination is carried out methodically the following steps should be observed:

1. Carry out examination of the mobile crane chassis/carrier as per BS 7121-2-1 and BS 7121-2-3
2. Carry out examination of the mobile crane upper works as per BS 7121-2- 1 and BS 7121-2-3
3. Perform wire rope examination as per BS ISO 4309
4. Generate a Report of Thorough Examination (ROTE) as per Schedule 1 of LOLER
5. Ensure that all details in the Report of Thorough Examination (ROTE) are correct

Thorough Examination of Crane Carrier/Chassis

Mobile cranes are currently exempt from the Goods Vehicles (Licensing and Operators) Regulations 1995 and the Goods Vehicles (Plating and Testing) Regulations 1988.

However, the Road Vehicles (Construction and Use) Regulations 1986 Regulation 100 requires that mobile cranes should:

"At all times be in such condition… that no danger is caused or is likely to be caused to any person in or on the vehicle or on a road"

Steering and Brakes

Check the steering to ensure all wheels turn in the correct direction. This is essential with all-wheel or multi-wheel steering. This check can be done when the crane is manoeuvring into position.

To check brakes, ask the operator to:

- Ensure gear is in neutral and apply the handbrake. Engage first gear and check to see if crane moves
- Press the footbrake and release handbrake. Check to see if crane moves
- Engage neutral and apply handbrake.

The competent person should then position themselves with a rear view of the crane to one side. Instruct the operator to apply the footbrake and check for brake lights operation.

Next, ask the operator to select reverse gear and check the reverse alarm and light(s).

Manufacturer's Information Plate/Label & CE mark

The manufacturer's information plate will contain Type/Model, Works or Serial number, Year of Manufacture, and where applicable, manufacturers name & CE mark.

Make sure all required markings are clear and legible.

Lights, Windscreen & Registration Plate

Examine…

- Headlights
- Sidelights
- Warning lights
- Indicators
- Hazards
- Windscreen wipers/washers
- Registration plate

Check that all lights function correctly.

Check the condition, function and security of windscreen wipers/washers.

Check that the registration plate is clear, secure and legible.

Reverse Alarm/Lights

Not all cranes will be fitted with both. What is fitted, however, must work properly.

Hook Attachment Points

Carefully check the hook attachment points, especially bolts or welds that are not normally visible - like behind the bumper.

Use a torch & mirror to inspect these if necessary.

Ensure that all accessories used to attach the hook block are examined and reported on as required to comply with local legislations.

Operator Cab on Carrier

Check…

- Housekeeping
- control identification
- Seat
- Safety belt
- Condition of pedals
- External condition of cab including bodywork, door & window mechanisms & mirrors

Tyres and Wheels

Check…

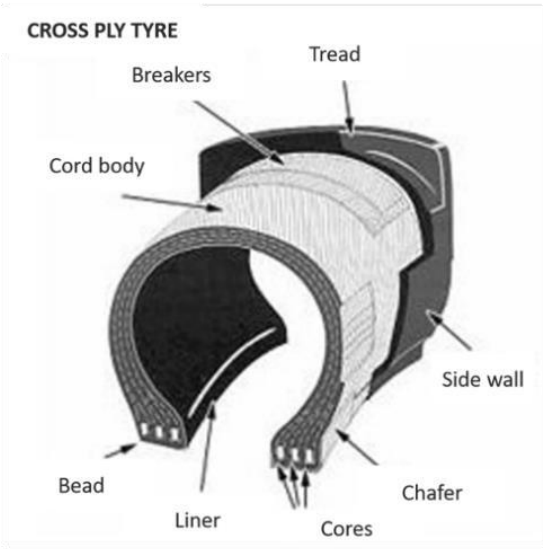
- Tyre condition
- Size
- Type
- Tyre pressures
- Valve caps
- Fixing studs/nuts for correct torque values

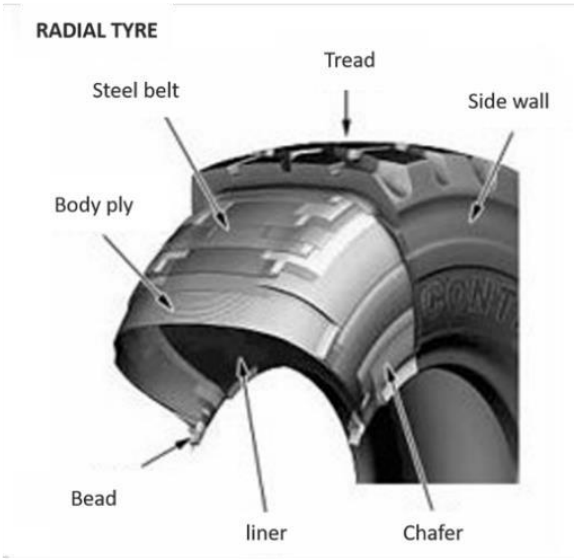
Tyre pressure is important for any crane, but it is essential that it is correct for cranes that have free on rubber (free on wheels) duties.

Manufacturers load calculations and speed of travel are based on the tyre pressures being correct to avoid tipping.

If testing on rubber duties, check to see if axle or suspension locks are fitted or required.

Most mobile cranes nowadays are fitted with radial tyres. Although cross ply tyres are rare, the examiner must ensure that the tyres fitted to a mobile crane are either all radial or all cross ply. **A mix between the two types of tyres is not acceptable.**





Automatic carrier levelling/ suspension system

Observe suspension lowering when setting up and suspension raising when preparing to finish. Investigate if any problems are observed.

Leaf/leaves springs suspension

Check…

- Security
- Condition
- Corrosion
- That they are correct for the model of crane

Notes:

Hydraulic Systems

Hydraulic tank fitted to crane

Hydraulic tanks may be round, square or rectangular, but all should have a visual means of checking the hydraulic oil level. Check the tank cap is the correct type and is fitted.

Round hydraulic tank

Rectangular hydraulic tank

- Check the hydraulic tank oil level is correct before setting up the crane
- Ensure the cap is fitted to the tank
- Check the filter if accessible
- With the PTO engaged, listen for adverse sounds coming from the pump during operation
- Check all pipes, flexible hoses and connections for leaks and condition

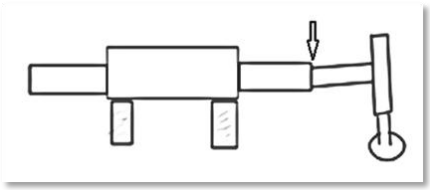
WARNING: Be aware of hot pressurised hydraulic oil whilst carrying out these checks

- Check all telescoping ram seals for signs of leakage

Notes:

Outriggers, Jacks & Pads

Outrigger Beams
Visually examine the outrigger beams to ensure they are level. Beams that are offset could indicate cracked or damaged welds or wear and that shims may need adding or replacing.



Examine all visible hoses, connections & pipes for cracks, deformation or leaks.

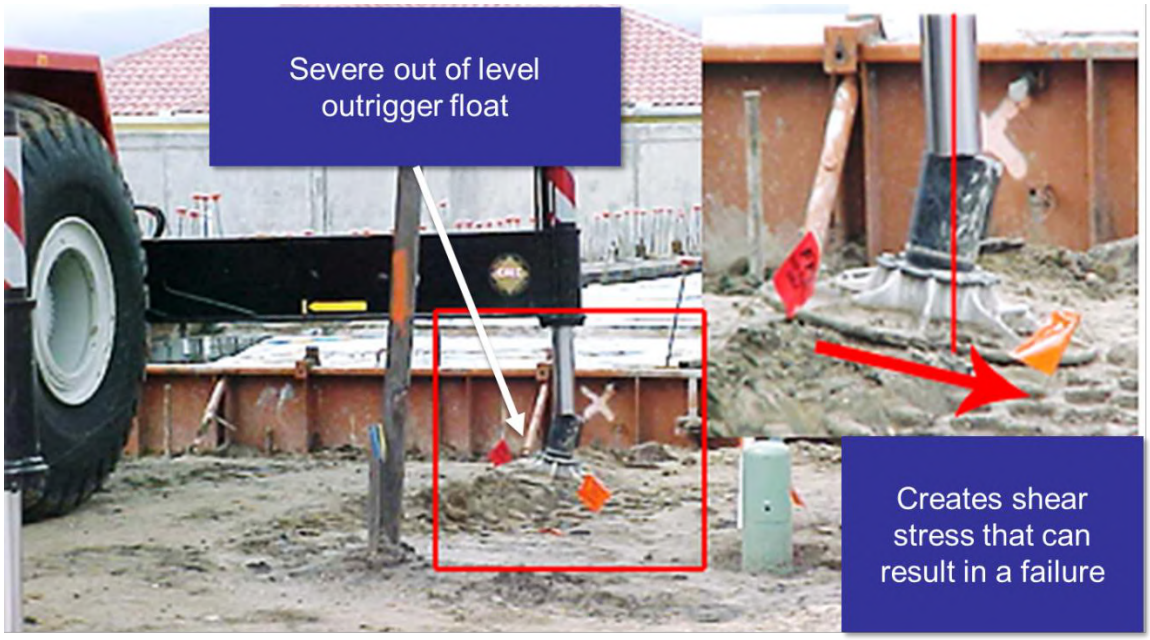
If access holes are available on the side of the beam, remove the covers and check the interior of the beam for hydraulic oil presence - this can indicate a leak in the system.

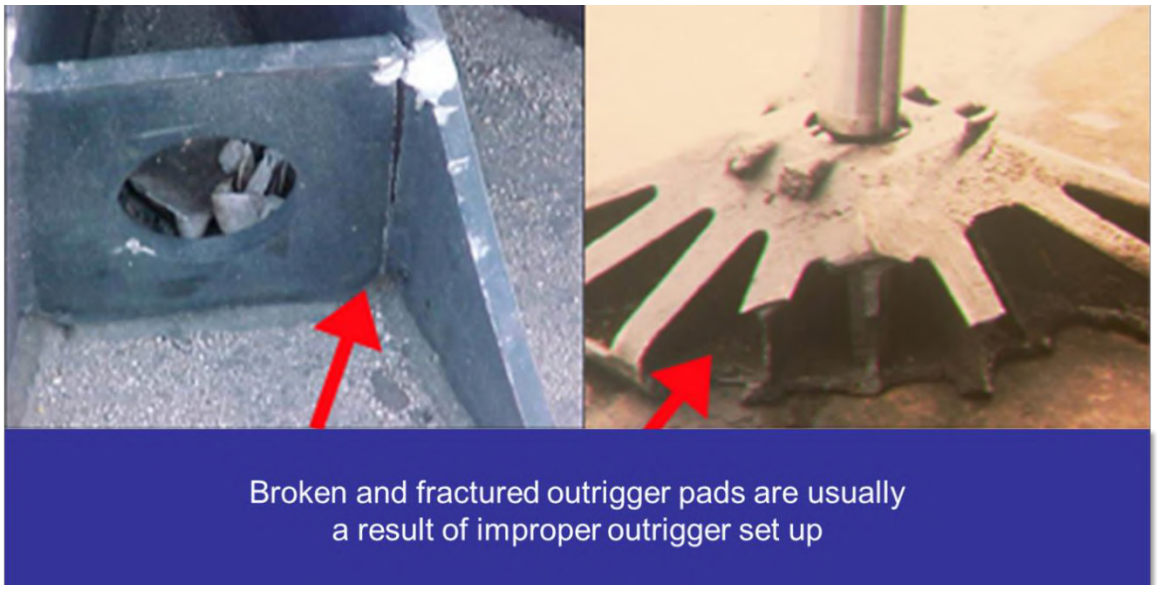
While the operator is setting up the crane and outriggers, observe them for smooth operation.

Ensure that the locking holes line up and that the locking pins are available and can be inserted.

Check the condition of operating controls and that they are clearly labelled.

Notes:





Safety Warning

When checking the outriggers, take all adequate precautions.

Working within the radius of the crane carries serious risk that the competent person must take into consideration.

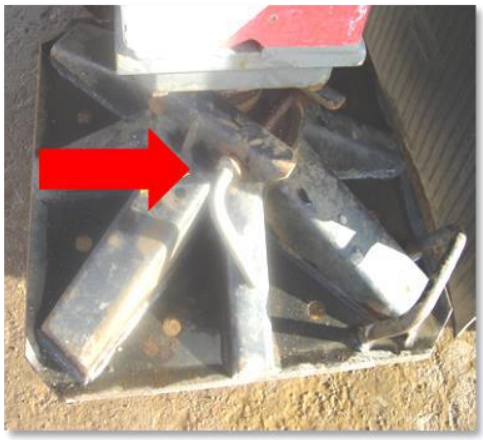
Serious injury and fatalities have occurred because operators and workers have approached a working crane.

Notes:

Outrigger Jacks & Pads

Check that the jack ram is dry. A film of oil can indicate a seal is leaking and it will get progressively worse. Use a torch if necessary and check the outer seal cover.

Ensure pads are undamaged and locking pins are available and can be easily fitted.

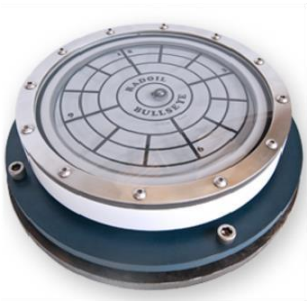


Further images of outrigger jacks, pads, hoses & pins…

Notes:

Outrigger controls & level gauges

Different crane levels gauges



Drive Shaft

Visually examine to ensure the shaft is secure, the condition of the shaft and, if visible, the PTO shaft is engaged.

Access Ladders

Check access ladders for damage, missing steps, attachment fixtures, broken welds and missing bolts etc.

Summary

- ✓ Drivers Cab
- ✓ Lights
- ✓ Brakes
- ✓ Gears
- ✓ Reverse Alarm
- ✓ Hydraulic tank oil level (checked before operating any hydraulic functions)
- ✓ Fuel Tank
- ✓ Tyres & Pressures
- ✓ Suspension
- ✓ Drive shaft
- ✓ Power take off (PTO) is engaged
- ✓ Outrigger jacks, pads & beams
- ✓ All pipework & connections including flexible & rigid hoses and holding valves
- ✓ Hydraulic cylinders
- ✓ Access ladders
- ✓ All bolts pins & fastenings
- ✓ Superstructure for cracks or damage

This list is not exhaustive.

Notes:

Typical Checklist for Thorough Examination

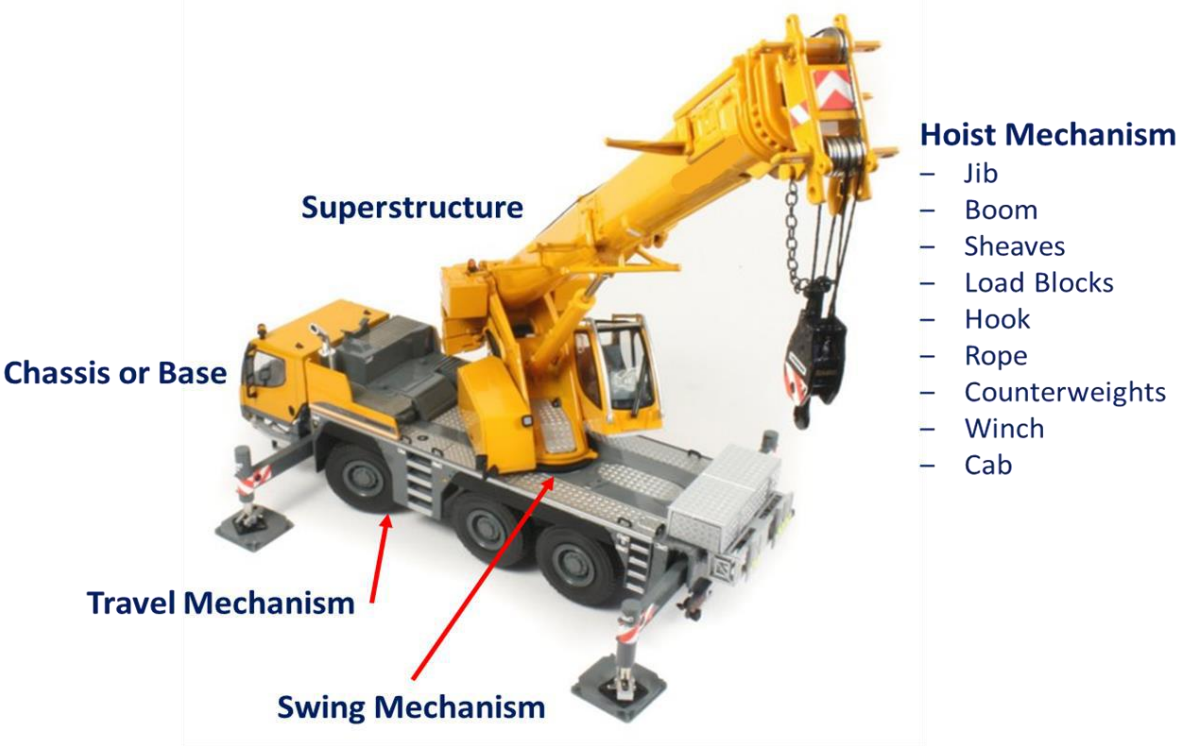
Checklist for Mobile Crane Thorough Examination

carried out per BS7121-2, Parts 2 & 3

Serial	Crane Sub-assembly	Safe	Unsafe	Observations
1.0	CRANE CARRIER/ CHASSIS			
1.1	Steering during manoeuvering into position			
1.2	Brakes during manoeuvering into position			
1.3	Manufacturers information plate			
1.4	Headlights & Sidelights			
1.5	Indicators			
1.6	Brake lights			
1.7	Reverse lights & alarm			
1.8	Windscreen wipers			
1.9	Windscreen washers			
1.10	Registration plate			
1.11	Hook block attachment point			
1.12	Hook block attachment accessories			
1.13	Operators cab information plate			
1.14	Operators cab interior and exterior housekeeping			
1.15	Cab Glass			
1.16	Operations and labels of all controls including horn			
1.17	Seat and seat belts			
1.18	Tyre conditions, pressures, security, type and size			
1.19	Suspension systems			
1.20	Hydraulic tank and oil level			
1.21	Outrigger controls			
1.22	Outrigger level gauges			
1.23	Outrigger Beams			
1.24	Outrigger Jacks			
1.25	Outrigger pads			
1.26	Fuel tank			
1.27	Air reservoirs			
1.28	Access ladders			
1.29	PTO shaft			

Notes:

13. THOROUGH EXAMINATION OF MOBILE TELESCOPING CRANE SUPERSTRUCTURE



Although important in its own right, the function of the crane carrier is to transport the crane superstructure to its operational site.

When there, the crane superstructure becomes the star of the show, and it is crucial that it performs as per the manufacturers specifications and works safely and efficiently.

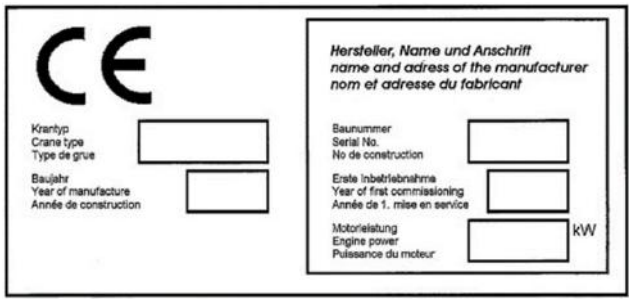
The examiner is required to check the following key examination areas as a **minimum:**

- Manufacturers plate, serial number, model, year of manufacture
- Counterweight and counterweight attachment system
- Operator cab
- RCIs
- Boom cylinder
- Boom
- Boom telescoping sections
- Boom telescoping hose recoil drum
- Boom length/angle sensor, recoil drum and cable
- Boom wear pads
- Winches
- Wire rope
- Wire rope anchors/terminations
- Hook block including sheaves
- Anti two block mechanism

Notes:

Manufacturer Plate

The information on the manufacturer's plate is required not just to confirm the identity of the crane, but also to ensure that the correct load charts are available to correctly verify the RCL. So, these markings are required to be clear and legible.



Counterweights and Attachments

Counterweights are essential to enable the crane to perform its duties. Fitting the counterweights as detailed in the load charts will ensure that the crane is working to its maximum boom lengths and radius.

Check that…

- the counterweight attachment rams fully extend when deployed and that they engage and lock
- both rams deploy correctly when the counterweights are fitted and both activate (rotate) to lock
- the operator's system display shows the correct sequence of operation

Examine the hydraulic rams and attachments for leaks, loose connections or damage.

Notes:

Operators Cab

As the competent person, you are checking the following:

- The cab housekeeping is good
- The operator's seat is in good condition
- There are no loose wires or panels anywhere in the cab
- The RCL is fully functional
- The crane-specific load charts are present in the operator cab
- There are no obstructions to the operators view
- The glass in the cab is all safety glass and has not been modified with anything other than the manufacturers specific glass
- That all the control functions and switches are clearly marked and that they perform as marked
- The swing brake engages and holds
- The tilt cab mechanism if applicable operates correctly
- Lights and windscreen wipers/washers function correctly
- Air conditioning/heater controls operate correctly

Speak to the operator or technician - they can tell you if there have been problems with the crane. Sometimes they will tell you more than they will report to their manager or maintenance colleague.

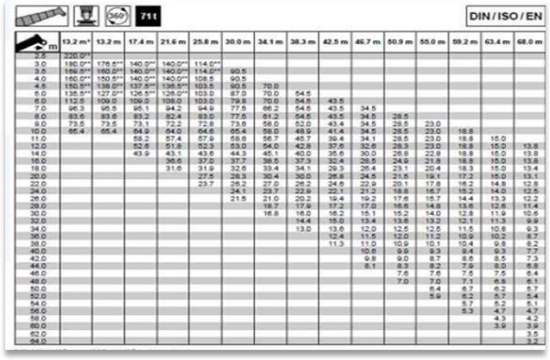
Crane Controls

Check that all the control functions and switches are clearly marked and that they perform as marked.

Rated Capacity Limiter

To verify that the RCL is operating correctly, take the following steps:

- Check rated capacity (load) charts are correct for model and type of crane
- Verify closed boom length on RCL against figures on rated capacity chart
- Pick a configuration and request operator to set boom length accordingly
- Boom out to a selected radius/angle
- Verify that capacity shown on RCL is same as shown in rated capacity chart
- Physically measure radius to verify it matches RCL
- Attach a known load, or lift a load using calibrated load cell and verify RCL
- Repeat for at least two different radii



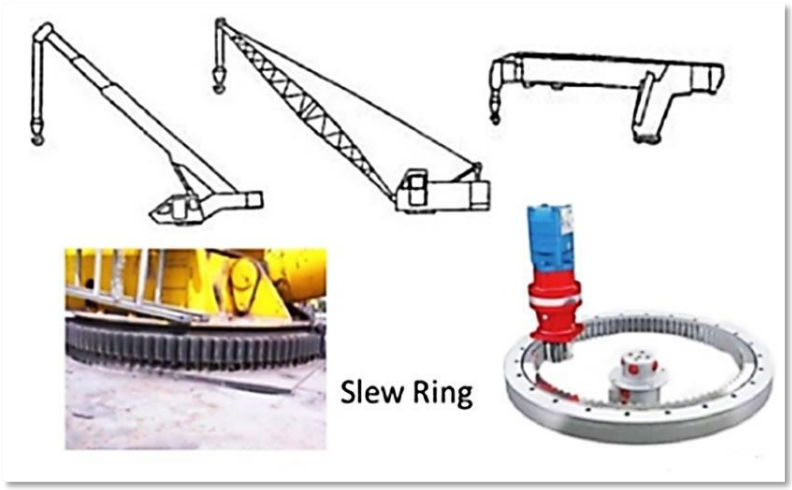
Load Monitoring Indicator

Check that the Load Monitoring Indicator (remote bar graph) is functioning and secure.

Cab Mounted Load Chart

Ensure that the load chart is correct and legible.

Swing Gear Mechanism



If internal gearing is used for the swing mechanism the only way to examine this, short of dismantling the assembly, is by using your visual and audible senses.

If the swing drive is external, it is relatively easy to examine. The points to consider are:

- Worn gear teeth
- Noisy drive motor
- Loose bolts

Observe the crane whilst slewing and note if there is any discernible rocking movement that would indicate loose bolts or worn gearing. Listen for any grinding of the drive motor.

If excessive movement is noted when the crane is under load, then take measurements using a dial test indicator (DTI) and compare with manufacturers readings if available. Dial test indicator measurements are a last resort that are rarely used and are non-conclusive unless previous data is available. However, it is another potential tool we can use.

Positive Swing Lock

All mobile telescoping cranes must be fitted with a positive swing lock to ensure that the boom cannot swing when in the locked position. This is essential if the crane is to be moved with the boom in the upright position (pick and carry duties).

While moving/being transported with the boom on the rest, the positive swing lock ensures the boom cannot rotate unexpectedly. There have been cases of booms swinging whilst travelling and causing accidents to other road users.

The example shown is just one type; there are many more different types.

Central Rotary Distributor

All mobile telescoping cranes are fitted with a **central rotary distributor** to allow the crane to rotate through a 360° arc.

The rotational coupling for hydraulics and electrical connections allows all crane actions to be performed normally even when the cab is rotated.

The examiner should ensure that all fastenings are secure, all hydraulic hoses and connections are not leaking and there is no damage to visible wires.

On older cranes, a safety chain was attached to ensure the coupling rotated with the crane in case securing bolts sheared.

Telescoping Booms

The telescopic boom on a mobile telescoping crane is attached to the swivel structure by boom pins and raised by a one or two hydraulic ram system.

- Check upper and lower boom pins, particularly the boom derrick ram attachment pins
- Failure to ensure locking pins are in place can cause the pin to work loose, resulting in boom collapse
- Check all hydraulic connections for loose fittings and leaks
- Observe derrick piston(s) while boom is being lifted. If oil is detected on the piston, it can indicate that the seal is leaking
- Operate boom up and down to clarify if there is actually a leak, as a leak would be more visible whilst the system is under pressure.
- Verify allowable deflection by measuring radius

Examples of single cylinder boom derrick ram -

Telescoping Boom Flexing

When fully extended and under load, modern booms can flex quite extensively. This is normal and allowable. However, if there is a downward bend whilst not under load, it may indicate that the bottom and top wear pads may need adjustment or replacement.

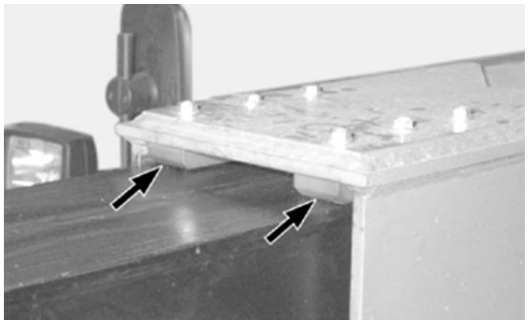
Wear pad adjustment or replacement is a commonly reported action. Crane owners and mechanics often don't like to hear this as it sometimes means pulling the boom to replace the inner set of wear pads.

Looking at a boom like the one on the right indicates that the side wear pads on the outer section of the boom require adjustment or replacement.

A simple method of checking to see if boom wear pads require replacing or adjustment is to fully extend the boom and get the operator to swing a short distance then stop suddenly, any movement in the boom can then be observed.

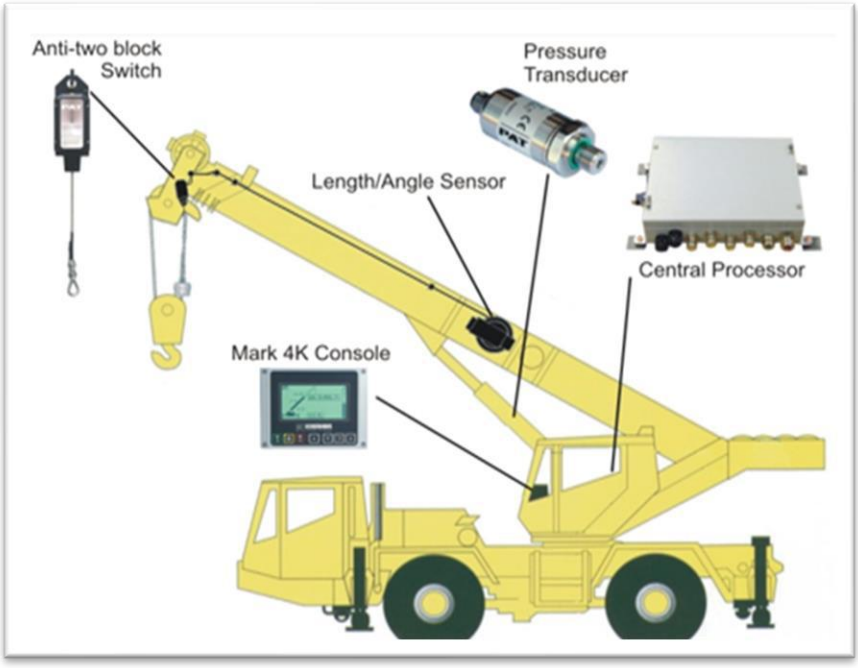
If the whole boom moves, this is expected and acceptable. If individual sections of the boom move sideways, adjustment or replacement of the wear pads in these sections are indicated.

Some examples of wear pad locations are shown below.



Notes:

Boom Pressure Transducer



Pressure transducers are installed in the hydraulic circuit that raises and lowers the boom cylinder(s). They monitor the pressure within that circuit.

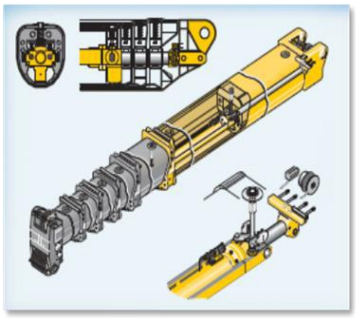
The difference in pressure between an unloaded boom and a loaded boom allows the rated capacity limiter to calculate the actual load being lifted.

Another method is to install a tensionmeter on the load line. With this, the differences in tension allow the rated capacity limiter to calculate the actual load being lifted.

Telescoping Systems

Older cranes may use a multi ram system for telescoping the boom and in these cases, all or most of the boom sections will move at the same time.

The modern tendency is to use a single ram telescoping system which will telescope the boom section a specific percentage of movement and then lock it in place before returning to its start point and repeating with the next section.



Because the telescoping rams are internal, it is not always possible to examine them. However, some cranes have viewports at the base of the boom that allow you to observe the rams closing.

If there is no option for seeing the ram, examine the boom base for signs of oil to determine whether there are any hydraulic leaks.

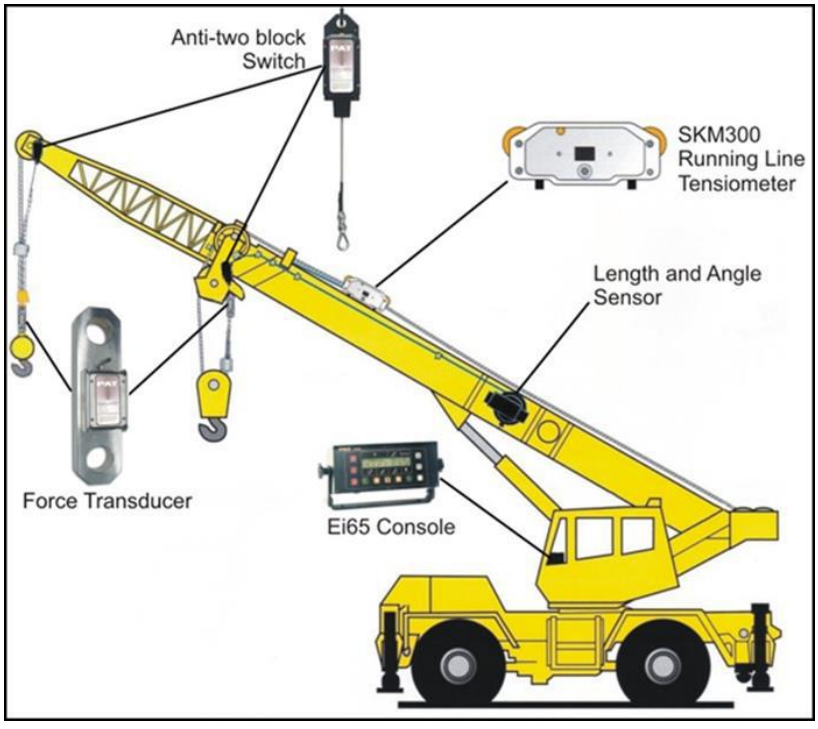
The condition of the hydraulic hoses on the recoil drum is also a clue as to whether there are any leaks.

Single stage ram systems have to be checked on the RCL display to ascertain whether they are operating to their correct configuration and whether the boom pin locking system is functioning.

Boom Furniture

Boom furniture may include:

- Boom length/angle sensor
- Cable Reeling Drum
- Limit switches
- Dynamometer
- Anti two block switch



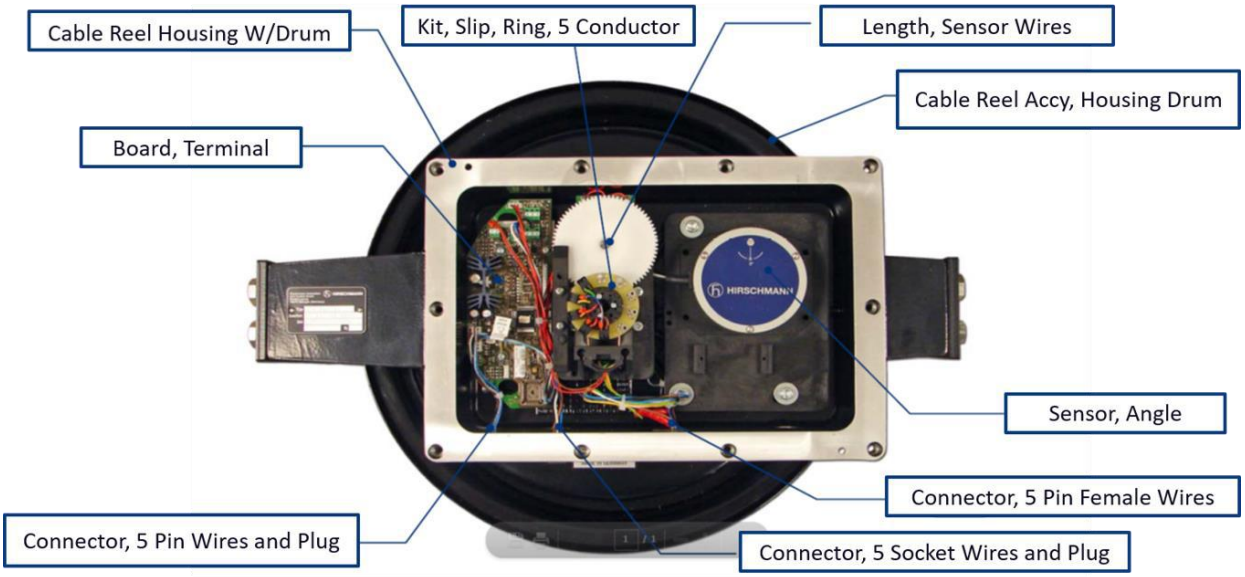
Attachments on booms are critical for the correct working of the Rated Capacity Indicator/Limiter.

Cable Reeling Drum (Power feed to angle sensor and other boom furniture)
Ensure that cable is laid flat on the drum, otherwise false length readings may be obtained.

The length of cable is mounted to the tip of the boom and transmits the anti-two block signal.

The number of turns and the diameter of the cable drum controls the length of the uncoiled cable. This determines the telescopic length.

Angle Sensor
The angle measurement is determined by an angle sensor mounted inside the cable reel housing shown below.



Fly Jibs and Mounting Structures

The difference between a fly jib and a luffing jib is that a fly jib is normally fixed in position during a lift and the main boom moves up and down.

A luffing jib, however, is the main mover in luffing configuration and the main boom is normally set at a fixed length and angle.

When fly jibs are stowed on the side of the crane boom it is critical to ensure that the jib attachment pins are also stowed on the boom to ensure that the correct pins are available to pin the jib to the boom.

The jib attachment lugs should also be examined to ensure they have not been damaged or distorted.




Boom stowed fly jib extensions, sometimes known as swing-aways, can be examined even when not erected.

With the main boom in a horizontal position over the side, the length of the boom can be examined.

Because most fly jib extensions are of lattice boom construction, pay attention to the main cord and lacings.

Check for damage such as distortion and cracked welds. Also check the attachment lugs and holes.

Fly Jib Angles

The angle of the fly jib may be variable from 0°- 60° and may be manually set or have a powered adjustable system in place.

Luffing Jibs

Luffing Jibs are used in conditions where it is impractical to boom the main boom up or down, e.g. close to a building(s) and to offer a greater radius as well as height for the crane.

The luffing jib is attached for extra height and extended to clear all obstructions. Then it can be 'luffed' up and down to cover a larger horizontal area than a fixed boom.

Luffing Jib Examinations

Performing an examination of a luffing jib involves more individual parts than a simple fly jib.

The jib itself is also a lattice boom construction and all cords and lacings require examination for distortion, damage and weld cracks.

The 'A' frame, support frame and all pendants and attachments require thorough examination to detect any distortion, damage, weld cracks or missing/unsuitable attachment pins.

This examination is performed at ground level during assembly.

Side Supported Lift

Old style superlifts normally consisted of additional weights on a platform or wheeled trolley, which then had to be attached to the crane.

Modern technology has evolved a method of supporting the boom by rigging extendable boom side-mounted wings which can increase the crane capacity significantly.

Some cranes have the side mounted superlift assembly permanently mounted. On others, it comes as a separate attachment for road weight restrictions. Shown here is a detachable version.

Boom Tip Sheaves

Examine boom tip sheave assemblies:

- Check for damage to sheaves
- Check sheaves are free running with no play in the bearings
- Ensure rope guides are in place and secured
- Check for wear caused by wire rope rubbing on guide

Severe damage can indicate that the wire rope may have damage as well.

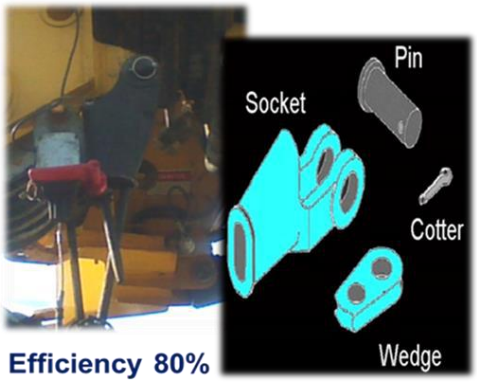
Sheaves must all be checked for wear. To do this apply a correctly sized sheave gauge and check.

Wire Rope Anchor

The hoist wire operates a hook block. To do this, the wire is either attached to the hook block or reeved and attached to the boom tip by a wire rope anchor.

It is essential that the correct wire rope anchor is attached and that the wire hoist rope has been inserted correctly and locked in place. Shown here are two methods currently in use to anchor the wire hoist rope. The one on the left is known as a **button type anchor** and the one on the right is a **wedge and socket anchor**.

It is essential the manufacturers guidelines are followed as the efficiency on the termination is only 80% for a wedge and socket within the manufacturers calculation with the rope fitted.

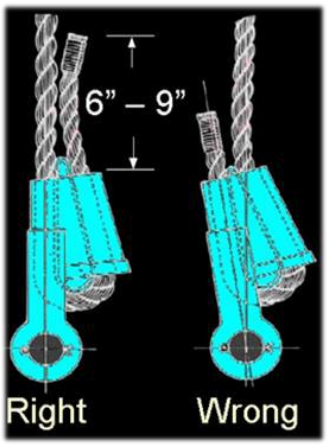


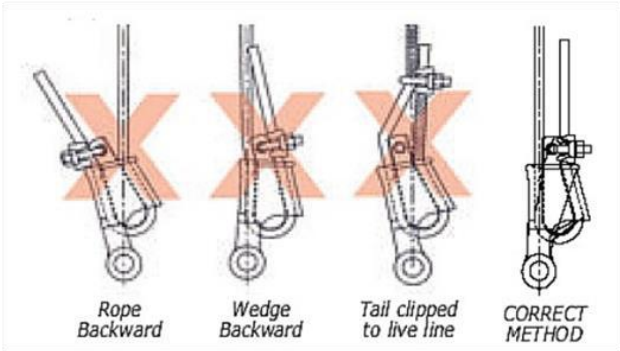
If the wire rope fitted with the manufactured end (button) fitting for the easy assembly anchor gets damaged close to the fitting, it cannot be cut and reused in that fitting. The wire rope has to be returned to the manufacturer for a replacement fitting or sent to a manufacturer recognised company for re-terminating, as the efficiency is not affected and will hold 100% in the calculation with the wire rope. e.g. 1t rope, the button termination will hold 1t. This can be as expensive as buying a new wire rope and often crane owners will just buy new.

With the wedge and socket, the socket must be the correct size for the diameter of the rope being used and that the wedge and socket are part of the same assembly and not mixed. Damaged end fittings are sometimes cut off and a suitable wedge and socket assembly fitted to allow the rope to continue in use. This is acceptable if correct assembly is used for the diameter wire and the mounting fittings.

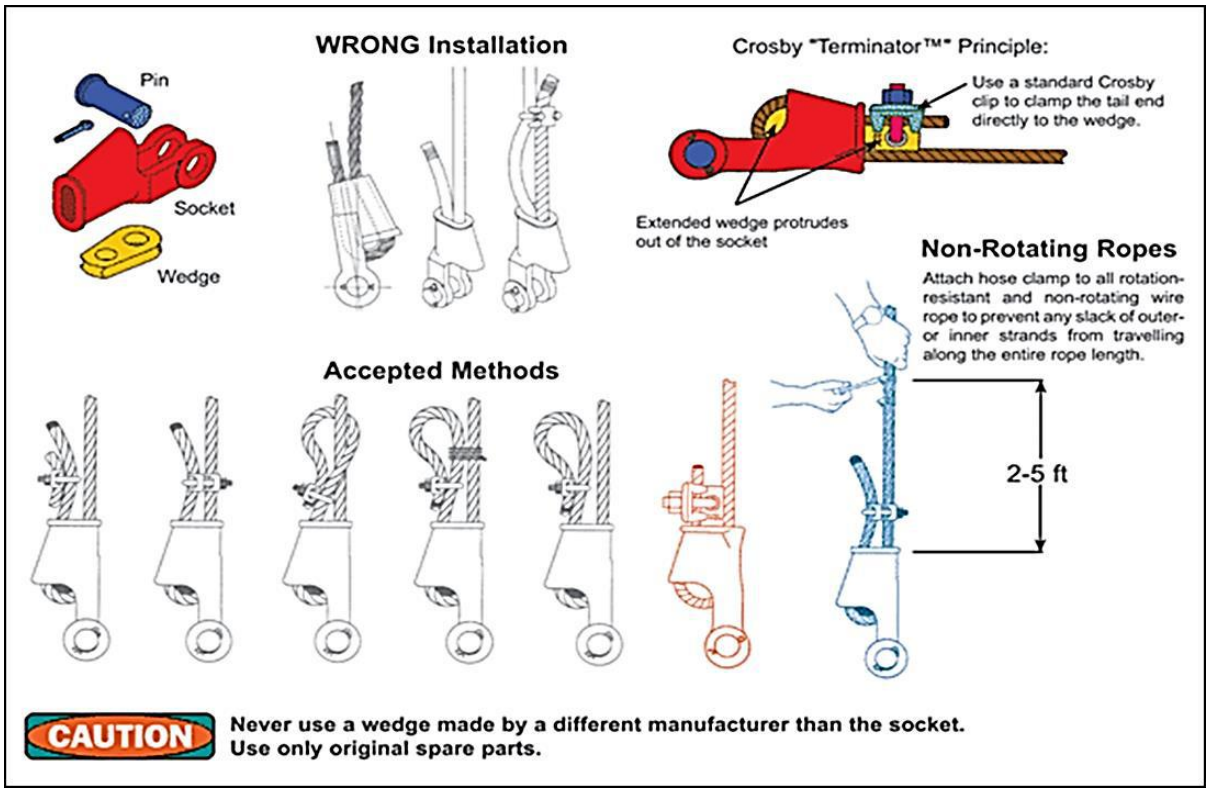
There are a number of ways the wedge and socket can be fitted. Shown below is the wrong way and the correct way. Also shown is a wedge with rope checker holes in it, that can be used as a guide to check if the wedge and socket are suitable for the wire rope size.

A common method of wrongly fitting a wedge and socket anchor is to reeve the live end down the slanting side of the wedge and back up the straight side. This causes the wire rope to sit at an angle and under load the pressure of the load will be concentrated on that small area at the anchor instead of being distributed over the whole diameter of the wire rope.





There are also several options for securing the tail. An example of one manufacturer's method is shown below.



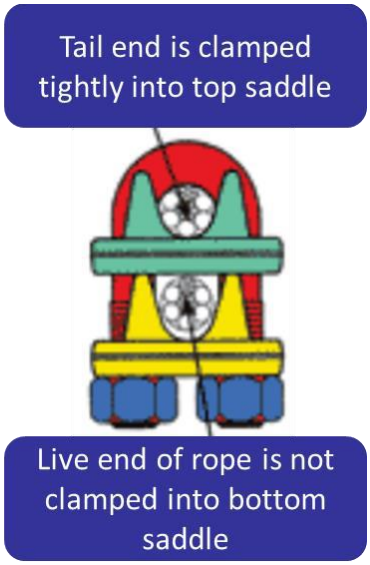
Notes:

Piggyback wedge socket clip

The piggyback wedge socket clip, is designed to secure the dead end of the hoist rope on a wedge socket. Using a piggyback wedge socket clip prevents crimping and damage to the live end of the wire rope.

The dead end is positioned between the first saddle and the “U” bolt. The hoisting end is positioned between the first and second saddle.

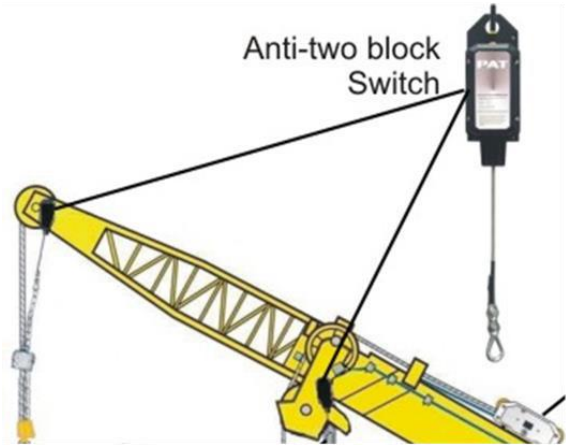
The nuts can then be installed and tightened. This allows the hoisting end to float within the space between the first and second saddle.



Anti Two Block System

The anti two block actuator consists of a weight suspended a measured distance from the boom tip by a chain or wire rope attached to the anti-two block switch.

When the weight is suspended from the microswitch, a continuous signal is transmitted to the RCL. When the weight is raised by the hook-block, it interrupts the signal causing a warning light and audible alarm to be activated at the operators console and prevents any further upward movement of the hook-block.



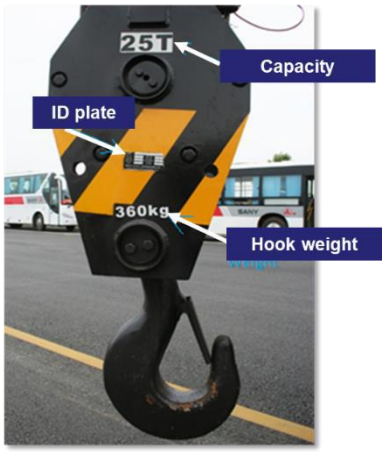
Ensure that all the assembly and safety pins are present and correctly in place.

To test the anti-two block alarm, ask the operator to raise the hook block until it is just below the suspended weight then slowly raise the hook block until the alarms activates or the weight is raised so that the alarms should activate.

Care must be taken to ensure a block to block incident does not occur during this test.

Hook Block

This hook block demonstrates the correct information that should be available on all mobile crane hook blocks.

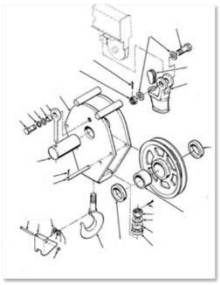


- Capacity or SWL - 25T
- Weight of Hook Block - 360kgs
- Manufacturer's plate

If the manufacturer's plate is not on side of the hook block, it can often be found on top of the block.

Examination of the hook block

Examination of the Hook Block should include but not be confined to the following:

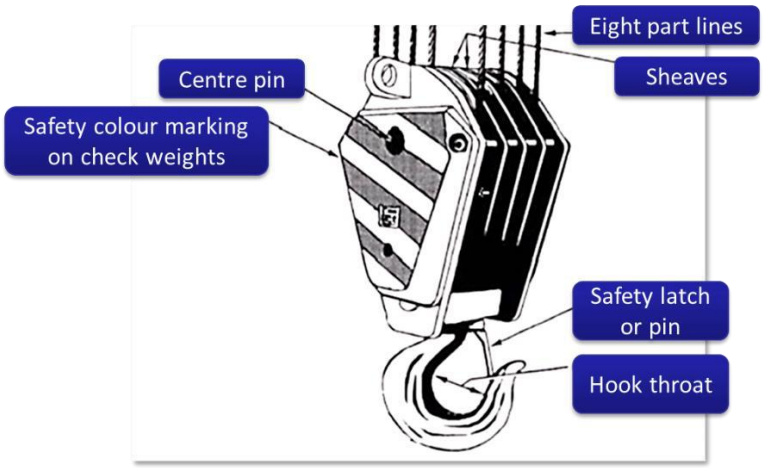


- Check for any visible damage to the hook block
- Check that the hook swivels in all directions and there is no excessive play in the bearings
- Check hook safety latch and throat opening for security and function
- Check manufacturers plate to find capacity, hook weight, wire rope diameter
- Confirm wire rope is of the correct diameter

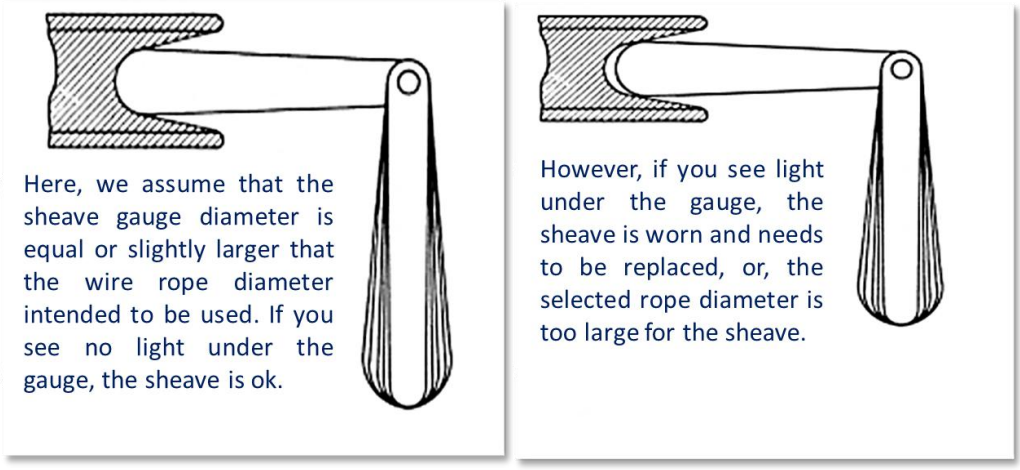
Notes:

On hook blocks that have a cross swivel, it must be checked to ensure it is free and operating correctly.

- Check block for overall damage
- Check sheaves for damage and free rotation with no excessive side to side movement



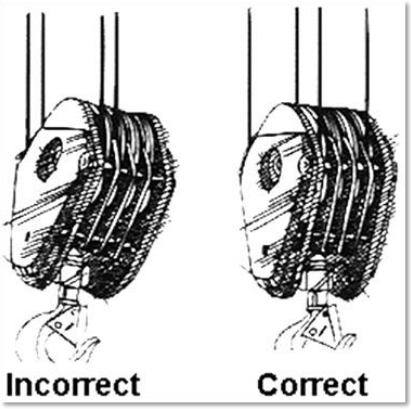
- Using a Sheave Gauge, check for wear on sheaves



Notes:

During the thorough examination, as the crane operator booms up, check to see that the hook block is reeved correctly.

If in doubt consult the load chart or the manufacturer's recommendations.



Hoist Drum Examination

Hoist drums must be thoroughly examined to ensure that:

- They are securely fastened to the superstructure
- There is no visible damage to the drum
- The hydraulic hoses and connections are secure and not leaking
- The wire hoist rope is layered on the drum correctly
- The drum rotates correctly
- The hoist brake operates
- There are no detrimental sounds coming from the drum during operation

Rope Block and Rope

A common fault is called cabling or putting a twist into the rope.

This fault occurs when reinstalling anchors after reeving up or down, putting a twist in to the rope or cabling as pictured.

Other reasons for the fault may be fitting the wrong lay of rope onto the drum or incorrectly installing the rope.

This fault means that the hoist cannot be used as all the parts will become stuck, potentially causing damage to various parts on the mobile crane.

One method to remedy this is to fully close the boom and lower down. Remove the anchor socket and reeve down to a single line. Use the hook block as weight and boom up, extend fully and lower off. The hook will spin. When the hook stops spinning, fold up and re-reeve, taking care not to introduce a twist.

Typical Checklist for Thorough Examination

Serial	Crane Sub-assembly	Safe	Unsafe	Observations
2.0	**CRANE SUPERSTRUCTURE**			
2.1	Counterweights			
2.2	Counterweight attachments			
2.3	Counterweight attachment rams			
2.4	Operator cab external			
2.5	Safety glass			
2.6	Operator cab internal			
2.7	Rated capacity charts			
2.8	Rated Capacity Indicator & Rated Capacity Limiter			
2.9	Controls			
2.10	Hoist			
2.11	Swing			
2.12	Boom up/down			
2.13	Boom telescoping			
2.14	Throttle			
2.15	Lights			
2.16	Switches & labels			
2.17	Steering if applicable			
2.18	Swing Brake			
2.19	Positive swing lock			
2.20	Windscreen wipers			
2.21	Cab tilt if applicable			
2.22	Swing Gear Mechanism			
2.23	Crane platform			
2.24	Rotary distributor			
2.25	Boom attachment pins			
2.26	Boom Cylinders			
2.27	External R.C.I. components			
2.28	Telescoping Boom			
2.29	Telescoping Boom Wear Pads			
2.30	Telescoping Boom Attachments (dynamometer; recoil drum)			
2.31	Anti-two block			
2.32	Fly-Jib attachment lugs			
2.33	Fly-Jib & Accessories			
2.34	Boom tip sheaves			
2.35	Hoist rope anchor & attachment point			
2.36	Hook block			
2.37	Hook block sheaves			

Serial	Crane Sub-assembly	Safe	Unsafe	Observations
2.0	**CRANE SUPERSTRUCTURE** (continued)			
2.38	Hoist Drum(s)			
2.39	Rope guides			

Notes:

14. WIRE ROPE EXAMINATION

Wire ropes are generally regarded as an expendable component.

The load rope requires replacement when examination shows that its condition has deteriorated and further use would not be suitable for safety reasons.

These criteria should never be exceeded if you follow well-established principles, such as those detailed in

- various standards
- LEEA COPSULE
- additional specific instructions from the 'original equipment manufacturer' (OEM) of the crane or hoist and/or by the manufacturer of the rope

When correctly applied, the discard criteria given in full in BS ISO 4309 are aimed at retaining an adequate safety margin. Failure to recognize them can be extremely harmful, dangerous and damaging.

Wire Rope Examination
The wire rope should always be clean. If this is not possible, consider using the electromagnetic wire rope method of examination.

In the absence of **OEM** criteria, BS ISO 4309 criteria may be used to determine the serviceability of the load rope fitted to a mobile crane.

BS ISO 4309:2017 - Modes of Deterioration and Assessment Methods

Mode of Deterioration	Assessment Method
Number of visible broken wires (randomly distributed, localized groups, valley breaks and those that are in the vicinity of a termination point)	By counting
Decrease in rope diameter (resulting from external wear/abrasion, internal wear and core deterioration)	By measurement
Fracture of strand(s)	Visual
Corrosion (external, internal and fretting)	Visual
Deformation	Visual and by measurement (wave only)
Mechanical damage	Visual
Heat damage (including electric arcing)	Visual

BS ISO 4309 – Wire Rope Discard

Discard Criteria (General)
The safe use of wire rope is qualified by the following criteria:

- The nature and number of broken wires
- Broken wires at the termination
- Localised grouping of wire breaks
- The rate of increase of wire breaks
- The fracture of strands
- Reduction of rope diameter, including that resulting from core deterioration
- Decreased elasticity
- External and internal wear
- External and internal corrosion
- Deformation
- Damage due to heat or electric arcing
- Rate of increase of permanent elongation

Wire Rope Examination

The examination of wire ropes should be systematic and follow a logical order so that no part of the rope, or the accessories and attachments to which it connects are missed. On cranes, pay particular attention at the following locations:

- Rope drum anchorage
- Rope within the area of a termination point
- Sections of rope travelling through sheaves
- Sections of rope travelling through the hook block
- Sections of rope that spool onto the rope drum, especially in areas where the rope crosses over itself in multi-layer drums
- Any section of the rope that can be damaged by abrasion in contact with an external fixture
- Any part of the rope that is exposed to heat

Broken Wires

It is usually the number of broken wires developing in a wire rope which causes its removal from service.

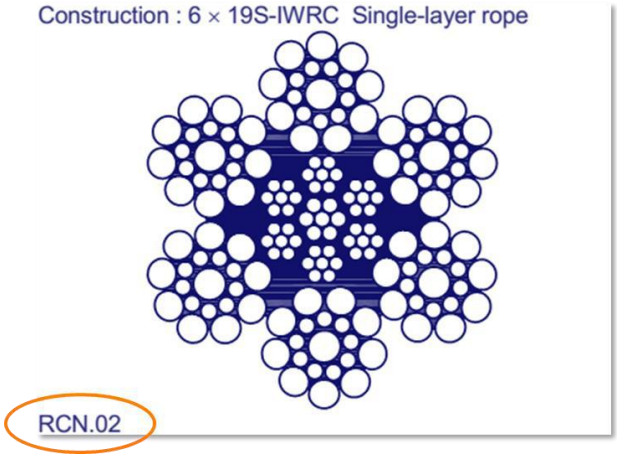
It is essential that the entire length of a wire rope is inspected frequently for **broken wires**, **excessive wear**, and **lack of lubrication**, especially **areas adjacent to terminal fittings** and where an accelerated rate of wear or corrosion is expected, e.g. where a rope passes around sheaves or pulleys, or is particularly exposed to the elements.

All examinations shall take into account these individual factors, recognising the particular criteria. BS ISO 4309 details the discard criteria for the allowable amount of broken wires, depending on the rope category number of the rope (RCN).

Example of BS ISO 4309 Rope Category Number

Before determining the discard criteria for load ropes under BS ISO 4309, it is necessary to identify the RCN of the rope.

As an example, we are going to look at a RCN 02 which is known from the manufacturers documentation:



The example from BS ISO 4309 below shows that an ordinary-lay rope, categorised as an RCN 02 (single-layer or parallel-closed rope) fitted to a multi-layer drum may have a maximum of **6 broken wires over a length of 6 x its diameter**, or **12 broken wires over a length of 30 x its diameter**, in a machine such as a mobile crane.

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Rope category number RCN (see Annex G)	Total number of load-bearing wires in the outer layer of strands in the rope[a] n	Number of visible broken outer wires[b]					
		Sections of rope working in steel sheaves and/or spooling on a single-layer drum (wire breaks randomly distributed)				Sections of rope spooling on a multi-layer drum[c]	
		Classes M1 to M4 or class unknown[d]				All classes	
		Ordinary lay		Lang lay		Ordinary and Lang lay	
		Over a length of $6d$[e]	Over a length of $30d$[e]	Over a length of $6d$[e]	Over a length of $30d$[e]	Over a length of $6d$[e]	Over a length of $30d$[e]
01	$n \leqslant 50$	2	4	1	2	4	8
02	$51 \leqslant n \leqslant 75$	3	6	2	3	6	12

Notes:

What if you do not know the RCN number?
If the RCN number of the load rope cannot be found in **annex G** of BS ISO 4309, the following method should be used for calculating the number of allowable broken wires:

- Determine the total number of load-bearing wires in the rope;
    - Simply add together all of the wires in the outer layer of strands except for any filler wires and read off the discard values for broken wires over a length of 6d and 30d for the appropriate conditions, in the tables provided.

Rope category number RCN (see Annex G)	Total number of load-bearing wires in the outer layer of strands in the rope[a] n	Number of visible broken outer wires[b]					
		Sections of rope working in steel sheaves and/or spooling on a single-layer drum (wire breaks randomly distributed)				Sections of rope spooling on a multi-layer drum[c]	
		Classes M1 to M4 or class unknown[d]				All classes	
		Ordinary lay		Lang lay		Ordinary and Lang lay	
		Over a length of $6d$[e]	Over a length of $30d$[e]	Over a length of $6d$[e]	Over a length of $30d$[e]	Over a length of $6d$[e]	Over a length of $30d$[e]
01	$n \leqslant 50$	2	4	1	2	4	8
02	$51 \leqslant n \leqslant 75$	3	6	2	3	6	12

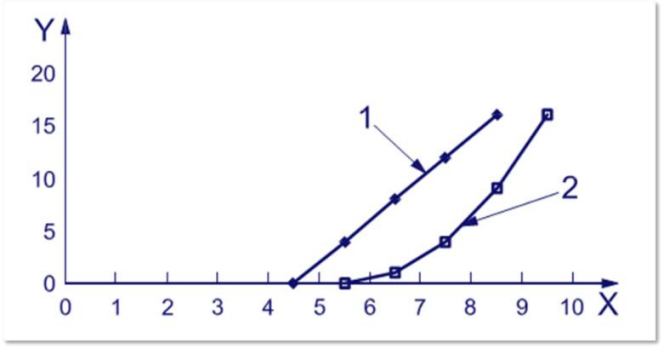
Deterioration
With 6 and 8-strand ropes, broken wires usually occur at the external surface.

With rotation-resistant ropes, there is a probability that the majority of broken wires will occur internally and are “non-visible” fractures.

Access to relevant standards, such as BS ISO 4309, is necessary in order to carry out thorough examinations correctly.

Notes:

Examples of Rate of Increase for Broken Wires in 2 Different Ropes
Generally, ropes develop broken wires at a greater rate later on in the life of a rope than in the early stages. Have a look at the following graph which shows two examples of this.



Key:
X = time, in cycles
Y = number of randomly distributed broken wires per unit length

- Check the entire length of the rope!
- Crane wire ropes do not have an indefinite life
- In 6 or 8 strand wire ropes, the wires tend to break at the surface
- In rotation resistant ropes, it is likely that the majority of broken wires will be internal
- One broken wire in a valley may be deterioration, but two or more should be considered grounds for discard
- Termination broken wires indicate high stress and therefore discard, although rope can be shortened if practicable.

Decrease in Rope Diameter

Uniform Decrease Along the Rope
Table 5 in the standard BS ISO 4309:2017 refers to decrease in wire rope. However, it does not apply to those sections of rope which are comparable to ropes in cross over zones or other sections of rope which are similarly deformed as a rope on a multi-layer rope.

Mobile cranes fall into this category so the table would be irrelevant in the wire rope inspection for the mobile crane competent person.

Reduction of Rope Diameter Resulting from Core Deterioration
Reduction of rope diameter resulting from deterioration of the core can be caused by:

a) Internal wear and wire indentation
b) Internal wear caused by friction between individual strands and wires in the rope, particularly when it is subject to bending
c) Deterioration of a fibre core
d) Fracture of a steel core
e) Fracture of internal layers in a rotation-resistant rope

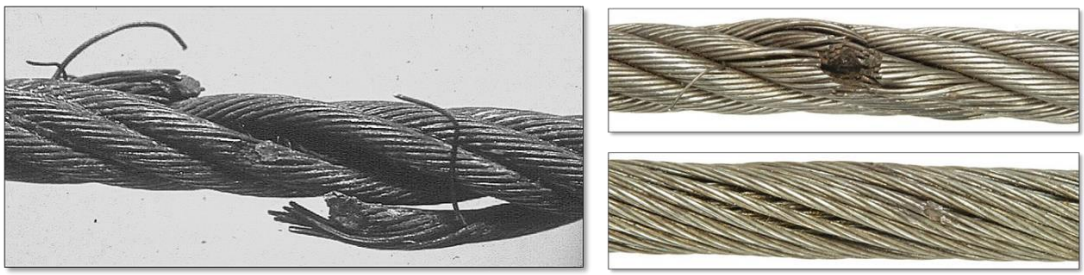
If these factors cause the actual rope diameter to decrease by **3%** of the nominal rope diameter for rotation-resistant ropes, or by **10%** for other ropes, discard the rope even if no broken wires are visible.

Note: New ropes will normally have an actual diameter greater than the nominal diameter.

Heating and Arcing Damage

Ropes that are not normally operated at temperature, but have been **subjected to exceptionally high thermal effects**, are externally recognizable by the associated heat colors produced in the steel wires and/or a distinct loss of grease from the rope, **shall be immediately discarded**.

If **two or more wires** have been affected locally, due to **electric arcing**, such as that resulting from incorrectly grounded welding leads, the **rope shall be discarded**. This can occur at the point where the current enters or leaves the rope.



Check for:

Kinks

Wear

Fatigue

Corrosion

Other Deformation or abnormalities

External Wear

Abrasion of the crown wires of outer strands in the rope results from rubbing contact, under pressure, with the grooves in the sheaves and drums. The condition is particularly evident on moving ropes at points of sheave contact when the load is being accelerated or decelerated, and is revealed by flat surfaces on the outer wires.

Wear reduces the strength of ropes by reducing the cross-sectional area of the steel strands. If the actual rope diameter has decreased by **7%** or more of the nominal rope diameter due to external wear, discard the rope even if no wire breaks are visible.

External and Internal Corrosion

General
Corrosion occurs particularly in marine and polluted industrial atmospheres. It will diminish the breaking strength of the rope by reducing the metallic cross-sectional area, and it will accelerate fatigue by causing surface irregularities which lead to stress cracking. Severe corrosion can cause decreased elasticity of the rope.

External Corrosion
Corrosion of the outer wires can often be detected visually. Wire slackness due to corrosion attack/steel loss is justification for immediate rope discard.

Internal Corrosion
This condition is more difficult to detect than the external corrosion which frequently accompanies it, but the following indications can be recognized:

a) Variation in rope diameter; in locations where the rope bends around sheaves, a reduction in diameter usually occurs. However, in stationary ropes it is not uncommon for an increase in diameter to occur due to the build-up of rust under the outer layer of strands

b) Loss of clearance between the strands in the outer layer of the rope, frequently combined with wire breaks between or within the strands

Confirmation of severe internal corrosion is justification for immediate rope discard.

Notes:

Level of Corrosion

Beginning of surface oxidation. Can be wiped clean.

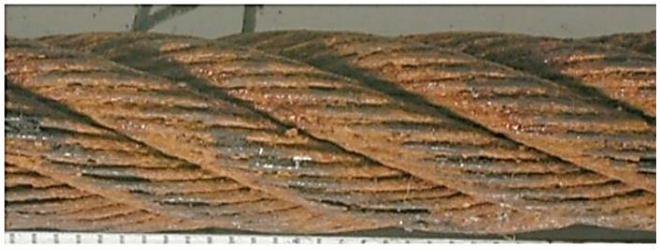
Rating: 0% towards discard.

Wires rough to touch, general surface oxidation.

Rating: 20% towards discard.

Surface of wire now greatly affected by oxidation.

Rating: 60% towards discard.



Surface heavily pitted and wires quite slack, there are also gaps between wires

Rating: discard immediately

Deformation

General

Visible distortion of the rope from its normal shape is termed "**deformation**" and can create a change at the deformation position which results in an uneven stress distribution in the rope.

Waviness

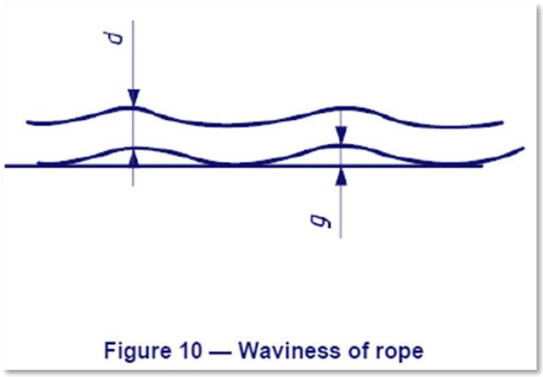
Waviness is a deformation in which the longitudinal axis of the wire rope takes the shape of a helix under either a loaded or unloaded condition. While not necessarily resulting in any loss of strength, a severe deformation can transmit a pulsation, resulting in irregular rope drive. After prolonged working, this will give rise to wear and wire breaks.

Discard the rope if either of the following conditions exists (see Figure 10 below):

a) On a straight portion of rope, which never runs through or around a sheave or spools on to the drum, the gap between a straight edge and the underside of the helix is 1/3 x *d* or greater

b) On a portion of rope, which runs through a sheave or spools on to the drum, the gap between a straight edge and the underside of the helix is 1/10 × *d* or greater

d = rope diameter



g = gap

Figure 10 — Waviness of rope

Local Increase in Rope Diameter

If the rope diameter increases by **5% or more for a rope with a steel core** or **10% or more for a rope with a fibre core** during service, investigate the reason for this and consider discarding the rope.

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NOTE: An increase in rope diameter that might affect a relatively long length of the rope. For example, the swelling of a natural fibre core can occur due to excessive absorption of moisture. This creates imbalance in the outer strands, which become incorrectly oriented.

Other conditions which affect the safe use of wire can include:

- Basket or lantern deformation
- Core or strand protrusion/distortion
- Wire protrusion
- Flattened portions
- Kinks or tightened loops
- Bends

Lubrication

Correct lubrication of wire ropes is essential if the ropes are to give satisfactory service. Good lubrication not only prolongs the life of the rope but also helps to reduce friction and preserves the internal parts.

All ropes are lubricated internally, and nearly all externally, during manufacture. During use, an **approved neutral lubricant** should be externally applied at frequent intervals and, if practicable, whilst not in use.

Thinner types of lubricant have the best lubricant qualities but the heavy, thicker lubricants are more suitable if the rope is constantly exposed to the elements or to water. For certain applications, dry lubricants may be preferable. In all cases, the lubricant must be acid free in nature.

Wire ropes should be clean and dry before lubricants are applied.

Combined Effect Assessment

Although broken wires are a common reason for discard, deterioration often results from a combination of factors. In such cases, the competent person needs to:

- Take account of the different modes of deterioration, particularly when they occur at the same location in the rope
- Make an overall assessment of the "combined effect" of the different modes of deterioration
- Decide whether the rope is safe to remain in service and, if so, whether it needs to be subjected to any revised inspection/discard provisions.

Method
One method of determining the combined effect is:

- Inspect the rope and record the type and amount of each individual mode of deterioration, e.g. number of broken wires in 6*d*, decrease in diameter in millimetres and extent of corrosion
- For each of these individual modes of deterioration, rate the severity and express it either as a percentage of the respective individual discard criteria, e.g. if 40 % of the allowable number of broken wires according to the individual discard criteria are found to exist, this represents a rating of 40 % towards discard, or in words, e.g. slight, medium, high, very high or discard
- Either add together the individual ratings at selected locations, only when they occur at the same location, and express the severity as a combined per cent value or make a judgement as to the combined degree of severity and express the rating in words, e.g. slight, medium, high, very high or discard.

Rope Examination Record

- For each periodic or special examination, the examiner shall provide a record containing information relating to the examination
- (Form 1 – ISO 4309) can be viewed for typical examples of examination records.

Typical Checklist for Thorough Examination

Serial	Crane Sub-assembly	Safe	Unsafe	Observations
3.0	Hoist ropes			

Notes:

15. TESTING AS PART OF THE THOROUGH EXAMINATION

Personnel carrying out thorough examinations – BS 7121-2 Extract
Competent persons should have the necessary attributes, competencies, knowledge and experience to enable them to carry out effective thorough examinations of cranes. The nature and extent of these will depend on the purpose of the examination to be undertaken, the complexity of the cranes to be examined and the consequences of failure of those cranes. It is essential that such persons have adequate training, information and independence to carry out the work required

Attributes of the Competent Person

Competent Persons should:

- Be physically fit for the tasks they are to undertake
- Have adequate eyesight (with correction if needed)
- Be comfortable working at height, over water or in a confined space (if required)
- Have a responsible attitude
- Be able to communicate clearly with other personnel in the location where thorough examination is taking place, including the need to take the crane out of service if it is unsafe to use
- Be able to demonstrate adequate literacy and numeracy
- Be aware of their own limitations in knowledge and experience

Source: BS 7121-2-1:2012 5.3.2

Competencies of the Competent Person

Competent Persons should be:

- Fully conversant with the machinery they are required to examine and its hazards, including operation necessary for thorough examination activities
- Properly instructed and trained
- Familiar with the procedures and precautions required for safe work at height, over water or in a confined space (where required)
- Have a responsible attitude
- 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. manufacturing, construction, process plant, nuclear, docks, airports, railways)
- Trained and competent in the selection, pre-use inspection and correct use of their personal protective equipment

Source: BS 7121-2-1:2012 5.3.3

Knowledge Base

Competent Persons should have:

- An understanding of the applicable crane design standards and codes of practice for the selection and use of the relevant cranes, together with the applicable examination criteria
- An understanding of the safety rules and associated codes of practice that are applicable to the relevant cranes
- An understanding of the inspection and maintenance requirements of cranes
- Knowledge of appropriate test procedures which may be employed and the interpretation and limitations of those techniques
- An understanding of drawings and manufacturing literature relevant to the cranes to be examined
- Knowledge of the materials and techniques used in the manufacture and assembly of the type of cranes to be examined

Source: BS 7121-2-1:2012 5.3.4

Practical Skills

Competent Persons should:

- Be capable of detecting defects or weaknesses in cranes which could compromise the safety of the crane
- Have sufficient knowledge and experience to assess the importance of defects or weaknesses in the crane and identify what actions need to be taken in order to rectify them. In particular, they should be able to:
    - Determine whether the crane is operating as intended
    - Specify the appropriate time-scales within which identified defects or weaknesses need to be rectified
    - Determine whether defects identified in the previous report of thorough examination have received attention
    - Determine whether all safety devices are functioning correctly
    - Check whether warning notices are correctly fixed and legible, and where necessary specify any limitations on the use of the crane
    - Witness any testing required as part of the thorough examination and evaluate the results
    - Report on the findings of the thorough examination

Source: BS 7121-2-1:2012 5.3.5

Assessment of Competence

Employers should determine through a formally documented assessment process the competence of each individual person, both existing employees and new entrants, based on the attributes, competencies, knowledge and skills listed in 5.3.2 to 5.3.5. A shortfall in attainment level does not necessarily preclude employment in this role but it is essential that such shortfalls are addressed before the person is allowed to carry out unsupervised thorough examinations of cranes.

All Competent Persons should be assessed on appointment, again within their first 12 months, and at regular intervals (not exceeding 4 years) thereafter. Assessment should form part of any training.

Source: BS 7121-2-1:2012 5.3.6

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

Source: BS 7121-2-1:2012 5.3.10

Continual Professional Development

Continuing professional development (CPD) is a joint responsibility between the Competent Person and their employer.

The employer should maintain a CPD record for each Competent Person. The record should include details of how CPD is being achieved and should include for example:

- Specific training towards enhancements/additions to competency
- Familiarization/re-familiarization, ongoing training and mentoring
- Any alterations and/or withdrawals of competency
- Enhancements to qualifications
- Membership of professional bodies/institutions
- Attendance at seminars and refresher training courses
- Visits to manufacturers and trade shows

Source: BS 7121-2-1:2012 5.3.11

Notes:

Thorough Examination

Technical product information
Before carrying out the thorough examination of a specific make and model of crane, the competent person should be provided with access to all relevant product specific technical information. This may be supplemented by information provided at briefing or training sessions delivered by the crane manufacturer or the employer.

It is recommended that in-house training is carried out by a trainer who has received model-specific technical training directly from the manufacturer.

Maintenance and Thorough Examination

Selection of the Competent Person
It is essential that the Competent Person undertaking the thorough examination of a crane has not been involved in the maintenance of the crane.

Testing as a Part of the Thorough Examination

Supplementary tests in support of thorough examination and for other purposes
The purpose of any supplementary testing is to support the thorough examination. These supplementary tests may be specified by the competent person and can cover a wide range of techniques, **not just overload testing**.

Tests directly supporting a thorough examination should be undertaken, completed by the date specified by the competent person and the results documented, in order to enable the subsequent thorough examination to be completed. The exception to this is overload testing, where a thorough examination should be undertaken before the overload test as well as afterwards.

Failure to complete these supplementary tests could prevent the completion of the subsequent thorough examination. In all circumstances the competent person should 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 testing can be carried out to verify the accuracy of the Rated Capacity Limiter and its conformance to the Rated Load Capacity Charts.

- Check the calibration of the RCL by raising a known test weight or by verifying using a calibrated load cell

To function test the RCL, configure the boom as per the Rated Load Charts for a selected load.

- Raise the selected load and boom load out to the maximum radius as allowed by the RCL
- Verify by measuring the radius and comparing it against the Rated Load Chart. Operate crane through all functions and return load to original start point

Configurations and Weights Generally Used

- To test the structural integrity of the crane, the crane would be configured with minimum boom length, minimum radius and maximum weight.

- To test the crane's stability, the crane would be configured with maximum boom length, maximum radius and minimum weight.

- The test should also include one intermediate test to confirm the rated capacity arc.

Hoist Brake Test

A hoist brake test and examination may be carried out to determine if a major overhaul of the braking system or the replacement of brake pads or shoes has been carried out successfully and correct adjustments made.

As a minimum, the operational testing should conform to the following:

- Dynamic testing to verify that a moving load can be halted at normal lifting and lowering speeds as per the manufacturer's instructions for dynamic testing
- Dynamic testing to verify that a moving load can be halted at normal lifting and lowering speeds after the emergency stop has been operated, as per the manufacturer's instructions for dynamic testing
- A static test to verify that the brake can hold a load without slippage.

Load Testing after Repair

Overload testing of cranes which have been altered or repaired
In addition to overload testing in support of a thorough examination, overload testing should be carried out in the event of any alteration or repair which could affect the strength of the crane.

Ensure that all parts affected by the repair are subjected to the test loads in accordance with the original crane specification.

It is essential that the competent person consults the crane manufacturer (or if they no longer exist, another design authority) to ensure that the selected test programme is adequate.

A load test should be completed shortly after any repair to verify the structural integrity of the crane and to reveal any weaknesses. The type, scope and method of the test should be as per the crane manufacturer's instructions. In this case, the report should also contain the following information: -

- Date of test and subsequent examination completion
- The crane configuration at time of test
- The unique serial number or identifying mark of the crane
- What test weights and what radii was used during the test
- Details of any defect and deformations

Notes:

16. REPORTING

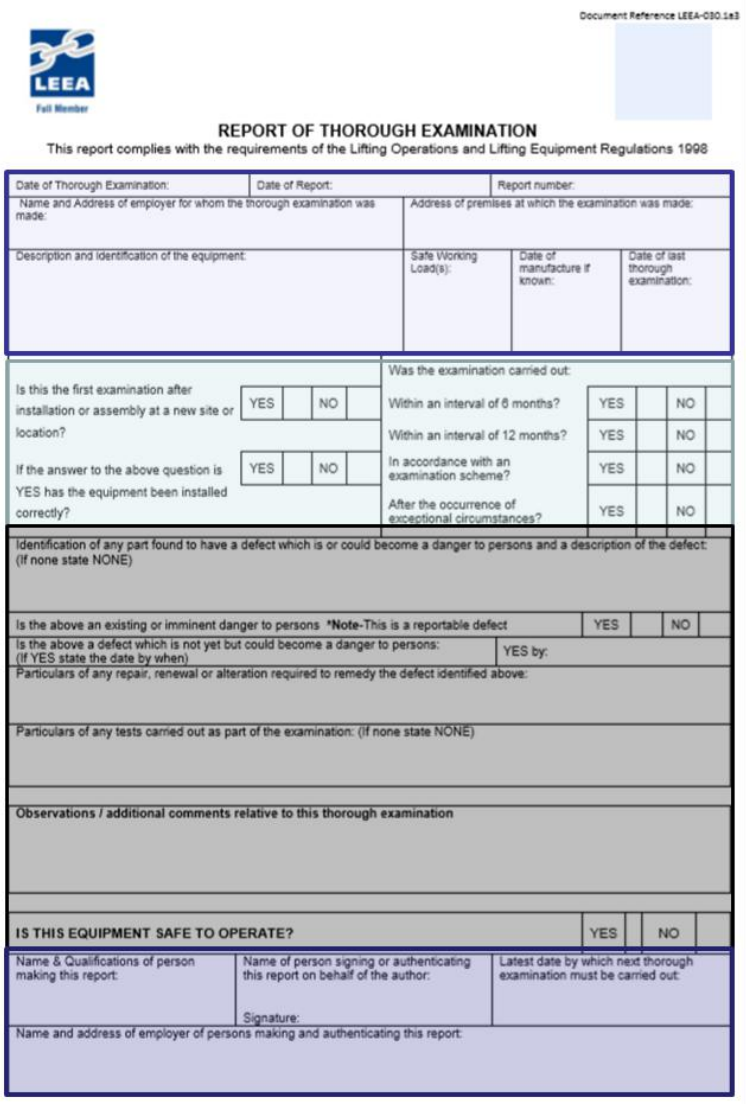
LOLER requires that the competent person carrying out the thorough examination makes a written report of that examination to the client for whom the examination has been carried out and also to the owner/hirer of the mobile crane. Often this may be the same person.

The competent person must sign their report, or have it authenticated on their behalf, and it must contain at least the information requested in LOLER Schedule 1.

A written report should be given at the time of thorough examination, especially if a defect has been discovered that is or could become a danger to persons.

Report Example

This is an example of a Thorough Examination Report that meets the requirements of Schedule 1 of LOLER.



Document Reference LEEA-030.1a3

LEEA Full Member

REPORT OF THOROUGH EXAMINATION

This report complies with the requirements of the Lifting Operations and Lifting Equipment Regulations 1998

Date of Thorough Examination:	Date of Report:	Report number:
Name and Address of employer for whom the thorough examination was made:	Address of premises at which the examination was made:	
Description and identification of the equipment:	Safe Working Load(s): / Date of manufacture if known: / Date of last thorough examination:	

Details of the equipment being examined

Is this the first examination after installation or assembly at a new site or location?	YES / NO	Was the examination carried out: Within an interval of 6 months?	YES	NO	
If the answer to the above question is YES has the equipment been installed correctly?	YES / NO	Within an interval of 12 months?	YES	NO	
		In accordance with an examination scheme?	YES	NO	
		After the occurrence of exceptional circumstances?	YES	NO	

Type of examination & examination periods

Identification of any part found to have a defect which is or could become a danger to persons and a description of the defect: (If none state NONE)		
Is the above an existing or imminent danger to persons *Note-This is a reportable defect	YES	NO
Is the above a defect which is not yet but could become a danger to persons: (If YES state the date by when)	YES by:	
Particulars of any repair, renewal or alteration required to remedy the defect identified above:		
Particulars of any tests carried out as part of the examination: (If none state NONE)		
Observations / additional comments relative to this thorough examination		
IS THIS EQUIPMENT SAFE TO OPERATE?	YES	NO

Defects

Name & Qualifications of person making this report:	Name of person signing or authenticating this report on behalf of the author: Signature:	Latest date by which next thorough examination must be carried out:
Name and address of employer of persons making and authenticating this report:		

Details of examiner

The first part of the form needs to be filled in with the details of the equipment being examined.

The second part describes the type of examination being carried out and the examination periods.

In the third part, the examiner will report the defects identified, if any.

The fourth will display the details of the examiner.

With this example of a completed examination report, the examiner has just finished examining a mobile crane before it was put into service for the first time.

Date of Through Examination: 21st July 2019	Date of Report: 21st July 2019		Report number: LEEA ABC 123
Name and Address of employer for whom the thorough examination was made: **ACME Lifting** **97 Old Edinburgh Road** **SM2 9YN**	Address of premises at which the examination was made: **ACME Lifting** **97 Old Edinburgh Road** **SM2 9YN**		
Description and identification of the equipment: **ACME Mobile Cranes** **All terrain crane** **Model ABC 123**	Safe Working Load(s): **16 tonnes**	Date of manufacture if known: **16th May 2019**	Date of last thorough examination **N/A**

The examiner will complete the following in the first section:

- The date when the examination took place
- The date when the report was completed
- The report number
- The name and address of the owner/ hirer of the crane
- The address where the examination took place
- The description of the equipment that has been examined and all the information needed to identify the equipment.

With this example, you will notice that the crane is new and it has never been examined before, therefore, the date of the last thorough examination is not available.

Notes:

Is this the first examination after installation or assembly at a new site or location?	YES		NO		Was the examination carried out:			
					Within an interval of 6 months?	YES		NO
					Within an interval of 12 months?	YES		NO
If the answer to the above question is YES has the equipment been installed correctly?	YES		NO		In accordance with an examination scheme?	YES		NO
					After the occurrence of exceptional circumstances?	YES		NO

In the second section, the examiner will choose the options which are relevant to the TYPE of examination carried out.

In our example, since it is the first examination of the crane before being put into service, we have chosen yes. We will assume for this example that the crane has been installed correctly.

Because it is the first examination, we're going to choose "No" for all the options regarding previous examinations.

If this was not the first examination, then the appropriate box would be marked with Yes.

Identification of any part found to have a defect which is or could become a danger to persons and a description of the defect:: (If none state NONE) **None**					
Is the above a defect which is of immediate danger to persons		YES		NO	
Is the above a defect which is not yet but could become a danger to persons: (If YES state the date by when)	YES by:				
Particulars of any repair, renewal or alteration required to remedy the defect identified above: **None**					
Identification of any parts not accessible for examination: **None**					
Particulars of any tests carried out as part of the examination: (If none state NONE) **Static test of the hoist brake, function test of the RCL – Correct operation of the hoist brake and configuration of the RCL**	**Ensure results of the test are also included!**				
IS THIS EQUIPMENT SAFE TO OPERATE?		YES		NO	

In the third section, the examiner will insert all the details of the defects they have been able to identify.

Because it is a new crane, no defects have been found in our example. But if the examiner did find any defects, they would need to specify what repairs are needed to remedy it.

Since no defects have been found, the examiner writes "none" here.

The examiner was able to access all the parts that needed to be inspected.

The examiner performed a static test of the hoist brake and a function test of the RCL. These details need to be clearly specified and the results included.

Finally, the examiners judgement is that the equipment is safe to operate, so the examiner circled yes.

Name & qualifications of person making this report:	Name of person authenticating this report:	Latest date by which next thorough examination **must** be carried out:
Lawrence Warren, Company Appointed Lifting Equipment Examiner Signature: Lawrence Warren	Dip Swati, Manager Lifting Equipment Examination Department Signature: Dip Swati	20 Jul 2020
Name and address of employer of persons making and authenticating this report: ACME Lifting Equipment Services, 79 Nenthead Road, Hellidon, N11 OWE, United Kingdom		

This last section is where the examiner will insert their details, starting with their name, position and signature.

The person authenticating the report has the responsibility of verifying the identity of the inspector and their qualification. Their name and signature is also included.

The examiner will insert the address of the company they work for.

Finally, the examiner states the date when the next examination must be completed by. Considering the conditions of use, the examiner set the date of the next examination to be completed within a period of 12-months.

Regulation 10 LOLER

A person making a thorough examination for an employer under regulation 9 of LOLER shall:

a) notify the employer forthwith of any defect in the lifting equipment which in their opinion is or could become a danger to persons;
b) as soon as is practicable make a report of the thorough examination in writing authenticated by them or on their behalf by signature or equally secure means and containing the information specified in Schedule 1 to:
    i. the employer; and
    ii. any person from whom the lifting equipment has been hired or leased;
c) where there is in his opinion a defect in the lifting equipment involving an existing or imminent risk of serious personal injury, send a copy of the report as soon as is practicable to the relevant enforcing authority

A person making an inspection for an employer under regulation 9 shall:

a) notify the employer forthwith of any defect in the lifting equipment which in their opinion is or could become a danger to persons;
b) as soon as is practicable make a record of the inspection in writing

Every employer who has been notified under paragraph (1) shall ensure that the lifting equipment is not used:

a) before the defect is rectified; or
b) after a time specified and before the defect is rectified

In this regulation “relevant enforcing authority” means –

a. where the defective equipment has been hired or leased by the employer, the Executive; and
b. otherwise, the enforcing authority for the premises in which the defective equipment was thoroughly examined

All defects need to be reported on. This includes where something has been repaired before, during or after the thorough examination.

Failure to report all defects is contrary to LOLER and potentially hides underlying problems with the crane. It also will not reflect the true history of the crane if not reported.

ACoP to Regulation 10 LOLER

Where the competent person identifies defects which must be made good within a specified timescale, they should submit the report promptly to allow the employer to take the necessary action within the required period.

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

Notes:

Notes:

REFERENCES AND RESOURCES

Standard	Title
BS 7121-2-1:2012	Code of practice for the safe use of cranes. Inspection, maintenance and thorough examination. General
BS ISO 4309:2017	Cranes. Wire ropes. Care and maintenance, inspection and discard

LEEA Guidance Ref.	Title
LEEA-015	BSI Reference Library List
LEEA-051	Guidance on Design, Inspection, and Use of Water Bags as Test Weight in the Offshore Industry

Resource	Link
Lifting Operations and Lifting Equipment Regulations - Approved Code of Practice and Guidance	http://www.hse.gov.uk/pubns/priced/l113.pdf
Provision and Use of Work Equipment Regulations – Approved Code of Practice and Guidance	http://www.hse.gov.uk/pubns/priced/l22.pdf

TRAINING

Operative training for all the equipment covered in this course study material should always take the manufacturer's information and instructions for use into account.

FEEDBACK

We would be grateful for your feedback regarding this course study material – you can use the note box below to list anything you would like to bring to our attention.

We value your views and will use your comments to help our continual improvement of our learning and development materials.

Thank you for your participation.

Andrew Wright
LEEA Deputy Chief Executive Officer

Course Study Materials - feedback to LEEA: