

SUPERVISORS

GUIDELINES FOR

SAFE USE OF CRANES



Produced by Civil Engineering Conference
For use by all railway civil engineering staff

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Safe Use of Cranes

Background

To satisfy the general as well as the specific needs of construction, industrial and Railway Civil Engineers, the evolution of the mobile crane had led to many types and designs of road and rail cranes and more recently Road / Rail excavators used as cranes. This handbook is concerned with the supervision of such cranes in the Railway environment.

The one basic requirement for the safe working of cranes involves selecting the right machine to suit the requirements of the job. If the basic characteristics do not match, then unsafe conditions are created before any work is done, this may lead to a make-do or improvised situation and accidents may ensue, some of which could be fatal.



This handbook will give an overview of good practise in crane supervision, which will include site inspection, crane selection and working methods.

Duties of Employers

It shall be the duty of every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all their employees. The provision of maintenance of plant and system of work that are, so far as is reasonably practicable, safe and without risk to health.

Duties of Employees

It shall be the duty of every employee whilst at work to take reasonable care for the health and safety of himself and of other persons, who may be affected by his acts or omissions at work and as regards any duty or requirements imposed on his employers or any other person.

Standards

There are over fifty British Standards dealing with lifting appliances and lifting gear under such headings as Cranes, Chains, Wire Rope, Lifting Slings, etc. Several codes or practices also exist.

Note this handbook is based on B.S. 7121 and current Railway Group Standards.

Notifiable Occurrences

This is defined as the collapse or overturning of any crane or failure, of any load bearing part thereof which taking into account the circumstances of the occurrence, which might have been liable to cause a major injury to any person.

Such occurrences must be reported to the Engineer in charge as soon as practicable, and a written report sent within 24 hours in addition to any functional instructions, or as required by R.I.D.D.O.R. Regulations. This instruction also applies to any crane coming into contact with overhead electrical power lines or cables.

H.A.S.A.W.A.

The Health & Safety at Work Act 1974 comes under criminal law, which means that violation of the Act renders the guilty party a criminal. This unlawful act or default is considered as an offence against the state and is punishable by the same by fines, imprisonment or both

* For the purpose of this document and to align with R.G.S the BS7121 reference to "appointed person". This person is referred to as Crane Controller.

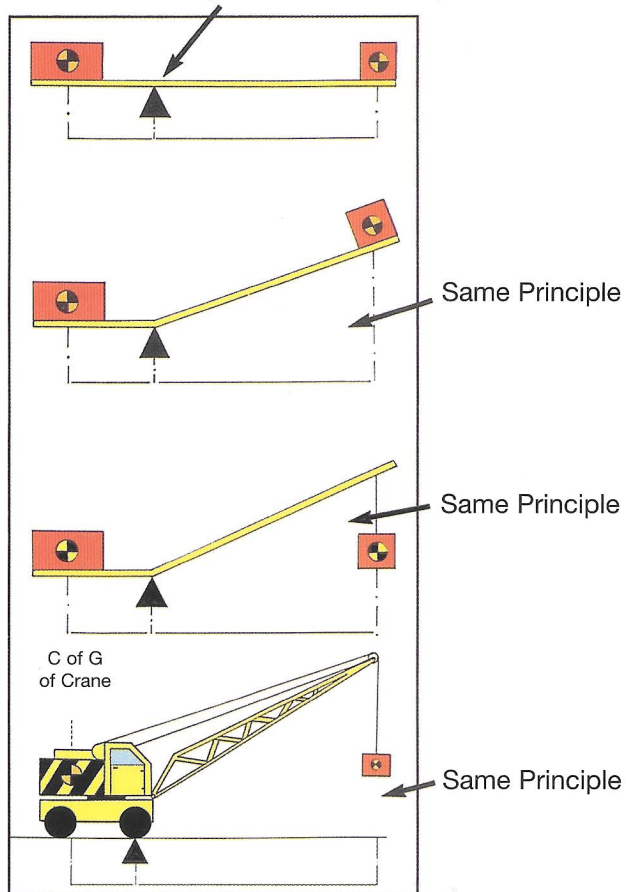
How Do Cranes Work

Basic Principles

(Lever Principle)

The principle of levers have been used throughout the ages, but regardless of the size of today's modern cranes, the basic principles of levers are still used and basic physics are applied to the lever, fulcrum, counter weight and load.

TIPPING POINT (OR TIPPING AXIS)



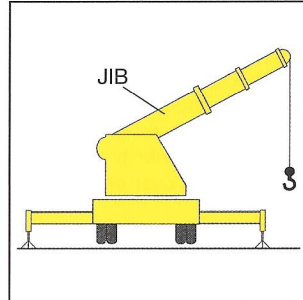
Theoretically at point of balance:-

$$(\text{Crane}) \times (\text{Horizontal Distance from C of G to tipping Axis}) = (\text{Horizontal Distance from C of G of load to tipping Axis}) \times \text{Load}$$

Basic Principle

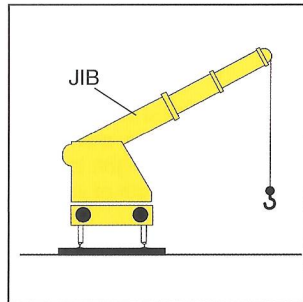
Road Crane

The principle design of a modern day road crane, is to enable the machine to travel from site to site under its own power. This created the problem that the width of an effective lifting vehicle would be too wide to travel on the road network. The problem was resolved by the use of retractable outriggers, which substantially increase the base dimensions of the crane thus greatly increasing stability and capacity.



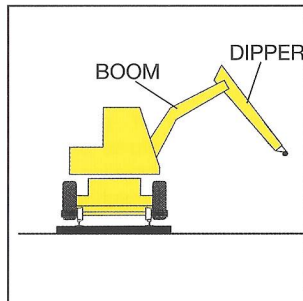
Rail Crane

Like road cranes, rail cranes also have similar problems with width and height but a lesser problem with weight. Older type rail cranes and the much larger breakdown cranes use the outrigger system, but the GP Rail Cranes used by Railway Civil Engineers, have been designed using weight in the lower working or carriage, to provide a low centre of gravity. This has given these civil engineering cranes a medium capacity and range but still remain within the railway clearance restrictions.



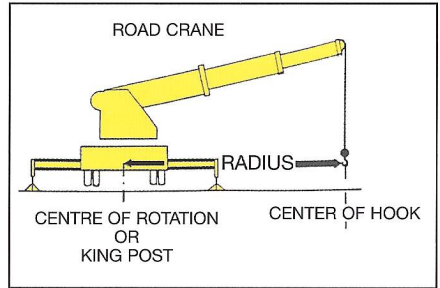
Road Rail Excavators

The modern road / rail excavator is an adaptation of a construction type machine for use on the railway. This has created the problem of reducing the effective wheelbase of the machine whilst raising the centre of gravity, thus creating a hybrid machine with a lift capacity less than a G.P. Rail Crane. Care must be taken as the machines are designed for a high speed of operation.



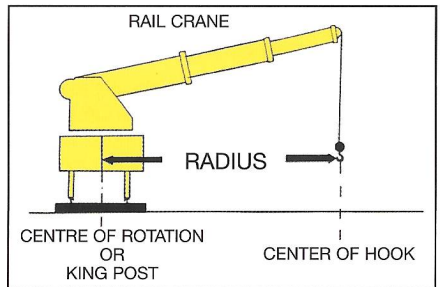
Stability

The basic principle of leverage may be simple physics, but for a crane to remain stable, all elements involved within the equation must remain within the design parameters as indicated in the lifting table. This includes length and angle of jib and counter weight in relation to the weight of the load. If any one of these elements does not meet the design parameters, stability is lost resulting in the crane tipping over or failure within the crane structure.



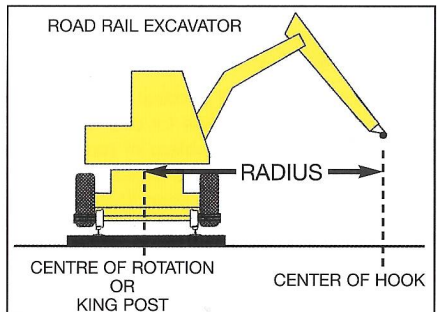
The first principle of stability is the combined effect of load, weight and crane radius (NOT ONLY THE LOAD). Radius is measured between two points, one being the centre of rotation and the other being the centre of crane hook.

The scale of load weight that determines the radius defines the crane's capacity, which unlike the load weight, is variable depending on angle and length of jib.

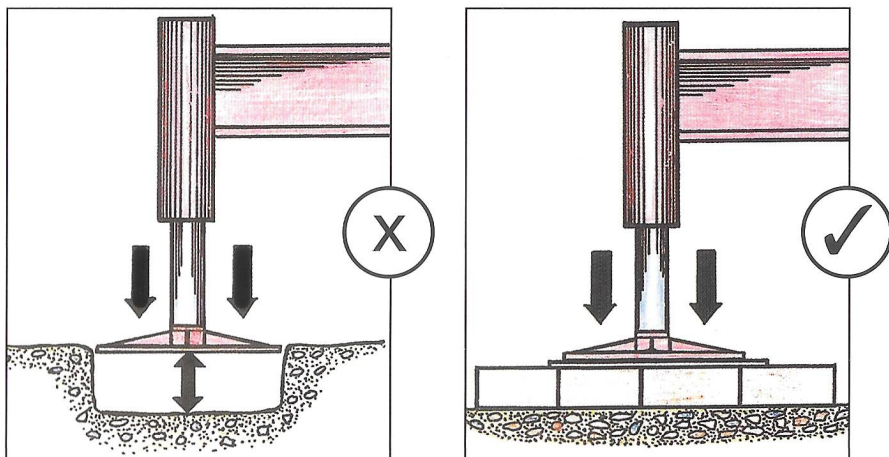


It is critical that the relationship between the weight of loads and radius remains within the design capacity of the crane known as the Safe Working Load (SWL).

Stability is also very dependant on the support structure or base on which the crane stands i.e. ground conditions or track conditions in the case of rail mounted cranes and other supporting equipment. It must be stressed that if ground conditions or supporting structures become unstable, the result will compromise the stability of the crane and again result in failure.



Packing and Support



Packing & Support of Outriggers

The main purpose of packing is to increase the area of outrigger base plates, to reduce ground loading pressures by displacement, through outriggers and support jacks onto the ground, the other purpose is to lift crane wheels clear of uneven ground.

It must be noted that all wheels of road cranes must be clear of the ground and at no time take any loading pressure.

It is essential that any packing used to support a crane outrigger, is sound and suitable for use.

Softwood sleepers or timbers are a common type of packing, for both road and rail cranes, which use outrigger or supporting jack systems. However, softwood sleepers and timbers are not always the best type of packing, due to the fact that most surplus sleepers and track timbers are life expired and the effectiveness of such timbers is very limited.

Points to look out for are splits and pipe rot, which is when sleepers or timber appears to be in good condition on the outside, but rotting has occurred through its centre. These could fail if used as packing thus resulting in loss of crane stability.

Other Hazards For the positioning of the crane and landed loads, the bearing capacity of the ground and possible existence of buried services should be taken into account at the planning stage.

Safe Use of Cranes

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Definitions

PERSON IN CHARGE OF LIFTING OPERATIONS

- Crane Controller:** A trained certified / competent person who will:-
Devise a safe system of work for a crane operation.
Specify cranes and lifting tackle.
Identify numbers of staff required for the lifting operation.
Communicate the safe system of work to staff.
Control the operation of cranes and supervise personnel in connection with the lifting operation.
(This is a Railway Safety Critical role).
- Operator:** A certified and competent person operating the crane, within a defined safe system of work.
Knows the limits of the cranes operation and is capable of reporting defects.
Carries out daily servicing and inspection.
Able to operate the crane safely.
(This is a Railway Safety Critical role for Rail Cranes and Road/Rail Excavators).
- Slinger:** A competent person capable of selecting and attaching/detaching lifting tackle to/from the load and capable of directing the movements of loads by crane power within the safe system of work.
- Competent Person:** A competent person is one who has the requisite knowledge and experience in both theory and practice of the methods of work and integrity of equipment, and is suitable in every way for the duties, which are to be undertaken.
- Training:** All staff who undertake duties with lifting operation will undergo training and certification and periodic assessment as required.
- Competency is:** Specified in Railway Industry Codes of Practice.
- Controller, Driver and Slinger, will be assessed by course examination. The certificate validity period will be two years, with a conditional clause in the event that if duties are not undertaken for one year, the employer should ensure that competence is maintained.

Safe Use of Cranes (cont'd)

Glossary of Terms

Automatic Safe Load Indicator (A.S.L.I.) -

This gives audible warning when the crane is approaching safe working load.

“Blocked” - The hydraulic locking of a railcrane's suspension.

Boom / Dipper - See diagram on page 7.

Cantilever Jib - Where the pivot is within the Jib's overall length (and not held at upper end - i.e. Strut Jib).

Cant Indicator - A device on Rail Cranes to indicate cant.

Derricking - Raising or lowering the crane jib.

Dunnage - Packing to lift load off ground to allow release of lifting tackle.

Fixed Axle - Term used in Road/Rail Excavators to identify the axle which has no suspension, over which there is a greater lift capacity.

Float Axle - Term used to identify the axle which has “free” movement. When unlocked the lifting capacity over this axle is reduced.

Free on Wheels - Term used to describe lifting machines travelling in road mode. NB. This includes crawler & rough terrain road cranes.

Free on Rail (lift & carry) - Term used to describe lifting machines travelling in rail mode.

NB. Rail Cranes may travel with suspension locked. Road Rail excavators must travel with suspension unlocked.

Groundsman - Any man who is appointed to assist with the crane working.

Handsignals - The approved BS7121 hand signals.

Hoisting/Lowering - Raising or lowering of the load.

Inclinometer (Road Cranes) - See Level Indicator.

King post (Centre of Rotation) - The pivot in the axis of rotation of the crane when it slews.

Lattice Jib - Type of fixed jib length design with “open” construction.

Level Indicator - A device fitted to show whether the crane is standing level or not.

Limit Switch - An automatically actuated device to stop a particular crane motion at its extremity(ies) or limit(s) of operation.

Load/radius Indicator - Visual indication of the safe working load indicator for jib position.

Log Book - Record book that is so designated by Driver/Hirer.

Manager - The person who has day to day responsibility for the management of the crane.

Outriggers - Extending transverse girders on crane carriage used to increase stability.

Over end duty - The arc of operation where there is an increased lifting capacity. This may vary from one end to the other.

Safe Use of Cranes (cont'd)

Glossary of Terms

Radius of lift - The distance from the hook or the centre of gravity of the load to the King post.

Rail Slipper - A device which sits on the rail and prevents crane movement by sliding friction (the wheel does not revolve).

Relieving Screws (similar to 'Axle Locks') on Road Cranes - When in use these transfer the weight direct from the crane to the crane wheels, relieving the wheel springs of the load.

Rough Terrain (or Cross Country cranes) - Wheeled crane designed to travel over uneven ground (but not while carrying a load).

Safe Working Load (SWL) - The maximum load which can be safely handled by a crane UNDER SPECIFIED CONDITION.

For Lifting Tackle it is the maximum load as assessed by a competent person, which may be under particular service conditions.

Safety Hook - A crane hook provided with a safety latch across the throat opening of the hook to prevent the sling being accidentally dislodged.

Self-propelled - A crane able to be driven for travelling (usually at low speeds from the lifting operations cab).

Slewing - When the crane jib is rotated on the crane carriage or crane truck.

Slinging back or hooking back, or snickling - Taking the lifting tackle chain around the load and putting hook around standing part. (NB. SWL of tackle is HALVED in this condition).

Tail Locks - Secure jib in line with carriage when travelling.

Tandem Lifting - When two identical machines are used together to lift the same level.

Telescoping - Extending or shortening jib length using extension elements in the basic jib structure.

Travelling - Movement of the crane on its own wheels along the rails or over the ground.

Truck (or Truck-mounted) - Cranes driven for travelling from a cab separate to that for lifting operations.

Wheel Scotch/Chock - A shaped piece of wood against which the crane wheel butts.

Operational Requirements

Protection of Trains Running on Lines which may be fouled by Cranes

A COSS must be appointed to set up a Safe System of Work to comply with the Rule Book GO/RT3000 Section T(ii).

Except in an emergency such work must be published in the Weekly Operating Notice, planned in advance and done at a time, which will cause the minimum of disruption to the passage of trains.

The crane controller is responsible to ensure that the crane(s) or load must not be allowed on or near the line until a Safe System of Work has been set up by the COSS.

Protection of any adjacent line(s) is required which may be fouled or affected when a crane is set up, operated or closed down. Protection is also required during the working of a crane, which may slew or extend above an adjacent line (even at a high level)

If the adjacent line is under possession the portion of line affected must be treated as a worksite within the possession and indicated by marker boards as required in Section T(iii) of the Rule Book.

The COSS will give permission for the crane controller to start work (this includes setting up), explaining the method of protection.

When it is necessary to allow trains to pass the COSS must request the crane controller to arrange for the whole of the equipment to be secured clear of the line, this will include the lowering of any suspended loads. The COSS will satisfy himself that the line is safe for the passage of trains before giving up his protection. Whilst protection is withdrawn the crane controller must ensure the crane(s) and loads are not allowed on or near the line until he has again received permission from the COSS to recommence work.

Responsibilities - Planning

Site Visits - Before Ordering Crane



Site visits must always be held before the planning of any lifting operation, to ensure that the site is suitable, and the selection of crane can be made to suit site conditions.

All lifting operations should be planned by a competent person to ensure that they are carried out safely and that all foreseeable risks have been taken into account and assessed.

Personnel who have the appropriate expertise and have been appointed for this purpose should carry out planning. In cases of repetitive or routine operations, this planning may only be necessary in the first instance, with periodic reviews to ensure that no factors have changed.

Planning should include the following.

- a) The load, its characteristics (weight centre of gravity and physical size) and the methods of lifting; NOTE:
 - i) It may also be necessary to make allowance for any adhesion between the load and its support.
 - ii) Unless weights are clearly indicated or are obtainable from unit weights, the weights of loads must be provided by Competent person, and marked on each load.
- b) The selection of a suitable crane(s) appropriate to the operation ensuring that adequate clearances are maintained between the load(s) and any other structure.
- c) The selection of lifting gear. The weight of which must be taken into account when assessing the load on the crane(s).
- d) The position of the crane(s) and of the load before, during and after the operation.
- e) The site of the operation taking into account proximity hazards, e.g. overhead equipment, third rail, buried services operational railway, space availability, other activities and the suitability of ground and track conditions.
- f) Any necessary erection and dismantling of the crane(s).
- g) The environmental conditions that exist or may occur at the site of the operation, which may necessitate stopping the operation when conditions are unsuitable.
- h) Alternative lifting methods which may be used as a contingency.

Responsibilities - On site

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RAIL CRANE SITE SAFETY CHECKLIST

1. Check that all track site protection is adequate for crane operations (T III and TII).
2. Check that any electrical isolations are arranged as required for national grid, telephone, and electrical traction cables (OHL, 3rd and 4th rail system).
3. Check that track conditions are adequate regarding ballast, sleepers and rail.
4. Check that track geometry is known and suitable for rail crane operations, (track geometry would include cant, gauge and gradient).
5. Check that other parties involved are informed.
6. Check that the loads are assessed and weights are known, including lifting equipment and are within cranes capacity for required working radius.
7. Check that all staff involved in the lifting operations are competent, certificated, and personal safety equipment is provided.
8. Check that lifting equipment is adequate and in test date.
9. Check that side and overhead clearances are adequate.
10. Check that site lighting is adequate.
11. Check that road protection is arranged if required.
12. Monitor rail head conditions.
13. Load to be restrained at all times.

ROAD CRANE SITE SAFETY CHECKLIST

1. Check that the correct crane has been arranged and is supplied.
2. Check that access and egress is adequate.

ROAD CRANE SITE SAFETY CHECKLIST (continued)

3. Check that ground conditions are capable of taking load. (If in doubt get advice from technical specialist).
4. Check that approach and working areas are as level as possible
5. Check that adequate protection is provided for under-ground services.
6. Check for any side or overhead obstructions and ensure that a 600mm clearance is maintained.
7. Check that all loads are assessed and weights known, including lifting equipment and are within cranes capacity for required working radius.
8. Check that all lifting equipment is adequate and in test.
9. Check that all staff involved in lifting operations are competent, trained, and personal safety equipment is provided.
10. Check that information regarding Plant Hire has been provided and checked.
11. Check that all track protection is adequate for crane operation (TIII and TII).
12. Check that road protection is arranged if required.

ROAD RAIL EXCAVATORS SAFETY CHECKLIST

For Road Rail Excavators ensure all items 1 to 13 for Rail Cranes are checked, in addition

1. Ensure that specialist lifting devices are fit for Purpose.
2. Always ensure that correct on and off tracking facilities on equipment are available to machines being put on or taken off rail.

Control of Crane

Duties of the Person appointed to Control the Lifting Operation

Crane Controller

The Crane Controller's duties should include the following:-

1. Responsibility for the organisation and control of the lifting operation.
2. Planning of the Lifting Operation - See page 14
3. Each item of equipment must be examined before use to ensure that adequate inspection and maintenance of the equipment has been carried out. Defective equipment must be brought to the attention of the controller.
4. No chain, rope or other equipment may be used for any load exceeding the Safe Working Load (SWL) stamped on the appliance.
5. Under no circumstances must the load exceed the rated capacity of the crane.
6. Know the weight of the load and the weight of your Lifting Tackle, since the total weight to be lifted is the sum of the two.
7. The crane hook must be positioned over the centre of gravity of the load to prevent the load swinging when raised. The Slinger or authorised person responsible for the lift must give clear and correct signals to the Crane Driver.
Note:
Only the Crane Controller to give the signal to the crane.
8. Make sure that the load is free before lifting and avoid being trapped when the strain is taken. Halt the lifting of the load after it has been raised a few inches to ensure that it is securely slung before continuing with the lift.
9. Avoid carrying the load over the heads of persons and where necessary warn persons in the vicinity to keep clear.

Control of Crane (cont'd)

10. Wire Rope Slings and Chains must never be shortened by tying knots in them, or by wrapping them around the crane hook, neither must chains be joined or shortened by means of Bolts or Wires. Use the correct length of Sling or approved device for adjusting the length of the Sling.
11. Slings should be protected from sharp edges by softwood or other suitable packing. Care should also be taken to avoid loads resting on Slings as this will cause deterioration.
12. The crane must not be allowed to move with Slings trailing from the Hook in a dangerous manner. Where low headroom etc limits the use of the full length of a Sling or Chain, the excess must be hitched in a safe manner.
13. Ensure that there is an effective procedure for reporting defects and incidents and taking any necessary corrective action.

The Crane Controller should be given the necessary authority for the performance of all these duties and, in particular, authority to stop the operation whenever he considers that danger is likely to arise if the operation were to continue.

Duties, but not responsibilities, may be delegated to another person where considered appropriate.

Capacity

Load Rating Information

All cranes are required to display a durable load radius chart with clearly legible letters and figures. The load radius chart must be displayed in the cab location, easily visible to the operator while at the controls.

It is essential that persons in charge of lifting operations understand the load radius chart and plan lifting operations within the "Safe Working Load" (S.W.L.) of the crane before work commences.

	MAX S.W.L. (TONNES)									
	1 FALL					2 FALL				
	OVEREND		FULL SLEW			OVEREND		FULL SLEW		
	JIB		CANT			JIB		CANT		
	UP	LEVEL	50	100	150	UP	LEVEL	50	100	150
3.7	6	6	6	6	6	12	12	12	12	12
4.2	6	6	6	6	6	12	12	12	12	9.5
5	6	6	6	6	6	9.3	12	9.3	8.2	7.2
6	6	6	6	6	5.8	7.1	12	6.8	6.3	5.8
7.5	5.5	6	5.2	4.7	4.2	5.5	9.3	5.2	4.7	4.2
9	4.6	5.8	3.8	3.4	8.9	4.6	5.8	3.8	3.4	8.0
11	3.5	4.2	2.5	2.0	4.6	3.5	4.2	2.5	2.0	1.6
13	2.7	2.7	1.2	1.0	0.7	2.7	2.7	1.2	1.0	0.7

N.B The term Fall is used to describe the number of vertical elements of rope between the lifting hook and the end of the jib. This can be varied by threading the rope through a system of pulleys.

Load Rating Information

Critical Lifts are those where the load weight is close to the S.W.L. When lifting load weights heavier than 75% of S.W.L., great care must be taken when making moves that changes the available S.W.L.

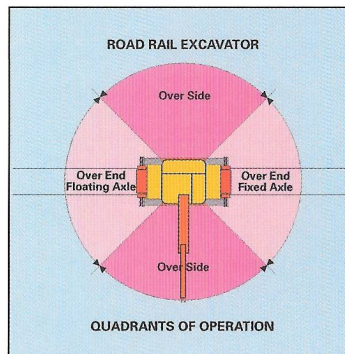
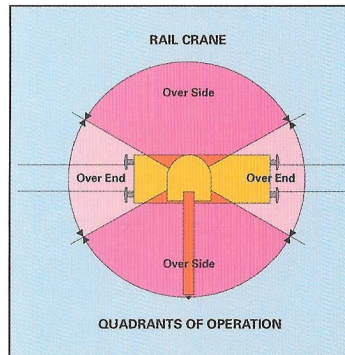
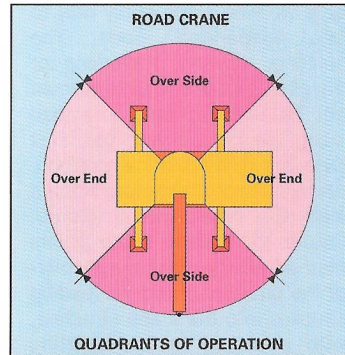
Operating Restrictions

Quadrant Working

The capacity of cranes changes during rotation of the upperworks, for this reason the cranes stability can be affected during lifting operations.

To provide uniform capacity most cranes have a 360° duty, which has a capacity in the middle and lower range. These capacity changes are identified in the load duty chart. The total area to which the crane jib can pass over is called its sweep, and would normally be 360°. Full sweep is then divided into operating areas called quadrants of operation, the crane duties are then based on the quadrant restrictions.

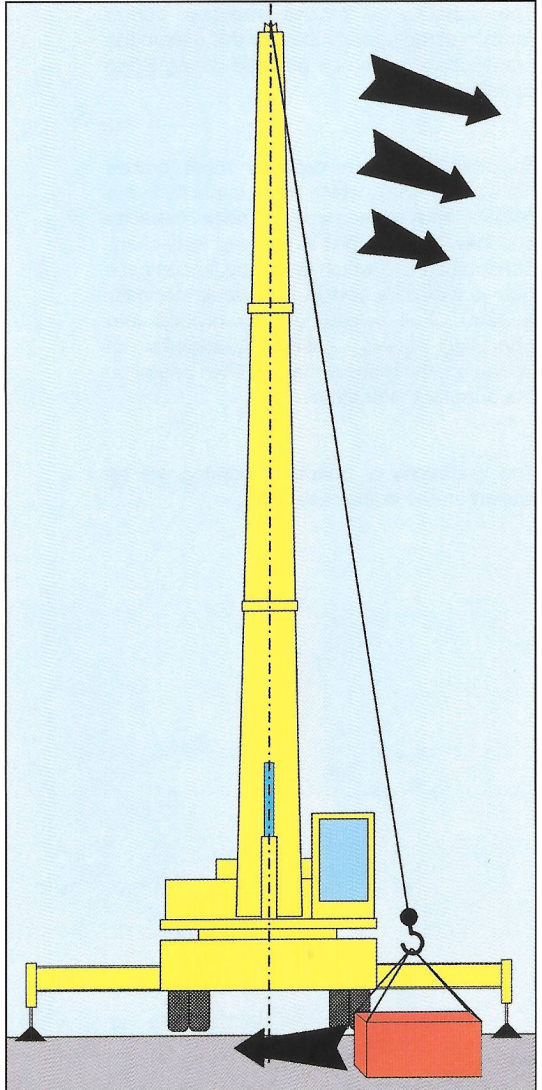
The limitations of quadrant working will be shown on the crane duty chart.



Vertical Lift

Vertical Lift

Safe working loads apply only to free suspended loads. The hoisting, slewing, traversing or travelling motions of a crane must not be used to drag any load along the ground with the hoist rope out of the vertical position. Always check that before lifting a load the hoist line is plumb. Failure to observe these points may adversely effect the stability of the crane or introduce loading stresses into the crane structure, with structure failure resulting without warning.



A Load Too Far!

Derricking and Telescoping movements may have a detrimental effect on cranes' ability to maintain equilibrium or stability.



The hoisting, slewing, traversing or travelling motions of a crane must not be used to drag any load along the ground, with hoist rope out of the vertical position.



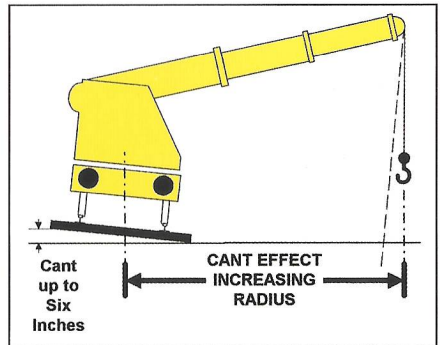
Canted Track

Canted Track (Rail Crane)

Persons in Charge of the lifting operation must take extra care when rail cranes are required to work on canted track. The capacity of a rail crane is reduced according to the amount of cant on which it is working, also when slewing on canted track or when travelling with the jib cross carriage on track where the cant changes, the true radius to the hook will change.

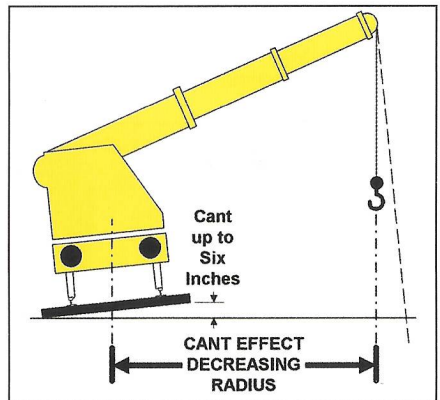
Slewing to Lowside

Care must be taken when Rail mounted cranes slew to the low side of canted track as there will be an effective increase in the true radius, which may result in the load being taken outside the S.W.L. radius within the resulting loss of stability.



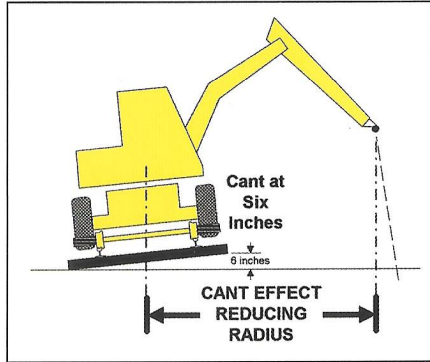
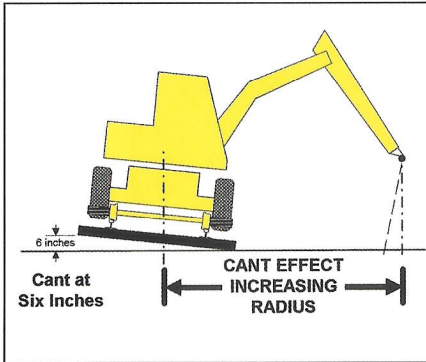
Slewing to Highside

Care must also be taken when rail mounted cranes slew to the high side of canted track, as there will be an effective reduction in the true radius. This may result in the load fouling the crane structure.



Canted Track (cont'd)

Canted Track (Road Rail Excavators)

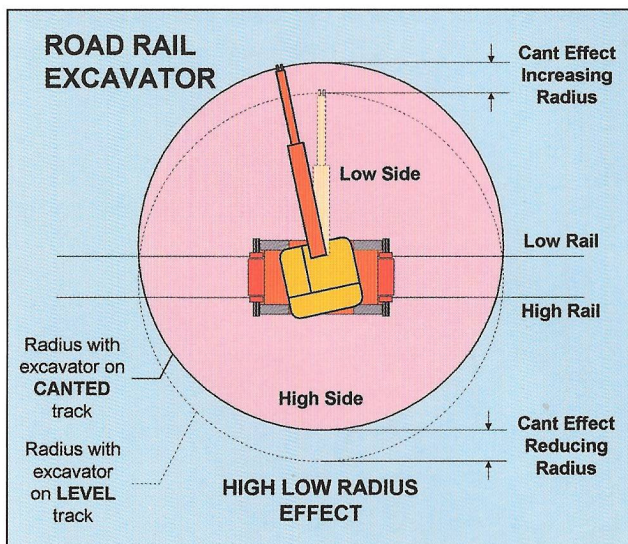
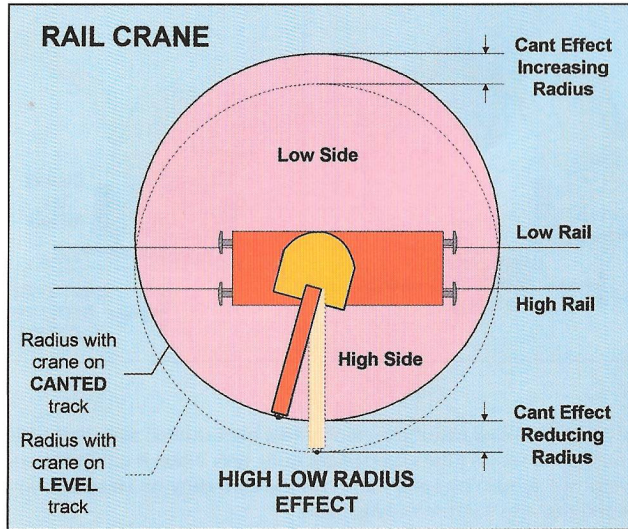


The majority of Road-Rail Excavators have only two cant duties; zero and 150mm cant. Care must be taken in selecting the appropriate duty, only when it can be guaranteed that the road rail excavator will remain on level track can the zero duty be selected. In all other cases it is recommended that the 150mm duty is used.

Where machines have a greater number of cant duties then the appropriate cant selection must be made.

Canted Track (cont'd)

Cant/Radius Diagrams



Gradient Working

Gradients (Rail Mounted Cranes)

When working on a gradient that changes within the limits of the worksite, the steepest gradient shall be taken as the ruling gradient for the purpose of determining gradient protection.

When Rail Mounted cranes are specifically designed for working on gradients, a notice indicating their capabilities when travel gear and brakes are fully operational is displayed in the cab. When moving on gradients, these cranes must be operated within the limits indicated on the notice.

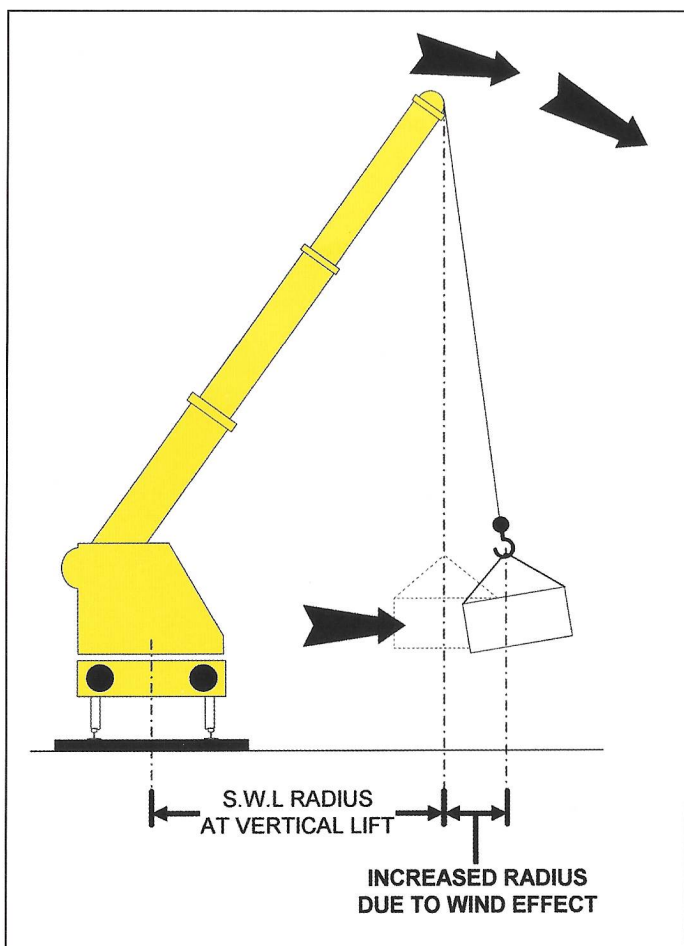
Where the limits of work involve moving over a summit, then gradient protection must be provided to suit the ruling gradient on each side of the summit.



Wind Effect

Effect

Wind loading on the crane can be critical depending on such factors as the boom length; boom angle, bulkiness of the load, (Large flat areas are most vulnerable) combined with direction and velocity of the wind. This effect can increase radius and be critical to the crane stability.



Setting Up Road Crane

Levelling Road Cranes

The importance of levelling the crane cannot be over-emphasised. All crane capacities listed in the load chart for a machine with outriggers extended to their full extent are based on the crane being set up dead level with the levelling equipment fitted on most road cranes. Two simple methods may be used to check that the crane is set up level, one is to use a carpenter's level across and in line with the crane body on top of the frame below the slewing ring. The second but not so accurate method is to face the end of the jib in its raised position and check that the hook and hoist ropes line up with the centre of the jib.

JIB LENGTH AND RADIUS	CHART CAPACITY LOST WHEN CRANE OUT OF LEVEL BY		
	1°	2°	3°
SHORT JIB, MINIMUM RADIUS	10%	20%	30%
SHORT JIB, MAXIMUM RADIUS	8%	15%	20%
LONG JIB, MINIMUM RADIUS	30%	41%	50%
LONG JIB, MAXIMUM RADIUS	5%	10%	15%

Ground Pressures

Ground Stability

Persons in charge of lifting operation must ensure that, the ground on which the crane is sited is reasonably level, well compacted, and stable enough to support the weight of the crane and its load without collapse or subsidence.

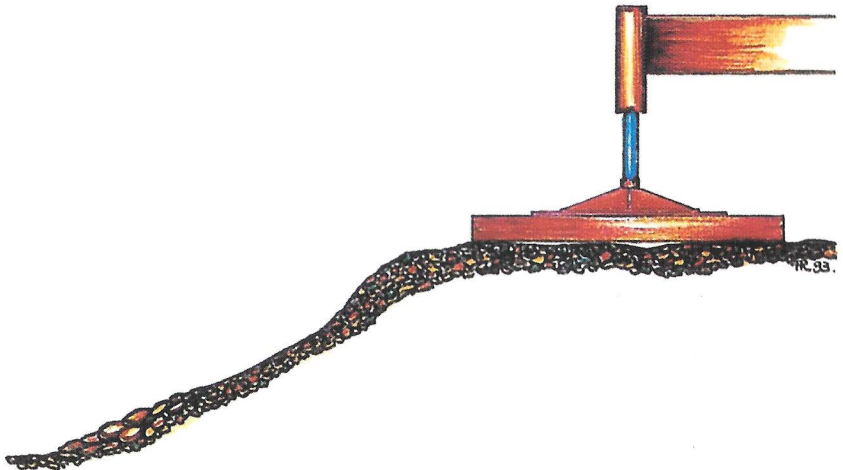
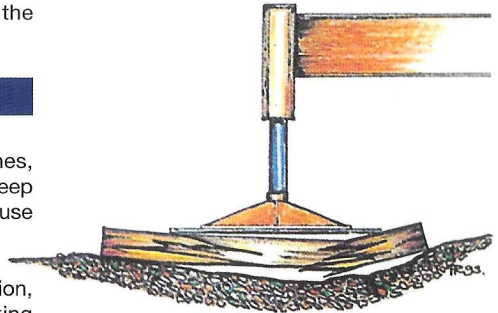
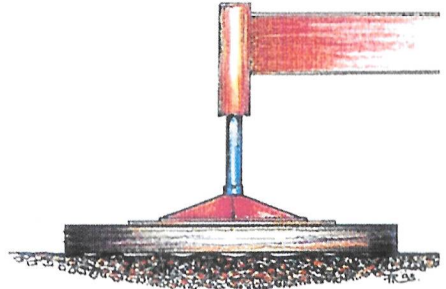
Uncompacted Ground

When working near new building works, expect the ground to be soft. Uncompacted back fill often extends all around the foundation.

Excavation

Whenever possible, avoid trenches, excavations, sloping locations with steep sides, as weight and vibrations can cause them to collapse.

When all lifts are to take place in one position, the practice of checking the packing following the initial lift should be carried out.



Ground Pressures

Ground Safe Bearing Pressures

In the absence of accurate tests, the following may be taken as a guide to the safe bearing pressures on various materials in tons per square foot:-

Type of Ground			Safe Bearing Pressure in Tons/Sq.ft. KN/m Sq.
Silt, Alluvial Earth, etc.			0 to 3/4 up to 3/4
	(Soft, or very soft		3/4 to 1-1/2
	(Sandy Firm		1-1/2 to 3
	(Stiff		3/4 to 1-1/2
Clay	(Firm		1-1/2 to 3
	(Stiff		3 to 6
	(Hard shaley clay		3 to 6
	(Very Stiff (boulder)		3 to 5
	(Sound Yellow		4 to 6
	(Blue		1 to 2
Sand	(Uniform	Loose	2 to 4
	(	Compact	2 to 3
	(Well-graded	Loose	4 to 6
	(	Compact	2 to 4
Gravel	(Sandy	Loose	4 to 6
	(	Compact	3
	(Clean	Loose	4 to 7
	(	Compact	1-1/2
Rock	(Chalk	Soft	3 to 6
	(	Hard	2
	(	Soft	5 to 10
	(	Moderately Hard	12
	(	Hard	

Handsignals

Operation Start

To identify person giving handsignals to crane driver.

Stop

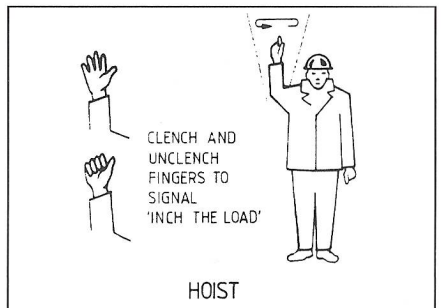
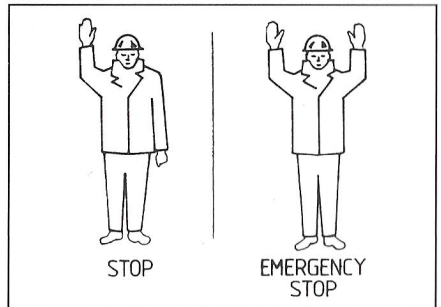
Must be given after every other handsignal, but in the case of travelling movement the stop signal must be given slowly to prevent sudden breaking and uncontrolled swinging of load.

Emergency Stop

This is the only handsignal that can be given by other persons who may identify a sub-standard condition during lifting operations.

Hoist

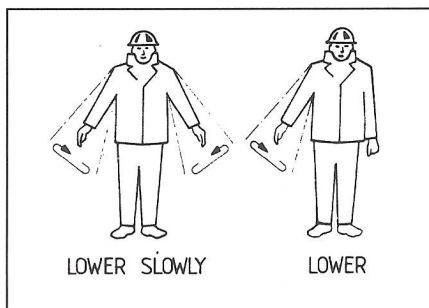
"Inch the load" is the first hoist instruction to be given. This movement is to allow identification of any sub-standard condition regarding balance of load and positioning of slings or if load is fouled in any way, before full hoist signal is made. Hoist instruction should only be given until a load is at a manageable height, in most cases this would be chest height. Load should only be lifted higher to clear obstruction.



Handsignals (cont'd.)

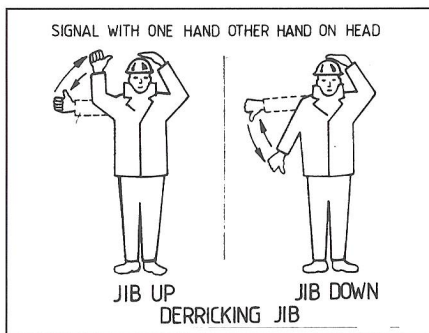
Lower

Signaller must ensure that all other persons involved in lifting operations are standing clear before lower movements are made.



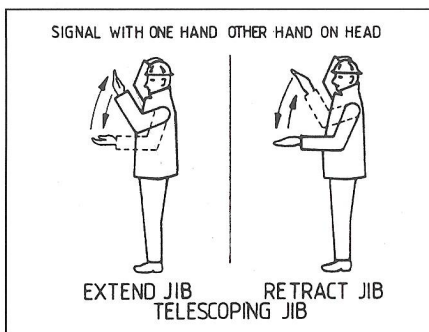
Derricking Jib

Derricking is one movement that can affect the stability of the crane. Derricking up will reduce radius but increase capacity. Derricking down increases radius but will reduce capacity. All Derricking movements should be taken with great care.



Telescoping Jib

Again this movement can affect the stability. Like derricking, telescoping alters the crane jib configuration. Telescoping out increases radius but reduces capacity, telescoping in reduces radius but increases capacity.

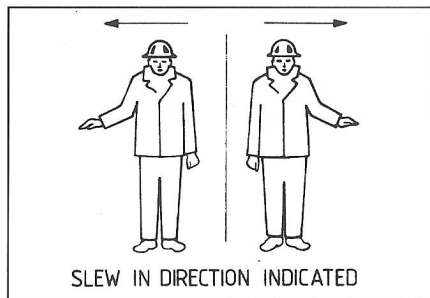


Handsignals (cont'd.)

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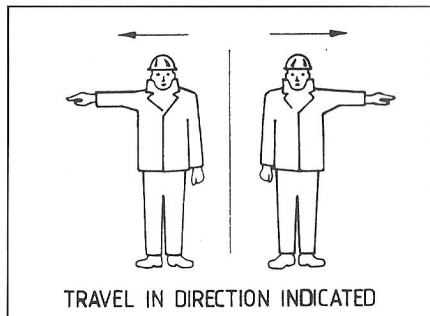
Slew

While slewing the load sideways take account of any obstructions to crane or load.



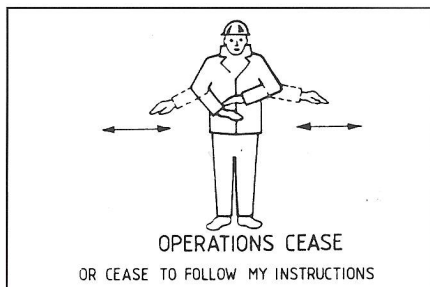
Travel

Cranes must travel at slow speed, with load near to the ground and in the case of rail cranes loads must always be travelled where possible with the crane jib in line with the track.



Operations Complete

Operation complete.
Await further instructions.



Slings

Instructions for Slings and Authorised Persons - Rules General

1. Each item of equipment must be examined before use.
Defective equipment must be brought to the attention of the controller.
2. No chain, rope or other equipment may be used for any load exceeding the Safe Working Load (SWL) stamped on the appliance or as shown in the charts and in the tables shown in the Lifting Tackle Stores.
3. Under no circumstances must the load exceed the rated capacity of the crane.
4. Where possible, know the weight of the load and the weight of your Lifting Tackle, since the total weight to be lifted is the sum of the two.
5. The crane hook must be positioned over the centre of gravity of the load to prevent the load swinging when raised. Clear and correct signals must be given to the Crane Driver by the Slinger or authorised person responsible for the lift.
NOTE:
Only one authorised person to give the signal to the crane Driver for any special lift.
6. Make sure that the load is free before lifting and avoid being trapped when the strain is taken. Halt the lifting of the load after it has been raised a few inches to ensure that it is securely slung before continuing with the lift.
7. Avoid carrying the load over the heads of persons and where necessary warn persons in the vicinity to keep clear.
8. Wire Rope Slings and Chains must never be shortened by tying knots in them, or by wrapping them around the crane hook, neither must chains be joined or shortened by means of Bolts or Wires. Use the correct length of Sling or approved device for adjusting the length of the Sling.
9. Slings should be protected from sharp edges by soft wood or other suitable packing. Care should also be taken to avoid loads resting on Slings as this will cause deterioration.
10. The crane must not be allowed to move with Slings trailing from the Hook in a dangerous manner. Where low headroom etc. limits the use of the full length of a Sling or Chain, the excess must be hitched in a safe manner.

Site Communications

Handsignals

The Crane Driver must only accept signals from one person appointed to these duties. The Crane Controller in charge of lifting operations may appoint a crane slinger to act in this capacity. Each signal given for a movement of the crane must be clear and unmistakable, the standards of Handsignals to use are construction industry based and comply with BS7121.

Verbal Instructions

If verbal instructions are given, great care must be taken to avoid any misunderstanding. All instructions must be continuous with the word "stop" after each instruction. It should be made clear to crane operators that instructions are continuous. In the event that an operator fails to hear a continuous instruction then he must stop immediately and await further instructions.

NOTE:

BEFORE ANY SIGNAL IS GIVEN TO CRANE DRIVERS, ALL OTHER PERSONNEL MUST BE WARNED AND BE STANDING CLEAR OF LOAD.

Use of Phonetic Alphabet is mandatory where safety instructions are given.

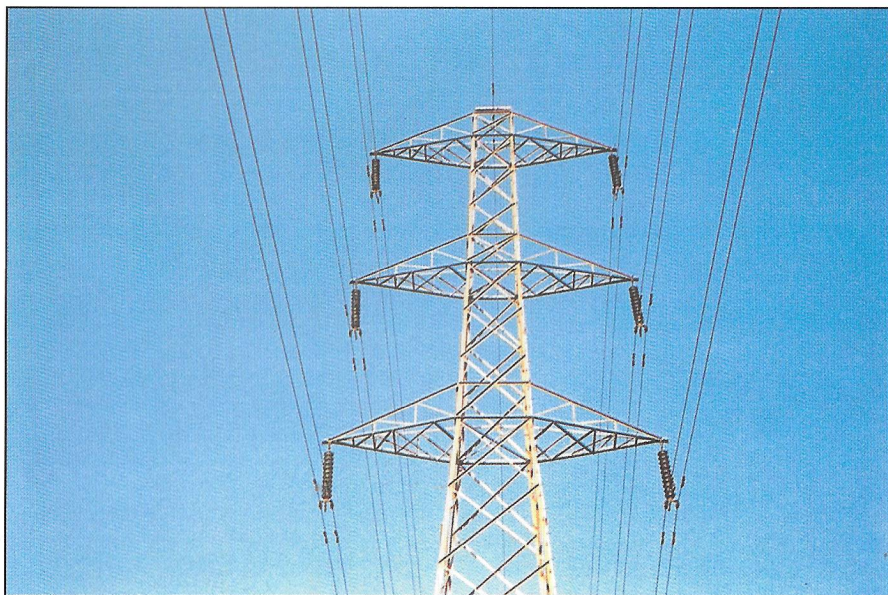


Working Near Overhead Power Lines

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Electrical Authority (National Grid)

Where overhead power lines cross in the vicinity of the site of work, the person in charge of lifting operations must take special precautions with regard to the position of the crane relative to the overhead conductors in accordance with the following requirement. A distance equal to the maximum jib length plus 6m (7 yards) must be measured out on either side of the “plumb” of any overhead conductors with demarcation signs or markers either side of overhead conductors. Persons responsible for planning the works must give consideration to consultation with the power cable owner and where necessary provide protection to the power lines.



All relevant instruction regarding working near overhead conductors (National Grid) must be displayed in the cab.

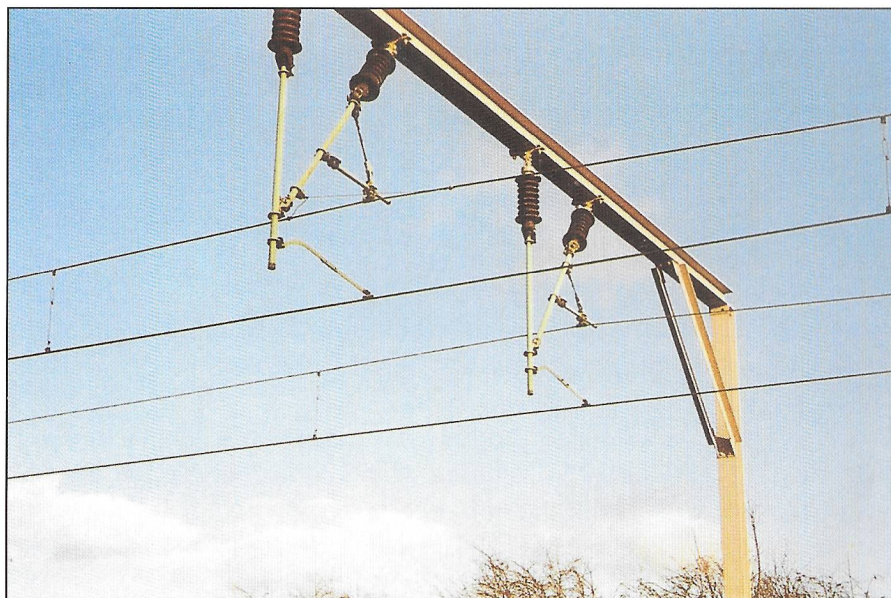
Reference to HSE Guidance Notes GS6 should also be carried out when working around overhead line conductors.

Working Near O/H Lines

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A/C Electrified Lines

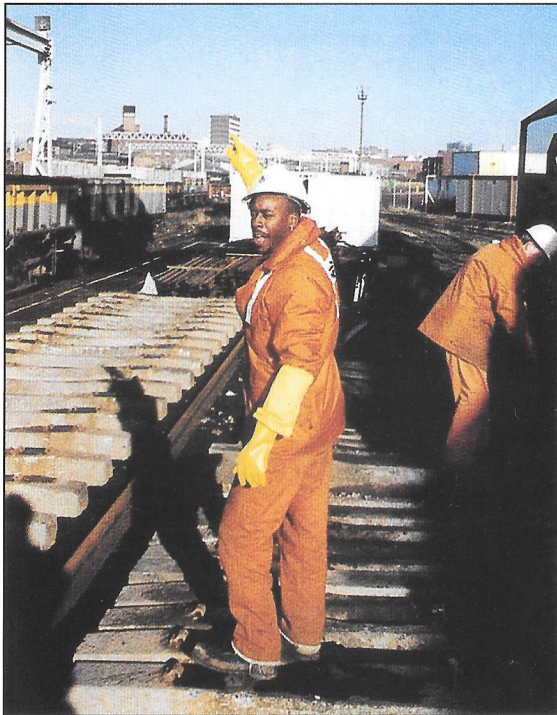
Whenever a crane or similar appliance has to be used on or near the electrified line, arrangements must be made with the Electrical Control Operator (ECO) for ensuring that the overhead line equipment has been isolated and earthed in accordance with the isolation and earthing instructions. These are contained within the Working on or about 25k.v. A.C. Electrified Lines Manual RT/E/S29987.



Personal Safety Equipment

Cranes Controllers should ensure that the work site is well signed, and all staff involved in the operations and visitors, are correctly equipped with appropriate personal protective equipment.

i.e. Safety Helmets, Safety Boots and all other items of safety equipment if required by the work.



Identification of Person Directing Crane Movements

It is strongly recommended that persons directing crane movement, are easily identifiable to the crane driver i.e. by wearing high visibility clothing which could be reflective gloves/armbands.

Approximate weight of Permanent Way Materials

60ft Track Panel (26 sleepers)

Tonnes

113A FB Rail on concrete sleepers (F27/24)	9.7
113A FB Rail on hardwood sleepers (Jarrah/Pan 8)	5.9
113A FB Rail on softwood sleepers (Pan 8)	5.2
95lb BH Rail on hardwood sleepers	6.1
95lb Rail on softwood sleepers	5.1

ADD 1 tonne when lifting from ballast
(ADD 2 tonne if ballast is frozen)

Ordinary Chair (S1)	22 Kg
Ordinary baseplate (BR1)	17 Kg
Concrete sleeper	280 Kg
Hardwood sleeper	100 Kg
Softwood sleeper	55-65 Kg
Concrete bearer per meter run (shallow depth)	130Kg
Concrete bearer per meter run (full depth inc. Pandrol housing)	143Kg

60ft Rail

Flat bottom (113lb)	1025 Kg (1 ton)
Bull head (95lb)	860 Kg (0.85 tons)
UIC 60	1104 Kg

Half-set FB Switches (including baseplates)

"B" 113lb Vert	2.1 tonnes
"D" 113lb Vert	3.3 tonnes
"E" Shallow Depth	3.5 tonnes

Common Crossing (including chairs/baseplates but not including check rails)

1 in 8 BH	1.5 tonnes
1 in 8 FB (113 lb Vert)	1.6 tonnes
1 in 12 BH	1.5 tonnes
1 in 9' (113lb Vert)	1.6 tonnes
1 in 9' Cast Manganese	1.8 tonnes
1 in 15 Cast Manganese	2.1 tonnes

Safe Use of Cranes

Weights of Construction Materials (Based on Volume)

Material	Approximate Weight		Material	Approximate Weight	
	kg/m	lb/ft3		kg/m	lb/ft3
METALS			TIMBER		
Iron	7690	480	Cedar	350	22
Lead	11374	710	Fir, Douglas, seasoned	545	34
Steel	7850	490	Fir, Douglas, unseasoned	640	40
Tin	7370	460	Fir, Douglas, wet	800	50
MASONRY			Fir, Douglas, Glue	545	34
Ashlar masonry	2240-2560	140-160	Laminated		
Brick masonry, soft	1760	110	Pine	480	30
Brick, masonry common	2000	125	LIQUIDS		
about 3 tonnes per thousand			Water	993	62
Brick masonry, pressed	2240	140	EARTH		
Clay tile masonry	960	60	Earth, wet	1600	100
Rubble masonry	2080-2480	130-155	Earth, dry	1200	75
Concrete, cinder	1600-1760	100-110	Sand and gravel, wet	1920	120
Concrete, slag	2080	130	Sand and gravel, dry	1680	105
Concrete, stone	2370	144	River sand	1920	120
Concrete, stone reinforced	2400	150	VARIOUS BUILDING MATERIALS		
ICE AND SNOW			Cement, Portland, loose	1505	94
Ice	900	56	Cement, Portland set	2930	183
Snow, dry, fresh fallen	128	8	Lime, gypsum, loose	850-1025	53-64
Snow, dry, packed	190-400	12-25	Mortar, cement-lime, set	1650	103
Snow, wet	430-640	27-40	Crushed rock	1440-1760	90-110
			Clay	2000	125
			Chalk	2000	125
			Ballast (clean)	1762	110
			Ballast (dirty)	1900	119

Specific Legislation

The following legislation current at the date of publication of this code contains provisions that apply to the provision, maintenance, examination and use of cranes.

1. Health and Safety at Work etc. Act 1974
2. The Mines and Quarries Act 1954
3. The Factories Act 1961
4. The Electricity (Factories Act) Special Regulations 1908 (S.R and O. 1908 No. 1312 as amended by S.R and O. 1944 No. 739)
5. The Docks Regulations 1988 (S.I. 1988 No. 1655)
6. The Quarries (General) Regulations 1955 (S.I 1956 No. 1780)
7. The Miscellaneous Mines (General) Regulations 1956 (S.I. 1956 No. 1778)
8. The Shipbuilding and Ship Repairing Regulations 1960 (S.I. 1960 No. 1932)
9. The Construction (General Provisions) Regulations 1961 (S.I. 1961 No. 1580)
10. The Coal and Other Mines (Mechanics and Electricians) Regulation 1965 (S.I 1965 No. 1559)
11. The Construction (Working Places) Regulations 1966 (S.I 1966 No. 94)
12. The Motor Vehicles (Construction and Use) Regulations 1986 (S.I. 1986 No. 1078)
13. The Chains, Ropes and Lifting Tackle (Register) Order 1938 (S.R and O. 1938 No. 599)
14. The Lifting Machines (Particulars of Examinations) Order 1963 (S.I. 1963 No. 1382)
15. Certificate of Exemption No. 1 Annealing. Factory Form 661.1938
16. Certificate of Exemption No. 6 (General) Telescopic Jib Cranes. Factory Form 2490. 1976
17. The Construction (Lifting Operations) Certificates Order 1962 (S.I 1962 No. 227)
18. The Construction (Lifting Operations) Certificates (Amendment) Order 1964 (S.I. 1964 No. 531)
19. The Construction (Lifting Operations) Reports Orders 1962 (S.I. 1962 No. 225)
20. The Construction (Lifting Operations) Prescribed Particulars Order 1962 (S.I 1962 No. 226)
21. The Construction (Lifting Operations) Prescribed Particulars (Amendment) Order 1962 (S.I. 1962 No. 1747)
22. The Factories Act (Northern Ireland) 1965
23. The Shipbuilding and Ship Repairing Regulations (Northern Ireland) 1971 (S.R. and O. No. 372)
24. The Construction (Lifting Operations) Regulations (Northern Ireland) 1963 (S.R and O. No. 86)
25. The Docks Regulations (Northern Ireland) 1934 (S.R and O. No. 37)
26. Road Traffic Act 1962.
27. The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985 (S.I 1985 No. 2033)
28. Mines and Quarries (Tips) Act 1969
29. Coal and Other Mines (Electricity) Regulations 1956 (S.I. 1956 No. 1766)
30. Miscellaneous Mines (Electricity) Regulations 1956 (S.I. 1956 No. 1779)
31. Quarries (Electricity) Regulations 1956 (S.I. 1956 No. 1781)
32. Railway Safety Critical Work Regulations 1994.

