TLILIC0023

Licence to Operate a Slewing Mobile Crane (up to 60 tonnes)

LEARNER GUIDE

Table of Contents

1.1 Introduction

These training materials are based on the National High Risk Work Licence Unit of Competency **TLILIC0023 - Licence to Operate a Slewing Mobile Crane (up to 60 tonnes).**

You will learn about:

- Planning the job.
- Selecting and inspecting equipment.
- Preparing the site and equipment.
- Performing the task.
- Shutting down the job and cleaning up.

1.1.1 What is a Slewing Mobile Crane?

A slewing mobile crane is a crane with a boom or jib that is capable of being slewed.

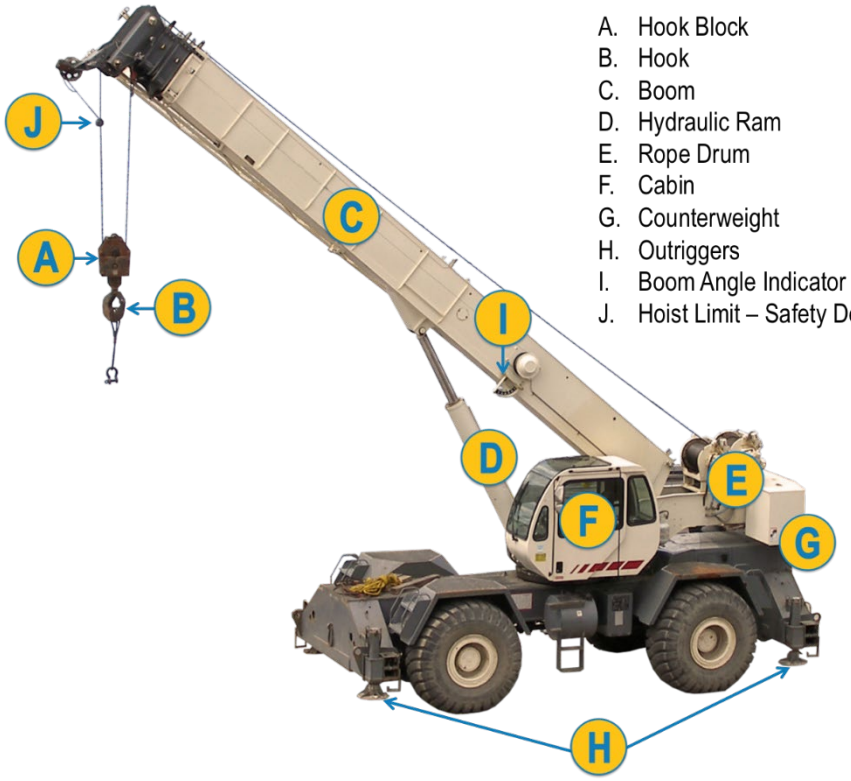
This course covers slewing mobile cranes with a capacity up to 60 tonnes.

This **does not** include:

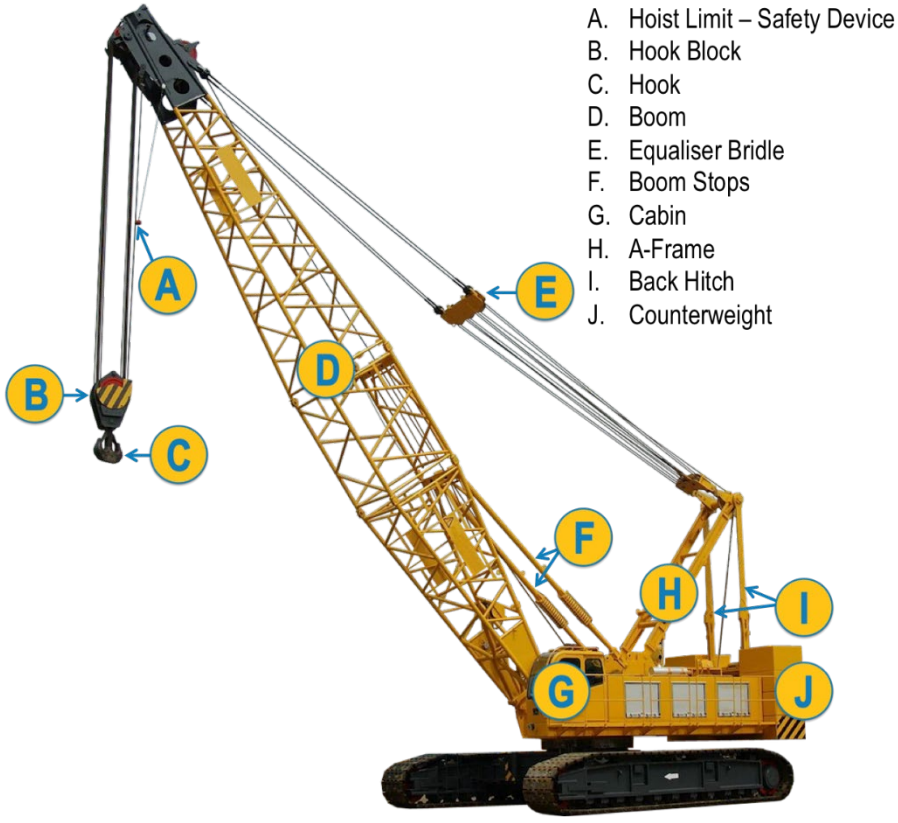
- A front-end loader; or
- A backhoe; or
- An excavator; or
- Other earth moving equipment, when configured for crane operation.

1.1.1.1 Parts of a Slewing Mobile Crane

Each slewing mobile crane is different. Always refer to the manufacturer's information before conducting any crane operations. The following diagram outlines the general parts of a slewing mobile crane.

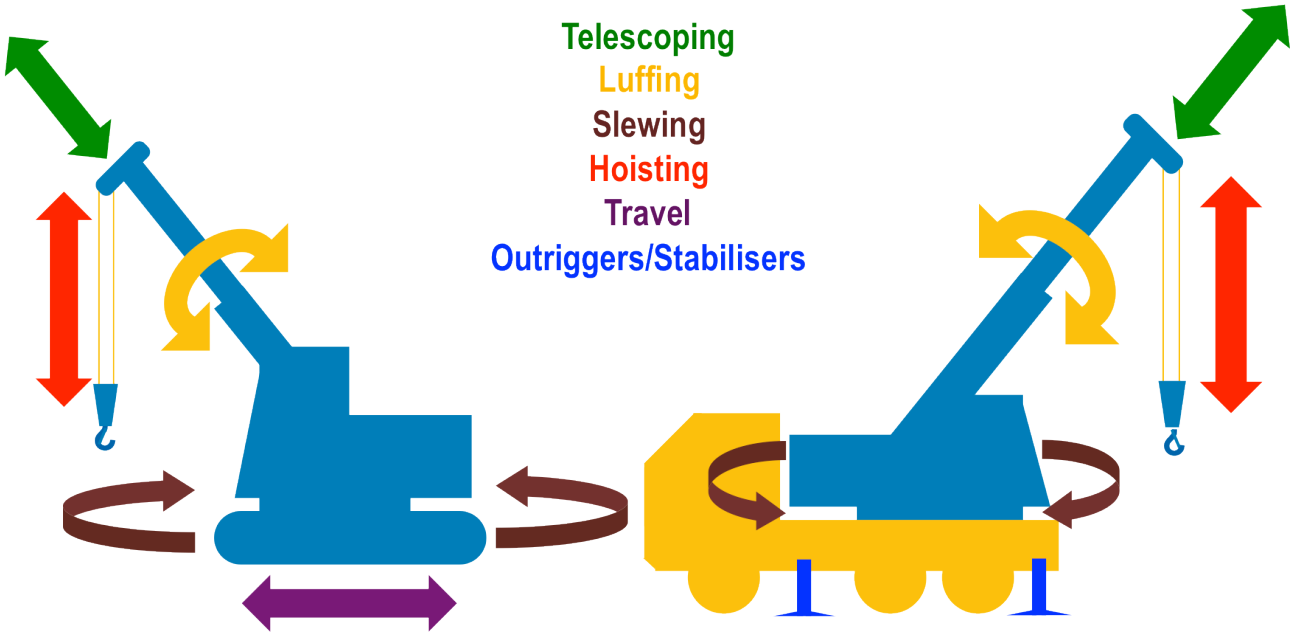


The following diagram outlines the general parts of a lattice boom type slewing mobile crane.



1.1.1.2 Slewing Crane Movements

Crane movements that you may use when shifting loads include:



- **Telescoping** – the extension and retraction movement of a hydraulic type boom.
- **Luffing** – the up and down movement of the boom.
- **Hoisting** – the raising and lowering of the hook block using the hoist rope.
- **Slewing** – the circular movement of the boom.
- **Travelling** – mobiling the crane with a load.
- Operation of **outriggers/stabilisers**.

1.2 Working Safely

You must follow all safety rules and instructions when performing any work. If you are not sure about what you should do, ask your boss or supervisor. They will tell you what you need to do and how to do it in a safe way.

1.2.1 Health and Safety Rules

Every workplace has to follow laws and rules to keep everyone safe. There are 4 main types:

Legislation	Explanation
Acts	These are laws that you have to follow.
Regulations	These explain what the law means.
Codes of Practice	These are instructions on how to follow the law, based on industry standards.
Australian Standards	These tell you what the minimum requirement is for a job, product or hazard.

Some states use OHS laws, and other states use WHS laws. They both talk about the same thing, but use different words or names for people. If you have any questions about safety rules you should talk to your boss or supervisor.

1.2.2 Duty of Care

Everybody in the workplace has a responsibility to keep themselves and others as safe as possible while they are at work. This is called a 'Duty of Care'.

Any licensed worker must take reasonable steps to make sure the way they work does not impact on the safety of themselves or any other worker. This is their legal duty of care. Your duty of care requires the following:

- To take reasonable care of your own safety and the safety of others.
- To cooperate with your employer in any way that ensures the health and safety of the workplace.
- To avoid taking unnecessary risks, acting dangerously or using workplace equipment in unsafe ways, or ways it is not designed to be used.

Failing to work safely can result in the health and safety regulator:

- Suspending or cancelling your licence.
- Refusing to renew your licence.
- Ordering that you are reassessed to ensure you are competent.
- Take legal action to prosecute you.

Your employer must take steps to ensure that the workplace is as safe as possible for you and other workers. In order to do this they can:

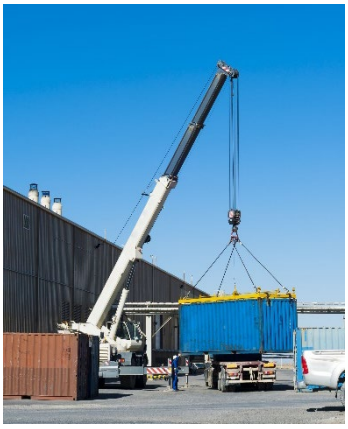
- Provide a safe workplace with minimal risks.
- Provide and maintain safe plant, equipment and structures.
- Provide and maintain safe systems/procedures for work.
- Provide facilities that are adequate for the personnel on site.
- Provide instruction, training, supervision and information for any work to be undertaken safely, **including any time you are required to use an unfamiliar piece of equipment**.
- Take action to ensure all equipment, plant & substances used on site is handled and stored in a safe way.

1.3 Planning for the Work

There will be specific requirements and things to consider when you plan for the task you will be completing.

You should think about:

- Communications (are they safe and adequate?).
- Location of the task.
- Implementation of exclusion zones.
- Permits and/or licences required for the task.
- Load configuration and conditions, weight, size of the load, slinging arrangements, method of attachment, load balance, load security (loose loads).
- Equipment required for the task.
- Availability of equipment.
- Capability/capacity of the crane.
- Safe work procedures.
- Specifics of the task.
- Issues specific to the site.



For example, if you needed to set up a crane in a busy street, you would need to check with the local authorities to see if there are any permits required for traffic control, any exclusion zones that need to be put in place, or if there are any conditions/ requirements under which you would need to operate the crane

The location of underground services should also be confirmed and planned for.

You should also check weather forecasts for the area as part of planning your job to ensure you are aware of any weather or environmental conditions that may impact the site and crane operations.

1.3.1 Work Instructions and Safety Information

All work needs to follow worksite and company safety procedures.

Procedures help to make sure that all work is done in a safe way, without damaging equipment or putting people in unsafe situations. They also help to make sure that work is done in the correct order and doesn't interrupt or get in the way of other work that is happening on the site.

Your work instructions will tell you the safest way to do the job, and the equipment that you will need to use. It is a good idea to check your work instructions with your boss or supervisor to make sure you know exactly what you need to do.

You need to be clear about what work you will be doing. Make sure you have everything about the job written down before you start. This includes what you will be doing, how you will be doing it and what equipment you will be using.

Make sure you have all of the details about where you will be working and the job. For example:

The Site

Is there clear access for all equipment? Are there buildings, structures, facilities or trees in the way? What are the ground conditions like? Is there a safe place for the load to be moved to?

The Weather

Is there wind, rain or other bad weather? Is it too dark?

Facilities and Services

Are there power lines or other overhead or underground services to think about?

Traffic

Are there people, vehicles or other equipment in the area that you need to think about? Do you need to get them moved out of the area? Do you need to set up barriers or signs?

Hazards

Are there dangerous materials to work around or think about? Will you be working close to power lines or other people?

The Task

What load is being moved? How big is it? How much does it weigh? Does it need any special lifting arrangements?

Instructions for the task can include:

- Manufacturer's guidelines (instructions, specifications, checklists).
- Industry operating procedures.
- Workplace procedures (work instructions, operating procedures, management plans, safety policies, checklists).

If you don't know where to get your instructions or you can't understand them, you can ask your boss or supervisor. They will tell you where to find your work instructions and explain what they mean.

You can also speak with your WHS workplace representative for more information about workplace safety.

1.3.1.1 Lifting Plans

Before starting the work, you will need to plan the job. This usually includes completing a Lifting Plan.

A lifting plan should include:

- Confirmed details of lifting and slinging requirements.
- Confirmed dimensions and mass.
- Site access and egress.
- Suitability and availability of materials.
- Tools and equipment.
- Identification of potential hazards.
- Probable control measures.
- Identification of site coordination requirements.

Shown here is an example of a lifting plan template:

LIFTING PLAN

Date:

Work location:	
Load description:	
Load dimensions:	
Load weight:	
Load location:	
Load destination:	

Lifting device:	
Lifting gear in use:	
Rigging configuration:	
Licensed Dogger/Rigger:	
Other personnel:	

Hazards identified:	
Controls to be implemented:	

Task plan:	*Step-by-step process of how the lift will be conducted and schedule of lifts.*
Tools & Equipment required:	
Communication method:	

Plan checklist:	❑ Is the exact weight of the load known and confirmed? ❑ Is the lifting device suitable for the lift (rated capacity)? ❑ Has equipment been checked and cleared for use? ❑ Have drawings and sketches been completed? ❑ Has a risk assessment been conducted?

Approval signoff:	

You will need to speak with other personnel on site while putting together the plan so that you can organise coordination requirements and hazard control measures.

Once you have completed your preliminary lifting plan in accordance with procedures and site requirements you will need to confirm that the job can be carried out the way you have planned. This is called confirming the job feasibility.

Confirming the job feasibility includes:

- Checking with any other personnel involved in the work to make sure they are:
  - Available.
  - Experienced, competent and qualified.
  - Aware of the requirements of the job and the lifting equipment that is available.

- Organising to contact:
  - The load designer.
  - Site management.
  - Suppliers.

The load designer is the person who determines the best way to pack and unpack items from a truck, pallet or container. They work out how items will fit together in the best way, as well as making sure the load is properly balanced.

You may need to speak to the load designer to make sure you:

- Unload items in the correct order.
- Load items correctly.

The load designer may also have information about:

- The load weight or size.
- The weight distribution for the load.

Speak with your supervisor once you have completed your plan to make sure it is achievable in the timeframe available to you.

1.3.2 Traffic Management Requirements

On worksites it is often necessary to control the movement of traffic around and through the site. To do this there are 2 different types of traffic management plans:

- **Traffic Management Plan** – deals with traffic moving through the site, i.e. traffic on public roads and members of the public.
- **Vehicle Management Plan** – deals with on-site vehicle movements, haul circuits and dump runs, and material routes.

As part of planning your work you need to confirm that the traffic management plan has been implemented according to workplace procedures.

1.4 Identify Hazards to Control Risks

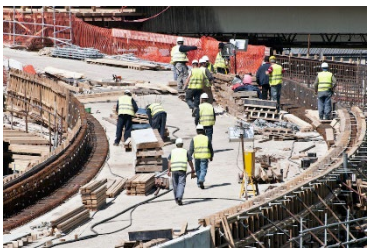
Before you start work, you need to check for any hazards or dangers in the area. If you find a hazard or danger you need to do something to control it. This will help to make the workplace safer.

Part of your job is to look around to see if you can find any hazards before you start any work.

A **hazard** is the thing or situation with the potential to cause injury, harm or damage.

When you start checking for hazards, make sure you look everywhere. A good way to do this is to check:

- **Up high** above your head.
- All around you **at eye level**.
- **Down low** on the ground (and also think about what is under the ground).



Some common hazards related to slewing mobile crane operations include:

- Overhead hazards such as power lines, service lines, and service pipes.
- Underground services.
- Ground surfaces and conditions including:
  - Surfaces that may not bear the weight of the crane or other equipment.
  - Recently filled trenches.
  - Slopes.
- Bad weather conditions such as strong winds, lightning or storms.
- Insufficient lighting/lack of illumination.
- Vehicle traffic.
- Plant and equipment.
- Pedestrians and workers.
- Site specific hazards such as dangerous materials.
- Trees.
- Buildings, facilities and other surrounding structures.
- Obstructions or obstacles.
- Unusual or difficult terrains.

1.4.1 Consulting with Other Workers about Hazards and Risks

Controlling a hazard can be a team effort and it's important that everybody knows what they need to do and how or if they need to change their work process to suit.

You should also speak with several personnel on site when preparing for work including:

- Safety officers.
- Site engineers (where applicable).
- Supervisors.
- Other workers.
- Managers who are authorised to take responsibility for the workplace or operations.
- Health and Safety Representatives.
- Work Health and Safety Committee members.

These people can help you to identify workplace specific hazards including unsuitable ground conditions and appropriate controls. It is important to speak with them to ensure that all workplace policies and procedures are being followed as well.

1.4.2 Assess Risks

Once you have identified the hazards on site or related to the work you will be doing you may be required to assess their risk level.

A **Risk** is the chance of a hazard causing harm, injury, damage or death.

Risk levels are worked out by looking at 2 factors:

Consequence	How bad will it be if the hazard causes harm?
Likelihood	What is the chance of the hazard causing harm?

You can use a table like the one shown here to work out the risk level:

	Consequence				
Likelihood	**1. Insignificant**	**2. Minor** First Aid Required	**3. Moderate** Medical Attention and Time Off Work	**4. Major** Long Term Illness or Serious Injury	**5. Catastrophic** Kill or Cause Permanent Disability or Illness
1. Rare	Low	Low	Moderate	Moderate	Moderate
2. Unlikely	Low	Low	Moderate	Moderate	High
3. Possible	Low	Moderate	High	High	Extreme
4. Likely	Moderate	Moderate	High	High	Extreme
5. Almost Certain	Moderate	High	High	Extreme	Extreme

For example, a hazard that has a **Major** consequence and is **Almost Certain** to occur has a risk level of **Extreme**.

	Consequence				
Likelihood	**1. Insignificant**	**2. Minor** First Aid Required	**3. Moderate** Medical Attention and Time Off Work	**4. Major** Long Term Illness or Serious Injury	**5. Catastrophic** Kill or Cause Permanent Disability or Illness
1. Rare	Low	Low	Moderate	Moderate	Moderate
2. Unlikely	Low	Low	Moderate	Moderate	High
3. Possible	Low	Moderate	High	High	Extreme
4. Likely	Moderate	Moderate	High	High	Extreme
5. Almost Certain	Moderate	High	High	**Extreme**	Extreme

The risk level will help you to work out what kind of action needs to be taken, and how soon you need to act.

The table below is an example of a site risk policy:

Risk Level	Action
Extreme	**This is an unacceptable risk level** The task, process or activity **must not proceed**.
High	**This is an unacceptable risk level** The proposed activity can only proceed, provided that: **1.** The risk level has been reduced to as low as reasonably practicable using the hierarchy of risk controls. **2.** The risk controls must include those identified in legislation, Australian Standards, Codes of Practice etc. **3.** The risk assessment has been reviewed and approved by the Supervisor. **4.** A Safe Working Procedure or Work Method Statement has been prepared. The supervisor must review and document the effectiveness of the implemented risk controls.
Moderate	**This is an unacceptable risk level** The proposed activity can only proceed, provided that: **1.** The risk level has been reduced to as low as reasonably practicable using the hierarchy of risk controls. **2.** The risk assessment has been reviewed and approved by the Supervisor. **3.** A Safe Working Procedure or Work Method Statement has been prepared.
Low	The proposed task or process needs to be managed by documented routine procedures, which must include application of the hierarchy of controls.

The action you take will depend on:

- The organisation's policies.
- The worksite's procedures.
- Relevant laws and regulations.

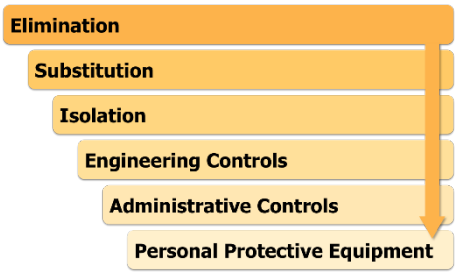
1.4.3 Control Hazards

The best way to control hazards is to use the Hierarchy of Hazard Control. The Hierarchy of Hazard Control is the name given to a range of control methods used to eliminate or control hazards and risks in the workplace.

You start at the top of the list and see if you can take away (eliminate) the hazard or danger.

If you can't take it away you move down the list to see if you can swap it for something safer (substitution).

Keep working through the list until you find something that controls that hazard or danger.



This table shows you the 6 different types of controls in order from best to worst:

Hierarchy Level	Action
1. Elimination	Completely remove the hazard. This is the best kind of hazard control.
2. Substitution	Swap a dangerous work method or situation for one that is less dangerous.
3. Isolation	Isolate or restrict access to the hazard.
4. Engineering Controls	Use equipment to lower the risk level.
5. Administrative Controls	Site rules and policies attempt to control a hazard.
6. Personal Protective Equipment	The least effective control. Use PPE while you carry out your work.

Hazard control measures need to be put in place before you start your work, or as soon as you see a hazard while you are doing your work. Hazard controls can sometimes be listed in your work instructions or you can ask your boss or supervisor for help.

Talk to the other workers in the area to make sure they are aware of the control measures you have put in place.

Once a hazard control is in place you will need to check to make sure it is working well to control the hazard or danger.

Talk to your supervisor or safety officer if you are not sure if it is safe enough to carry out your work. If you think the hazard is still too dangerous you should not try to do the work.

1.4.3.1 Personal Protective Equipment

Personal Protective Equipment (PPE) is clothing and equipment designed to lower the chance of you being hurt on the job. It is required to enter most work sites.

As a minimum, a person involved in crane operations must wear personal protective clothing such as:

- A safety helmet (hard hat).
- Safety boots/footwear.
- High-visibility clothing.

Other PPE includes:

- Gloves.
- Safety goggles/glasses.
- Reflective vest.
- Relevant breathing apparatus.
- Hearing protection.
- Skin and sun protection.
- Any other items required by the site.

All safety equipment such as PPE should be selected and inspected while the work is being planned and before any work is started.

Make sure any PPE you are wearing is in safe working condition and is suitable for the job.

If you find any item of PPE that is not in serviceable condition, tag it and remove it from service. Report the fault to your supervisor who will organise the repair or replacement of the PPE.

1.4.3.2 Working Near Power Lines

Working near power lines (also called electric lines) can be dangerous if you are not careful.

It is very important that you know the safe operating distances for different types of power lines and the steps you must take if your job needs you to work closer than the safe distances.

Generally, if you need to work closer than the safe work distance you must:

- Contact the local electrical authority for permission to work closer (this is called an exemption or access permit).

- Have the power lines shut off. If this is not possible then have the power lines insulated by the electrical authority.

- Use a spotter (depending on local laws and rules).

Distances are different depending on the state or territory you are working in and the voltage of the power lines. You should check with the authority responsible for the power lines for information and advice to find out the voltage of power lines in your work area.

Queensland

The Queensland Electrical Safety Regulation breaks down the distances in detail. Exclusion zones are broken down not only by size of power line but also by the competency level of the operator. This means that the requirements should be clarified with the electrical authority before work commences even if the distance appears to be outside the zones.

The following minimum distances are provided as guidance:

Power Line Type	Distance
Up to 132kV	3.0m
132kV up to 330kV	6.0m
330kV and above	8.0m

New South Wales

In New South Wales, for anyone who is not accredited, equipment operation may not be any closer than the following distances to power lines:

Power Line Type	Distance
Up to and including 132kV	3.0m
Above 132kV up to and including 330kV	6.0m
Above 330kV	8.0m

To work closer than these distances requires authority from the relevant electrical authority and adherence to cl.64(2)(e) of the regulations.

Australian Capital Territory

In the ACT mobile plant operators and persons erecting or working from scaffolding must maintain a safe minimum distance to power lines as outlined in the table below:

Power Line Type	Distance
Less than 33kv	4.0m
33kV or more (transmission lines)	5.0m

Victoria

In Victoria the Framework for Undertaking Work Near Overhead and Underground Assets states that equipment must not be closer than the following distances to power lines:

Power Line Type	Distance
Distribution lines up to and including 66kV (power poles)	6.4m (or 3.0m with a qualified spotter)
Transmission lines greater than 66kV (towers)	10m (or 8m with a qualified spotter)

Tasmania

In Tasmania equipment must not be closer than the following distances to power lines:

Power Line Type	Distance
Up to and including 133kV (poles)	6.4m (or 3m with a safety observer)
Greater than 133kV (towers)	10m (or 8m with a safety observer)

South Australia

In South Australia mobile plant operators and persons erecting or working from scaffolding must maintain a safe minimum distance to power lines as outlined in the table below:

Power Line Type	Distance
Up to 132kv (including 132kv poles)	6.4m (or 3.0m with a spotter)
132kv or more (including 132kv towers)	10.0m (or 8.0m with a spotter)

Western Australia

In Western Australia this falls under Regulation 3.64 from the OSH Regulations and states the following as the minimum distances:

Power Line Type	Distance
Up to 1kV (insulated)	0.5m
Up to 1kV (uninsulated)	1.0m
Above 1kV and up to 33kV	3.0m
Above 33kV	6.0m

Northern Territory

In the Northern Territory equipment must not be closer than the following distances to power lines:

Power Line Type	Distance
Up to and including 132kV (distribution lines)	6.4m (or 3m with a spotter)
Greater than 132kV (transmission lines)	10m (or 8m with a spotter)

Power Line Visual Indicators

There are a range of different indicators in use across the country to identify the position of overhead power lines.

Important: Visual indicators **DO NOT** insulate the power lines so exclusion zones and safe operating distances must still be used, even when any of these systems are in use.

Tiger Tails and Coloured Markers
Tiger tails or coloured markers are used to clearly show the location of overhead power lines. Poles may also be coloured up to 3m from the ground.

Marker Balls or Flags
Marker balls are fixed to the power line and are often red or another bright colour.

Safety, Warning and Danger Signs
Signage may also be present to warn of overhead power lines and services.

1.4.3.3 Task-Specific Control Strategies

Some examples of risks/hazards and their possible controls include:

Situation:
A person or object near the chassis or outriggers of a slewing crane.

Hazard:
- The person or object could be hit or crushed by the crane and/or load when it is moving.

Control:
- Exclusion zones.

Situation:
Retracting/folding a boom.

Hazard:
- Someone being trapped, struck or crushed by the boom.
- Someone being hit by the boom or load.

Controls:
- Placing the operator safely out of the entrapment/exclusion zone.
- Setting up barricades to make sure all other people (pedestrians, workers) are clear of the hazardous area.

Situation:
Working near pedestrians or site personnel, or other mobile plant or vehicles.

Hazard:
- Hitting or crushing a person with the crane or load, or hitting other plant or vehicles.

Controls:
- Pedestrian/vehicle exclusion zones.
- Warning signs.
- Protective barriers.
- Flashing hazards lights (only if they don't impair the crane operator's vision).
- Traffic control (e.g. a flag person).
- Gantries.
- Hoardings.

Exclusion Zones

Exclusion zones separate the crane operations from other workers, plant and structures on the site or in the immediate work area. This includes the areas around the crane and load, as well as the lift, slew and travel areas.

1.4.4 Apply Hazard Control Measures

Hazards controls need to be applied before any work is started, or as soon as a hazard is identified if it is identified during crane operations.

Hazard controls may include:

- Safety tags on electrical switches/isolators.
- Insulated power lines.
- A safety observer used inside an exclusion zone.
- Disconnected power.
- Adequate illumination/lighting.
- Traffic and pedestrian barricades and controls.
- Trench covers.
- Movement of obstructions.
- Personal protective equipment (PPE).

Other or different controls may be specified in your work instructions or site procedures.

1.4.4.1 Lighting the Work Area

If the crane work is being carried out at night or in a darkened area, there must be adequate temporary lighting in place for the work to begin.

The entire work area must be sufficiently lit up to ensure the work can be carried out safely.

1.5 Check the Path of Movement

When planning your work check the path of movement for the crane and load for any obstructions. This is to make sure that you have identified all hazards in the path of movement and put effective control measures in place.

When checking the path of movement think about:

- The size (dimensions and mass) and type of load.
- Dimensions of the crane including the radius of the boom.
- The surface condition and suitability of the pickup and landing sites.
- Overhead power lines.
- Underground services.
- Communication arrangements with the dogger.
- Preventing pedestrians and workers accessing the pathway.
- If there is a need for spotters/observers.
- The distance and speed of travel and the direction of travel.
- Any obstructions, including:
  - Equipment.
  - Materials.
  - Other vehicles, plant and people.
  - Building and other structures.
  - Overhead power lines.

Always decide on the path of movement for a load during your planning, before you move the load.

1.5.1 Load Destination Checks

Make sure that the load destination is tidy and ready to receive the load. Check that the load will be supported by the load destination. For example, if placing the load onto a concrete floor use site information gained from engineers or consult with authorised site personnel.

You may need to organise for the setup of blocks or chocks to keep the load stable once it is lowered and to allow personnel to safely remove the lifting gear without it being damaged or crushed by the weight of the load.

You will also need to check that there is safe access for walking and unpacking the load.

If the load is to be placed on a Cantilevered Crane Loading Platform (CCLP) it is important that you ensure the CCLP is capable of supporting the load.

This can be done through checking the load limit or rated capacity (normally marked on the platform).

If the CCLP is not marked you should seek advice from the manufacturer.

1.6 Communications

As a crane operator you need to be able to communicate effectively with those around you while you work. This may include workers such as doggers and riggers.

It is important that you are able to understand all the instructions necessary to use all relevant equipment safely.

These can include:

- Manufacturer's guidelines (instructions, specifications, checklists).
- Industry operating procedures.
- Workplace procedures (work instructions, operating procedures, checklists).

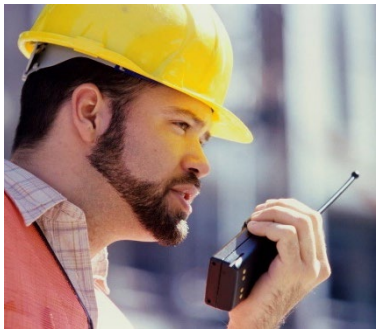
Select appropriate communication methods while planning and preparing for crane operations, before work is started.

Communication methods may take the form of:

- Verbal and non-verbal language.
- Listening.
- Questioning to confirm understanding.
- Written instructions.
- Signage.
- Making and interpreting hand signals.
- Bells, buzzer and whistle signals.
- Use of communication equipment such as fixed channel two-way radios.
- Appropriate worksite protocols.

Effective communication is important because you need to be able to consult with other workers at different stages of the work to make sure that you are following the lift plan and site and workplace procedures.

Choosing the most appropriate communication method for the job will depend on the specific circumstances you may encounter during operations.



For instance, if the crane operator remains constantly in view of the person dogging the load then hand signals would be an effective communication method. If however the load is not always going to be in sight of the crane operator then whistle signals could be employed.

Fixed channel two-way radios can be used when they are going to prove more effective than other methods.

They are particularly useful when the operator is out of view of the load and whistle signals could not be heard or would prove confusing due to other crane operations in the area.

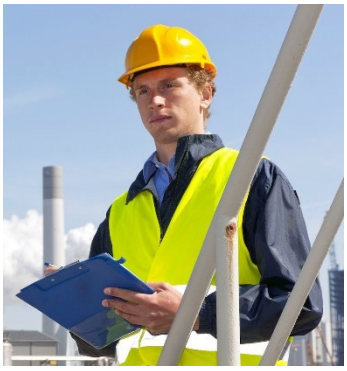
2.1 Load Assessment

Part of putting together a job plan includes assessing the load itself. Different types of loads will have different requirements for safe lifting.

The person who slings the load (a person holding a dogging licence) is responsible for establishing the weight of the load that is to be lifted.

The crane operator is responsible for communicating with the person slinging the load and giving them appropriate information such as the capacity of the crane that is to be used.

By identifying the weight of the load you will be able to properly assess whether or not the crane will be able to shift the load and the limitations of operation for the crane.



It is extremely dangerous to attempt to lift a load of unknown weight – you could cause structural damage to the crane and damage to the lifting gear and load.

You can determine the weight of a load a number of ways. These include:

- Checking with the driver who delivers the load. The weight may be marked on the delivery docket (consignment note) or on a weighbridge certificate.
- Checking the load itself. The weight may be marked on the load or the packaging it arrives in.
- Weighing the load.
- Estimating the weight of the load through appropriate calculations.

2.1.1 Common Loads

The table below lists the weights of common loads:

Material	Weight
Aluminium	2.7t per cubic metre
Bricks	4.0t per 1000 bricks
Bronze	8.5t per cubic metre
Cast Iron	7.2t per cubic metre
Cement (25 bags)	1.0t
Clay	1.9t per cubic metre
Coal	864kg per cubic metre
Concrete / Cement	2.4t per cubic metre
Copper	9.0t per cubic metre
Earth	1.9t per cubic metre

Material	Weight
Granite	2.6t per cubic metre
Gypsum	2.3t per cubic metre
Iron, ore	5.4t per cubic metre
Lead	11.2t per cubic metre
Mild Steel	7.85t per cubic metre
Poly Pipe	1.1t per cubic metre
Timber (hardwood)	1.1t per cubic metre
Timber (soft)	0.6t per cubic metre
Water	1.0t per cubic metre

2.2 Choose the Right Crane for the Job

Part of planning the job is to check that the crane will be able to shift the load safely. This means you need to check the capability and limitations of the crane.

When choosing the right crane or cranes for the job it is important to take into account:

- Environmental conditions you are going to work under including weather and ground conditions.
- Size of work access points.
- Number and frequency of lifts.
- Weights and dimensions of loads.
- Maximum height and radius of lifts.
- Procedure for the movement of loads (e.g. lifting only, mobiling).

Refer to the manufacturer's specifications, crane chart and range diagrams to see if the crane is appropriate for the job.

You will be able to use this information to configure the crane for operation.

2.2.1 Select Lifting Gear

The load and working environment will determine the type of lifting gear that you need to use. Lifting gear includes all equipment associated with the lifting and moving of the load from the hook down.

Mark in your plan the lifting gear that will be used along with the details of how it will be applied to control the load during the lift.

Lifting gear includes:

- Chains.
- Slings.
- Shackles.
- Beams.
- Clamps.
- Other attachments that can be used to lift or secure a load.

When assessing the lifting gear needs you will also need to consider whether the load requires packing and dunnage.

The use of packing, padding, lagging, edge protection, dunnage and corner pads can protect the lifting gear from sharp corners on a load and increase the safety of the lift.

Packing protects the load and lifting gear from damage during the lift, and also allows for safer attachment and detachment of the lifting gear.

It is important that the correct lifting gear is selected for each load that you are lifting. Here are some examples:

Load Type	Suggested Lifting Gear
A pallet of bricks	A brick or block cage.
Steel plates	Plate or lifting clamps.
A single gas bottle	A suitable stillage or lifting box that ensures the load is stable and secure.
A load of loose pipes	Suitable stillage, pallets or slings.
Pre-cast panels	Lifting clutches.
A timber truss	Lifting beam and/or long sling or wire.
A load that is easily damaged	Synthetic webbing slings.
A bulky load or a load with uneven weight disbursement	Lifting beam.

It is extremely important that all lifting gear is inspected before use to ensure that all items are safe to use and are appropriate for the task. A licensed dogger is responsible for the inspection of lifting equipment.

Accurate records of all checks and maintenance that is carried out need to be kept. Most sites have workplace forms, logbooks or checklists for writing down details of all equipment maintenance work. They are used to record the history of the equipment so that all operations and any problems can be monitored. They are also a way of making sure that all repairs and maintenance are done correctly and on time.

Equipment is often tagged to let you know that it has been checked by an experienced and authorised person and is safe to use. Some organisations use a range of tags in different colours to identify the time that a piece of equipment was last checked.

2.2.2 Flexible Steel Wire Ropes

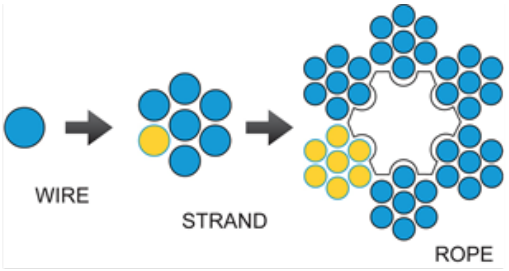
There are two principle grades of flexible steel wire rope (FSWR):

- **Grade 1570** – This rope is galvanised in appearance and usually has a fibre core.
- **Grade 1770** – This rope is blackish in appearance and usually has an independent wire core.

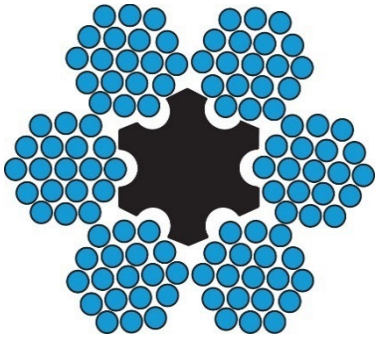
The smallest diameter of FSWR that can be used for lifting purposes is 6mm.

The maximum temperature exposure for fibre core FSWR is not to exceed 95°C.

FSWR is constructed of wires and strands laid around a central core.



In the example below there are 19 wires to the strand and 6 strands around the core making up the rope:



It is important not to confuse wires and strands. If a strand is broken, the rope is unusable. A single broken wire in a sling is not as important unless broken immediately below a metal fitting or anchorage.

FSWR slings are available in a number of different configurations including:

- Soft eye.
- Thimble eye.
- 2-leg sling.
- 4-leg sling.
- Open swage socket.
- Closed swage socket.
- Hook captive.
- Master link captive.

2.2.2.1 Inspection Criteria for FSWR

If a FSWR shows any of these then it is unsuitable for lifting.

Possible FSWR defects:	
Missing or illegible rated capacity tag.	Abrasion wear.
Bird-caging (strands loosened from proper tight lay).	Stretched or overloaded FSWR.
Severe kinking or fractures from bending or reeving.	Knotted FSWR.
More than 10% wear in the rope diameter.	Core collapse.
Crushed/damaged strands.	High stranding.
Splice, ferrule, eye or thimble damage.	High temperature exposure.
Severe/serious corrosion (indicated by loose and springy wires).	
Excessive number of broken wires. (Not to exceed 10% of the total number of wires in the FSWR over a distance of not more than one rope lay – where one rope lay is approximately 8 x the diameter of the FSWR). E.g. 10mm diameter. 6/19 FSWR – 6 x 9 = 114 wires 114/10 = 11.4 = 11 wires 11 Broken wires over a distance of 8 x 10mm = 80mm	

If any of these are present then the **FSWR MUST NOT BE USED!**

2.2.2.2 Rated Capacity of FSWR

The rated capacity of a sling is the maximum load limit that may be lifted by that sling during a straight lift.

Calculate the Rated Capacity of FSWR

To calculate the rated capacity in kilograms of FSWR, square the rope diameter (D) in millimetres (mm) and multiply by 8.

For example:

Rope diameter = 12mm

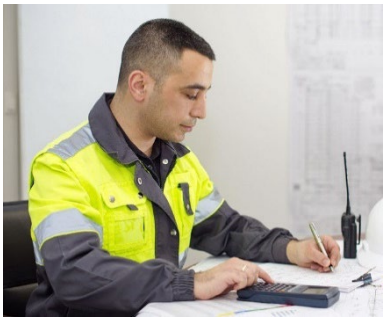
Rated Capacity (kgs) = D^2 (mm) x 8
= D (mm) x D (mm) x 8
= 12 x 12 x 8
= 1,152 kg

Therefore:

Rated Capacity (t) = 1.15 tonnes

Calculate the Required Diameter of FSWR

The above equation can be reversed to calculate the diameter (D) in millimetres of FSWR needed to lift a given load. To do this, divide the load (L) in kilograms by 8 and find the square root of the result.



For example:

Load = 1,152 kg

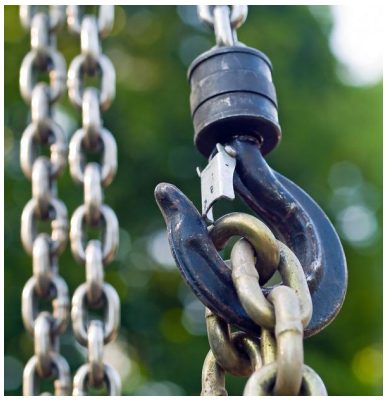
Diameter of FSWR (mm) = √(1,152 / 8)
= √144
= 12 (mm)

Therefore:

A FSWR sling of at least 12 mm in diameter is needed to lift a 1,152 kg load for a straight lift.

2.2.3 Chains

Lifting chains and chain slings are marked with different letters. These letters tell you what grade the chain is:



- Grade 30 (L) = 30(L) or 30 or 3. This is the minimum grade chain used for safe lifting of loads.
- Grade 40 = M or 40 or 4 or 04 (High tensile chain).
- Grade 50 = P or 50 or 5 or 05.
- Grade 60 = S or 60 or 6 or 06.
- Grade 80 = T (Higher tensile/High grade Herc-Alloy chain used extensively for all load lifting uses).
- Grade 100 = V (Very high tensile chain – Usually pink in colour).

The following types of chains MUST NOT be used for lifting a load:

- Wrought iron chain.
- Grade 75 (transport lashing chain).
- Proof coil chain.
- Approved grade chains under allowable diameter.
- Mild steel chain.

Lifting chain is proof-tested short link chain. The barrel of short link chain requires a greater force to bend, provides greater strength, reduces the tendency to twist and provides better reeving performance.

Grade markings or letters denoting the grade are stamped or embossed on the chain at least every metre or every 20 links, whichever is less.

Grade 80 (T) chain is the minimum grade of chain that can be used for general load lifting uses, such as wrapping and reeving.

2.2.3.1 Inspection Criteria for Chains

If a chain shows any of these then it is unsuitable for lifting.

Possible Chain Defects:	
Missing rated capacity tag.	Twists and/or kinks and/or knots.
Cracks in link welds, spot-welding.	Stretching, locked, movement restricted.
Exposure to excessive heat.	Gouged/cut more than 10% of original link diameter.
Pitting.	Severe/excessive rust or corrosion.
Squashed/crushed more than 10% of original link diameter.	
Excessive wear on chain (over 10% wear in link diameter).	

If you are using sling shorteners you must ensure they do not have more than 10% wear. More than 10% wear condemns them for use and they must not be used.

If any of these are present then the chain **MUST NOT BE USED!**

Chain slings should be made up to AS 3775 Chain slings–Grade T or the manufacturer's recommendations. When ordering parts for chain slings, ensure that they comply with the appropriate Standard.

The manufacturer's tag must be fixed on all chain slings. The tag must detail the rated capacity of the sling under all conditions and configurations of use.

If you cannot find a legible manufacturer's tag the chain sling should be taken out of service, in line with safe work procedures.

2.2.3.2 Rated Capacity of Chain

The rated capacity of chain is determined by the grade (G).

Do not use a chain to lift if it does not have a manufacturer's tag that gives details of the rated capacity. Return it to the manufacturer for rated capacity assessment and retagging.

Calculate the Rated Capacity of Grade 80 Chain

To calculate the rated capacity of 80 grade lifting chain in kilograms, square the diameter (D) in millimetres (mm) and multiply by G (grade of chain) by safety factor (0.4 for Grade 80 chain).

For example:

Chain diameter = 10mm
Chain Grade = 80 (T)

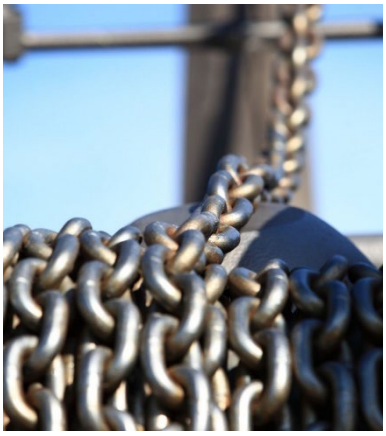
Rated Capacity (kgs) = D^2 (mm) x 80 x 0.4
= D^2 (mm) x 32
= D (mm) x D (mm) x 32
= 10 x 10 x 32
= 3200 kg

Therefore:

Rated Capacity (t) = 3.2 tonnes

Calculate the Required Diameter of Grade 80 Chain

The previous equation can be reversed to calculate the diameter (D) in millimetres of chain needed to lift a given load. To do this, divide the load (L) in kilograms by G multiplied by safety factor and find the square root of the result.



For example:

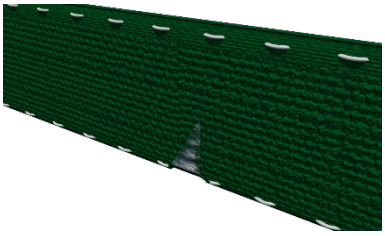
Chain Load = 3200 kg
Chain Grade = 80 (T)

Diameter of Chain (mm) = √(Load (kg) / (80 x 0.4))
= √(3200 kg / 32)
= √100
= 10 mm

Therefore:

A Grade 80 (T) chain, 10 mm in diameter, is needed to lift a 3200 kg load for a straight lift.

2.2.4 Synthetic Webbing Slings



Flat webbing and round synthetic slings are used for lifting where it is necessary to protect the load from damage and for protection from electrical hazards.

They are made from nylon, polyester, polypropylene or aramid polyamide. Each sling must be labelled with their rated capacity.

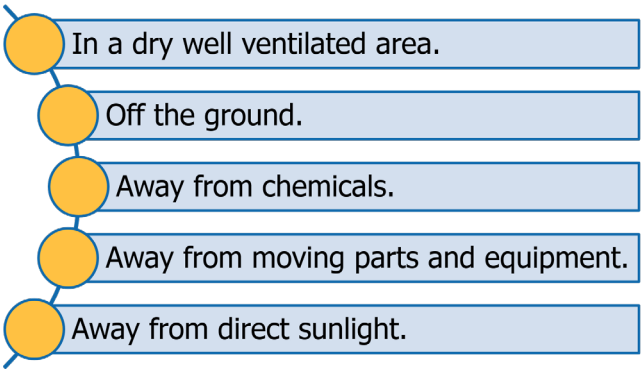
Ensure that synthetic web slings are not twisted when being used to support or lift loads, as this will decrease the rated capacity of the sling.

Round synthetic slings are one of the most DANGEROUS types of lifting sling available to doggers and riggers. This is mainly because the fibres inside the sling do the lifting instead of the outside webbing sleeve.

This is dangerous because you cannot see the condition of the internal fibres. Therefore, it is extremely important that these types of slings are checked thoroughly for cuts, burn marks and tears on the outer sleeve.

You should only ever use round synthetic slings for round loads or loads with edges that have been packed with soft packing materials, e.g. car inner tube or carpet.

Synthetic webbing slings must be stored:



Synthetic slings are colour coded, however you must always go by the rated capacity tag and not rely on the marking or colour coding.

The tag should display:

- The rated capacity.
- Angle factors.
- Reeve factors.
- Manufacturer.
- Grade/applications.
- Conditions of use.
- Inspection date.
- Year of manufacture.
- Serial number.

2.2.4.1 Inspection Criteria for Synthetic Slings

If a synthetic sling shows any of these then it is unsuitable for dogging and should be tagged, separated from usable equipment and reported to the appropriate person.

Possible Synthetic Sling Defects:	
Missing or illegible Rated Capacity tag.	Damage to stitching.
Stretched or damaged sleeve.	Burn marks on outer sleeve.
Cuts, tears or contusions in outer sleeve.	Damage from temperature or sunlight exposure.
Broken fibres/strand (internal wear). You can usually feel a soft lump on the inside of the sleeve.	
Excessive internal or external wear, burns or abrasions.	
Damage from chemical exposure (including alkaline or acidic substances or solvents).	
Damage to eyes, terminal attachments or end fittings.	

2.2.5 Shackles

A shackle is a portable link, used for joining various pieces of lifting equipment. The two main shapes for load lifting are the 'dee' and 'bow' shackles.

Almost all shackles are made of round bar and have circular eyes. The pin of the common shackle screws directly into one eye and should preferably have a collar.

In some shackles, the pins pass clear through both eyes and are secured by a split pin forelock (i.e., split flat cotter pin) or nut and split pin.

If you are using a shackle to support multiple slings ensure that you use a bow shackle. Always use the correct size of shackle pin. Do not use a nut and bolt in place of the proper shackle pin. A bolt that does not fit tightly is likely to bend and break.

Shackles must have the following information stamped on them:

- Manufacturer's identification.
- Grade (M or 4, S or 6)
- Working Load Limit.
- Identification markings linking the shackle to the test certificate.

These details should be found on the shackle itself – not on the pin.

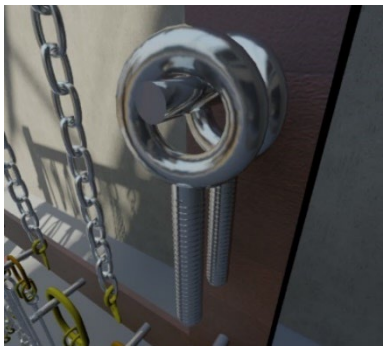
Bow Shackle

Dee Shackle

If a shackle shows any of these defects then it is unsuitable for dogging:

Possible shackle defects:	
Missing or illegible rated capacity.	Bent or warped.
Stretched, wrong or defective pin.	Cracks and chips.
Pin won't screw in and/or missing retaining pin.	Over 10% wear.

2.2.6 Eyebolts



Eyebolts are used extensively as lifting lugs on set pieces of equipment. The safest eyebolt is a collared eyebolt. Uncollared eyebolts should only be used where the pull on the eyebolt is vertical.

Collared eyebolts can be used where the pull is at an angle or a vertical lift. The underside of the eyebolt should be machined and the seating upon which the eyebolt is tightened should also be machined.

The eyebolt should be tightened so that both faces meet in a neat tight fit. If both faces are apart the collar is of no use.

Where two eyebolts are used to lift a load, a pair of slings should be shackled into them. Do not reeve a single sling through two eyebolts and then put both eyes on the hook.

Uncollared Eyebolt

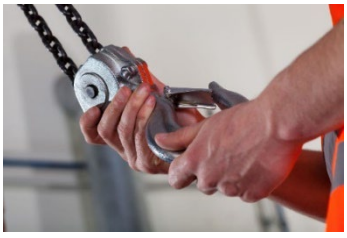
Collared Eyebolt

2.2.7 Hooks

There are many different shapes and sizes of hooks. They range from mild steel to very high-grade alloy steel. Hooks used with chain to make chain assemblies are usually Grade T or Grade 80 strength.

All hooks must be marked with their rated capacity and have a safety latch fitted to stop slings from dislodging.

Hooks must not be used if there is over 10% wear in the bite.

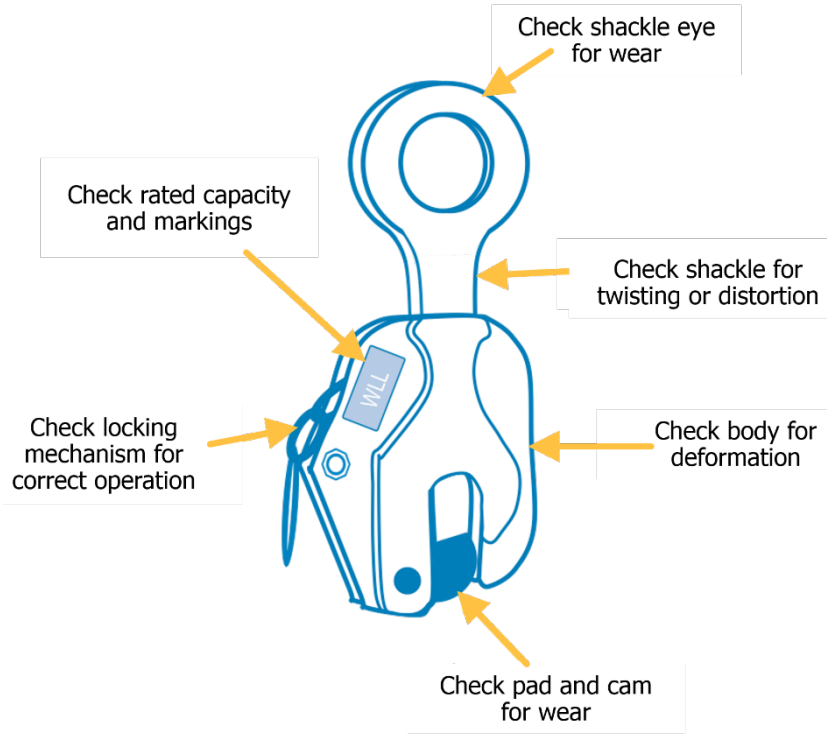


2.2.8 Plate Clamps and Beam Clamps

Plate clamps are designed to increase the purchase on the plate as it is lifted. All plate clamps must be marked with their rated capacity and the relevant compatible plate size.

Any of the following defects will make the plate or beam clamp unsafe to use:

- The cleanliness of all the biting teeth.
- Cracks in the body.
- The locking mechanism.
- Also check for stretching of the lifting ring and for security of all the bolts/pins.



2.2.9 Spreader and Lifting Beams

Spreader and lifting beams are devices which spread the load evenly for a given lift. They are generally made to suit a particular job.

Most have a central lifting point for the crane or lifting medium, and have two or more lugs underneath to take the load slings. All spreader beams must be suitable to lift the particular load and must be branded with the rated capacity.

The rated capacity must include the weight of the load plus all lifting gear (slings, shackles etc.). The spreader beam must also display the weight of the beam and its serial number.

2.2.9.1 Lifting Beam

Lifting beams have a centre-lifting lug at the top to accommodate a crane hook and a bottom lug at each end for connecting slings. Headroom for the lift is reduced, as no top slings are required.

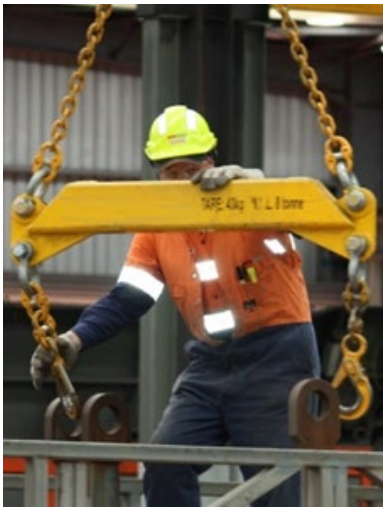
2.2.9.2 Spreader Beam

A spreader beam literally "spreads" a two-legged top sling. A spreader beam has better stability than a lifting beam and a higher potential capacity for a given size of steel section used. Spreader beams require more headroom than lifting beams due to the two-legged sling arrangement at the top.

2.2.9.3 Lifting Lugs

Lifting lugs are components that are found in some lifting gear and loads to assist with lifting.

Lugs are built with an opening in the centre so that cables can be attached, through these openings, for lifting purposes.



Lifting lugs may be:

- **A permanent attachment** – such as in a box with built in lugs or a spreader beam.
- **A temporary attachment** – such as the addition of eyebolts to a load.

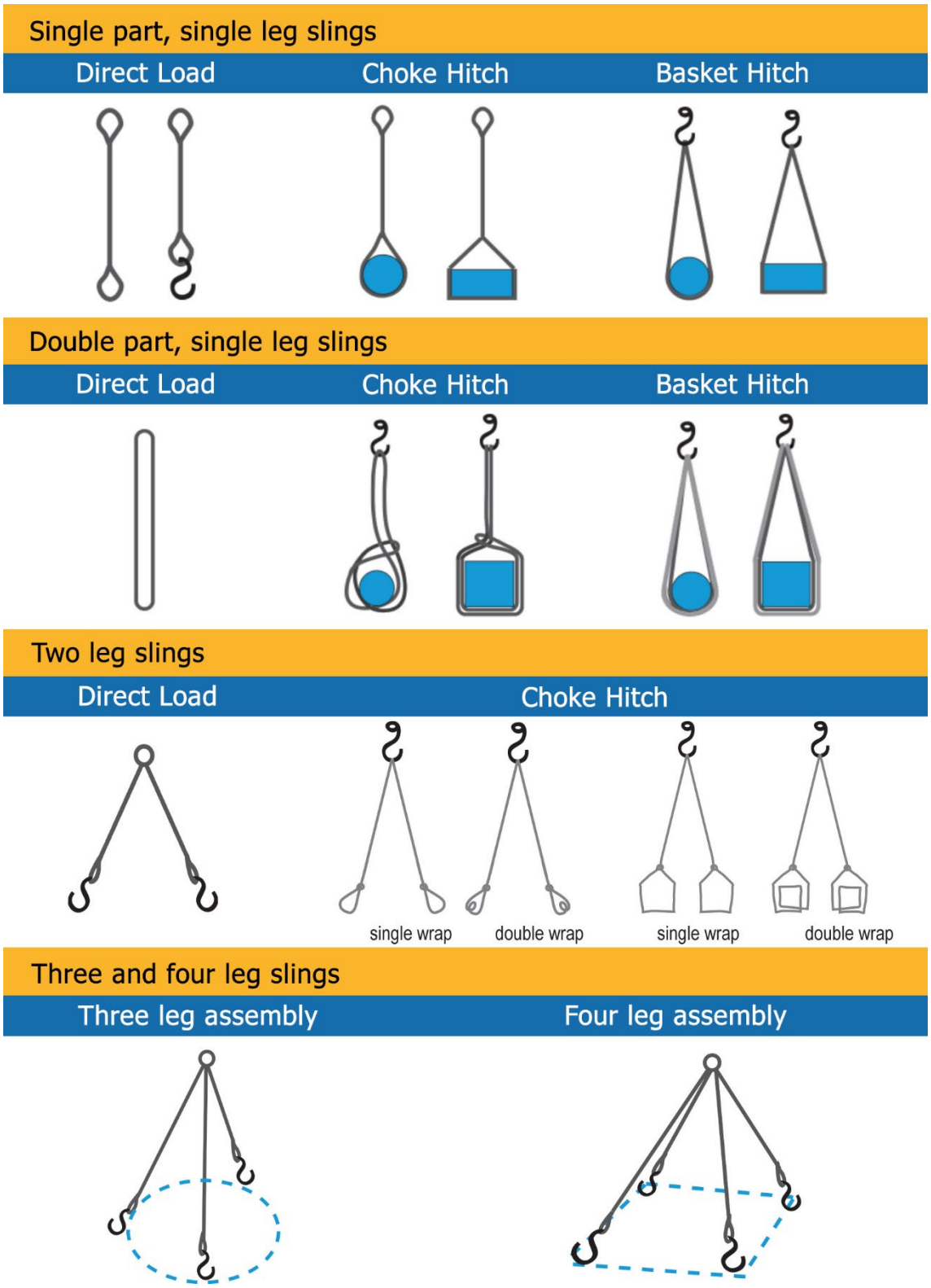
If a load or piece of lifting equipment is fitted with lifting lugs, ensure that you:

- Visually inspect the lugs, making sure that there is no evidence of:
  - Welds splitting or cracking.
  - Damage, splitting, separation or stretching.
- Check that the rated capacity is suitable for the job.
- Check the lugs for positioning in relation to the centre of gravity of the load being lifted.

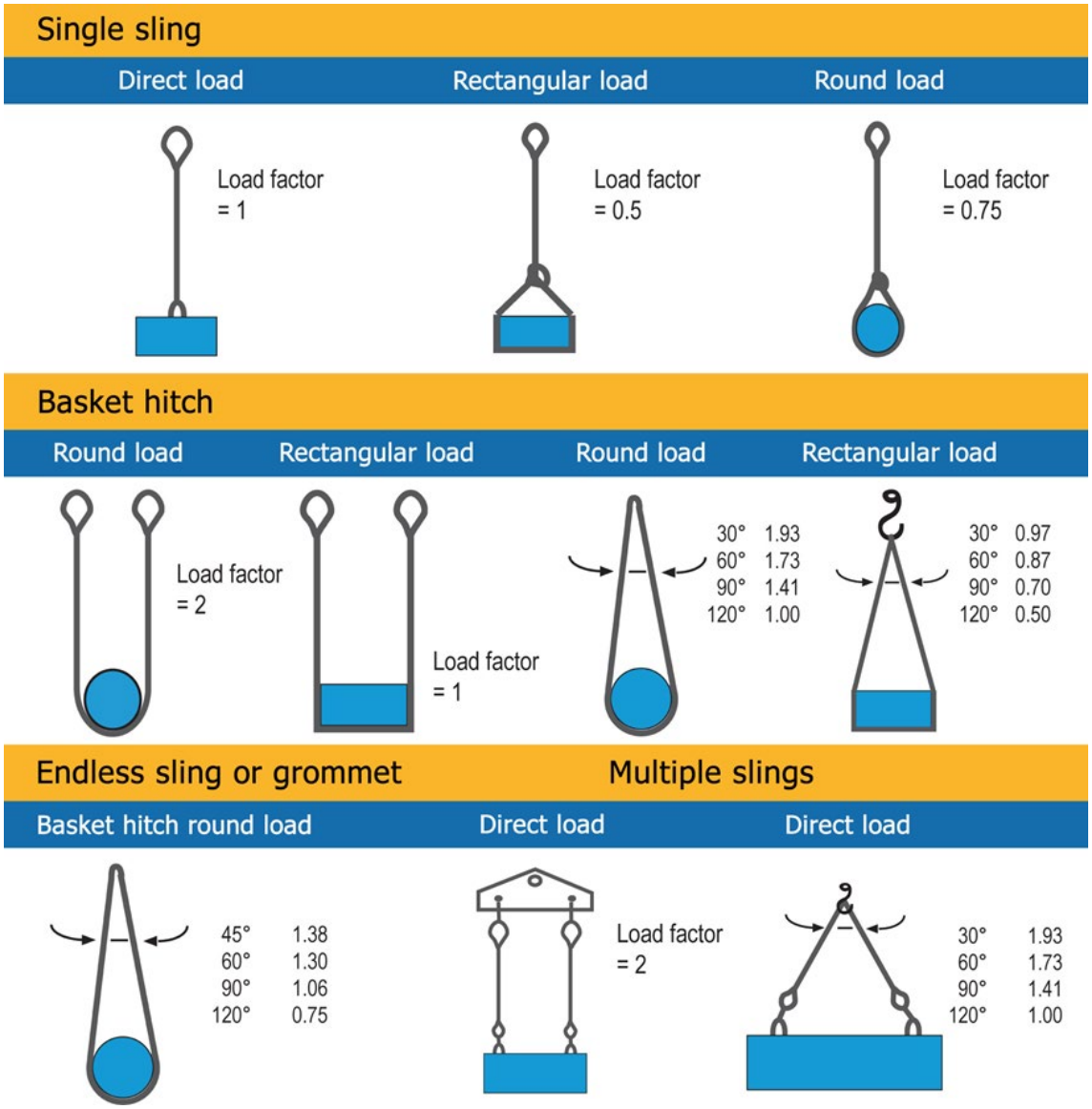
2.2.10 Slinging Techniques and Calculations

The slinging technique or configuration used for a load will depend on the size, shape and requirements of the load. For example, if a chain sling is reeved or choked around a steel beam with an angle not greater than 60 degrees you would double wrap the reeve or choke to prevent them from slipping once the load is lifted.

Some slinging techniques reduce the rated capacity of the slings. This needs to be calculated using the appropriate load factors to ensure the lifting capacity of the slings will be sufficient to safely shift the load. Information about the safe use of slings can be found in Australian Standards and the manufacturer's specifications.



2.2.11 Load Factors and Slinging



The lifting capacity decreases as the angle between the legs of the sling attachment increases. Different methods of slinging will also alter the lifting capacity.

A simple rule of thumb for a good safe working angle is to make sure that the horizontal distance between the points of attachment of the load does not exceed the length of the slings.

This will ensure that the angle between the two legs of the sling does not exceed 60°.

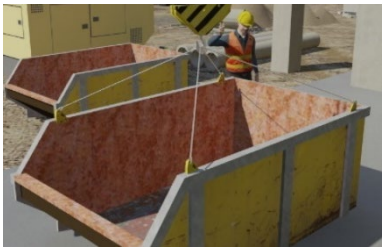
The recommended safe angle between two legs of a sling is 60°.

The recommended maximum angle between the two legs of a grade 80 or 100 chain sling is 120°.

When a dogger or rigger is using two slings to lift a load and are determining the length and capacity of the slings required, they will need to consider:

- The weight of the load.
- The reeve factors.
- The angle factors.
- The size of the load.
- The slinging method.
- The clearance required to make the lift.

When slinging a rigid object with a multi-legged sling it must be assumed that only two of the sling legs are taking the load.



Additional legs do not increase the rated capacity of the sling assembly, therefore each leg has to be capable of taking half of the weight of the load.

The maximum angle of a four-legged sling is the greatest angle between any two of the four slings. This is generally between the diagonally opposite legs. The rated capacity is assessed through the largest included angle in the multi-legged sling assembly.

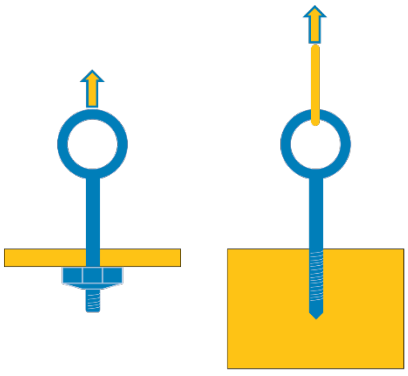
The rated capacity of slings decreases as the angle between the slings increases or if the slings are nipped or reeved. All factors must be considered when determining which sling is the correct one to lift a given load.

Included Angle	Load Factor
60 degrees	1.73
90 degrees	1.41
120 degrees	1

2.2.12 Using Shackles and Eye Bolts

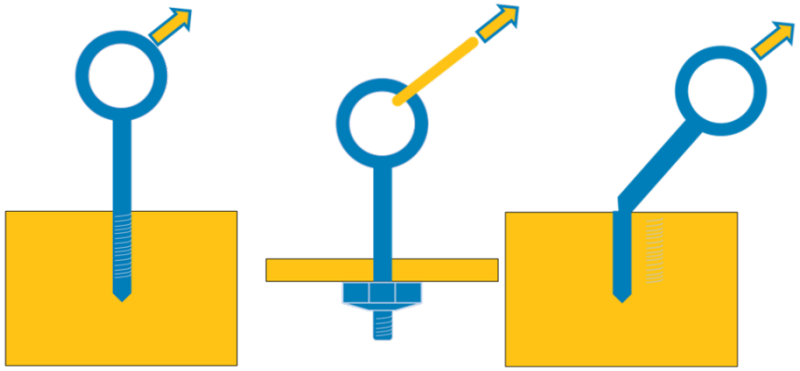
When using multiple slings, always use a bow shackle large enough to accommodate all of the eyes safely on the bow. The pin of the shackle should rest on the hook.

Uncollared eyebolts should only be used with straight lifts.



If the sling is set at an angle to the uncollared eyebolt, the sideways pull on the eyebolt could cause it to fail.

If shoulderless eye and ring bolts are pulled at an angle (as shown) they will either bend or break.

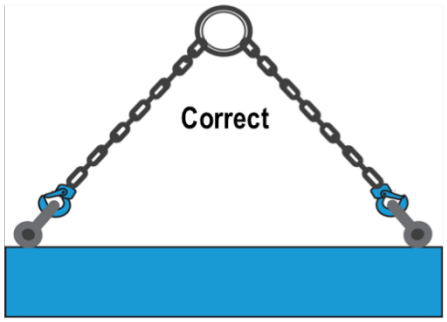


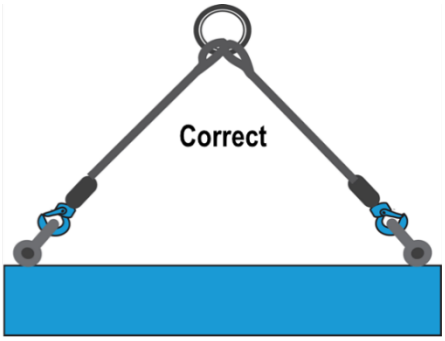
Collared eyebolts should always face the same direction so that angled slings are pulling sideways.

Where two eyebolts are used to lift a load, a pair of slings should be shackled into them. Do not reeve a single sling through two eyebolts and then put both eyes on the hook.

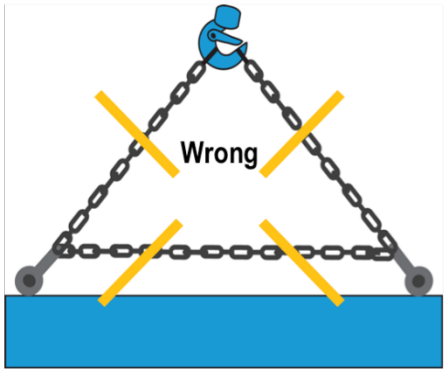
If using only one eyebolt in a vertical lift, make sure it is lashed to the load to prevent it from unwinding during the movement of the load.

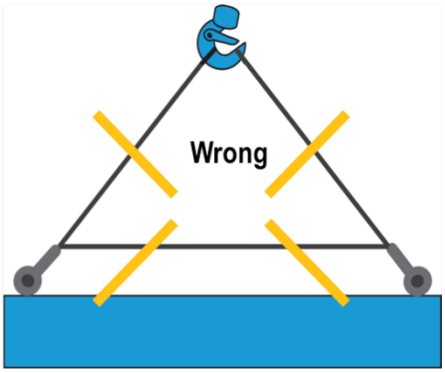
Make sure the eyebolts are screwed down tightly so that the collar is in contact with the load.





Here the strain on the eyebolt is doubled.





2.2.13 Safe Slinging Techniques

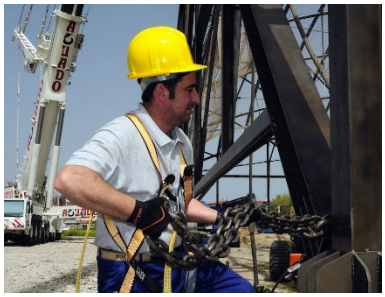
The safest slinging points on a load can be determined through calculation or by conducting a test lift.

Calculations such as measuring the distances from the centre of the load out to the slinging points and evenly distributing the weight will ensure that the lifting points are safe.

This is the best method, but may not always be possible.

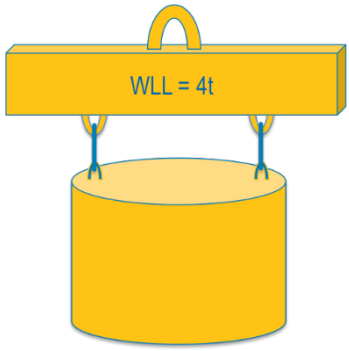
When selecting suitable slinging points, the following should be considered:

- The centre of load distribution and load balance.
- Security of slings.
- Reeve and angle factors.
- Weight of load.
- Avoiding damage to the load.



The following are examples of slinging techniques and the formulae that are used to ensure the slinging is completed in a safe manner.

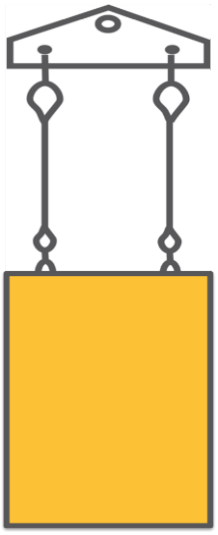
2.2.13.1 Slinging Technique 1



A drum filled with water is to be lifted with two vertical flexible steel wire rope (FSWR) slings fixed to a spreader:

- The weight of the load is 1500kg.
- The lifting beam weighs 400kg and is rated to 4 tonne.

What is the minimum diameter FSWR required to safely lift the drum?



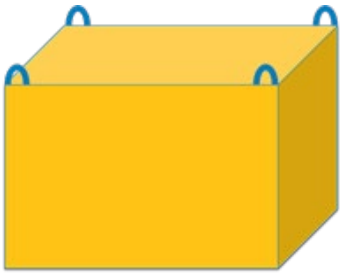
Calculations

Rated Capacity = Weight of load divided by angle factor.
= 1500 ÷ 2
= 750kg

Diameter of FSWR sling (mm) = Square root of (Rated Capacity (kg) ÷ safety factor 8)
= √(750 ÷ 8)
= √93.75
= 9.682

Therefore:
FSWR diameter = 10mm (rounded up from 9.682)

2.2.13.2 Slinging Technique 2



A box with built-in lifting lugs is to be lifted.

The included angle between the diagonally opposite sling legs is 90 degrees.

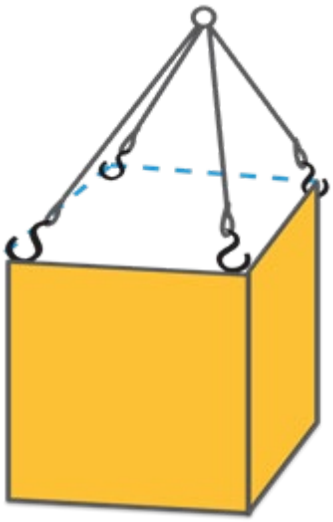
- The chain slings are Grade (80) T.
- The chain diameter is 12mm.

What is the maximum load that can be lifted (rounded down to the nearest 10th of a tonne)?

Calculations:
Firstly, calculate the rated capacity for the chain using the formula:

Rated Capacity (kg) = D squared (mm) x (grade x 0.4)

Rated Capacity (kg) = D^2 (mm) x (grade x 0.4)
= 12 x 12 x (80 x 0.4)
= 12 x 12 x 32
= **4608kg**



For multi-legged slings, it must be assumed that only two slings are taking the load. Therefore, the permissible load is calculated for one pair of diagonally opposite slings.

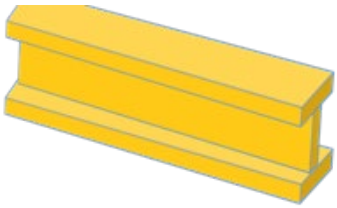
Multiply the rated capacity by the angle factor (1.41 for a pair of slings with an included angle of 90 degrees) to calculate the maximum load of the box.

Maximum Load = Rated Capacity x angle factor
= 4608kg x 1.41
= **6497.28kg**

This is then converted to tonnes and rounded down to the nearest 0.1t. Therefore:

Maximum load = 6.4t (rounded down from 6497.28kg)

2.2.13.3 Slinging Technique 3



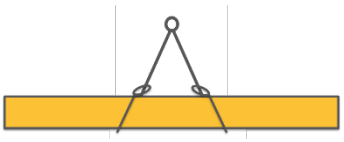
A pair of FSWR reeved slings is to be used to lift a steel beam.

- The angle between the sling legs is 90 degrees.
- The steel beam weighs 173kg/m.
- The steel beam is 5m long.

Calculate the weight of the load and the minimum diameter of FSWR required to lift it.

Calculations

Weight of the Load = steel beam length (m) x steel beam weight (kg)
Weight of the Load = 5 x 173
= **865kg**
Diameter of Sling = √(Load ÷ safety factor ÷ reeve factor ÷ angle factor)
= √(865 ÷ 8 ÷0.5 ÷ 1.41)
= √153.369
= **12.384**



Therefore:
Minimum Diameter of Sling = 13mm (rounded up from 12.384mm)

2.2.13.4 Slinging Technique 4

A square load is to be lifted using a set of Grade 80 (T) chains. The chains are slung in a two-legged sling and reeved around the load.

- The included angle for the slings is 60 degrees.
- The weight of the load is 2000kg.

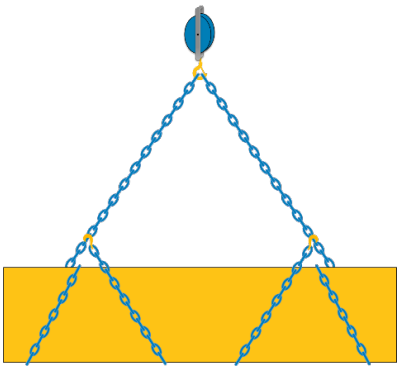
Using the angle of the sling and the weight of the load calculate the chain diameter that will need to be used.

Calculations:

The formula to calculate the necessary grade 80 (T) chain diameter is:
Chain Diameter = √(weight of the load ÷ reeve factor ÷ load factor ÷ 32)

The reeve factor around rectangular loads = 0.5
The load factor for slings at 60 degrees = 1.73

Chain Diameter = √(2000 ÷ 0.5 ÷ 1.73 ÷ 32)
= √72
= **8.49**



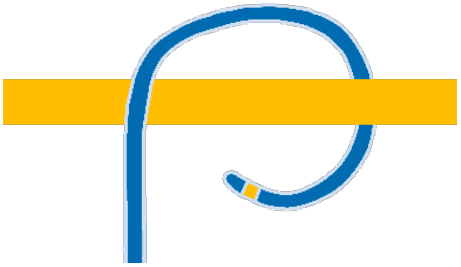
Therefore:
The minimum Grade 80 (T) chain diameter that can be used in this configuration to lift this load is 9mm.

2.2.14 Temporary Rope Connections

The following knots, bends and hitches may be used by the dogger to make temporary connections to the load:

- Clove hitch.
- Rolling hitch.
- Single bowline.
- Sheet bend.

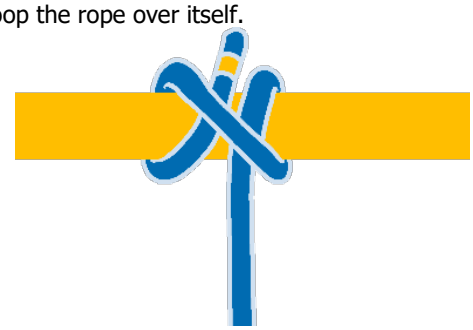
Clove Hitch around a Round Object



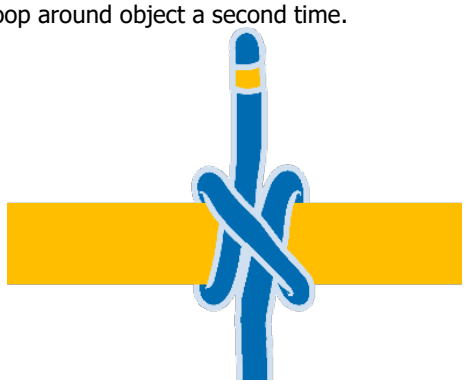
1. Pass the end of the rope around the object.

2. Loop the rope over itself.

3. Loop around object a second time.



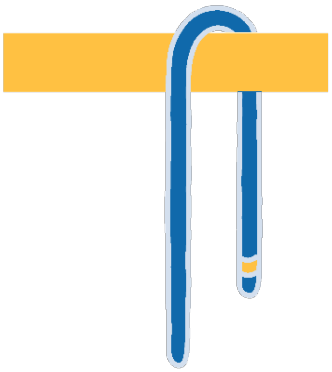
4. Thread the end under itself.



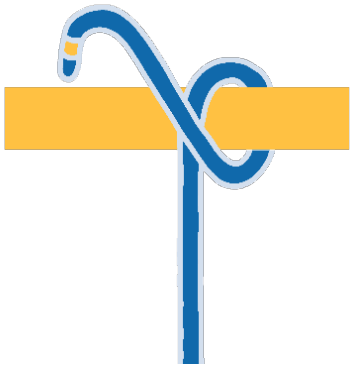
5. Pull tight to form the clove hitch.

This is used to commence rope lashing. It is not safe for other purposes unless the ends are secured with an additional half-hitch.

Rolling Hitch around a Round Object



1. Loop the rope over the object.



2. Pass the end around the object.

3. Continue around to make a half hitch going over the first turn.

4. Tuck the second loop between the rope length and the first turn.

5. Continue around the object to add a final half hitch. Tucking the end under the loop.

6. Pull the rolling hitch tight.

This is used to secure a stopper, or two ropes pulling in opposite directions. It is preferable to a clove hitch or blackwall hitch, as long as rolling turns are put on in the proper direction of pull.

Single Bowline

1. Form a small loop leaving enough rope for the required loop size.

2. Bring the end of the rope up to the loop.

3. Pass the rope through the loop like tying an overhand knot.

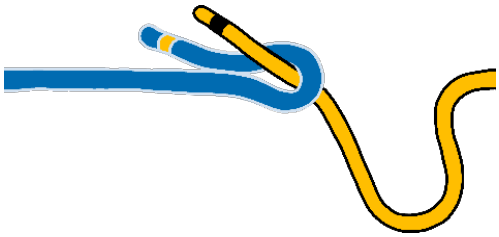
4. Turn the rope end under the main length creating another loop.

5. Pull end through the small centre loop

6. Tighten the knot leaving the loop at the required size.

This is used for making a temporary eye in the end of a rope.

Sheet Bend to another Rope



1. Form a bight (loop) in the first rope and hold in one hand.

2. Pass the second rope through the loop.

3. Pass the second rope behind the first.

4. Tuck the second rope under itself in the centre of the knot

This is used to join two dry ropes of different sizes. It is safer when a double sheet bend is used. The smaller rope must be bent around the larger rope.

2.2.15 Determine Special Requirements and Lifting Points of Load

You need to confirm whether the load has any specific lifting points. This will help to inform the types of lifting gear and the configuration of slings to best handle the load.

The manufacturer may have specifications or information relating to the load and how it should be handled, especially in the case of hazardous, fragile or unstable loads.

You should access the manufacturers' specifications or engineers' reports and specifications for details on special or unique loads including:

- Load centre of gravity.
- Stress points.
- Lifting points.
- Spread of load.
- Travel path of load.
- Special slinging requirements.
- Lifting and/or landing requirements.

2.3 Crane and Equipment Checks

Before using a crane or other equipment you will need to check that it is in safe working order and is suitable for the task.

Routine checks include:

- Pre-start checks (checks done before the crane is started up).
- Operational checks (checks made after the crane is started up).

If you find a danger/safety tag attached to the crane or an item of equipment while carrying out an inspection then you must leave it in place.

Do not remove the tag or use the crane or equipment (unless you have been authorised to remove the tag by somebody competent who has deemed the crane safe).

The only people that can remove the tag is the person who put it there **or** someone authorised to remove it in line with workplace safety procedures.

2.3.1 Pre-Start Checks

Routine pre-start checks should be carried out according to procedures including:

- The manufacturer's guidelines. This may include a range of instructions, specifications including the operator's manual or appropriate checklists.
- Industry operating procedures.
- Workplace procedures, instructions, operating procedures and checklists.

Routine pre-start checks include:

- Visually checking the motor.
- Signs of damage to the structure, including:
  - The crane.
  - The boom/jib.
- The condition of the tyres/tracks is safe and legal (as applicable).
- Tyres are at the correct pressure.
- All fluid levels including:
  - Oil (e.g. motor, hydraulic, gearbox).
  - Fuel.
  - Battery water.
  - Radiator water/coolant level.
  - Lubrication (grease).
- No evidence of fluid/oil/water leaks, particularly under the crane/vehicle.
- Hydraulic rams and hoses for damage or leaks.
- Outriggers/stabilisers and packing.
- Crane configuration.
- All wire ropes, anchorages, wedge sockets and splices.
- Winch drum condition.
- Slew ring (where visible).
- Jib.
- Needle (where applicable).
- Rooster sheave (where applicable).
- Retaining pins.
- Auxiliary hoist (where applicable).
- Rope and rope drums.
- Lifting hook.
- The logbook is present, current, and checked for maintenance records and defects.
- Safety tags – check that none are on the crane.
- Load charts are present and appropriate to the crane.
- Signs/signage and labels (or notices) are present, correct and legible. This includes:
  - Rated capacity.
  - Manufacturer's data plate and labels.
  - Load charts.
  - Crane decals
  - Control labels.
- Communication system.

2.3.1.1 Boom Checks

The boom and superstructure of the crane must be checked to ensure there are no defects that would make the crane unsafe to use.

Boom defects to check for include:

- Cracks – particularly in the boom, superstructure or welds.
- Bends or twists in the boom or superstructure.
- Flaking paint.
- Loose or missing bolts.
- Oil leaks.
- Rust from joints or welds.
- Bent pins.

2.3.1.2 Tyres

Check that all tyres are in good condition and are inflated to the correct pressure as stated on the crane's load chart or in the operator's manual.

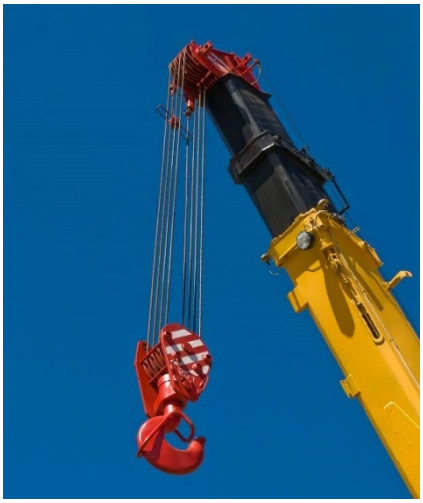
The stability of the crane depends on the tyres being correctly inflated. The tyre pressure also affects the capacity of the crane.

If the tyre pressure is lower than the pressure on the load chart then the crane will be able to lift less weight.

You will need to inspect crawler tracks and mechanisms if the crane is fitted with them.

2.3.1.3 Lifting Hook

Inspect the lifting hook for damage or excessive wear.



Defects that would render a lifting hook unusable include:

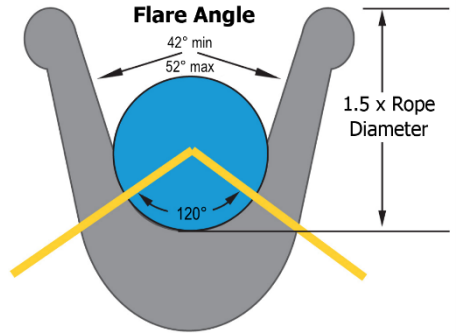
- Cuts, gouges or more than 10% wear.
- Bill stretched more than 5%.
- Cracks or twisting of the hook.
- Exposure to excessive heat.
- Safety latch that is damaged or missing.
- Rated capacity mark/stamp missing from the hook.

2.3.1.4 Sheaves

Sheaves lead the rope over the head of cranes and hoists and are used in pulley systems to gain a mechanical advantage.

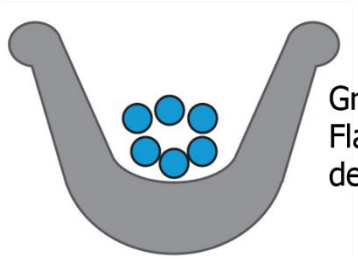
Make sure that the Flexible Steel Wire Rope (FSWR) sits neatly in the base of the sheave groove. The amount of FSWR sitting in the groove should be either one third (1/3), 120° or as per the manufacturer's specifications.

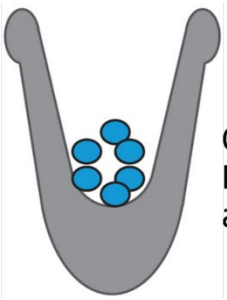
The groove depth of a sheave should not be less than 1.5 times the diameter of the FSWR (or in accordance with the manufacturer's specifications).



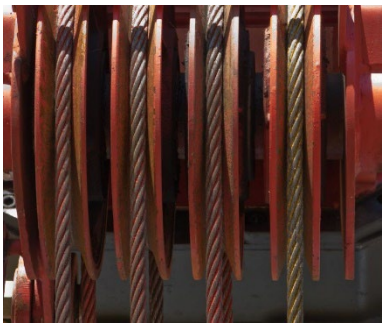
Correct Groove

If the grooves are too large then the rope will be flattened and deformed. If the grooves are too small the rope will be pinched and abraded. Any damage to the FSWR may lead to its failure.


Groove too large. Flattens and deforms the FSWR.


Groove too small. Pinches and abrades the FSWR.

Inspect the sheaves for damage or excessive wear. Defects that would render a sheave unusable include:



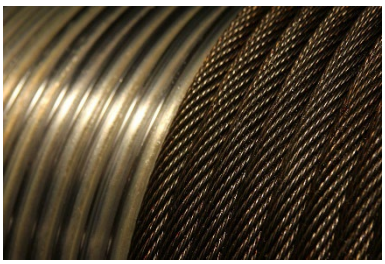
- Sheave is twisted or deformed or out of shape.
- Excessive wear in any groove.
- Damage (e.g. cracks) in the flange.
- Worn sheave pins or wear of the hinge pin.
- Damage to cheek plates or cheek plate wall/partition that is too far from or too close to the sheave.

2.3.1.5 Drums

The drum is the pulling mechanism that rotates, hauls in and stores surplus wire.

The braking mechanism is connected to either the drum or the gearing. The drum or gearing is joined to the drive mechanism.

Drums are measured from the centre to the inside of the flange. A drum that measures 1m from flange to flange is therefore a 0.5m drum.



The rope should lie neatly on the drum and not be bunched up. When the hook block is at its lowest possible point there should still be a minimum of three full turns on the drum (or as per the manufacturer's specifications).

When the drum has been wound to its maximum turns the flange must still extend 2 rope diameters above the outer layer of the rope.

The rope must be anchored to the drum with a fixed mechanical anchorage such as a socket and wedge or a clamp and bolts.

Be aware of the danger of not properly tightening an anchorage – **DO NOT** rely on the frictional grip relayed by the two turns on the drum.

2.3.1.6 Boom Pawl

Check to see if the boom pawl has engaged the ratchet. This could mean that the boom brakes are creeping due to mechanical failure, moisture or the condition of the brakes.

2.3.1.7 Lifting Equipment

Inspect lifting equipment for damage or defects before each use.

Check for more than 10% wear in the following:

- Shackles.
- Chains.
- Crane sling shorteners.
- The bite of a hook.

If there is 10% or more wear the lifting equipment is not safe to use.

2.3.2 Access and Start the Crane

To start the crane you will need to safely access the cabin. Use any ladders, steps, footholds or grab rails provided.

Climb into the cabin safely using three points of contact at all times. This means having two hands and one foot or two feet and one hand in contact with the crane at all times. Make sure all points of contact are free from slipping or tripping hazards, e.g. grease or debris.

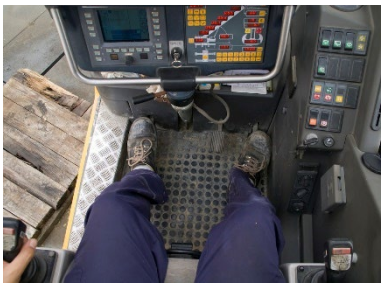
Start the crane according to the manufacturer's start-up procedure.

If you hear any abnormal noises after starting up you will need to shut the crane down. Put a danger tag on the crane and report the noise to the appropriate person.

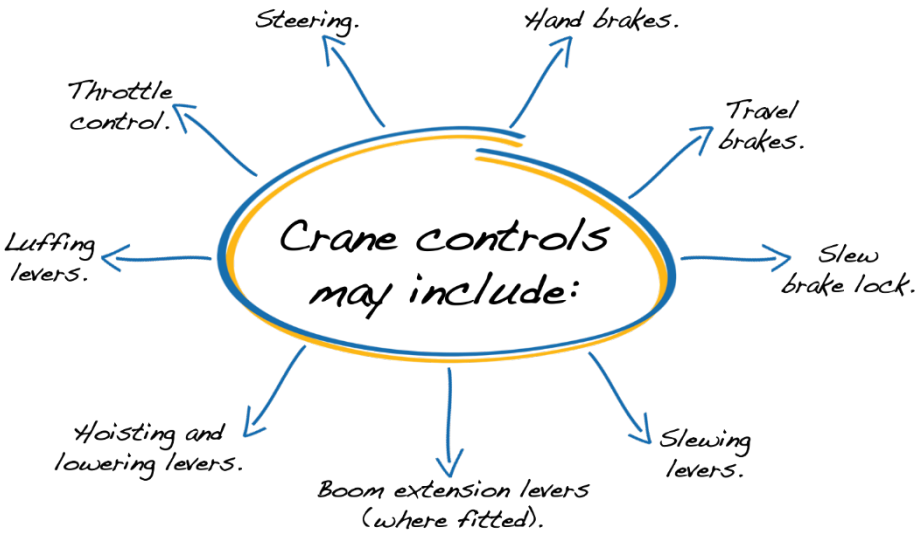
2.3.3 Locate and Identify Controls

Before starting up the crane and carrying out operational checks, it is important that you are familiar with the location of various controls and their functions.

Make sure all control labels are present and legible.



Controls may include:



2.3.4 Check the Crane Logbook

The crane logbook is used to record information on crane operation, servicing and repairs, the daily safety checks that are completed and to report defects and whether the defects have been rectified.

The crane logbook may also be called the:

- Service logbook.
- Logbook.
- Service book.
- History record.

All defects must be recorded in the crane logbook, along with any action taken to return the crane to service.

You should check the logbook to make sure:

- It is applicable to the crane.
- The crane owner is recorded.
- The crane's registration/certificate is current.
- Previous daily safety checks have been carried out and recorded.
- There are not any reported defects that have not been fixed (rectified).
- All repairs and defect rectifications are recorded.

As the crane operator you must record all crane defects in the logbook (crane operator's logbook) and according to any other workplace procedures.

Do not start up the crane if previously reported defects have not been fixed.

As well as the crane logbook, check that all signs, labels and decals are present and readable. This information will tell you the crane's capacity and capabilities.

2.3.5 Check the Crane Safety Devices

Check all safety devices on the crane including:

- Horns and sirens.
- Audible and visual reversing devices.
- Operator restraint devices (e.g. safety belt).
- Lights.
- Two-block/double block system.

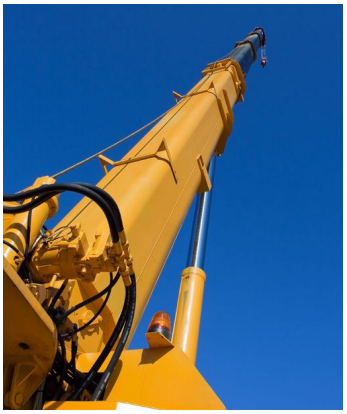
You can test the accuracy of the load mass indicator by selecting a load that you already know the weight of, lifting it and comparing the result on the indicator against the known weight of the load. Load mass indicator testing should be done following the manufacturer's specifications.

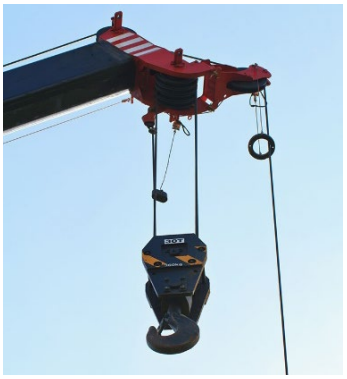
2.3.6 Operational Checks

Operational checks are done after pre-start checks and only if no faults or defects were found.

Make sure you have plenty of room to test out the crane before starting it up.

It is important that the crane is tested to the full range of its capacity to ensure that the crane is safe and functioning correctly.





Operational checks include:

- All hazard controls are in place.
- You have a clear view from the operating position across all work zones, wherever possible. This will ensure that your view is not obscured when carrying out operations.
- All crane movements and controls are smooth and tested to the full extent of their capacity including:
  - Boom movements including in and out (extending/telescoping) and luffing.
  - Hoist movements including slew, raise and lower.
  - Controls, including the throttle control.
- Inspecting the travel limits.
- Warning devices and systems.
- Warning lights and devices.
- Horn, lights and drive indicator.
- Communications.
- Brakes (slew brake and travel brake if fitted).
- Steering.
- All gauges are functioning correctly.
- Slew brake lock.
- Travel brakes
- Hand brakes.
- Limit switches.
- Two-block/double block system present and in good condition.
- Outriggers deployed and functioning.
- Tyres are clear of the ground.
- Packing is the correct size and has been placed correctly.
- The crane is level and stable.
- Checking the maximum radius and load radius indicator.

You may also be required to input data into the crane's computer and make sure that it is accurate and matches the configuration of the crane.

2.3.7 Check Communication Equipment

Inspect all communication equipment before starting the crane work to make sure that it is working correctly and that effective communication can be established and maintained at all times.

Communication equipment used in crane operations may include whistles, bells, buzzers or fixed channel two-way radios.

Where radio communication equipment is used, the transmitting frequencies of the equipment must be selected to prevent interference to or from other radio equipment being used in the vicinity of the crane.

2.3.8 Report Any Faults

You can use an inspection checklist/logbook to record all checks carried out and all defects identified.

If you find any faults or signs of defects on the crane or the crane cannot function to the full range of its movements, you must:

1. Tag out the crane to isolate it from use.
2. Report the defect.
3. Do not use the crane until the fault or defect has been fixed (rectified).
4. Record the fault in the crane logbook.

Report any evidence of tampering or interference with the crane to your supervisor or other responsible person.

DO NOT use the crane or equipment until it has been fixed and returned to service.

2.4 Check Ground Conditions

Before setting up the crane you will need to make sure the ground is suitable for the work being done and that it will support the weight of the crane and load.

Ground conditions that you may encounter include:

- Rough uneven ground.
- Backfilled ground.
- Soft soils.
- Hard compacted soil.
- Rock.
- Bitumen.
- Concrete.

The ground should be checked by a competent person such as an engineer before setting up the crane so that the bearing pressure value of the soil can be established, and the crane will remain stable.

Check to make sure there are no underground services running through the area where you plan to set up the crane. The pressure of the equipment could cause damage to the underground services, pipes or cables.

The crane could become unstable during operation if the ground is unsuitable, e.g. rough, uneven or soft. Setting up a crane on uneven ground will also decrease the capacity of the crane.

Do not set up a crane on backfilled trenches. They may not have compacted completely and are dangerous to set the crane up on.

You may need to use plates or packing under the outriggers to make sure the crane remains stable on soft ground.

When setting the crane up on a concrete slab an engineer's report is required to confirm that the concrete slab can support the weight of a crane.

2.5 Drive the Crane to the Work Area

If you are satisfied that the ground at the work area is suitable for crane operations, drive the crane to the work area and begin to set up.

Follow all manufacturer's specifications, procedures and relevant motor vehicle road legislation when driving the crane to the work area.

Maintain safe speeds and watch out for pedestrians and other vehicular traffic on site. Turn on warning lights to warn others of your approach.

It is important to remember that a HRW licence to operate a mobile slewing crane **does not** licence you to drive the crane on public roads, thoroughfares or to the work area. You will need the appropriate truck licence to drive the crane on roads.

2.6 Position the Crane for Work

Once you have arrived at the work area you will need to correctly position the crane for work operations.

Make sure the crane is placed so that all tasks can be carried out safely and effectively. Ensure that you:

- Establish the safe working radius (or reach) of the crane.
- Check that there are adequate clearances from hazards and structures such as power lines or buildings.
- The crane is in an appropriate position for the work to be completed.
- Check the path of movement of the load.

If any wheels or outriggers begin to sink during set-up you will need to stop operations and rectify the sinking. You may need to add more packing under the stabilisers/outriggers or if this is not possible you will need to move the crane to a more suitable and stable position.

Use a bubble level indicator to make sure the crane is level when setting up.

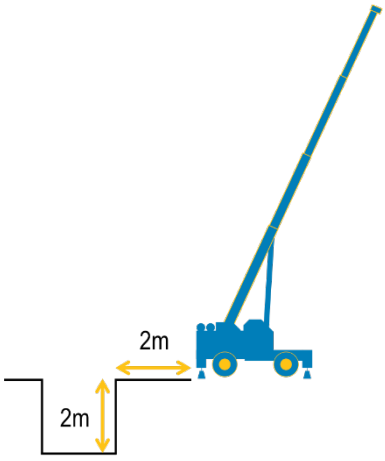
Take into account the specific issues related to a particular work area including access and egress, ground bearing pressure and any details outlined in the engineer's report (if there is one).

Setting Up Close to Trenches/Excavations

Do not set up outriggers/stabilisers close to an excavation. The pressure of the crane could cause a collapse of the excavation wall.

The distance to safely set up a crane near a trench or excavation will depend on the soil conditions. However, the general rule is to position the crane at a distance that is the same as the depth of the excavation or trench.

This means that if a trench is 2 metres deep you would set up the crane 2 metres away.



Setting Up and Operating Close to Buildings

If you were working near a building there are number of things to consider and actions to take:

- If possible, set up the boom so that it slews away from the building.
- Determine if protection for the building will be required. For example, fitting screens to easily damaged areas such as windows.
- Pay close attention to the effect of wind on loads, as wind speeds tend to increase around buildings.
- Take extra care of back-filled trenches placed close to the building.
- Check that there is adequate space to allow for the movement of the counterweight as the crane slews.
- Check for underground services adjacent to the building.

Setting Up in Restricted Spaces

When setting up a crane in a restricted space it is important to consider and ensure that:

- Access is adequate – the crane can enter, operate and exit the work area.
- The manufacturer's specifications can be followed while operating the crane.
- There are no workers or obstructions in the work area.
- The boom can be safely slewed without it, or the counterweight, striking any surrounding structures.
- The possible need to use a guide.
- There is adequate access for the load to be slung and landed safely.
- There is space available for the outriggers to be extended.

2.6.1 Outriggers/Stabilisers

Once the crane is in position you may need to deploy the outriggers. Outriggers (sometimes called stabilisers) are hinged or sliding beams that are used to keep the crane stable during operation.

Outriggers can be used with packing to help distribute the weight of the crane and load on softer ground.

The outriggers generally need to be fully extended to bring the tyres off the ground and make the crane level (in accordance with the manufacturer's specifications). Otherwise the crane can become unstable during operation. Always follow the manufacturer's instructions to determine the correct configuration of outriggers.

Never reset the outriggers while the crane is in use, as this can cause major instability.

If the crane is set up and one or more wheels or outriggers begin to sink you must stop operations. If possible, rectify the sinking. If this isn't possible you will need to relocate the crane to an area where it is possible to ensure the crane stability.

2.6.2 Packing

Selecting the correct packing is important. There are different kinds and sizes of packing available including:

- Steel plates.
- Hardwood packing (pigstying or cribbing).

Packing must cover as much area as possible to distribute the load. Make sure you always determine the minimum area of packing under each outrigger to ensure that the crane and load remain stable.

Hardwood (pigsty) packing should be arranged so that each layer is at a 90 degree angle to the one underneath.

2.6.2.1 Calculating the Required Size of Packing

Working out the size of the packing area required is an important step in safely setting up the crane.

You may need to use packing or mats under the outriggers to make the crane stable on soft ground. Different ground and soil types have different load bearing pressures depending on how firm or dense they are.

Soil Type	Load Bearing Pressure (tonnes per m^2)
Hard rock	200
Shale rock and sandstone	80
Compacted gravel (with up to 20% sand)	40
Asphalt	20
Compacted sand	20
Stiff clay (dry)	20
Soft clay (dry)	10
Loose sand	10
Wet clay	Less than 10

When working out the area of required packing you will need to know:

- Total mass of the crane.
- Total mass of the load to be lifted.
- The soil bearing pressure.

If this information is known you can then use the following formula to work out the required size of packing in metres squared (m^2).

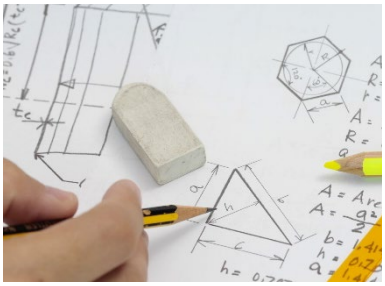
$$\text{Area of packing } (m^2) = \frac{\text{Load on outrigger}}{\text{Load bearing pressure of soil type}}$$

However, if the load will be slewing over **multiple outriggers** you need to use this formula instead:

$$\text{Area of packing } (m^2) = \frac{0.65 \times (\text{Crane Mass} + \text{Load Mass})}{\text{Soil Bearing Pressure (V)}}$$

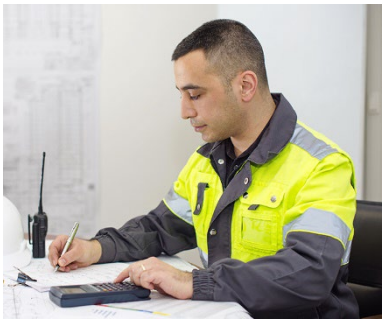
Example – Calculating the Required Area of Packing Lifting over Multiple Outriggers

If a mobile slewing crane that weighs 29200kg is to be set up to lift a 15t load on compacted gravel. What is the smallest packing pad needed for each outrigger?



The following sized outrigger pads are available:

- 0.25m^2
- 0.5m^2
- 0.75m^2
- 1m^2



The first step is to deduce all the information required.

- Total Crane Mass = 29200kg = 29.2t
- Load to be lifted = 15 tonne.
- Compacted Gravel = 40 tonnes/m^2.

Now that the data is in an easily accessible format we can use it to find the minimum required area of packing for this configuration.

Calculations

$$\text{Area of packing } (m^2) = \frac{0.65 \times (\text{Crane Mass} + \text{Load Mass})}{\text{Soil Bearing Pressure (V)}}$$

$$= \frac{0.65 \times (29.2 + 15)}{40}$$

$$= \frac{0.65 \times (44.2)}{40}$$

$$= \frac{28.73}{40}$$

$$= 0.72 \text{ m}^2$$

Therefore the smallest packing pad needed for each outrigger would have an area of 0.72m^2, so the required outrigger size would be 0.75m^2.

2.7 Configure the Crane

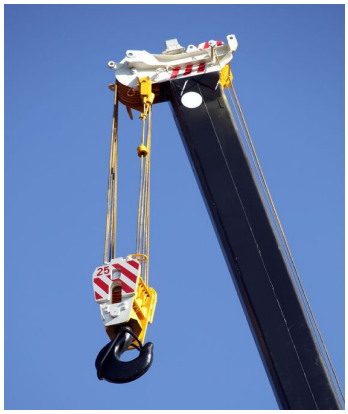
The crane will need to be configured properly to suit the tasks that are to be done. This may include the configuration of the boom/jib, fly jib or counterweights. Carry out all crane configuration procedures according to the crane manufacturer's instructions.

Consult the load chart for the crane to make sure the crane is configured correctly for the loads that need to be lifted.

2.7.1 Boom Configuration

The boom and jib may need to be assembled for the lift. Make sure the maximum radius and minimum radius luff limits are known, and the boom has been configured accordingly.

Some cranes have a manual boom extension. Make sure the boom extension is secured according to the manufacturer's specifications.

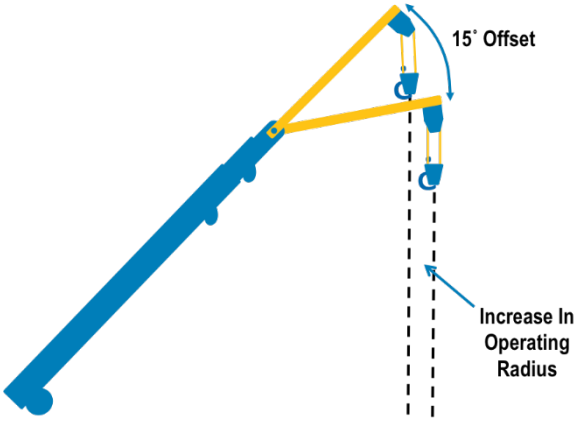


2.7.2 Fly Jib

You can find the ratings of a fly jib by consulting the load chart. For instance, a fly jib offset at 15 degrees will have a **lower** rating than at zero degrees.

If a fly jib is stowed on the main boom section then the rated capacity of the crane may be reduced.

Also check the load chart or crane specifications to see if you are allowed to mobile the crane with a load on the fly jib.



2.7.3 Counterweights

Small cranes usually have a fixed counterweight, whereas larger cranes may have counterweights that can be removed and configured. Consult the manufacturer's specifications to find information on when and how to configure counterweights and how to secure them to the crane. Extra counterweights can only be added if the manufacturer's specifications allow it.

A counterweight should be clearly marked with its weight/mass and the crane manufacturer's name/trademark.

Misuse of counterweights could result in crane instability or structural damage to the crane.

2.8 Input Computer Data

Note: Not all cranes are fitted with a crane computer. Check the operator's manual for the crane you are using to see if it has a crane computer installed.

The crane computer is used to help configure the boom/jib and counterweights.

It also includes the load limiting/indicating system used to warn you in situations where the crane is overloaded or likely to become unstable.

When setting up the crane, all relevant details should be entered into the crane computer (where applicable). This may include:

- The weight of the load to be lifted.
- The boom length.
- The operating radius.
- The total weight of the lifting gear.

Test that the crane computer is working by comparing the computer results with the crane load chart, or complete the pre-operational testing in the manufacturer's specifications.

2.9 Test Communication Equipment

Before starting work you will need to make sure any communication equipment you are using is working properly on-site. Consult the manufacturer's instructions to make sure the equipment is working correctly.

Check for radio interference and make sure you are not interfering with other workers on-site who may also be using radios. Use a dedicated frequency to prevent interference with other equipment. Make sure batteries are fully charged and that you have spare batteries in case they are needed.

3.1 Determine Crane Capacity

You will need to determine the characteristics and capabilities of the crane you are going to use so that it can be configured to suit the loads that are to be moved.

Information relating to the capabilities of a crane can be found in:

- The appropriate load charts.
- The manufacturer's specifications.
- The operator's manual.
- Marked or labelled on the crane itself.

The lifting capacity of a crane is limited by structural strength (when the operating radius is small) and stability (when the operating radius is large).

3.1.1 Load Charts

Load charts or crane charts contain details of the crane and the information you need to properly calculate the crane's capacity in any given configuration. As well as the crane's dimensions and weight, the load chart will tell you the:

- Operating radius of the crane.
- Rubber ratings.
- Weight of the hook block.
- Winch line pull in tonnes or kilograms.
- Rated capacity for a given crane configuration (crane radius and boom length and angle, jib/fly ratings, counterweight configurations).
- Multiple rope fall capacities (e.g. 2-fall and 4-fall hook block configurations).

Check the load chart to determine how different boom and counterweight configurations will affect the capacity of a crane.

CRANE LOAD CHART

Showing Rated Lifting Capacity (in tonnes) On Fully Extended Outriggers

Radius	10.1m Boom		18.1m Boom		26.0m Boom	
(m)	Over Rear	Over Side	Over Rear	Over Side	Over Rear	Over Side
3.0	25.00	25.00	14.00	14.00		
3.5	21.70	21.70	13.40	13.40		
4.0	18.50	18.50	12.75	12.75		
4.5	15.50	15.50	12.15	12.15		
5.0	12.80	12.80	11.60	11.60	7.40	7.40
5.5	10.50	10.50	10.00	10.00	7.10	7.10
6.0	8.80	8.80	8.70	8.70	6.65	6.65
6.5	7.70	7.55	7.70	7.70	6.40	6.40
7.0	6.85	6.60	6.85	6.60	6.10	6.10
7.5	6.20	5.70	6.20	5.70	5.75	5.75
8.0	5.60	4.95	5.60	4.95	5.40	5.40
8.5	5.05	4.36	5.05	4.35	5.00	4.80
9.0			4.60	3.85	4.60	4.35
10.0			3.90	3.10	3.90	3.50
11.0			3.30	2.65	3.30	2.95
12.0			2.80	2.25	2.80	2.50
13.0			2.40	1.95	2.40	2.15
14.0			2.10	1.55	2.10	1.80
16.0					1.55	1.30
18.0					1.20	0.95
20.0					0.90	0.60
22.0					0.70	0.40
24.0					0.55	0.25

Load charts have a solid line running across them:

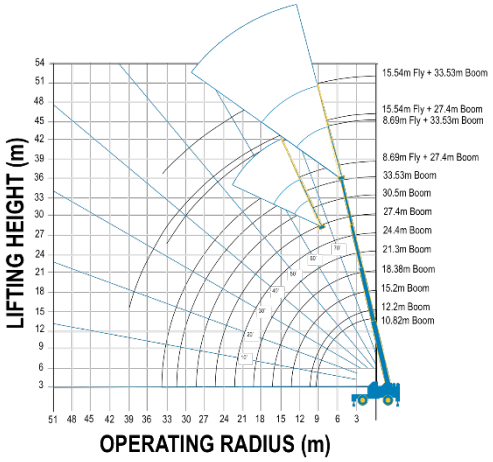
- All numbers **ABOVE** the line are based on structural strength. Overloading the crane in these configurations will result in structural damage to the crane.
- All numbers **BELOW** the line are based on stability. Overloading the crane in these configurations will result in crane instability.

Load charts will contain a range diagram.

As the name suggests, the range diagram is used to work out the lifting range of the crane. This chart indicates what boom length is required to pick up and lift a load in relation to distance and height.

A range diagram may provide the following information:

- Boom elevation height versus height of a building or structure.
- Crane configuration requirements.
- Jib attachment operating radius.
- Minimum allowable clearance between load blocks and the head sheave (tip of boom).



Where a precise reading is not available on the load chart you must always use the higher operating radius. The increased operating radius decreases the rated capacity.

DO NOT risk overloading the crane.

If the load chart is unreadable from age or wear you must not operate the crane. Have the load chart replaced before attempting to lift anything with the crane.

3.1.2 Factors that Affect the Amount a Crane Can Lift

One of the most important things you need to know in order to work out the crane's capacity is the operating radius. This is the distance at which a crane can operate safely with a known weight.

You will need to take into account a number of factors to make sure that you are working within the operating radius of the crane. This can include:

- The boom/jib angle.
- The boom/jib length.
- Boom/jib deflection.

The fly jib may be offset at an angle causing the rated capacity of the crane to decrease.

Boom/jib deflection should also be taken into account when determining the capacity of a crane. Boom/jib deflection is the slight bending of the boom/jib under the weight of the load. Boom/jib deflection can result in a slight increase in the operating radius, which reduces the amount of weight that can be lifted safely by the crane.

Luffing the boom up will decrease the operating radius, allowing the crane to safely lift more.

Before attempting to lift anything you need to calculate the amount of weight that the crane will be lifting. You need to subtract the weight/mass of any lifting gear, including hook block, slings, spreader beams, kibbles and ladles, from the rated capacity to work out the weight of a load that you can safely lift with the crane.

All of these items must be deducted from the rated capacity of the crane to determine the actual rated capacity of the crane at a particular radius.

The hook block may be reeved to gain a mechanical advantage in the lifting gear. A hoist that is using a block with multiple falls of rope (sheaves or parts) may be able to raise a heavier load. Always make sure the load is within the safe range for the crane.

It is important to take into account the forces and loads placed on the crane and the load when conducting operations. This may include:

Dynamic Forces	Caused by the movements of the crane and load.
Wind Loads	Caused by the pressure of wind on the crane or load.

Check that the crane hook has an adequate rated capacity for the loads that are to be lifted. The rated capacity of a hook should be stamped or marked on the hook itself.

3.1.2.1 Crane Capacity Calculations

It is important that you are able to calculate the capacity of different crane configurations using information found on the load chart.

Each crane has a set of documents that outline its unique specifications.

Note: The "Crane Specifications – Slewing Mobile Crane (Up to 60 Tonnes)" is being used for these examples and should not be used for any other purpose.

Example 1 – Lifting on the Main Hook with the Jib Stored

You will often be lifting loads on the main hook, with the jib stored.

Using the "Crane Specifications – Slewing Mobile Crane (Up to 60 Tonnes)" information found in Appendix B, work out the maximum load that can be lifted on the main hook when the crane is to be set up in the following configuration:

Crane Configuration	
Outriggers	Maximum Extension
Main Boom Length	21.30m
Working Radius	12.0m
Operating Area	360° (over side and rear)
Jib	Stored
Lifting Gear	2 Sheave Hook Block

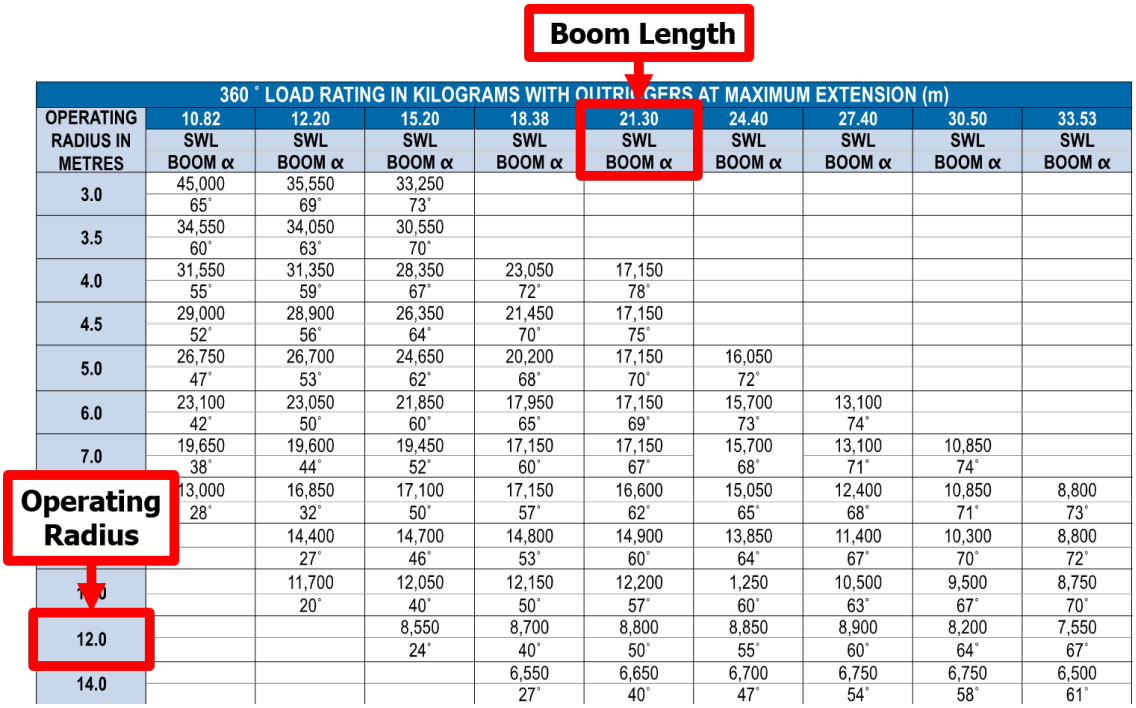
Step 1 – Select the Applicable Load Chart Section
The first step in working out the maximum load is to work out which section of the specifications relates to the configuration of the crane.

This configuration is on outriggers at maximum extension and with an operating area of 360˚ so we will be referring to the "360˚ Load Rating in Kilograms with Outriggers at Maximum Extension (m)" chart.

360 ˚ LOAD RATING IN KILOGRAMS WITH OUTRIGGERS AT MAXIMUM EXTENSION (m)									
OPERATING RADIUS IN METRES	10.82 SWL BOOM α	12.20 SWL BOOM α	15.20 SWL BOOM α	18.38 SWL BOOM α	21.30 SWL BOOM α	24.40 SWL BOOM α	27.40 SWL BOOM α	30.50 SWL BOOM α	33.53 SWL BOOM α
3.0	45,000 65˚	35,550 69˚	33,250 73˚						
3.5	34,550 60˚	34,050 63˚	30,550 70˚						
4.0	31,550 55˚	31,350 59˚	28,350 67˚	23,050 72˚	17,150 78˚				
4.5	29,000 52˚	28,900 56˚	26,350 64˚	21,450 70˚	17,150 75˚				

Step 2 – Determine the Rated Capacity for the Configuration
The second step in working out the maximum load involves using the chart to find the rated capacity that corresponds to the main boom length and the operating radius.

The main boom length is 21.30m and the operating radius is 12.0m.



360 ˚ LOAD RATING IN KILOGRAMS WITH OUTRIGGERS AT MAXIMUM EXTENSION (m)									
OPERATING RADIUS IN METRES	10.82 SWL BOOM α	12.20 SWL BOOM α	15.20 SWL BOOM α	18.38 SWL BOOM α	21.30 SWL BOOM α	24.40 SWL BOOM α	27.40 SWL BOOM α	30.50 SWL BOOM α	33.53 SWL BOOM α
3.0	45,000 65˚	35,550 69˚	33,250 73˚						
3.5	34,550 60˚	34,050 63˚	30,550 70˚						
4.0	31,550 55˚	31,350 59˚	28,350 67˚	23,050 72˚	17,150 78˚				
4.5	29,000 52˚	28,900 56˚	26,350 64˚	21,450 70˚	17,150 75˚				
5.0	26,750 47˚	26,700 53˚	24,650 62˚	20,200 68˚	17,150 70˚	16,050 72˚			
6.0	23,100 42˚	23,050 50˚	21,850 60˚	17,950 65˚	17,150 69˚	15,700 73˚	13,100 74˚		
7.0	19,650 38˚	19,600 44˚	19,450 52˚	17,150 60˚	17,150 67˚	15,700 68˚	13,100 71˚	10,850 74˚	
[illegible]	13,000 28˚	16,850 32˚	17,100 50˚	17,150 57˚	16,600 62˚	15,050 65˚	12,400 68˚	10,850 71˚	8,800 73˚
[illegible]		14,400 27˚	14,700 46˚	14,800 53˚	14,900 60˚	13,850 64˚	11,400 67˚	10,300 70˚	8,800 72˚
[illegible]		11,700 20˚	12,050 40˚	12,150 50˚	12,200 57˚	1,250 60˚	10,500 63˚	9,500 67˚	8,750 70˚
12.0			8,550 24˚	8,700 40˚	8,800 50˚	8,850 55˚	8,900 60˚	8,200 64˚	7,550 67˚
14.0				6,550 27˚	6,650 40˚	6,700 47˚	6,750 54˚	6,750 58˚	6,500 61˚

The intersecting point between the "Main Boom Length" column and "Operating Radius" row contains all of the rated capacity and boom angle information relating to this configuration.

360 ° LOAD RATING IN KILOGRAMS WITH OUTRIGGERS AT MAXIMUM EXTENSION (m)									
OPERATING RADIUS IN METRES	10.82 SWL BOOM α	12.20 SWL BOOM α	15.20 SWL BOOM α	18.38 SWL BOOM α	21.30 SWL BOOM α	24.40 SWL BOOM α	27.40 SWL BOOM α	30.50 SWL BOOM α	33.53 SWL BOOM α
3.0	45,000 65°	35,550 69°	33,250 73°						
3.5	34,550 60°	34,050 63°	30,550 70°						
4.0	31,550 55°	31,350 59°	28,350 67°	23,050 72°	17,150 78°				
4.5	29,000 52°	28,900 56°	26,350 64°	21,450 70°	17,150 75°				
5.0	26,750 47°	26,700 53°	24,650 62°	20,200 68°	17,150 70°	16,050 72°			
6.0	23,100 42°	23,050	21,850	17,950 65°	17,150 69°	15,700 73°	13,100 74°		
7.0	19,650 38°			17,150 60°	17,150 67°	15,700 68°	13,100 71°	10,850 74°	
8.0	13,000 28°			17,150 57°	16,600 62°	15,050 65°	12,400 68°	10,850 71°	8,800 73°
9.0		14,400 27°	14,700 46°	14,800 53°	14,900 60°	13,850 64°	11,400 67°	10,300 70°	8,800 72°
10.0		11,700 20°	12,050 40°	12,150 50°	12,200 57°	1,250 60°	10,500 63°	9,500 67°	8,750 70°
12.0			8,550 24°	8,700 40°	8,800 50°	8,850 55°	8,900 60°	8,200 64°	7,550 67°
14.0				6,350 27°	6,650 40°	6,700 47°	6,750 54°	6,750 58°	6,500 61°
16.0				5,050 14°	5,200 34°	5,250 42°	5,300 49°	5,350 53°	5,350 58°
18.0					4,100 17°	4,200 35°	4,250 43°	4,250 47°	4,300 53°
20.0						3,350 24°	3,400 37°	3,450 43°	3,450 49°
22.0						2,700 10°	2,750 30°	2,800 38°	2,850 45°
24.0							2,250 18°	2,300 31°	2,350 39°
26.0								1,850 24°	1,900 32°
28.0								1,500 19°	1,550 30°
30.0									1,250 17°

8,800
50°

The rated capacity for this configuration is 8800kg, with a boom angle of 50°.

Step 3 – Determine the Weight of Lifting Gear
The third step consists of determining what adjustments (or deductions) need to be made to the rated capacity.

Deductions include the weight of any lifting gear and the jib.

Adjustments:

- The **lifting gear** being used in this example is the two sheave hook block and it weighs 300kg.
- The **jib** is stored on the boom and weighs 400kg.

This makes a total deduction of:
300 + 400 = 700kgs

WEIGHT OF LIFTING EQUIPMENT				
LIFTING GEAR	SINGLE LINE WEIGHTED HOOK	2 SHEAVE HOOK BLOCK	3 SHEAVE HOOK BLOCK	5 SHEAVE HOOK BLOCK
WEIGHT TO BE DEDUCTED FROM SWL	150 kgs	300 kgs	350 kgs	400 kgs

JIB WEIGHTS – BOOM DEDUCTIONS			
BOOM EQUIPPED WITH	JIB STORED	8.69m	15.54m
BOOM DEDUCTION	400 kgs	900 kgs	1800 kgs

Step 4 – Complete Calculations
The fourth step involves subtracting the weight of any lifting gear and the jib from the rated capacity of this configuration.

The maximum load that can be lifted by a configuration can be found by using the following formula:

Maximum Load = Rated Capacity – Weight of Lifting Gear

Maximum Load = Rated Capacity – Weight of Lifting Gear
= 8800kg – 700kg
= 8100kg

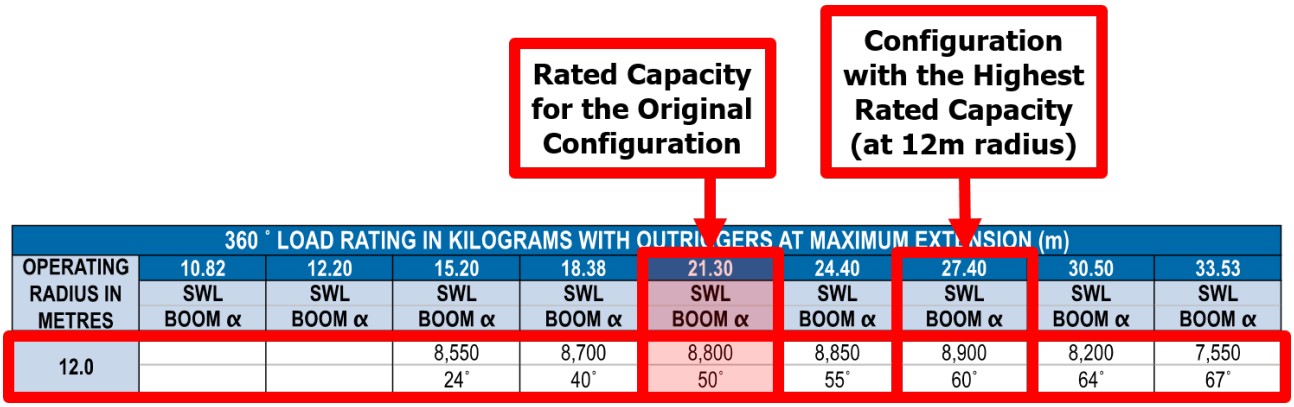
Therefore, the maximum load that could be lifted in this configuration would be **8100kg**.

Increasing the Capacity Using the Same Radius

On some occasions you will need to be determine if a heavier load can be lifted, while keeping the same operating radius.

To determine if this is possible focus on the row with the same operating radius. Using the information from Example 1 this would be the 12.0m radius row.

Looking across the row the highest possible rated capacity occurs when the boom is extended to 27.4 metres, with the capacity increased from 8800kg to 8900kg. This is an increase of 100kg.



360 ˚ LOAD RATING IN KILOGRAMS WITH OUTRIGGERS AT MAXIMUM EXTENSION (m)									
OPERATING RADIUS IN METRES	10.82 SWL BOOM α	12.20 SWL BOOM α	15.20 SWL BOOM α	18.38 SWL BOOM α	21.30 SWL BOOM α	24.40 SWL BOOM α	27.40 SWL BOOM α	30.50 SWL BOOM α	33.53 SWL BOOM α
12.0			8,550 24˚	8,700 40˚	8,800 50˚	8,850 55˚	8,900 60˚	8,200 64˚	7,550 67˚

It is important to note that if the boom is extended past 27.4 metres the capacity decreases.

Example 2 – Lifting on the Main Hook with the Jib Fitted

For some lifts the jib will be fitted to the main boom rather than being stored. Even when the jib is fitted you may still need to lift loads using the main hook.

Use the "Crane Specifications – Slewing Mobile Crane (Up to 60 Tonnes)" found in Appendix B to work out the maximum load that can be lifted on the main hook using the following configuration:

Crane Configuration	
Outriggers	Maximum Extension
Main Boom Length	27.40m
Working Radius	16.0m
Operating Area	360° (over side and rear)
Jib	15.54m Jib fitted with single line auxiliary hook incorporating a 20° offset
Lifting Gear	5 Sheave Hook Block

Step 1 – Select the Applicable Load Chart Section
The first step in working out the maximum load is to work out which section of the specifications relates to the configuration of the crane.

This configuration is on outriggers at maximum extension and with an operating area of 360°. Because the jib is not being used to lift the load we will be referring to the "360° Load Rating in Kilograms with Outriggers at Maximum Extension (m)" chart.

360 ° LOAD RATING IN KILOGRAMS WITH OUTRIGGERS AT MAXIMUM EXTENSION (m)									
OPERATING RADIUS IN METRES	10.82 SWL BOOM α	12.20 SWL BOOM α	15.20 SWL BOOM α	18.38 SWL BOOM α	21.30 SWL BOOM α	24.40 SWL BOOM α	27.40 SWL BOOM α	30.50 SWL BOOM α	33.53 SWL BOOM α
3.0	45,000 65°	35,550 69°	33,250 73°						
3.5	34,550 60°	34,050 63°	30,550 70°						
4.0	31,550 55°	31,350 59°	28,350 67°	23,050 72°	17,150 78°				
4.5	29,000 52°	28,900 56°	26,350 64°	21,450 70°	17,150 75°				

Step 2 – Determine the Rated Capacity for the Configuration
The second step in working out the maximum load involves using the chart to find the rated capacity that corresponds to the main boom length and the operating radius.

The main boom length is 27.40m and the operating radius is 16.0m.

Boom Length

Operating Radius

360 ° LOAD RATING IN KILOGRAMS WITH OUTRIGGERS AT MAXIMUM EXTENSION (m)									
OPERATING RADIUS IN METRES	10.82 SWL BOOM α	12.20 SWL BOOM α	15.20 SWL BOOM α	18.38 SWL BOOM α	21.30 SWL BOOM α	24.40 SWL BOOM α	27.40 SWL BOOM α	30.50 SWL BOOM α	33.53 SWL BOOM α
3.0	45,000 65°	35,550 69°	33,250 73°						
3.5	34,550 60°	34,050 63°	30,550 70°						
4.0	31,550 55°	31,350 59°	28,350 67°	23,050 72°	17,150 78°				
4.5	29,000 52°	28,900 56°	26,350 64°	21,450 70°	17,150 75°				
5.0	26,750 47°	26,700 53°	24,650 62°	20,200 68°	17,150 70°	16,050 72°			
6.0	23,100 42°	23,050 50°	21,850 60°	17,950 65°	17,150 69°	15,700 73°	13,100 74°		
7.0	19,650 38°	19,600 44°	19,450 52°	17,150 60°	17,150 67°	15,700 68°	13,100 71°	10,850 74°	
8.0	13,000 28°	16,850 32°	17,100 50°	17,150 57°	16,600 62°	15,050 65°	12,400 68°	10,850 71°	8,800 73°
		14,400 27°	14,700 46°	14,800 53°	14,900 60°	13,850 64°	11,400 67°	10,300 70°	8,800 72°
		11,700 20°	12,050 40°	12,150 50°	12,200 57°	1,250 60°	10,500 63°	9,500 67°	8,750 70°
12.0			8,550 24°	8,700 40°	8,800 50°	8,850 55°	8,900 60°	8,200 64°	7,550 67°
14.0				6,550 27°	6,650 40°	6,700 47°	6,750 54°	6,750 58°	6,500 61°
16.0				5,050 14°	5,200 34°	5,250 42°	5,300 49°	5,350 53°	5,350 58°
18.0					4,100 17°	4,200 35°	4,250 43°	4,250 47°	4,300 53°

The intersecting point between the "main boom length" column and "operating radius" row contains all of the rated capacity and boom angle information relating to this configuration.

360 ° LOAD RATING IN KILOGRAMS WITH OUTRIGGERS AT MAXIMUM EXTENSION (m)									
OPERATING RADIUS IN METRES	10.82 SWL BOOM α	12.20 SWL BOOM α	15.20 SWL BOOM α	18.38 SWL BOOM α	21.30 SWL BOOM α	24.40 SWL BOOM α	27.40 SWL BOOM α	30.50 SWL BOOM α	33.53 SWL BOOM α
3.0	45,000 65°	35,550 69°	33,250 73°						
3.5	34,550 60°	34,050 63°	30,550 70°						
4.0	31,550 55°	31,350 59°	28,350 67°	23,050 72°	17,150 78°				
4.5	29,000 52°	28,900 56°	26,350 64°	21,450 70°	17,150 75°				
5.0	26,750 47°	26,700 53°	24,650 62°	20,200 68°	17,150 70°	16,050 72°			
6.0	23,100 42°	23,050 50°	21,850 60°	17,950	17,150	15,700 73°	13,100 74°		
7.0	19,650 38°	19,600 44°	19,450 52°			5,700 68°	13,100 71°	10,850 74°	
8.0	13,000 28°	16,850 32°	17,100 50°			5,050 65°	12,400 68°	10,850 71°	8,800 73°
9.0		14,400 27°	14,700 46°			3,850 64°	11,400 67°	10,300 70°	8,800 72°
10.0		11,700 20°	12,050 40°			,250 60°	10,500 63°	9,500 67°	8,750 70°
12.0			8,550 24°	8,700 40°	8,800 50°	8,850 55°	8,900 60°	8,200 64°	7,550 67°
14.0				6,550 27°	6,650 40°	6,700 47°	6,750 54°	6,750 58°	6,500 61°
16.0				5,050 14°	5,200 34°	5,250 42°	5,300 49°	5,350 53°	5,350 58°
18.0					4,100 17°	4,200 35°	4,250 43°	4,250 47°	4,300 53°
20.0						3,350 24°	3,400 37°	3,450 43°	3,450 49°
22.0						2,700 10°	2,750 30°	2,800 38°	2,850 45°
24.0							2,250 18°	2,300 31°	2,350 39°
26.0								1,850 24°	1,900 32°
28.0								1,500 19°	1,550 30°
30.0									1,250 17°

5,300
49°

The rated capacity for this configuration is 5300kg, with a boom angle of 49°.

Step 3 – Determine the Weight of Lifting Gear
The third step consists of determining what adjustments (or deductions) need to be made to the rated capacity.

Deductions include the weight of any lifting gear and the jib.

Adjustments:

- The **lifting gear** being used in this example is the five sheave hook block and it weighs 400kg.
- The **jib** is 15.54m and is fitted on the boom and weighs 1800kg.
- The jib is fitted with a single line weighted hook (**auxiliary hook**), which weighs 150kg.

This makes a total deduction of:
400 + 1800 + 150 = **2350kgs**

WEIGHT OF LIFTING EQUIPMENT				
LIFTING GEAR	SINGLE LINE WEIGHTED HOOK	2 SHEAVE HOOK BLOCK	3 SHEAVE HOOK BLOCK	5 SHEAVE HOOK BLOCK
WEIGHT TO BE DEDUCTED FROM SWL	150 kgs	300 kgs	350 kgs	400 kgs

JIB WEIGHTS – BOOM DEDUCTIONS			
BOOM EQUIPPED WITH	JIB STORED	8.69m	15.54m
BOOM DEDUCTION	400 kgs	900 kgs	1800 kgs

Step 4 – Complete Calculations
The fourth step involves subtracting the weight of any lifting gear and the jib from the rated capacity of this configuration.

The maximum load that can be lifted by a configuration can be found by using the following formula:

Maximum Load = Rated Capacity – Weight of Lifting Gear

Maximum Load = Rated Capacity – Weight of Lifting Gear
= 5300kg – 2350kg
= 1950kg

Therefore, the maximum load that could be lifted in this configuration would be **1950kg.**

Increasing the Capacity Using the Same Radius

On some occasions you will need to be determine if a heavier load can be lifted, while keeping the same operating radius.

To determine if this is possible focus on the row with the same operating radius. Using the information from Example 2 this would be the 16.0m radius row.

Looking across the row the highest possible rated capacity occurs when the boom is extended to 33.53 metres, with the capacity increased from 5300kg to 5350kg. This is an increase of 50kg.

Rated Capacity for the Original Configuration

Configuration with the Highest Rated Capacity (at 16m radius)

360 ° LOAD RATING IN KILOGRAMS WITH OUTRIGGERS AT MAXIMUM EXTENSION (m)									
OPERATING RADIUS IN METRES	10.82 SWL BOOM α	12.20 SWL BOOM α	15.20 SWL BOOM α	18.38 SWL BOOM α	21.30 SWL BOOM α	24.40 SWL BOOM α	27.40 SWL BOOM α	30.50 SWL BOOM α	33.53 SWL BOOM α
16.0				5,050 14°	5,200 34°	5,250 42°	5,300 49°	5,350 53°	5,350 58°

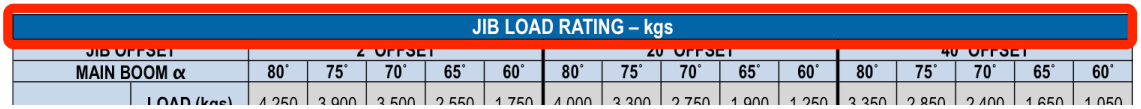
Example 3 – Lifting on the Auxiliary Hook with the Jib Fitted (Based on Radius)

When the jib is fitted a load can also be raised on the hook fitted to the jib, which is the auxiliary hook.

The maximum load that can be raised on the auxiliary hook using the same configuration details as in Example 2 can also be found by referring to "Crane Specifications – Slewing Mobile Crane (Up to 60 Tonnes)" found in Appendix B.

Step 1 – Select the Applicable Load Chart Section
The first step to finding the maximum load that a configuration can lift is to locate the relevant information in the crane specifications.

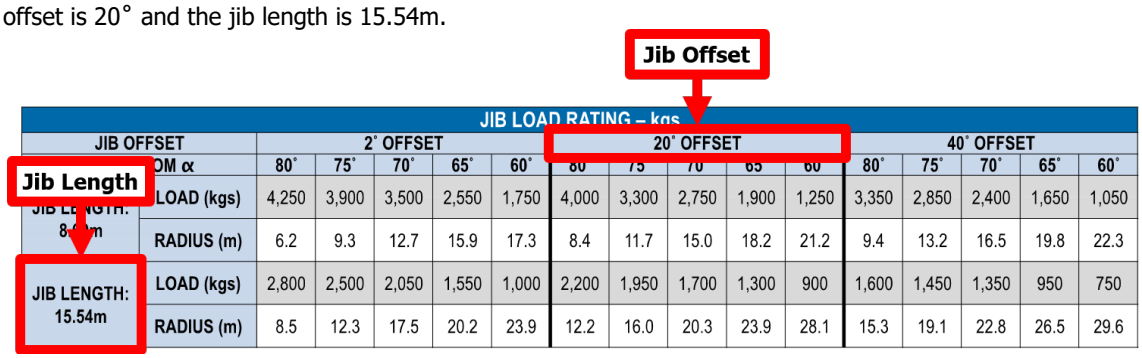
For this configuration we will be using the "Jib Load Rating – kgs" table because the auxiliary hook is fitted to the jib.



JIB LOAD RATING – kgs																
JIB OFFSET		2˚ OFFSET					20˚ OFFSET					40˚ OFFSET				
MAIN BOOM α		80˚	75˚	70˚	65˚	60˚	80˚	75˚	70˚	65˚	60˚	80˚	75˚	70˚	65˚	60˚
	LOAD (kgs)	4,250	3,900	3,500	2,550	1,750	4,000	3,300	2,750	1,900	1,250	3,350	2,850	2,400	1,650	1,050

Step 2 – Determine the Rated Capacity for the Configuration
The second step in working out the maximum load involves using the chart to find the rated capacity that corresponds to the offset, jib length and the operating radius.

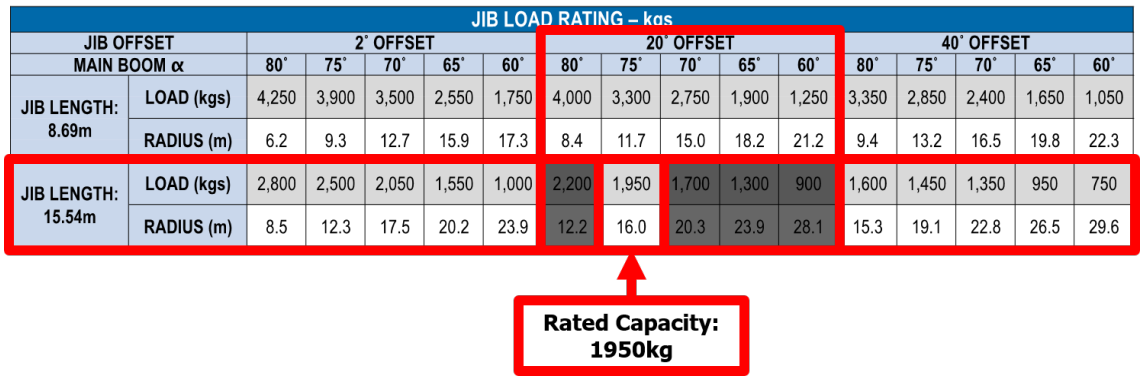
The jib offset is 20° and the jib length is 15.54m.



JIB LOAD RATING – kgs																
JIB OFFSET		2˚ OFFSET					20˚ OFFSET					40˚ OFFSET				
MAIN BOOM α		80˚	75˚	70˚	65˚	60˚	80˚	75˚	70˚	65˚	60˚	80˚	75˚	70˚	65˚	60˚
JIB LENGTH: 8.69m	LOAD (kgs)	4,250	3,900	3,500	2,550	1,750	4,000	3,300	2,750	1,900	1,250	3,350	2,850	2,400	1,650	1,050
	RADIUS (m)	6.2	9.3	12.7	15.9	17.3	8.4	11.7	15.0	18.2	21.2	9.4	13.2	16.5	19.8	22.3
JIB LENGTH: 15.54m	LOAD (kgs)	2,800	2,500	2,050	1,550	1,000	2,200	1,950	1,700	1,300	900	1,600	1,450	1,350	950	750
	RADIUS (m)	8.5	12.3	17.5	20.2	23.9	12.2	16.0	20.3	23.9	28.1	15.3	19.1	22.8	26.5	29.6

The intersecting point between the "Offset" column and "Jib Length" row contains the information for different operating radius lengths.

The operating radius we require is 16.0m. The rated capacity for this configuration can be found in the corresponding load row.



JIB LOAD RATING – kgs																
JIB OFFSET		2˚ OFFSET					20˚ OFFSET					40˚ OFFSET				
MAIN BOOM α		80˚	75˚	70˚	65˚	60˚	80˚	75˚	70˚	65˚	60˚	80˚	75˚	70˚	65˚	60˚
JIB LENGTH: 8.69m	LOAD (kgs)	4,250	3,900	3,500	2,550	1,750	4,000	3,300	2,750	1,900	1,250	3,350	2,850	2,400	1,650	1,050
	RADIUS (m)	6.2	9.3	12.7	15.9	17.3	8.4	11.7	15.0	18.2	21.2	9.4	13.2	16.5	19.8	22.3
JIB LENGTH: 15.54m	LOAD (kgs)	2,800	2,500	2,050	1,550	1,000	2,200	1,950	1,700	1,300	900	1,600	1,450	1,350	950	750
	RADIUS (m)	8.5	12.3	17.5	20.2	23.9	12.2	16.0	20.3	23.9	28.1	15.3	19.1	22.8	26.5	29.6

The rated capacity for this configuration is 1950kg.

If the exact required radius is not listed you should go to the next highest radius. For example, if the required radius was 15 metres, the next **highest** radius would be 16 metres.

Step 3 – Determine the Weight of Lifting Gear
The third step consists of determining what adjustments (or deductions) need to be made to the rated capacity.

Deductions include the weight of any lifting gear. The jib does not need to be deducted because the Jib Load Rating has already been included the rated capacity amount.

Adjustments:
- The **lifting gear** being used in this example is the five sheave hook block and it weighs 400kg.
- The jib is fitted with a single line weighted hook (**auxiliary hook**), which weighs 150kg.

This makes a total deduction of:
400 + 150 = **550kg**

WEIGHT OF LIFTING EQUIPMENT				
LIFTING GEAR	SINGLE LINE WEIGHTED HOOK	2 SHEAVE HOOK BLOCK	3 SHEAVE HOOK BLOCK	5 SHEAVE HOOK BLOCK
WEIGHT TO BE DEDUCTED FROM SWL	150 kgs	300 kgs	350 kgs	400 kgs

Step 4 – Complete Calculations
The maximum load that can be lifted by a configuration can be found by using the following formula:

Maximum Load = Rated Capacity – Weight of Lifting Gear

Maximum Load = Rated Capacity – Weight of lifting gear
= 1950kg – 550kg
= 1400kg

Therefore, the maximum load that could be lifted in this configuration would be **1400kg.**

Example 4 – Lifting on the Auxiliary Hook with the Jib Fitted (Based on Angle)

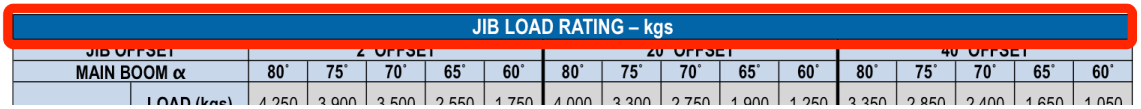
During some lifts the required configuration will be based on a required boom angle, rather than the radius.

Use the "Crane Specifications – Slewing Mobile Crane (Up to 60 Tonnes)" found in Appendix B to work out the maximum load that can be lifted on the auxiliary hook using the configuration from Example 2, using the boom angle, rather than a required working radius.

Crane Configuration	
Outriggers	Maximum Extension
Main Boom Length	27.40m
Boom Angle	65°
Operating Area	360° (over side and rear)
Jib	15.54m Jib fitted with single line auxiliary hook incorporating a 20° offset
Lifting Gear	5 Sheave Hook Block

Step 1 – Select the Applicable Load Chart Section
The first step to finding the maximum load that a configuration can lift is to locate the relevant information in the crane specifications.

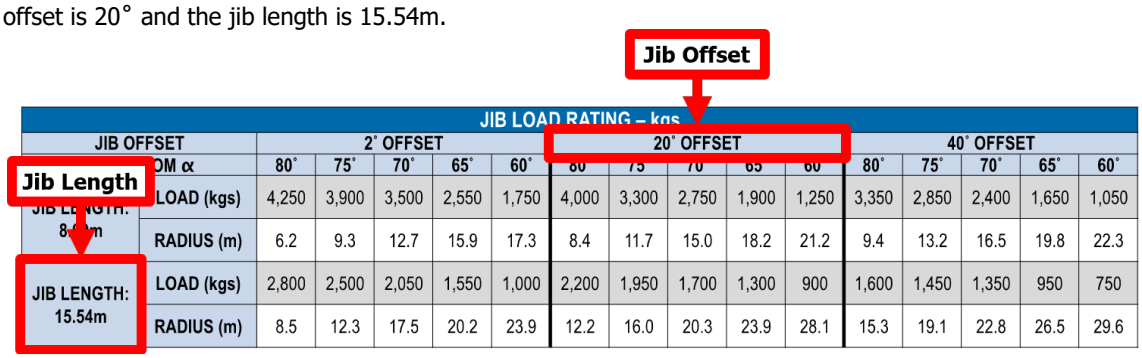
For this configuration we will be using the "Jib Load Rating – kgs" table because the auxiliary hook is fitted to the jib.



JIB LOAD RATING – kgs																
JIB OFFSET		2° OFFSET					20° OFFSET					40° OFFSET				
MAIN BOOM α		80°	75°	70°	65°	60°	80°	75°	70°	65°	60°	80°	75°	70°	65°	60°
	LOAD (kgs)	4,250	3,900	3,500	2,550	1,750	4,000	3,300	2,750	1,900	1,250	3,350	2,850	2,400	1,650	1,050

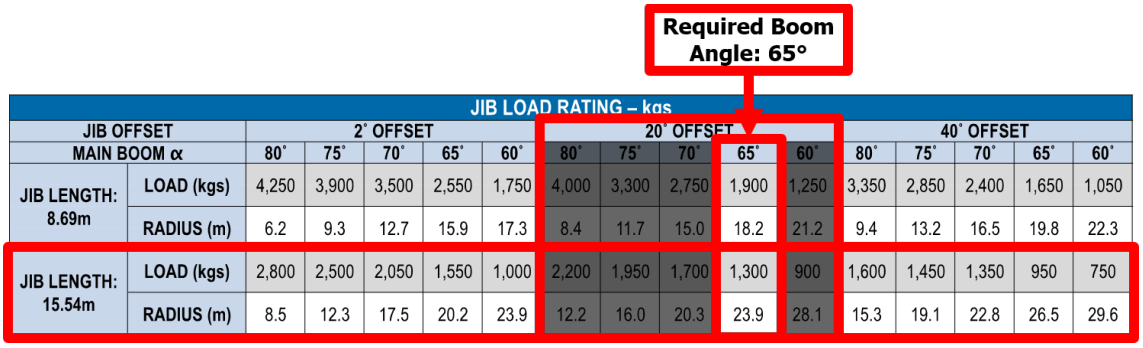
Step 2 – Determine the Rated Capacity for the Configuration
The second step in working out the maximum load involves using the chart to find the rated capacity that corresponds to the offset, jib length and the boom angle.

The jib offset is 20° and the jib length is 15.54m.



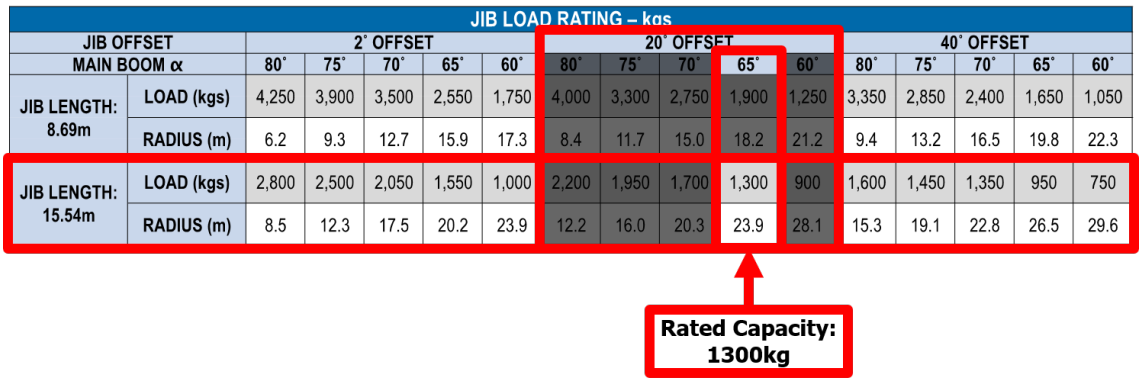
JIB LOAD RATING – kgs																
JIB OFFSET		2° OFFSET					20° OFFSET					40° OFFSET				
MAIN BOOM α		80°	75°	70°	65°	60°	80°	75°	70°	65°	60°	80°	75°	70°	65°	60°
JIB LENGTH: 8.69m	LOAD (kgs)	4,250	3,900	3,500	2,550	1,750	4,000	3,300	2,750	1,900	1,250	3,350	2,850	2,400	1,650	1,050
	RADIUS (m)	6.2	9.3	12.7	15.9	17.3	8.4	11.7	15.0	18.2	21.2	9.4	13.2	16.5	19.8	22.3
JIB LENGTH: 15.54m	LOAD (kgs)	2,800	2,500	2,050	1,550	1,000	2,200	1,950	1,700	1,300	900	1,600	1,450	1,350	950	750
	RADIUS (m)	8.5	12.3	17.5	20.2	23.9	12.2	16.0	20.3	23.9	28.1	15.3	19.1	22.8	26.5	29.6

The required boom angle is 65°.



JIB LOAD RATING – kgs																
JIB OFFSET		2° OFFSET					20° OFFSET					40° OFFSET				
MAIN BOOM α		80°	75°	70°	65°	60°	80°	75°	70°	65°	60°	80°	75°	70°	65°	60°
JIB LENGTH: 8.69m	LOAD (kgs)	4,250	3,900	3,500	2,550	1,750	4,000	3,300	2,750	1,900	1,250	3,350	2,850	2,400	1,650	1,050
	RADIUS (m)	6.2	9.3	12.7	15.9	17.3	8.4	11.7	15.0	18.2	21.2	9.4	13.2	16.5	19.8	22.3
JIB LENGTH: 15.54m	LOAD (kgs)	2,800	2,500	2,050	1,550	1,000	2,200	1,950	1,700	1,300	900	1,600	1,450	1,350	950	750
	RADIUS (m)	8.5	12.3	17.5	20.2	23.9	12.2	16.0	20.3	23.9	28.1	15.3	19.1	22.8	26.5	29.6

The rated capacity for this configuration can be found in the corresponding load row for the 15.54m length jib.



JIB LOAD RATING – kgs																
JIB OFFSET		2° OFFSET					20° OFFSET					40° OFFSET				
MAIN BOOM α		80°	75°	70°	65°	60°	80°	75°	70°	65°	60°	80°	75°	70°	65°	60°
JIB LENGTH: 8.69m	LOAD (kgs)	4,250	3,900	3,500	2,550	1,750	4,000	3,300	2,750	1,900	1,250	3,350	2,850	2,400	1,650	1,050
	RADIUS (m)	6.2	9.3	12.7	15.9	17.3	8.4	11.7	15.0	18.2	21.2	9.4	13.2	16.5	19.8	22.3
JIB LENGTH: 15.54m	LOAD (kgs)	2,800	2,500	2,050	1,550	1,000	2,200	1,950	1,700	1,300	900	1,600	1,450	1,350	950	750
	RADIUS (m)	8.5	12.3	17.5	20.2	23.9	12.2	16.0	20.3	23.9	28.1	15.3	19.1	22.8	26.5	29.6

The rated capacity for this configuration is 1300kg.

Step 3 – Determine the Weight of Lifting Gear
The third step consists of determining what adjustments (or deductions) need to be made to the rated capacity.

Deductions include the weight of any lifting gear. The weight of the jib does not need to be deducted in this configuration because the Jib Load Rating has already been factored into the rated capacity amount.

Adjustments:
- The **lifting gear** being used in this example is the five sheave hook block and it weighs 400kg.
- The jib is fitted with a single line weighted hook (**auxiliary hook**), which weighs 150kg.

This makes a total deduction of:
400 + 150 = **550kg**

WEIGHT OF LIFTING EQUIPMENT				
LIFTING GEAR	SINGLE LINE WEIGHTED HOOK	2 SHEAVE HOOK BLOCK	3 SHEAVE HOOK BLOCK	5 SHEAVE HOOK BLOCK
WEIGHT TO BE DEDUCTED FROM SWL	150 kgs	300 kgs	350 kgs	400 kgs

Step 4 – Complete Calculations
The maximum load that can be lifted by a configuration can be found by using the following formula:

Maximum Load = Rated Capacity – Weight of Lifting Gear

Maximum Load = Rated Capacity – Weight of lifting gear
= 1300kg - 550kg
= 750kg

Therefore, the maximum load that could be lifted in this configuration would be **750kg.**

3.1.3 Review Work Plans and Information

Before starting any crane operations you will need to make sure that all necessary factors have been considered so that you can do any lifts safely. Make sure you have taken into account the following:

- The weights and dimensions (sizes) of the loads you need to move.
- The chosen crane is capable of lifting these loads.
- Access to and egress from the areas you are working in or the routes you need to take, including the loading and set-down sites.
- Hazards and obstructions been dealt with.
- The radius of the lift and crane.
- Potential boom deflection when releasing a load.

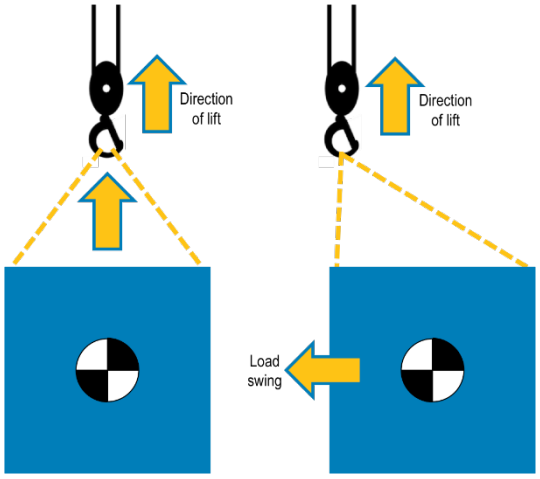
When you are confident that all necessary factors have been considered and all potential problems dealt with you will be able to start operations.

If you find that any hazard control measures are not in place or are inadequate (don't minimise the risk enough) you should report this to your supervisor or other authorised person before continuing with the work.

3.2 Position the Crane Hook

The crane hook should be positioned above the centre of gravity of the load before lifting operations are commenced. This will help to keep the load from swinging out of control, slipping from the sling arrangement when it is lifted, or being dragged or snigged when it is moved.

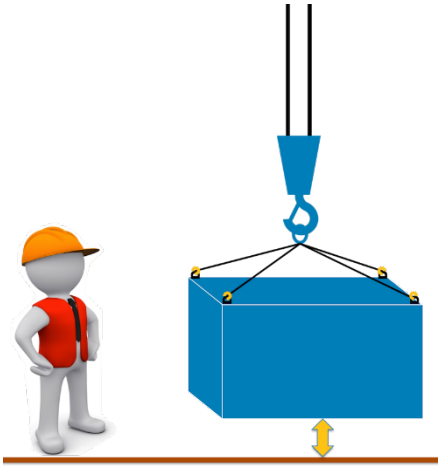
Get the dogger or rigger to guide you to make sure the crane hook is positioned correctly above the load. The load will then need to be connected to the hook/lifting gear as set out in the lift plan. Make sure you follow the directions and instructions of the dogger or rigger during the positioning and connection and throughout the lift.



3.3 Conduct a Test Lift

Before moving the load it is important to conduct a test lift.

A test lift is performed by raising the load slightly off the lifting plane (e.g. ground or truck bed). Associated personnel such as doggers and riggers will be able to determine if the load is slung correctly by the amount the load moves as it is lifted.



Conducting a test lift will allow you to check that:

- The load is:
  - Stable.
  - Secure.
  - The expected weight.
- The crane is:
  - Working correctly.
  - Stable.

Test lifts can also be used to ensure that:

- Load measuring equipment can be used to verify the calculated weight of the load.
- Near-capacity loads do not overload the crane.
- Loads of unusual shape or weight distributions are slung correctly.
- All crane equipment is functioning properly.
- Adjustments to the slinging can be made in a safe manner.

If there are any problems with the lift (e.g. the load is unstable or slung incorrectly) then you should lower the load immediately and make the necessary adjustments before conducting another test lift. Don't continue working until the issues have been addressed and fixed.

3.4 Follow Communication Signals

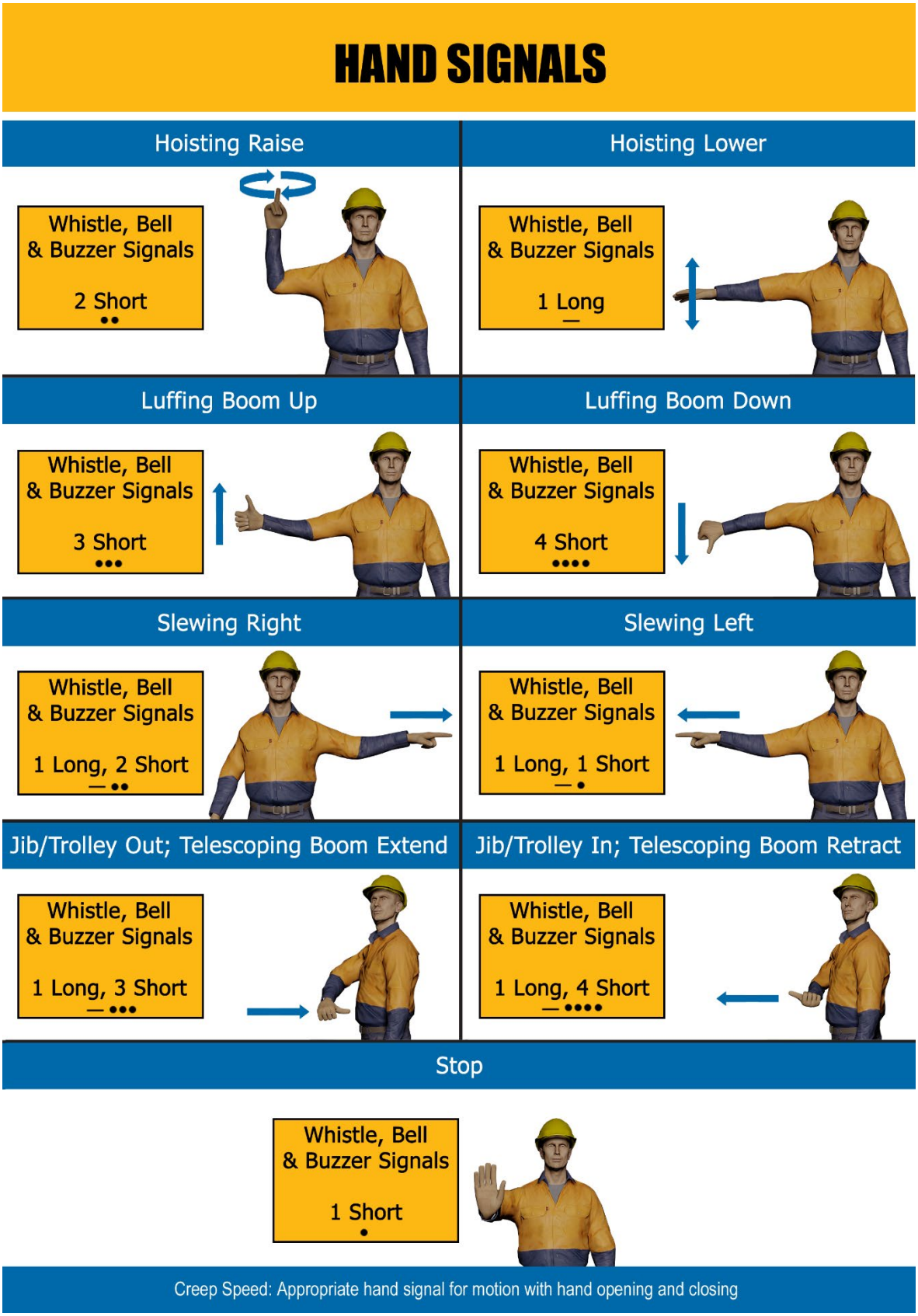
Always follow the directions given to you by the person dogging the load. To direct you they may use:

- Hand signals.
- Whistle signals.
- Two-way radios.

They may also use verbal communication, particularly when planning the move or discussing the work.

If at any point you are unsure of the directions being given to you, stop all crane motions and confirm the instructions with the person giving them (dogger, spotter or observer).

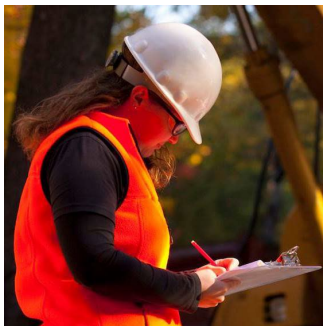
Shown here are the hand and whistle signals used in Australia:



3.5 Operate the Crane

Once you are satisfied that the load is ready to be moved safely, begin the lift. If your view is obstructed, get a competent person to warn you of any hazards in the path of the load.

If new or unforeseen hazards appear while operations are being carried out, you will need to stop and control them before carrying on with your work.



Always operate the crane according to procedures, including:

- Manufacturer's guidelines.
- Industry operating procedures.
- Workplace procedures.

Consult the crane's load charts and manufacturer's specifications to find information when deciding which side of a rubber-rated crane is the most stable to lift a load over.

3.5.1 Crane Movements

Follow all appropriate procedures and standards when transferring loads.

You can ensure the stability of the crane during load shifting by following these practices:

- Make sure the crane is set up properly, in accordance with the manufacturer's instructions.
- Only shift loads that are less than the cranes maximum capacity for the current configuration.
- Monitor the crane computer throughout the movement of the load.
- Do not operate the crane in wind speeds that are higher than the rated limit set by the manufacturer.
- Avoid any practice that could lead to shock loading.

Make sure all crane movements are controlled and smooth. Quick or jerky movements may cause the load to swing, increasing the operating radius to a dangerous length resulting in carrier instability or structural damage to the crane.

Relevant crane movements will be determined by the task requirements. They may include:

- Moving the boom/jib up and down, otherwise known as luffing.
- Operating the outriggers/stabilisers.
- Raising and lowering the hoist.
- Slewing the boom/jib.
- Telescoping in and out.
- Travelling or mobiling the crane.

Consult the load chart to find out what effect slewing the boom from the front of the vehicle to the back of the vehicle will have on the lifting capacity of the crane (it may vary a great deal).

Always stay within the safe operating radius of the crane.

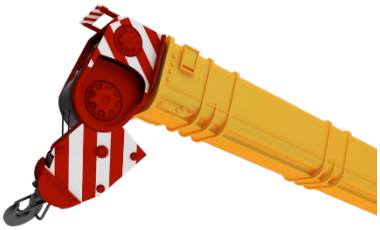
If at any time the crane cannot function to its full range of movements, you must:

- Tag out the crane.
- Log the issue in the crane logbook.
- Report the issue following workplace requirements.

3.5.2 Double Blocking

A hoist limit or cut-out switch can be used to stop the winch or warn the operator before the hook block makes contact with the head block.

If the hoist limit switch is exceeded this can cause damage to the crane by the hook/block assembly being dragged into the head sheaves, or double blocking (sometimes known as two-blocking), which prevents further winding up of the hoist drum.



Double blocking can result in the following:

- Broken Flexible Steel Wire Rope (FSWR).
- Dropped load.
- Damaged sheave.
- Structural damage to the crane.

Ensure that the hoist limit/cut-out switch is checked and fully functioning before operating the crane.

3.5.3 Lifting Personnel

If you are going to lift personnel with a crane you will need to use a workbox that meets all the necessary requirements of the workplace, the crane manufacturer and Australian Standards.

When lifting personnel with the crane, ensure that the dogger is located in a position where they can safely observe and direct the movements of the crane.

3.5.4 Using Taglines

If associated personnel are involved in the lift, the dogger may use a tagline to assist in controlling the load and the safe landing of the load.

It is necessary to use a tagline when working near overhead power lines or if there is a risk of a loss of control during the landing process.

Dry non-conductive rope, dry natural fibre rope or dry natural rope should be used as taglines to reduce any risk of conductivity.

Non-conductive ropes should be used as taglines to reduce any risk of conductivity.

Make sure the tagline is **at least** 16mm diameter.

3.5.5 Monitor the Movement of the Load

It is important to continually monitor the movement of the load to make sure the load remains safe, that no workers are put in danger and that the crane remains stable. This enables you to identify and control any hazards that may occur while moving a load. You will also be able to monitor for and catch any load swing that may occur and adjust movements accordingly, such as driving into the sway, timing crane movement, and centering the crane over the load.

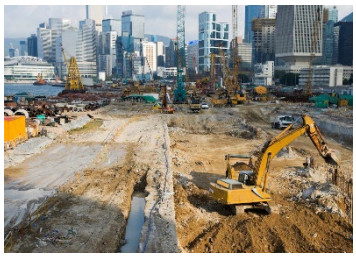
Do not raise or lower the boom or load over workers or pedestrians. This is extremely dangerous and could result in a serious injury or death.

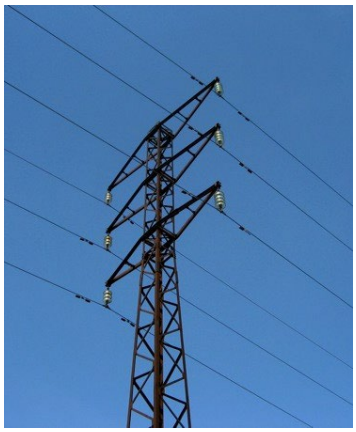
Never drag or snig the load as this may cause the crane to overload, cause damage to the crane, load or lifting equipment, or cause the crane to become unstable.

3.6 Review the Route of Travel

Before moving off with the crane and load check that the path of movement is appropriate for the crane.

You should check the route of travel for:





- Uneven or dangerous terrain and other obstacles or obstructions.
- Hazards that may have appeared while you have been operating the crane.
- All surfaces over which you are to travel can take the weight of the crane.
- Potholes and soft or rough ground.
- Power lines.
- Overhead obstructions.
- Obstacles.
- Workers in the area.
- Blind corners.
- Traffic flow.
- Underground services.

Organise to have materials moved out of the way where possible and have traffic controlled to prevent an accident.

3.7 Configure the Crane to Mobile Loads

Configure the crane to mobile the load according to the manufacturer's instructions.

If you are required to mobile the crane with a load on the hook make sure the crane boom and rope are configured with the boom retracted and lowered, with minimal fall in the rope, and as close to the ground as is reasonably possible.

Make sure all outriggers/stabilisers are stowed and locked before the crane is mobiled. Store all loose components and restrain the boom according to procedures. Disengage all drives and put the controls in the off position. Release any brakes and prepare to mobile the crane.

3.8 Mobile the Load

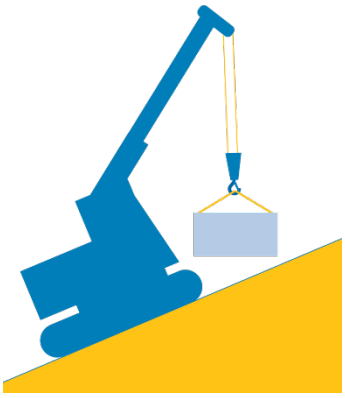
Follow all safety procedures while mobiling a load including:

- Keep to an appropriate speed. This could be:
  - A speed that is safe for the working environment.
  - As slow as possible.
  - At walking pace.
- Accelerate and brake gently to minimise load swing.
- Keep the boom/jib at a minimum length.
- Keep the load as close to the ground as possible.
- Keep the boom/jib as low as possible and in line with the crane.
- If possible, try to stay on a firm, level surface while mobiling a load as this will keep the crane stable and keep the amount of load swing to a minimum.
- Keep the load stable by using taglines.

Mobiling Loads on Slopes or Inclines

Extra care needs to be taken when mobiling loads on slopes or inclines. To do this safely you should:

- Always have the load facing uphill when moving up or down a hill.
- Be aware of the ground conditions – smooth, even, slippery, side slope etc.
- Consider:
  - Rated capacity of the crane.
  - Speed of travel – it may be different to mobiling on level surfaces.
  - Load swing.
  - Having load as close to the ground as possible and safe.
  - Minimum boom extension and angle.
  - Angle of the incline.
- Operate in accordance with the crane load chart and manufacturer's instructions.



Mobiling a load up an incline is hazardous and you will need to be careful that the crane does not lose stability.

3.8.1 Monitor Weather Conditions

Keep an eye on the weather conditions around the crane.

Be particularly careful of the effect of wind. The force of wind may cause the load to swing or spin around or cause crane instability or damage. Wind pressure could also damage the load or cause the crane to slew out of control.

Facing the crane into the wind may force the boom back into the crane causing structural damage to the crane. It may also cause the crane to tip backwards. The effect will depend on the type of crane superstructure.

The effect of wind during load shifting operations can be minimised by applying the slew brake, lowering the load and making it safe, confirming that the slew brake is applied, applying guy ropes and braces or by stopping work completely.

If wind speeds exceed the allowable limits for the crane you will need to lower the load and make the crane and load safe.

Check the manufacturer's specifications, load chart, operator's manual or the crane itself for information related to maximum allowable wind speeds for operations.

If a severe electrical storm is approaching, you should lower the load and pack up the crane. Do not operate the crane during an electrical storm.

If it begins to rain heavily and you have to stop operating the crane for a period of time, you must re-check the ground conditions before recommencing work. If the ground has become unsuitable you will have to move the crane to a new position.

3.8.2 Land the Load

It is important to minimise upwards boom/jib movement when releasing a heavy load from the crane hook. Slowly and smoothly release the load, lowering the boom/jib a fraction to compensate for any upward movement.

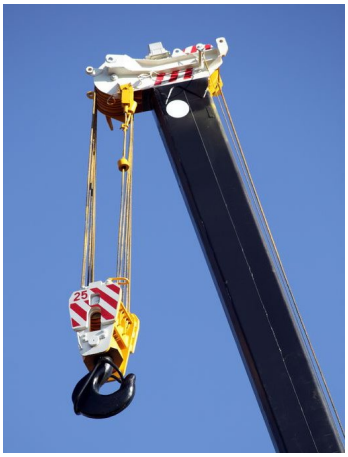
Land the load at the prepared load destination. The load destination should be prepared to ensure that the load is stable and secure from movement once landed. Loads should be landed on blocks or packing (where necessary) to allow the safe removal of the lifting gear.

Round loads should be chocked to prevent the load from rolling or shifting once the lifting gear is removed. Lifting equipment should be properly stored or prepared for the next task.

Do not continue to winch/luff down after landing the load or hook block. This can cause bird nesting, loose spooling of the winch wire or unsheaved rope in the sheaves.

Make sure you continue to monitor the load while it is being disconnected from the hook or lifting gear to make sure it is safe and that the crane doesn't move during this process as it could cause injury to the dogger/rigger or damage the load if the boom or hook move and hits them.

Do not leave the crane controls until you have done the following:



1. Made sure the crane is not still carrying a load.
2. Raised the crane hook to a safe height.
3. Shut down the crane according to the manufacturer's specifications.
4. Folded/retracted the boom (if applicable).
5. Secured the crane against unauthorised use.

No load should be allowed to remain suspended on the hook if the crane is going to be left unattended. Leaving the load suspended from the hook creates the risk that the load may lower, swing or become unstable.

3.8.2.1 Remove Lifting Gear

Make sure you continue to monitor the load while it is being disconnected from the hook or lifting gear to make sure it is safe and that the crane doesn't move during this process as it could cause injury to the dogger/rigger or damage the load if the boom or hook move and hits them.

If the lifting gear is remaining on the crane hook it needs to be raised up to a safe height and out of the way, avoiding any personnel or obstructions.

Otherwise, the lifting gear should be removed from the crane hook and the load and stored safely to avoid damaging it.

3.8.2.2 Inspect Lifting Gear

After the work is completed all lifting gear that was used needs to be checked for any signs of damage that would render it unsafe for future use. This inspection needs to be done by an authorised person such as a qualified dogger or rigger.

The same indicators of wear or damage that are checked for before using the equipment should be looked for again, after using it.

Any defective equipment that is identified needs to be tagged out and isolated to ensure it is not used by anyone else until it can be replaced or repaired. All defects need to be reported in accordance with workplace procedures. This may include both verbal and written reporting.

Written records should be completed and submitted to the appropriate person. A standard form should be available at the workplace for reporting equipment defects.

3.9 Unplanned and Unsafe Situations

Unplanned or unsafe situations can occur at any time while you are operating a crane. These may include:

- Failure/loss of control (e.g. brakes, steering).
- Failure of equipment (e.g. hydraulic system).
- Environmental conditions (e.g. wind, lightning, storms).
- Obstacles and obstructions.
- Unusual or difficult terrains.

If an unsafe incident occurs whilst you are operating a crane you will need to:

1. Stop work immediately and if it is safe to do so.
2. Assess the problem.
3. Find a solution if possible (resolve the problem).
4. If needed, seek advice and assistance.
5. Report the incident according to procedures.

3.9.1 Crane Malfunctioning

Keep a look out for indications that the crane is malfunctioning, including warning lights, cut-outs and alarms, during crane operations. They may indicate that a defect has occurred.

If you observe these warning signs you will need to do the following:

1. Stop.
2. Identify the problem.
3. Slowly lower the load, ensuring it is under control.
4. Tag out the crane.
5. Report the problem to the appropriate person.
6. Fill out the logbook.
7. **Do not** use the crane until the problem has been fixed.

3.9.2 Problem with a Limiting Device

If you found a limiting device had been damaged or was not working correctly you would need to take the following steps:

- Stop working immediately.
- If you are carrying a load, notify the person dogging the load and anybody else in the immediate area, then it should be lowered to the ground (if safe to do so).
- Put a danger tag on the crane.
- Report the problem to an appropriate person.
- Record the issue in the logbook for repair so any defects can be fixed.

3.9.3 Abnormal Noises and Vibrations

If at any time during the shifting of loads there is an abnormal movement of the boom or hoist, such as vibrations, or abnormal noises you should immediately:

1. Notify the dogman and anyone in the immediate area.
2. Stop the operation/task.
3. Lower the load (if applicable).
4. Shut down the crane.
5. Tag out the crane.
6. Report the problem to the appropriate person.
7. Have the crane inspected to check for any damage caused.
8. Fill out the logbook.
9. **Do not** use the crane until the problem has been fixed.

3.9.4 Loose Connection Pins

If you notice during operations that the connection pins on the lattice boom section on a pin jib crane are loose, you will need to stop work straight away and contact an authorised person (e.g. supervisor).

3.9.5 Problem with the Crane's Computer or Visual Display

If the computer or visual display is not working correctly when lifting loads, you will need to:

1. Slowly lower the load, ensuring it is under control (if applicable).
2. Shut down the crane.
3. Assess the computer or visual display unit and decide if the problem can immediately be fixed.
4. Tag out the crane.
5. Refer to the load chart.
6. Report the problem to the appropriate person.
7. Fill out the logbook.
8. **Do not** use the crane until the problem has been fixed.

3.9.6 Unstable Crane or Load

If the crane becomes unstable during operations (e.g. an outrigger pad begins to sink), you will need to lower the load, stop operating the crane, assess the situation and seek help.

If the outrigger packing begins to sink into the ground during crane operation, you must immediately:

1. Lower the load if it safe and appropriate.
2. Stop operations.
3. Assess the situation.
4. Seek assistance.
5. Report the issue to the appropriate person.

If at any time the load becomes unstable, stop and lower the load (if safe to do so) and address the reason for the instability (e.g. lifting gear, crane, weather conditions).

3.9.7 Contact with Power Lines and Other Electrical Emergencies

Emergency situations involving electricity are extremely serious as injury or death can occur very quickly. A timely and effective response is necessary to deal with the situation.

If the crane comes into contact with overhead power lines or the dogger shows signs of electrocution from the crane hook you will need to:

- DO NOT touch anyone who is being electrocuted or is in contact with power lines.
- Warn others to stay away.
- Try to break the contact with the power line.
- Stop the crane.
- If it is safe to do so, stay in the crane. If this isn't possible, jump clear of the crane and then hop or shuffle away, at least 8 metres from the closest part of the crane. The emergency descent device may also need to be activated.
- Call for help.
- Render any assistance required.
- Secure the area.
- Follow the site procedures for first aid and reporting incidents.
- Report to the required parties:
  - Management.
  - Power company.
  - Safety regulator.
- Before reusing the crane have it checked and approved for use.

3.10 Workplace Emergencies

Site emergencies may include:

- Fire (electrical, chemical, gas, mechanical, paper, wood or natural).
- Gas leak.
- Toxic and/or flammable vapour emissions.
- Vehicle/machine accident.
- Chemical spill.
- Injury to workers.
- Structural collapse.

Always communicate with the person dogging the load prior to leaving the crane.

3.10.1 Emergency Response

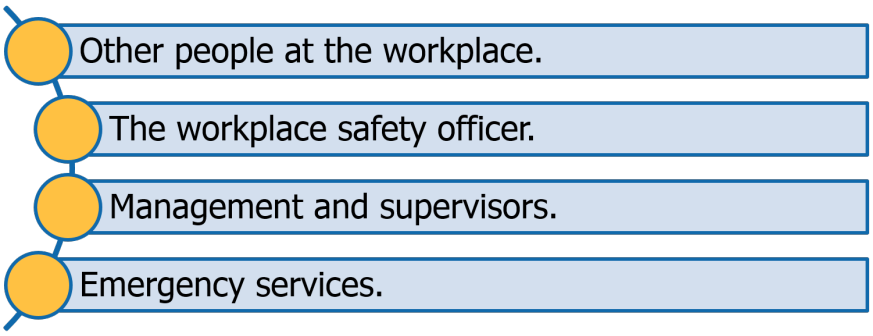
If an emergency situation arises it is essential to communicate the important information. You should communicate:

- That an emergency situation exists.
- The nature of the emergency (e.g. fire, structure collapse).
- Where the emergency is and the unsafe area/s.

Always follow the emergency procedures for the workplace, such as evacuating personnel or contacting the first aid officer.

3.10.2 Reporting an Emergency

There are a number of people that will need to be told about the emergency. These include:



When calling emergency services (dial 000) let the operator know the following details:

- Where the emergency is.
- What has happened.
- What is being done to address the emergency.
- Your name.

Do not hang up the phone until you have been given instructions on how to proceed.

3.10.3 First Aid

First Aid kits must be supplied by your employer. The location of these kits should be clearly marked with signage.

In the case of an emergency where somebody requires first aid, notify your supervisor or first aid officer and they will take action.

3.11 Conclude Operations

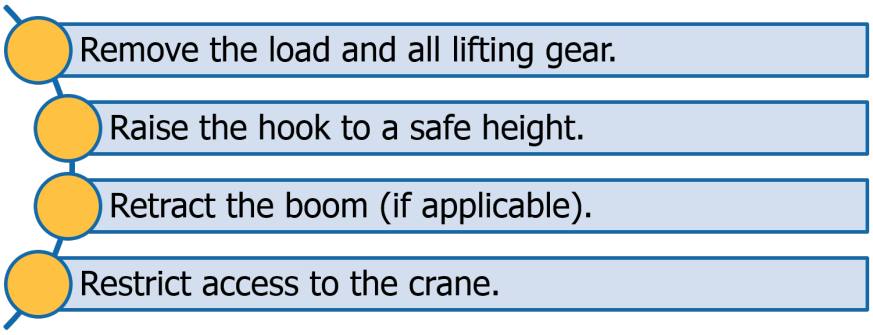
Once the job has been completed you will need to conclude operations in accordance with site procedures and manufacturer's specifications.

Generally, this will involve:

- Removing hazard control measures.
- Packing up the crane.
- Shutting down and securing the crane.

3.11.1 Leaving a Crane Unattended Overnight

If you are leaving a crane unattended overnight you will need to:



Where applicable you will need to stow the crane as per manufacturers specifications and ensure that all motion locks and brakes are applied.

3.11.2 Removing Hazard Control Measures

Any hazard control measures that are no longer required should be removed from the work area (e.g. removal of temporary fences/barricades or signage).

3.11.3 Packing Up the Crane

Once the hazard control measures have been removed, the crane needs to be packed up in preparation for travel to the designated secure shutdown location.

It is important that all site procedures and manufacturer's specifications are followed throughout this process.

The packing up of the crane may include:

- Stowing and securing the crane boom/jib.
- Applying motion locks and brakes.
- Stowing and securing the outriggers/stabilisers.
- Stowing and securing the plates and packing.

3.11.3.1 Stow and Secure the Crane Boom/Jib

Stow the boom/jib during shutdown, before you move the crane. Follow all of the manufacturer's instructions and specifications when stowing crane boom/jib, including the fly jib.

Secure the boom using the relevant motion locks and brakes (e.g. hoist lock).

Secure the hook as per the manufacturer's specifications.

Lifting gear and any other associated equipment should also be stowed and secured. Counterweights may also need to be removed and secured in their storage location before travel.

3.11.3.2 Apply Motion Locks and Brakes

It is important that all relevant motion locks and brakes are applied when shutting the crane down or leaving the crane unattended. Ensure that all manufacturers' specifications and site safety procedures are followed.

3.11.3.3 Stow and Secure Outriggers/Stabilisers

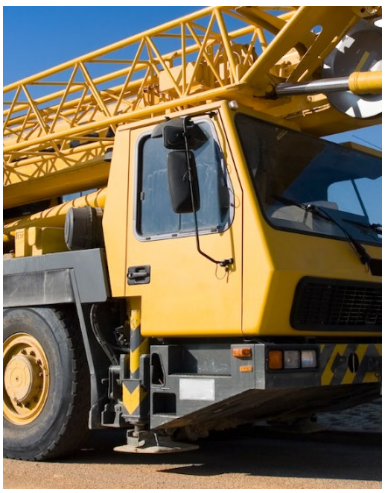
Follow all appropriate procedures and manufacturer's specifications when securing and stowing the outriggers/stabilisers. Retract all outriggers/stabilisers and (if applicable) lock them in with the correct pins.

3.11.3.4 Stow and Secure Plates and Packing

Stow and secure all plates and packing. Clean the steel plates and place 'pig-sty' packing either on the carrier or in a designated storage area so they will be ready and easily accessible for future use.

3.11.4 Preparing the Crane for Travel

Once everything has been stowed and secured, check that the crane is prepared for travel to the designated shutdown site.



Make sure that the path of travel is clear and safe to drive the crane along. Ensure that the hook/lifting assembly is raised clear of any obstructions and all parts are in their designated configurations (stabilisers/outriggers locked). Loose items should be stored appropriately. Ensure that you follow all manufacturer specifications and site safety procedures.

If you are driving the crane on a public road to a different site you will need to also:

- Check the tyre pressure.
- Unlock the suspension for safe road travel.
- Disengage drives to hydraulic pumps, booms, outriggers and turn off all controls.

3.11.4.1 Travel to Shutdown Site

Once all appropriate checks have been made and the crane is deemed ready to travel, you may progress to the shutdown site.

Depending on site procedures you may travel to a designated site parking area or an offsite location. Ensure that you follow all manufacturers' specifications, site safety procedures and the site traffic management plans. If the crane is travelling to an offsite location, make sure that all road laws and regulations are followed.

3.11.5 Shutting Down and Securing the Crane

Once the crane is in the designated shutdown location ensure that you follow the manufacturer's specifications and site safety procedures.

A typical shutdown procedure may include:

- Raising the hook clear of obstructions.
- Retracting the boom/jib.
- Making sure the hoist brake is applied (if applicable).
- Retracting the hoist rope and hook block.
- Positioning/securing the boom/jib.
- Retracting the outriggers/stabilisers.
- Idling the engine to stabilise the temperature.
- Turning off the engine (where applicable).
- Putting all controls in neutral (if applicable).
- Turning the isolator switch off (if fitted) and securing it.
- Removing the ignition key (where applicable).
- Locking and securing the cabin (where applicable).
- Removing hazard controls if no longer needed.
- Securing the crane for travel.

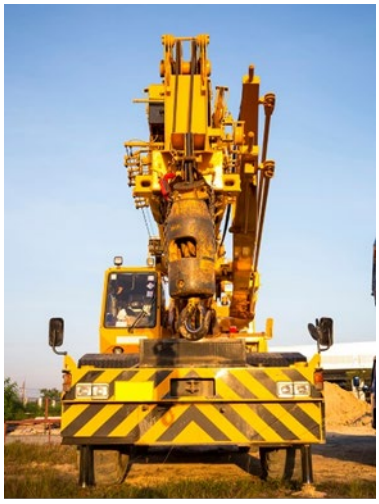
3.12 Conduct Post-Operational Checks

After completing shutdown procedures, it is important to conduct all post-operational checks to ensure that the crane is ready for the next operator.

Carry out these checks in accordance with the manufacturer's instructions and relevant site procedures. You are checking the crane for any damage or defects that have occurred during use.

Refer to the crane logbook or inspection checklist for a list of items that should be checked on the crane.

A routine post-operational check of a slewing mobile crane may involve:



- Checking for any damage including:
  - Structural damage to the boom/jib.
  - Damage to the crane.
- Checking all fluid levels and for any signs of leaks.
- Checking the condition of tyres or tracks.
- Making sure loose items are stowed or secured correctly, including plates and packing.
- Using load restraints if and when necessary.
- Stow the jib, following the manufacturer's specifications. This may involve lowering/raising/folding, or raising/extending/unfolding the jib.
- Retracting or lowering the boom for any travel.
- Stowing and securing outriggers/stabilisers according to procedures.
- Checking that the hook/lifting assembly has been raised clear of obstructions.
- Any applicable controllers are in neutral.
- Making sure the hoist brake is applied.
- Locking and securing the cabin controls and securing access to the crane.
- Turning the isolator switch off (if applicable) and securing it.
- Any other checks as specified in the manufacturer's instructions.
- Removing any hazard controls (if any are still in place and if required).

3.12.1 Record and Report Damage and Defects

Any faults that you find during the post-operational checks need to be recorded, reported and appropriately rectified, in line with workplace procedures.

Generally, this will involve:

- Isolating the crane or faulty equipment and attaching a danger tag to it.
- Recording the fault as per site procedures (e.g. in the crane or service logbook).
- Reporting the fault to an authorised person for corrective action.

Appendix A – Slewing Mobile Crane (Up to 60 Tonnes) Inspection Checklist

Slewing Mobile Crane Inspection Checklist			
Company Name:		Date:	
Operator Name:		Site:	
Machine Number:			
Check Type (please circle)	Pre-Start		Post-Operational
Component	**What to Check for**	**✓**	**Comments**
Pre-Start Checks			
External Check			
Structure.	Signs of damage to the crane or boom/jib.		
Tyres or tracks.	Inflation, pressure, tension, damage, covers.		
Outriggers/stabilisers and packing.	Excessive wear, damage, cracks, leaks.		
Underneath machine.	Leaks, loose parts, damage.		
Crane configuration.	Is correct for the requirements.		
Hydraulic rams and hoses.	Damage, wear, leaks.		
Wire ropes, anchorages, wedge sockets and splices.	Damage, wear, secure.		
Winch drum.	Cleanliness, damage, condition.		
Slew ring.	Damage, wear, secure.		
Jib.	Damage, wear, secure.		
Needle.	Damage, wear, secure.		
Rooster sheave.	Damage, wear, secure.		
Retaining pins.	Damage, wear, secure.		
Lifting hook.	Damage, wear, secure.		
Decals and signage.	Correct and legible, including rated capacity, manufacturer's data plate and labels, load charts, crane decals and control labels.		
Overall machine.	Loose or missing parts, damage, wear, missing guards and safety devices.		**Out of Service Tag Attached? Yes / No**
Engine Check			
Fluids.	Oil (motor, hydraulic and gearbox), fuel, battery water, radiator water/coolant level and lubrication (grease).		
Batteries.	Cleanliness, loose nuts and bolts.		
Air filter.	Damage, dirt build up, indicators.		
Radiator.	Damage, leaks, dirt build up, blockages.		
Hoses.	Leaks, wear, damage.		
Belts.	Tightness, wear, cracks.		
Overall engine.	Damage, dirt build up, leaks.		**Out of Service Tag Attached? Yes / No**

Component	What to Check for	✓	Comments
Internal/Cabin Check			
Levers, controls and gauges.	Damage, cleanliness, labels, working.		
ROPS.	Damage, cracks, wear.		
Floor plates.	Clear and free of oil/grease.		
Seat and seat belts.	Adjustment, damage, wear.		
Fire extinguisher.	Damage and charge.		
Logbook, running sheet, vehicle history, service sheets.	Present and correct.		
Mirrors.	Adjusted, clean, visible.		
Overall cabin interior.	Cleanliness, damage, missing parts.		**Out of Service Tag Attached? Yes / No**
Operational Checks			
Master and isolation switches, start switch or key.	Present, functioning, damage.		
Joy sticks or levers.	Functioning, damage, wear.		
All crane movements and controls.	Working, damage, wear, dirt build up on pedals.		
Travel limits.	Working correctly.		
Warning devices, lights and systems.	Functioning, damage, wear.		
Horn, lights and drive indicator.	Wear, damage, functioning.		
Communication system.	Working reliably.		
Gauges.	Oil pressure, fuel level, engine temperature, hydraulics, speedometer.		
Two-block/double block system.	Present and in good condition.		
Outriggers.	Deployed and functioning, tyres clear of the ground, crane level and stable.		
Packing.	Correct size and has been placed correctly.		
Radius.	Maximum radius and radius load indicator.		
Computer.	Data accurate and matches crane configuration.		**Out of Service Tag Attached? Yes / No**

Action Taken to Repair Slewing Mobile Crane:	
Name:	Date of Repair:
Return to Service Authority by Supervisor	
Comments:	

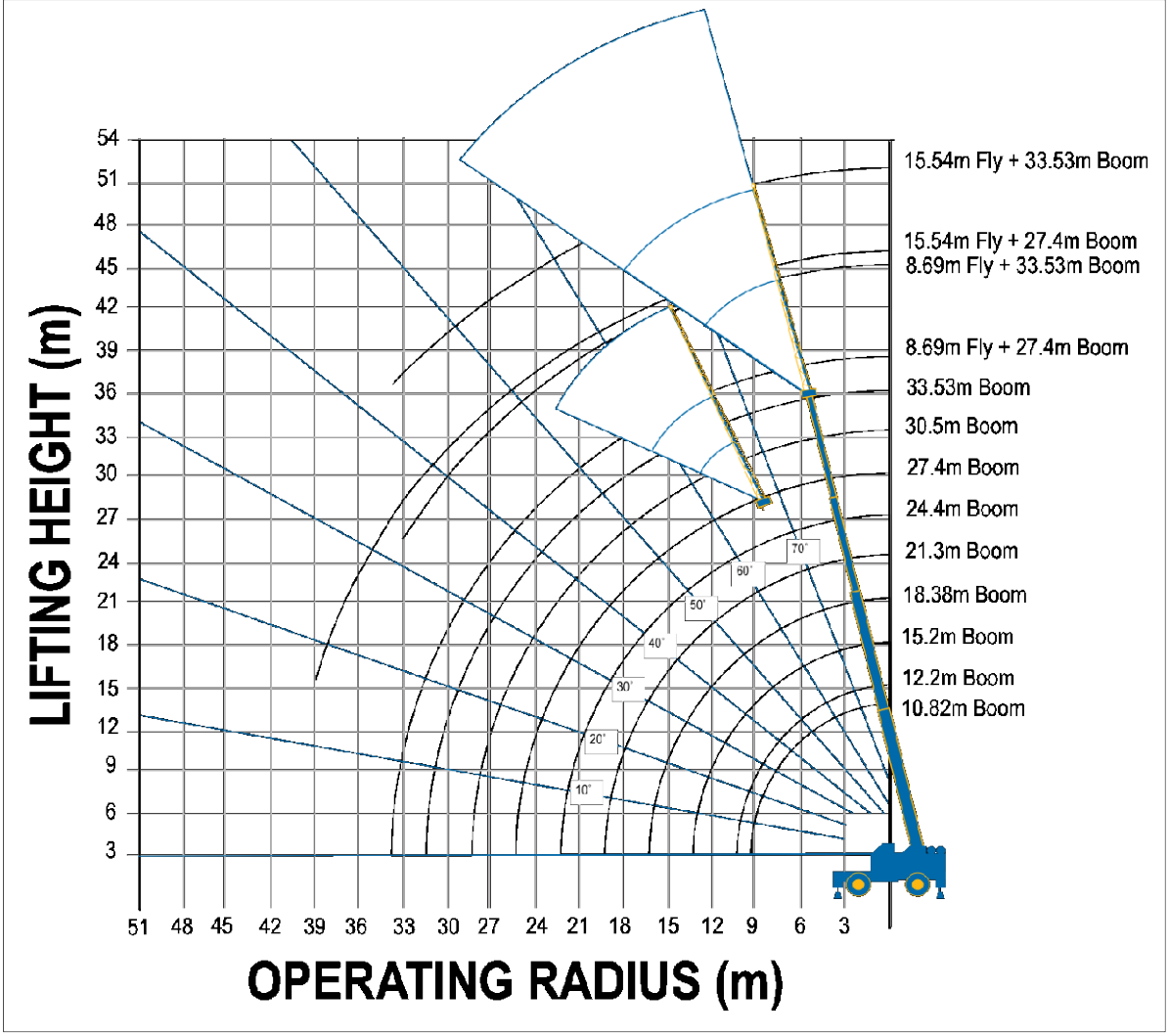
Supervisor Name:	Signature:	Date:

Appendix B – Crane Specifications – Slewing Mobile Crane (Up to 60 Tonnes)

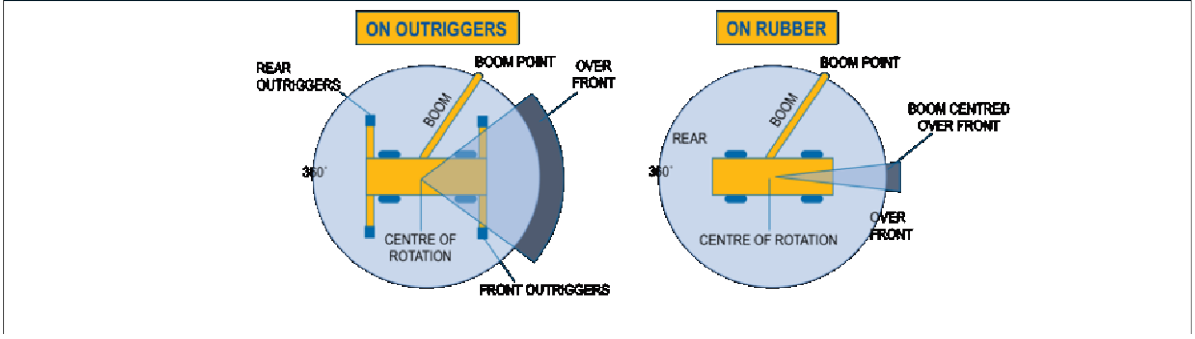
CRANE SPECIFICATIONS – SLEWING MOBILE CRANE (UP TO 60 TONNES)

This load chart is for assessment use only and must not be used for any other purpose.

RANGE CHART



AREA OF OPERATION



CRANE SPECIFICATIONS – SLEWING MOBILE CRANE (UP TO 60 TONNES)

This load chart is for assessment use only and must not be used for any other purpose.

360 ˚ LOAD RATING IN KILOGRAMS WITH OUTRIGGERS AT MAXIMUM EXTENSION (m)									
OPERATING RADIUS IN METRES	10.82 SWL BOOM α	12.20 SWL BOOM α	15.20 SWL BOOM α	18.38 SWL BOOM α	21.30 SWL BOOM α	24.40 SWL BOOM α	27.40 SWL BOOM α	30.50 SWL BOOM α	33.53 SWL BOOM α
3.0	45,000 65˚	35,550 69˚	33,250 73˚						
3.5	34,550 60˚	34,050 63˚	30,550 70˚						
4.0	31,550 55˚	31,350 59˚	28,350 67˚	23,050 72˚	17,150 78˚				
4.5	29,000 52˚	28,900 56˚	26,350 64˚	21,450 70˚	17,150 75˚				
5.0	26,750 47˚	26,700 53˚	24,650 62˚	20,200 68˚	17,150 70˚	16,050 72˚			
6.0	23,100 42˚	23,050 50˚	21,850 60˚	17,950 65˚	17,150 69˚	15,700 73˚	13,100 74˚		
7.0	19,650 38˚	19,600 44˚	19,450 52˚	17,150 60˚	17,150 67˚	15,700 68˚	13,100 71˚	10,850 74˚	
8.0	13,000 28˚	16,850 32˚	17,100 50˚	17,150 57˚	16,600 62˚	15,050 65˚	12,400 68˚	10,850 71˚	8,800 73˚
9.0		14,400 27˚	14,700 46˚	14,800 53˚	14,900 60˚	13,850 64˚	11,400 67˚	10,300 70˚	8,800 72˚
10.0		11,700 20˚	12,050 40˚	12,150 50˚	12,200 57˚	11,250 60˚	10,500 63˚	9,500 67˚	8,750 70˚
12.0			8,550 24˚	8,700 40˚	8,800 50˚	8,850 55˚	8,900 60˚	8,200 64˚	7,550 67˚
14.0				6,550 27˚	6,650 40˚	6,700 47˚	6,750 54˚	6,750 58˚	6,500 61˚
16.0				5,050 14˚	5,200 34˚	5,250 42˚	5,300 49˚	5,350 53˚	5,350 58˚
18.0					4,100 17˚	4,200 35˚	4,250 43˚	4,250 47˚	4,300 53˚
20.0						3,350 24˚	3,400 37˚	3,450 43˚	3,450 49˚
22.0						2,700 10˚	2,750 30˚	2,800 38˚	2,850 45˚
24.0							2,250 18˚	2,300 31˚	2,350 39˚
26.0								1,850 24˚	1,900 32˚
28.0								1,500 19˚	1,550 30˚
30.0									1,250 17˚

WEIGHT OF LIFTING EQUIPMENT				
LIFTING GEAR	SINGLE LINE WEIGHTED HOOK	2 SHEAVE HOOK BLOCK	3 SHEAVE HOOK BLOCK	5 SHEAVE HOOK BLOCK
WEIGHT TO BE DEDUCTED FROM SWL	150 kgs	300 kgs	350 kgs	400 kgs

JIB WEIGHTS – BOOM DEDUCTIONS			
BOOM EQUIPPED WITH	JIB STORED	8.69m	15.54m
BOOM DEDUCTION	400 kgs	900 kgs	1800 kgs

HOIST REEVING						
NUMBER OF PARTS OF ROPE	1	2	3	4	5	6
PERMISSIBLE WINCH LOAD (kgs)	7,500	15,000	22,500	30,000	37,500	45,000

CRANE SPECIFICATIONS – SLEWING MOBILE CRANE (UP TO 60 TONNES)

This load chart is for assessment use only and must not be used for any other purpose.

JIB LOAD RATING – kgs																
JIB OFFSET		2˚ OFFSET					20˚ OFFSET					40˚ OFFSET				
MAIN BOOM α		80˚	75˚	70˚	65˚	60˚	80˚	75˚	70˚	65˚	60˚	80˚	75˚	70˚	65˚	60˚
JIB LENGTH: 8.69m	LOAD (kgs)	4,250	3,900	3,500	2,550	1,750	4,000	3,300	2,750	1,900	1,250	3,350	2,850	2,400	1,650	1,050
	RADIUS (m)	6.2	9.3	12.7	15.9	17.3	8.4	11.7	15.0	18.2	21.2	9.4	13.2	16.5	19.8	22.3
JIB LENGTH: 15.54m	LOAD (kgs)	2,800	2,500	2,050	1,550	1,000	2,200	1,950	1,700	1,300	900	1,600	1,450	1,350	950	750
	RADIUS (m)	8.5	12.3	17.5	20.2	23.9	12.2	16.0	20.3	23.9	28.1	15.3	19.1	22.8	26.5	29.6

NOTES ON LOAD RATINGS	
DEFINITIONS	**Operating Radius –** The horizontal distance from the axis of rotation before loading the centre of the vertical hoist line or tackle with load applied.
	Loaded Boom Angle – This is given to assist in setting up the crane only. It gives an approximation of the radius for a specified boom length. This approximation does not allow for boom or tyre deflection. The ratings are only for the boom length and Load Radius shown.
	Safe Working Load (SWL) – The total suspended load, including the weight of load and load handling equipment, that the machine can safely lift under ideal conditions at a given boom length and load radius.
WARNINGS	This machine has been designed to meet the requirements of AS1418.1 & 1418.5 and has been tested in accordance with these standards for pick and carry operation on tyres.
	The Safe Working Loads shown are for this machine as it was originally manufactured. The lifting capacities only apply when all the manufacuturers instructions have been rigidly followed. Any modifications to this machine or use of equipment other than specified can result in a reduction of capacity.
	If improperly operated or maintained, this machine can be hazardous. Operation and maintenance of this machine must be in compliance with the information in the operators, service, parts and safety manuals furnished.
	Reduced crane lifting capacities for the particular job shall be established by the operator with due allowances for adverse operating conditions. These conditions may include the supporting surface, pendulum action of the load, jerking or sudden stops of the load and other factors affecting stability, two machine lifts, electrical wires, adverse weather, wind, hazardous surroundings, experience of personnel, etc.
	Safe Working Loads are based on freely suspended loads with the machine on a firm, level (max. slope 1% gradient / 0.6˚) and uniform surface. Lifting or travelling with a load on soft or uneven ground can be hazardous and will reduce the capacity of the crane. No attempt shall be made to drag the load along the ground in any direction.
	The SWL include the weight of hooks, blocks, slings and auxiliary lifting devices. Their weight must be subtracted from the listed rating to determine the net load that can be lifted.
	Loaded boom angles at specified boom lengths give only an approximation of the operating radius. The boom angle before loading should be greater to account for boom deflection increasing the radius as the load is lifted.
	Side loading of the machine and load swing out may cause structural failure or machine tip-over. Side loads may be generated by: lifting when not level; sudden acceleration or deceleration in articulating with a load; dragging a load; pushing a load; wind forces on load and boom structure.
	It is safe to attempt to telescope any load within the limits of the rating chart. The maximum load that may be telescoped is limited by hydraulic pressure, boom angle and powered boom sections lubrication.
	The maximum speed for pick & carry operation is 2 km/h. The transmission shall be set to low range.

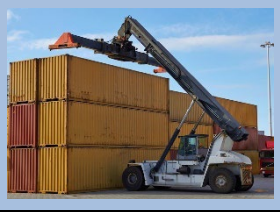
Supplement: Characteristics of Other Crane Classes

Slewing mobile crane operators may also operate other classes of cranes under the licensing laws relevant to crane operation – commonly called 'encompassment arrangements'. C2 licence encompasses the crane classes of:

- CV – Vehicle loading crane with a capacity of 10 metre tonnes or more.
- CN – Non slewing mobile crane with a capacity exceeding 3 tonnes.
- RS – Reach stacker.

Always check the licensing regulations for the state/territory you are operating in.

It is important to be aware that the different crane classes have different characteristics and factors that can impact stability whilst mobiling loads. Some of the characteristics and factors to consider are outlined below.

	Crane Type		
Characteristic/ Factor To Consider	**Non-Slewing Mobile Crane (CN)**	**Vehicle Loading Crane (CV)**	**Reach Stacker (RS)**
			
Articulation of crane	When articulating there is a reduced carrying capacity, as per the cranes load chart.	N/A	N/A
Correct tyre pressure (inflation/ condition)	Check that all tyres are in good condition (safe and legal) and are inflated to the correct pressure as stated on the crane's load chart or in the operator's manual. The stability of the crane depends on the tyres being correctly inflated. The tyre pressure, or inconstant pressure, also affects the stability and capacity of the crane. If the tyre pressure is lower than the pressure on the load chart then the crane will be able to lift less weight.	Make sure that tyres are safe and legal for road travel, at the correct pressure and in good condition.	The stability of the reach stacker depends on the tyres being correctly inflated. The tyre pressure also affects the stability and capacity of the reach stacker. If the tyre pressure is lower than the pressure on the load chart, or there is inconsistent pressures across the tyres, then the reach stacker will be less stable.
Driving safely on public and private roadways	A HRW licence to operate a non-slewing crane **does not** licence you to drive on public roads, thoroughfares or to the work area. You will need the appropriate truck licence to drive the crane on roads.	N/A	A HRW licence to operate a reach stacker **does not** licence you to drive it on public roads.

	Crane Type		
Characteristic/ Factor To Consider	**Non-Slewing Mobile Crane (CN)**	**Vehicle Loading Crane (CV)**	**Reach Stacker (RS)**
Emergency procedures in the event of an incident (e.g. loss of control)	If an unsafe incident or emergency occurs whilst you are operating a non-slewing mobile crane you will need to: **1.** Stop work immediately (if safe to do so). **2.** Assess the problem. **3.** Find a solution if possible/resolve the problem. **4.** If needed, seek advice and assistance. **5.** Report the incident according to procedures.	If an unsafe/emergency situation occurs whilst you are operating a vehicle loading crane you will need to: **1.** Stop work immediately (if safe to do so). **2.** Assess the problem. **3.** Find a solution if possible/resolve the problem. **4.** If needed, seek advice and assistance. **5.** Report the incident according to procedures.	If the reach stacker steering controls or brakes are not working properly you must immediately stop (if possible) or move the reach stacker to an open area away from other equipment and personnel. Once you have stopped you should turn off the reach stacker and contact your supervisor and report the fault. Do not use the reach stacker until it has been repaired and returned to service.
Pick up and carry the load	Details for pick and carry operation will be included in the load chart. This will include details relating to any effect on articulation, the effect on capacity, maximum pick and carry travel speed for travel, and the transmission/gear to use.	N/A	N/A
Side slope derations	Operating along a side slope (more than 1% gradient) will reduce the rated capacity (deration) of the crane. Refer to the side slope deration diagram/chart provided by the manufacturer for the percentage deration to apply to the rated capacity/SWL for the configuration on the crane.	N/A	N/A
Position of operator	N/A	Use the controls on the opposite side to the load movement. Make sure you do not allow the boom to luff or slew into the 'exclusion zone' – directly above the operator control station (or your head if operating the crane via remote). Allowing the boom to move through the exclusion zone is extremely dangerous as you could be struck by the boom of the crane or by the load itself.	N/A

	Crane Type		
Characteristic/ Factor To Consider	**Non-Slewing Mobile Crane (CN)**	**Vehicle Loading Crane (CV)**	**Reach Stacker (RS)**
Use of stabilisers	N/A	If used, the outriggers/ stabilisers need to be fully extended (or extended to the manufacturer's specifications) to bring the tyres off the ground and make the crane level (in accordance with the manufacturer's specifications). Outriggers/stabilisers can be used with packing to help distribute the weight of the crane and load on softer ground.	Whether you are using stabilisers or not will affect the maximum allowable capacity or container configuration. Use of stabilisers will increase lifting capacity.
Impact of boom height and steering on stability	N/A	N/A	Having the boom extended further or raised higher than recommended can make the reach stacker unstable, effecting the steering and stability, potentially causing the reach stacker to tip. Carry the container/load at the height recommended by the manufacturer. Travel with the boom at the minimum boom length for the conditions.