

CRANES, HOISTS AND LIFTING GEAR

LEARNING OUTCOME

Describe the minimum requirements relating to the inspection, safe operation and maintenance of cranes, hoists and lifting gear.

ASSESSMENT CRITERIA

- List at least three types of plant used in a workplace for each of the following - cranes, hoists and lifting gear.
- Describe the statutory or minimum requirements relating to cranes, hoists and lifting gear.
- Describe the control strategies to be adopted in the operation and use of cranes, hoists and lifting gear with reference to current standards.

REFERENCES

- WH&S Act 2011 Part 2 Duties;
- WH&S Regulations 2011;
 - Section 82 - Exceptions
 - Section 108 and Sch 3 – Registration
 - Section 235 – Major Inspections
 - Chapter 5 – General duties of PCBU designing plant
 - Part 4.5 – High Risk Work
 - Schedule 3 – High Risk Work
 - Schedule 5 - Registration
- Plant - Code of Practice;
- Tower Cranes Code of Practice 2006 (Qld) & Tower Cranes Code of Practice 2017
- AS 1418 - Cranes (including hoists & winches);
- AS 1438 - Wire-coil flat slings;
- AS 1353 - Flat synthetic-webbing slings;
- AS 1666 - Wire-rope slings;
- AS 2089 - Sheave blocks for lifting purposes;
- AS 2317 - Collared Eyebolts;
- AS 2318 - Swivels for hoists;
- AS 2319 - Rigging, screws and turnbuckles;
- AS 2321 - Short-link chains for lifting purposes (non-calibrated);
- AS 2549 - Cranes - Glossary of terms;
- AS 2550 - Cranes - safe use;
- AS/NZS 2615 - Hydraulic trolley jacks;
- AS 2740 - Wedge-type sockets;
- AS 2741 - Shackles;
- NOHSC: 1006 - Worksafe Australia - National occupational health and safety certification standard for users and operators of industrial equipment.

ATTACHMENTS

- [Electrical Safety Code of Practice 2010 – Working near overhead and underground electric lines, Appendix B Exclusion Zones](#)
- [Tower Crane Code of Practice 2017](#)
- [Mobile Crane Code of Practice 2006](#)

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CRANES, HOISTS AND LIFTING GEAR

INTRODUCTION

Cranes, hoists and lifting gear are commonly used within industrial workplaces as a means of moving and shifting equipment and materials. The specific duties with regard to cranes are as follows:

Work Health and Safety Regulation 2011 (WHS Regulation)

Part 4.5 – High risk work:

This section requires persons who operate cranes to have an authority to operate. There are a number of crane high risk work licences detailed in Schedule 3 of the WHS Regulation.

Definitions:

Schedule 19 of the WHS Regulation 2011 defines a Crane as:

A Crane means an appliance intended for raising or lowering a load and moving it horizontally including the supporting structure of the crane and its foundations, but does not include any of the following

- (a) an industrial lift truck;*
- (b) earthmoving machinery;*
- (c) an amusement device;*
- (d) a tractor;*
- (e) an industrial robot;*
- (f) a conveyor;*
- (g) building maintenance equipment;*
- (h) a suspended scaffold;*
- (i) a lift.*

BASIC DEFINITIONS

The following information is an extract from AS 1418 – CRANES. Some definitions are from the WHS Regulation.

Bridge crane means a crane that—

- (a) Consists of a bridge beam or beams, that are mounted to end carriages at each end; and
- (b) Is capable of travelling along elevated runways; and
- (c) Has one end or more hoisting mechanisms arranged to traverse across the bridge.

Crane - a specifically designed structure equipped with mechanical means for moving a load by raising and/or lowering, and whilst the load is in such state of motion or suspension transporting it; the structural member for which the boom or jib load is suspended.

Crane Capacity - the safe working loads (SWL) of a crane are the maximum loads under specified conditions for which a crane may be used.

Crane Operator - means of a person who has charge of and operates a crane, hoist etc.

Crane Rating Charts - load chart - a chart or graph fitted to the crane illustrating and/or specifying the lifting capacities for the given radii plus other relevant safety information.

Dogging work means—

- (a) The application of slinging techniques, including the selection and inspection of lifting gear, to safely sling a load; or
- (b) The directing of a plant operator in the movement of a load when the load is out of the operator's view.

Gantry crane means a crane that—

- (a) Consists of a bridge beam or beams supported at one end or both ends by legs mounted to end carriages; and
- (b) Is capable of travelling on supporting surfaces or deck levels, whether fixed or not; and
- (c) Has a crab with one or more hoisting units arranged to travel across the bridge

High risk work means any work set out in schedule 3 of the WHS Regulations as being within the scope of a high risk work licence.

High risk work licence means any of the licences listed in schedule 3 of the WHS Regulations.

Hoist means an appliance intended for raising or lowering a load or people, and includes an elevating work platform, a mast climbing work platform, personnel and materials hoist, scaffolding hoist and serial hoist, but does not include a lift or building maintenance equipment

Licence holder means—

- (a) For a high risk work licence—the person who is licensed to carry out the work.

Load Weight Indicator (LWI) - a device fitted on the jib of a crane to assess the weight of the mass.

Longitudinal Travel Motion, Longitudinal Travel Motor - The motion of the whole crane on its gantry or tracks ~~shall is be~~ known as the longitudinal travel motion and the motor causing this motion ~~is shall~~ be termed the longitudinal travel motor.

Luffing - the angular movement of the crane jib in a vertical plane.

Mast climbing work platform means a hoist with a working platform used for temporary purposes to raise personnel and materials to the working position by means of a drive system mounted on an extendable mast that may be tied to a structure.

Materials hoist means a hoist that—

- (a) Consists of a car, bucket or platform cantilevered from, and travelling up and down outside, a face of the support of a structure; and
- (b) Is used for hoisting things and substances but not persons.

Mobile crane means a crane capable of travelling over a supporting surface without the need for fixed runways and relying on gravity for stability.

Monorail Crane - a crane consisting essentially of a fixed single rail or track supporting a travelling hoisting unit.

Non-slewing mobile crane means a mobile crane incorporating a boom or jib that cannot be slewed, and includes—

- (a) An articulated mobile crane; or
- (b) A locomotive crane;

But does not include vehicle tow trucks.

Personnel and materials hoist means a hoist—

- (a) That is a cantilever hoist, a tower hoist or several winches configured to operate as a hoist; and
- (b) That is intended to carry goods, materials and people.

Portal boom crane means a boom crane or jib crane that is mounted on a portal frame that, in turn, is supported on runways along which the crane travels.

Reach stacker means a powered reach stacker that incorporates an attachment for lifting and lowering a shipping container.

Safe Working Load (SWL) - the maximum rated load which can be safely handled by a machine under specified conditions.

Self-erecting tower crane means a crane—

- (a) That is not disassembled into a tower element and a boom or jib element in the normal course of use; and
- (b) Where the erection and dismantling processes are an inherent part of the crane's function.

Slewing mobile crane means a mobile crane incorporating a boom or jib that can be slewed, but does not include—

- (a) A front-end loader; or
- (b) A backhoe; or
- (c) An excavator; or
- (d) Other earth moving equipment;

When configured for crane operation.

Tower crane means—

- (a) A boom crane or a jib crane mounted on a tower structure; and
- (b) In schedule 3—
 - (i) The crane, if a jib crane, may be a horizontal or luffing jib type; and
 - (ii) The tower structure may be demountable or permanent;

But, in schedule 3, does not include a self-erecting tower crane.

Vehicle loading crane means a crane mounted on a vehicle for the purpose of loading and unloading the vehicle.

Work box means a personnel carrying device, designed to be suspended from a crane, to provide a working area for a person elevated by and working from the device.

PLANNING

The planning and application of crane requirements should commence as early as possible in the development of each project.

Where cranes are required to operate in or near new buildings or structures, crane loadings and access should be considered at the project design stage.

Wherever practicable, the planning should include consultation with the crane manufacturer and proprietor.

Matters to be Considered

At appropriate stages during planning, the following matters ~~shall~~should be considered, where applicable:

- Establishment of a management plan.
- Selection of cranes.
- Obtaining authorisations.
- Requirements of regulatory authorities.

- Site access and crane siting.
- Protection and safety of public.
- Proximity of power lines and other services.
- Procedures for the setting up and dismantling of the crane and the method of lift.
- Makeup of the crane crew, which may include:
 - erection crew;
 - crane operator;
 - doggers;
 - spotters;
 - riggers;
 - power line observers; and
 - persons under training or instruction.
- Communication system.
- Weather conditions.
- Ground conditions.
- Proximity of excavations.
- Selection of lifting gear.
- Personal safety equipment.
- Emergency procedures.
- Inspection, maintenance and repair.
- Lightning protection.
- The documentation of work procedures where the lifting operation is not a routine type, eg. multiple crane lifting.
- Consultation and co-ordination with other groups working in the area.
- Night operations.

CRANE SELECTION

Before selecting a crane for a particular operation, the following information ~~shall~~ should be ascertained:

- The mass of the load to be lifted.
- The nature of the load to be lifted.
- The speed and frequency of operation.
- The maximum load that will be imposed on the crane.
- The nature of the rigging or slinging to be used.
- The position from which the load is to be lifted.

- The position to which the load is to be placed.
- The movement limitations of the crane and the load.
- Other limitations of the crane.
- Where multiple crane lifting is involved:
 - how the load is to be proportioned;
 - how the load proportioning is to be maintained;
 - whether the cranes have appropriate additional capacity over the proportioned load to be lifted; and
 - the operating characteristics of the crane, e.g. speed of hoisting.
- The environmental factors.

The danger of instability due to loss of inflation of a tyre should be considered. For example, foam-filled tyres should be used for rough terrain.

MAINTENANCE, INSPECTION AND REPAIR

Management's instructions for routine maintenance and inspection of the crane ~~shall~~ should be readily available. The instructions ~~shall~~ should include the manufacturer's recommendations for routine maintenance and inspection, and ~~shall~~ should give specifications for consumable items such as ropes, lubricating oil, and hydraulic fluids.

A logbook (record) ~~shall~~ must be kept of all cranes, giving all pertinent information such as hours worked, adjustments, insulation checks, renewal of parts, inspections and repairs. Based on this record, a program of planned maintenance and repair work should be introduced to contribute towards trouble-free and ~~s~~ safe operation. The logbook should be kept on the crane.

Inspection

Each crane ~~shall~~ should be inspected periodically in accordance with ~~management's~~ manufacturer's instructions and with full consideration of the crane duties, to ensure that:

- the parts of the crane subject to deterioration through corrosion, damage, wear, abrasion and like effects are replaced before they become unserviceable; and
- the crane is maintained in a safe, serviceable condition.

Major inspection

Management's instructions ~~shall~~ should include directions for the extent and frequency of major inspections.

The frequency of major inspections ~~shall~~should be in conformance with the manufacturer's recommendations and as a minimum every 10 years as required by Section 235 of the WHS Regulation.

A major inspection shall have the following meaning:

- A comprehensive and detailed examination by a competent person sufficient to ensure that the crane is safe to use.
- As considered necessary by a competent person, visual examination shall be supplemented by non-destructive examination to determine the condition of the crane.
- As considered necessary by a competent person, parts of the crane shall be dismantled to enable the condition of the crane to be determined.
- As considered necessary by a competent person, such measurements of crane components shall be taken to enable the condition of the crane to be determined.

Notes:

- The frequency and extent of inspections ~~shall~~should be related to the severity of the operating conditions of the crane.
- Inspections ~~shall~~should be thoroughly conducted by a competent person authorised by management. All such inspections ~~shall~~should be appropriate to both the current crane use and future crane use.
- The crane ~~shall~~should be maintained in a clean and accessible condition to enable inspections to be made safely and efficiently.
- Documentation ~~shall~~should be readily available stating that the crane has been inspected by a competent persons and is in a safe, serviceable condition.

Where experience has shown particular problems with a crane or hoist, then a specific program ~~shall~~should be established to alleviate the problems.

Maintenance and repair

All maintenance and repair ~~shall~~should be carried out in accordance with the ~~management's~~manufacturer's instructions using suitable tools and any special equipment specified for the purpose.

Worn or serviceable parts

Any part of a crane, or its ancillary or auxiliary equipment, which become worn or unserviceable as to constitute a hazard or impair the operation of the crane or may constitute a hazard before the next periodic inspection, ~~shall~~should be repaired and replaced. The repaired or new part ~~shall~~must comply with the manufacturer's recommendations or specifications and, where these are not available, to the relevant requirements of the applicable part of AS1418 – CRANES, HOISTS AND WINCHES.

Notes:

Repairs must comply with the particular requirements of the regulatory authority.

Log Maintenance

Prior to leaving the crane, the operator or other person responsible ~~shall~~should record in the logbook the crane checks, adjustments, renewal of parts, repairs and inspections performed, the hours worked by the crane, duties, performed by the crane including maximum loading and all incidents and irregularities of loading, operation, wear, damage and the like concerning the safe use of the crane. Each load entry ~~shall~~should be signed by the responsible person making the entry and should contain details of that person's identification and qualification.

SAFE CRANE OPERATION

When operating a crane, the crane operator ~~shall~~should:

- not exceed the rated working load of the crane except for the express purpose of a test of the crane under the supervision of a competent person;
- be familiar with the location and operation of the main isolating switch;
- be familiar with the location and operation of the fire-fighting equipment;
- avoid sudden stops, jerks or other movements which may cause the load to swing unduly;
- not move the hook or load when the hook or load is out of sight except where directed to do so by an authorised person such as a dogger or rigger;
- ensure that the hook or load is sufficiently raised to avoid collision with any object during horizontal movement;
- not hoist off vertical;
- avoid moving the load, lifting attachment or other object horizontally other than when the load is freely suspended from the crane;
- when engaging the crane or part of the crane with end stops, do so with minimal impact;

- follow the signals or directions given by the authorised person unless a dangerous situation would be created by so doing in which case no movement shall be undertaken;
- when loads have to be handled in the vicinity of persons, do so with extreme care;
- avoid developing slack rope when landing a load; and
- position bridge and gantry cranes at their normal parking position when out-of-service.

When a crane is under pedestrian control (i.e. using pendant controls, radio controls or infrared controls) the operator ~~shall~~ should maintain a sufficiently close relationship with the load to ensure good visibility and that safe handling takes place. A clear and defined pathway for the operator is critical. When using radio controls, management should make provision for the security of the transmitter when not in use.

MULTIPLE CRANE OPERATION

Hoisting a load with two or more cranes requires greater attention to planning and supervision than hoisting with one crane, because the effects of the relative motion between the cranes may induce additional loadings on the cranes, the load and the lifting gear. Because of this and the difficulty in monitoring these additional loads, multiple crane hoisting ~~shall~~ should be used only when the physical dimensions, characteristics, mass or required movement of the load prevent the operation from being carried out by a single crane.

Multiple crane hoisting ~~shall~~ should be planned with extreme care and ~~shall~~ should include an accurate assessment of the proportion of the load to be carried by each crane. It is essential that planning ~~shall~~ should ensure that the hoist ropes remain vertical.

During multiple crane hoisting operations, only one motion should be undertaken at any time, and movements should be planned so that luffing-up is used in preference to luffing-down.

Capacity Requirements

For multiple crane hoisting operations using two or more cranes, the following minimum capacity requirements for each crane ~~shall~~ apply:

- For two cranes - 20 percent greater than the calculated share of the load.
- For three cranes - 33 percent greater than the calculated share of the load.
- For four or more cranes - 50 percent greater than the calculated share of the load.

Planning for Multiple Crane Hoisting

Mass of load - The total mass of the load and its distribution load ~~shall~~ should be either known or calculated. If the information is taken for a technical drawing, allowance should be made for manufacturing tolerances.

Centre of gravity - The position of the centre of gravity ~~shall~~ should be assessed carefully and allowances made for each uncertainty.

Mass of lifting gear - The mass of the lifting gear ~~shall~~ should be part of the calculated load on the cranes and its mass distribution ~~shall~~ should be accurately known.

Synchronisation of the crane motions - The crane motions should be synchronised; therefore, cranes of equal capacity and similar characteristics should be used whenever possible. In practice, there will always be some variation due to differences in response to the activation of the motion controller and the setting and efficiency of the braking system.

Crane Operation - Stability

General - Acceleration and braking motions during travelling ~~shall~~ should be applied gently to minimise the swing of the load. Taglines should be used to prevent pendulum motion of the load. The load should be carried as near to the supporting surface as is practicable.

Persons assisting the crane operator ~~shall~~ should not be located between a suspended load and the crane and they ~~shall~~ should be visible to the crane operator.

Boom slew position in relation to the carrier ~~shall~~ should be kept inside the specified sector.

Surface preparation - Where necessary, the surface to be traversed should be prepared to ensure a firm and level access route for the crane. Surface depressions and potholes should be filled to prevent the crane from tilting laterally or in the direction of travelling. Where surface penetration may occur in soft surfaces, mats or other suitable travelling should be laid.

Out of level operation - The rated capacity of a crane is determined with the crane levelled to within one degree. A crane out of level by more than one degree may suffer -serious reduction in lifting capacity. The worst effect is when cranes with long booms are operating at short radius.

Slopes - Negotiation of slopes by mobile cranes travelling with suspended loads should be avoided. Where the negotiation of a slope is unavoidable, a competent person should be consulted and be in attendance to advise on the feasibility of the operation and the precautions to be taken. It is essential that any crane used in this type of operation has adequate capacity over the loads to be hoisted. In general, the load should always be carried on the uphill side of the crane, irrespective of the direction of travel. The slewing lock should be engaged. Slewing should be avoided except to maintain the load in the uphill direction. Loads should always be placed on the uphill side of the crane and precautions taken so that neither the boom or jib nor crane become unstable on release of the load. Loads should always be carried as near to the surface as practicable.

Before a gradient is ascended, digging locks, where fitted on a crawler crane, should be engaged in position to prevent the crane from running backwards.

When the working location is reached, both digging locks should be engaged to prevent any movement of the crawler tracks before the clutch is shifted for travel to slew.

Avoidance of side loading on boom or jib - Booms and jibs are designed to operate with the load vertical to the axis of the boom or jib. Side loading may cause the boom or jib to collapse and should be avoided. With any side loading, the moment arm for the sideways component of the loading is the length of the boom and for very long booms this may have a serious deleterious effect on crane stability.

OPERATION NEAR OVERHEAD POWER LINES

Precautions

- When operating a crane in close proximity to aerial conductors, the following precautions ~~shall~~ should be observed by the operator and other persons working with the crane; When operating in an unfamiliar area, check for the presence of aerial conductors.
- Consider all such conductors to be live unless it is positively known that they have been de-energised and isolated. Documentary evidence of the continuing isolation of the power supply ~~shall~~ should be obtained before approaching conductors.
- The load and crane ~~shall~~ should not approach any closer than the exclusion zones specified in the following: ~~*Refer to the~~ Exclusion Zones Table at the end of this chapter.
- Notify the power supply authority and obtain special procedures from that authority when it is necessary to operate within the distances.
- Where necessary, provide ground barriers to warn operators.
- Use non-conducting taglines when these are required.
- Do not allow any person, other than the crane operator, to be in contact with any part of the crane or the load, except with a non-conducting tagline, once the lift has commenced.
- Ensure appropriate earthing systems are fitted and in contact with the ground.
- High visibility bunting may be applied to the conductors as an indication of location of the conductors.

SUSPENSIONS OF PERSONS BY CRANE

A person ~~shall~~ should not ride upon the hook or the sling of a crane or upon any load while the load is being moved. A person suspended from a crane ~~shall~~ should be accommodated in a workbox designed for the purpose.

The use of the workbox should ~~shall~~ be limited to those situations where it is necessary to elevate personnel to perform special tasks of short duration and where it is not practicable to use scaffold or a specially designed device.

Requirements for the Workbox

The workbox ~~shall~~ should:

1. ~~•~~ be a unit specifically designed as a workbox;
2. ~~•~~ be marked on two sides with:
 - a. ~~○~~ the tare weight of the workbox,

- ~~b.~~ the maximum number of occupants,
- ~~c.~~ the maximum mass which can be carried, in kilograms, and
- ~~d.~~ an identification reference;

- 3. contain no more than three persons, one of whom shall be a dogger;
- 4. be in a safe working condition;
- 5. slings shall be permanently attached to the workbox by locked shackles or other similar means;
- 6. have provisions for safety harness lanyards to be attached;
- 7. be painted in high visibility colour;
- 8. where an access door is fitted, it shall only open inwards and be provided with means to secure the door; and
- 9. only be used to lift persons and their equipment.

Note:

Where regulatory authorities have specific requirements for the construction and use of workboxes, these ~~shall~~ should be adhered to.

Requirements for the Crane Used With a Workbox

A crane used with a workbox ~~shall~~ should:

- be fitted with a safety hook;
- be equipped with controls that return to the neutral position when released and this action causes the motion to stop;
- be equipped with power lowering;
- be equipped with a lockout control to prevent free fall of the workbox and its contents;
- be fitted with an up-limit switch on the hoist motion; and
- be fitted with a down limit switch, if the workbox is to be lowered below the crane supporting surface.

Operation of the Crane with Suspended Personnel

When personnel are suspended from a crane, the crane operator ~~shall~~ should:

- remain at the controls of the crane
- ensure that all movements of the crane are carried out under power;
- ensure that at the maximum radius of the task to be performed, the crane has a minimum safe working load of 1000 kg;
- ensure that, when the jib or boom of the crane is at its maximum radius for the task to be performed, the safe working load for the crane in this condition, when divided by 2, is equal to or greater than the total load of the workbox and its contents;

- ensure that the workbox ~~shall is~~ only ~~be~~ used to lift persons and their equipment;
- ensure that at least one of the workers in the workbox is a licensed Dogger; and
- have effective means of communication with any person in the workbox; and
- ensure that mobile cranes do not travel while people are in the workbox.

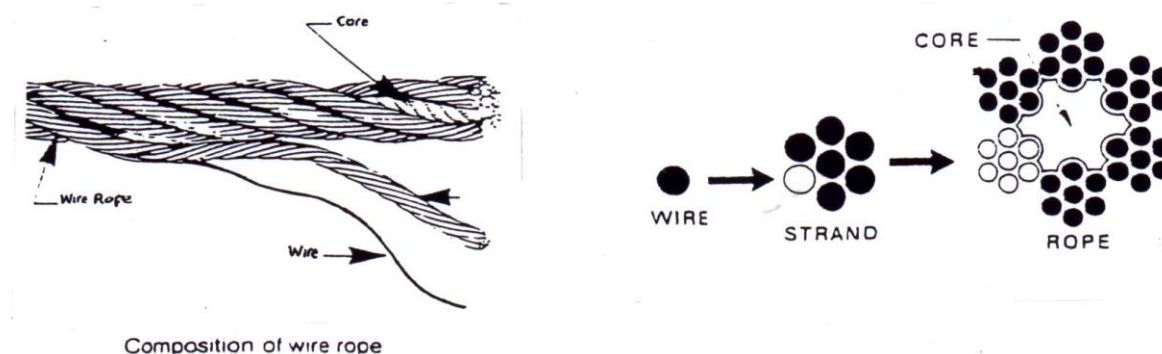
It is recommended that flammable liquids, oxyacetylene cylinders and the like, be correctly secured and housed in a compartment separate to the workbox and that only minimum quantities, sufficient to carry out the work, are carried together with a suitable fire extinguisher.

Personnel suspended from a crane ~~shall should~~ wear a general purpose safety harness complying with AS 1891, with the safety line attached to the work box.

It is not recommended that personnel exit from a workbox in an elevated position. Where this is the most practicable method and where the workbox cannot be suitably landed, it ~~shall~~ should be securely attached to the structure before personnel enter or leave the workbox. A two lanyard system should be employed by anyone exiting a workbox at height.

STEEL WIRE ROPE CONSTRUCTION

Steel wire rope (SWR) is constructed of wires and strands laid around a central core.



The most common types of cores used for SWR used in lifting applications are as follows:

Fibre Core - FC

A Fibre Core Rope is more flexible but is prone to crushing and deformation.

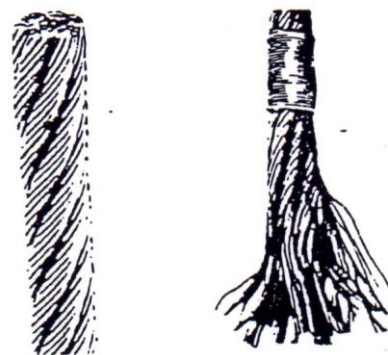
Independent Wire Rope Core - IWRC

An Independent Wire rope Core is stronger and more resistant to crushing.

Forming

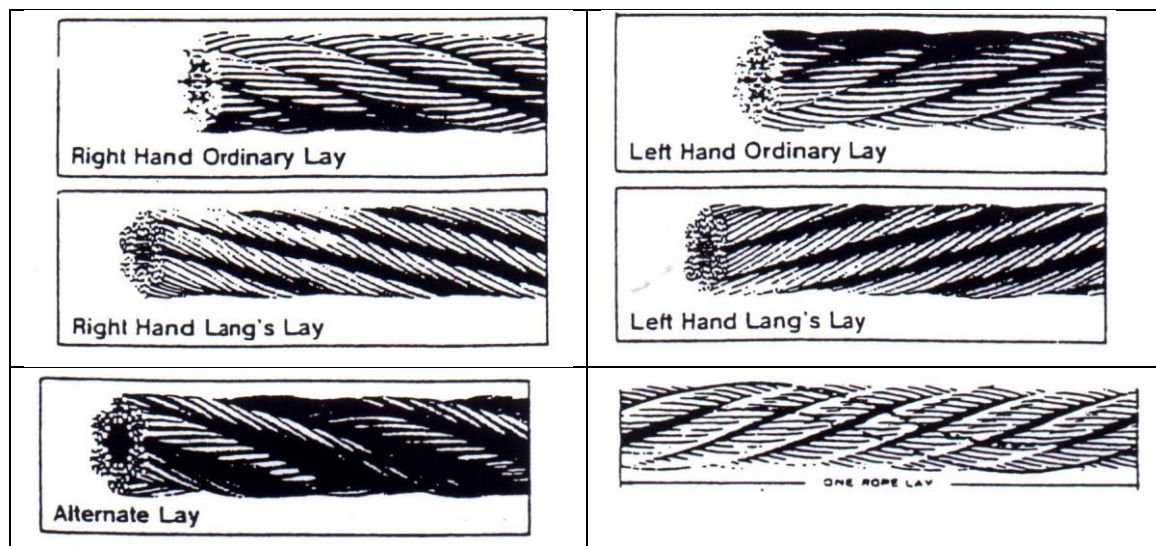
SWR are normally either preformed or non-preformed.

All crane ropes should be preformed.



Types of SWR Lays

This refers to the way the wires in the strand, and the strands in the rope are formed into the completed rope.



Inspection of Steel Wire Rope, Slings

All SWR in continuous service should be *visually* inspected once every working day. A thorough inspection of all ropes in use should be made at least once a month. Inspections should be conducted by a competent person who should inspect for the following:

Discard Factors for General Crane Hoist and Winch Ropes

- Broken Wires (No more than 10% in 8 times diameter of rope)
- Corrosion
- Kinks
- Crushed or Flattened Sections
- Bird-Caging and High-Stranding
- Damaged Thimbles
- Damaged Splices
- Stretching
- >33% Wear on Individuals Wires
- Broken Wires near Socket End
- Adjacent Broken Wires
- Heat Damage

CHAINS

Although chain is from five to six times heavier than other lifting equipment (e.g. Steel Wire Rope), it is more durable and can withstand rough handling and can be stored without deterioration.

As various types of chain are in use today, an important part of the operator's knowledge is to be able to recognise those chains that are used for lifting purposes and those that are not.

Types of Links

There are many types of chain being manufactured. It is important to recognise those best suited for lifting. ~~The most commonly encountered are:~~

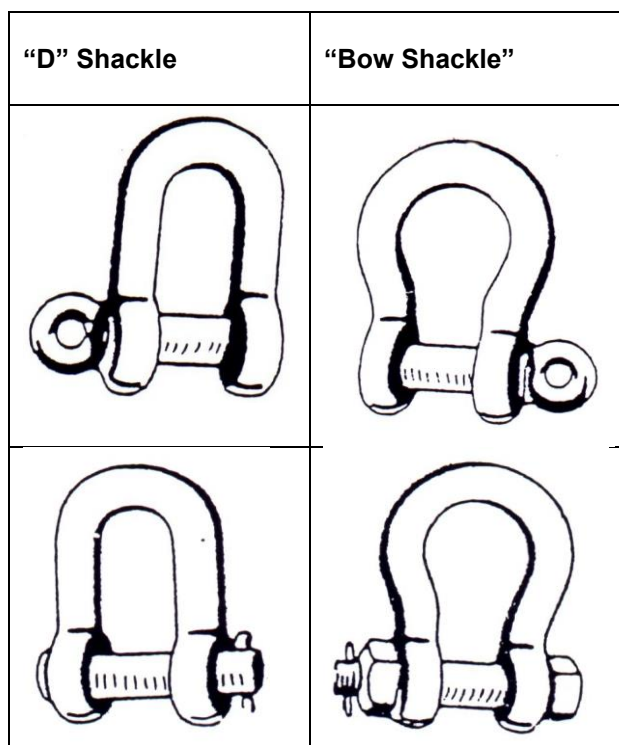
Inspection

All chains used for lifting should be inspected prior to, and after use for the following.

- Stretched links or deformation
- Rust
- Bent or deformed link
- Peen Marks (Work Harding)
- Safe Working Load Tag
- Pitting
- 10% wear on any component
- Identification markings
- Chemical attack
- Knots
- Pin Wear (Hammerlocks)
- Cracks
- Heat exposure

SHACKLES

There are two main types of shackles used for lifting purposes with five common variations. The two main shackles are:



The Screw Pin Shackle is the most commonly used shackle. This shackle has an eye in the pin so that it can be moused to prevent it from unscrewing.

The Pin and Forelock Shackle is commonly used for marine work as it has no thread to seize up from corrosion. The pin has a tapered slot at the open end to take the forelock. The slot is tapered to prevent the forelock from seizing in the hole. Some shackles have the forelock replaced by a cotter or split pin. Securing the pin in this fashion will allow the pin to turn without fear of it unscrewing.

The Countersunk Head Shackle is used where there is a chance of tackle fouling on the shackle pin head. The shackle pin is a threaded pin with a countersunk and slotted head. The shackle pin hole is countersunk to take in the pin and allow it to be tightened flush with the tackle.

The Oval or Pear shaped Pin Shackle is normally a thickened shackle used for heavy lifting. The pin is designed to fit into a pear or oval hole on either side of the shackle and secured into place with a forelock. This shape prevents the pin from turning and therefore will not disturb the load.

The Hexagonal Head Shackle is also commonly used in a corrosive environment and is normally heavily galvanised. This shackle is used where the pin may need to rotate freely and safely. The pin has a hexagonal head and the nut is screwed onto the pin and is prevented for unscrewing by a split pin passing through the shackle pin or through the nut and pin.

Inspection

Prior to use shackles should be inspected for the following;

- SWL - Without this marking a shackle cannot be used.
- 10% wear on the body or pin of the shackle.
- Correct pin for the shackle.
- Deformation.
- Cracks.
- Grade markings.

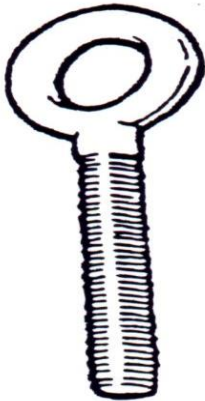
Eyebolts - General

The eyebolt is often used in low lift applications within most industries. Eyebolts due to their size strength and conditions that they are often exposed to, should be used with **due care**.

Eyebolts when used should be of a good fit and require to be tightened down until the collar is against the mating surface.

Types of Eyebolts

There are many types of eyebolts, but the two most commonly used are:

Collared Eye Bolt	Plain Eye bolt
	

Inspection of Eyebolts

Eyebolts should be inspected prior to use in lifting applications, for the following:

- Capacity of eyebolt in regard to weight to be lifted.
- Markings (either imperial or metric)
- Thread of eyebolt
 - cross threading
 - thread mismatch (imperial/metric)
 - thread condition
 - bent
- Eye and body of eyebolt
- Collar
- Cracks/Fatigue
- Nicks/Gouges
- Rust - in countersunk hole

Note: The thread of the countersunk hole on the object to be lifted should also be inspected also.

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