DOGGING

CPCCLDG3001 Licence to perform dogging

LEARNER GUIDE

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MODIFICATION HISTORY

Version	Date	Nature of Amendment
1	7 Feb 19	Creation
2	12 Apr 21	Review – Updated Unit of Competency
3	19 Mar 24	QR Code added to cover page

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INTRODUCTION

This training course is based on the National High Risk Licence Unit of Competence CPCCLDG3001 Licence to perform dogging.

This unit specifies the skills and knowledge required to perform dogging activities safely in accordance with all relevant legislative requirements. Competence in this unit, does not in itself result in a High Risk Work Licence (HRWL).

A person performing this work is required to hold a Dogging High Risk Work Licence (HRWL). This unit requires a person performing dogging activities to:

- Plan the job.
- Select and inspect equipment.
- Prepare site and equipment.
- Perform task.
- Shut down job and clean up.

LICENSING/REGULATORY INFORMATION

Legislative and regulatory requirements are applicable to this unit of competency. This unit is based on the licensing requirements of Part 4.5 of the Model Work Health and Safety (WHS) Regulations 2017 and meets Commonwealth, State and Territory HRWL requirements.

The National Assessment Instrument (NAI) is the mandated assessment for the HRWL to operate the relevant licencing class as detailed in this unit.

REQUIRED SKILLS

Required skills for this unit are:

- Communication techniques in the workplace including whistles, hand signals and use of fixed channel two-way radios.
- Communication skills at a level sufficient to communicate with other site personnel.
- Calculate rated capacity of lifting equipment.
- Apply different methods for making temporary connections to loads using fibre and synthetic ropes.
- Ability to interpret rated capacity and working load limit tags.
- Hazard identification and control.
- Slinging techniques.
- Selection and inspection of lifting equipment.
- Directing crane operators in the moving of loads in a safe manner, using a slewing crane.

- Inspection and care of a wide range of lifting equipment to appropriate Australian Standards and/or manufacturer's specifications.

REQUIREED KNOWLEDGE

Required knowledge for this unit is:

- Appropriate mathematical procedures for estimation and measurement of loads.
- Basic knowledge of types of cranes and their functions.
- Commonwealth, state or territory WHS legislation, standards and codes of practice relevant to the full range of techniques for undertaking dogging activities.
- Load stability and safety factors in line with manufacturer's specifications.
- Types of lifting equipment and slinging techniques for use, and their limitations and performance in a wide range of conditions (including but not limited to slings, beams, accessories, clamps, work-boxes, bins and pallets).
- Understanding of the hierarchy of control.

ASSESSMENT CONDITIONS

As a minimum, assessors must satisfy applicable regulatory requirements, which include requirements in the Standards for Registered Training Organisations current at the time of assessment.

As a minimum, assessment must satisfy applicable regulatory requirements, which include requirements in the Standards for Registered Training Organisations current at the time of assessment.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.
Assessment must occur in workplace operational situations. Where this is not appropriate, assessment must occur in simulated workplace operational situations that reflect workplace conditions.

- Simulators must not be used in the assessment of this unit of competency.

Resources for assessment must include access to:

- Appropriate lifting plant in a safe/serviceable condition in accordance with manufacturer requirements.
- Relevant and appropriate materials, tools, equipment and personal protective Equipment currently used in industry.
- applicable documentation including:
  - approved codes of practice and guidance material
  - relevant Australian technical standards
  - manufacturer guidelines (instructions, requirements or checklists) for performance assessment

- relevant industry standards and operating procedures (where applicable)
- relevant workplace documentation.

HIGH RISK WORK LICENCE REQUIREMENTS

Any person who is undertaking training for a High Risk Work (HRW) licence according to the Work Health & Safety (WHS) Regulations must be currently enrolled in a course of HRW training and being supervised at the workplace by a person with a current HRW licence for the work.

The holder of a HRW licence is responsible for taking reasonable care and not adversely affecting the health and safety of other people while performing the HRW.

Once you pass your assessment you will have 60 days to apply for your licence. You must renew your licence within 12 months of its expiry otherwise:

- Your licence can't be renewed.
- You need to repeat the course and re-apply for your licence.
- You need to enrol in the course again and be supervised by somebody who has a current licence for the same class.

You can still do high risk work without a licence as long as:

- You are enrolled in a high risk course for the class, and
- You are being supervised by a person who has a HRW licence for the same class.

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. 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.

Your employer might ask you for evidence that you have a high risk licence before you start any high risk work. You can show them:

- Your licence.
- Proof from the training company that you have passed your assessment.
- Proof that you are currently completing a course for high risk work.

WHAT IS DOGGING

Dogging work involves exercising judgement (making decisions) when:

- Selecting appropriate slinging methods and lifting gear by:
    - considering load size and shape
    - determining load weight (its mass) and centre of gravity, and
- Inspecting lifting gear like chains, slings, ropes, cables and hooks used to attach loads to plant to ensure it is not defective.

Dogging work also includes:

- Directing a plant operator in the movement of a load when the load is out of the plant operator's view by communicating with the plant operator using hand signals, whistles or two-way radios.

Note: Plant in this context means a crane or hoist or other plant used as a crane or hoist.

WHEN IS A DOGGER REQUIRED

Safe Work Australia's information sheet on dogging states, a dogger is required to carry out dogging work. Slinging loads where judgement is not required and where the load is always in view of the plant operator is not dogging work, therefore a dogger is not required.

You **must** have a dogging licence, or be under direct supervision of a person with a dogging licence as part of a training program to be able to do the following tasks:

- Selecting slings.
- Inspecting slings.
- Choosing how to sling the load.
- Directing the crane operator while the load is being moved.

Appendix 1 provides more information on the conditions when a dogger is required.

PLAN THE JOB

It is important that you are aware of all the requirements relating to your work, before you start. Therefore to work safely we need to plan the job by taking into consideration:

- Any compliance documentation.
- Job or task requirements.
- Priorities or sequencing.
- Site rules.
- Permits and procedures.
- Inspecting the work area (Layout, structures, equipment & environmental).
- Selection of appropriate equipment as per operational requirements.
- Identifying hazards/risks.
- Implementing hazard/risk treatments.
- Working in accordance with:
    - Procedures (site and equipment)
    - Regulations
    - Codes of practice
    - Australian Standards

Other areas that you should consider when planning dogging tasks should include:

- Communications are safe and adequate.
- Access and egress to and from the work area.
- Location and specifics of the task.
- Permits or licences required to carry out the work.
- Equipment required for the task.
- Availability of equipment for the task.
- Type, capacity and capability of the crane.
- Safe work procedures that need to be followed.
- The type, condition, size and configuration of the load that is being moved.
- Identification and description of the work site (e.g. site details).
- Assessment of conditions and hazards (e.g. hazard report).
- Identifying equipment defects (e.g. fault reports or isolation systems).
- Accessing diagrams or plans.
- Safety Data Sheets.
- Consignment notes (items and weights).

If unsure about your work/task requirements you may need to consult with:

- Supervisor.
- Site Safety Officer.
- Manufacture to ascertain limitations/specifications.

COMPLIANCE DOCUMENTATION

Before you begin your task ensure that you access the relevant documentation and plan your work. Part of this is identifying any compliance documentation.

Compliance documentation is essential to all aspects of operations on every worksite.
From work instructions through to quality and environmental requirements, compliance documentation sets out the what, when, how and who of everything that needs to be done in the safest, most effective way.

Interpretation of compliance documentation will allow you to make the right decisions for each situation or task. Interpretation means understanding what is required of you and how you are expected to perform the tasks.

Applying documentation involves following all instructions given by these documents at all times – they are designed to keep you safe.

Statements containing the words "must", "shall" or "will" are often used within these documents to indicate that there are mandatory (legally must be applied) requirements.
Each project site will have different compliance documentation that must be referred to.

This may include:

- Legislative, organisation and site requirements and procedures.
- Work Health and Safety (WHS)/ Workplace Health and Safety (WHS) legislation, codes of practice and guidance material.
- Manufacturers' guidelines and specifications.
- Australian Standards.
- Codes of Practice.
- Equal Employment Opportunity and Disability Discrimination legislation.
- Licence and certification requirements.
- Internal permit control systems.
- Mechanical and electrical isolation processes.
- Company policy and permit control systems.

Compliance documentation may be provided by:

- WHS authorities and ASCC/NWHSC.
- Environment Protection Authority (EPA).
- Employment and workplace relations legislation.

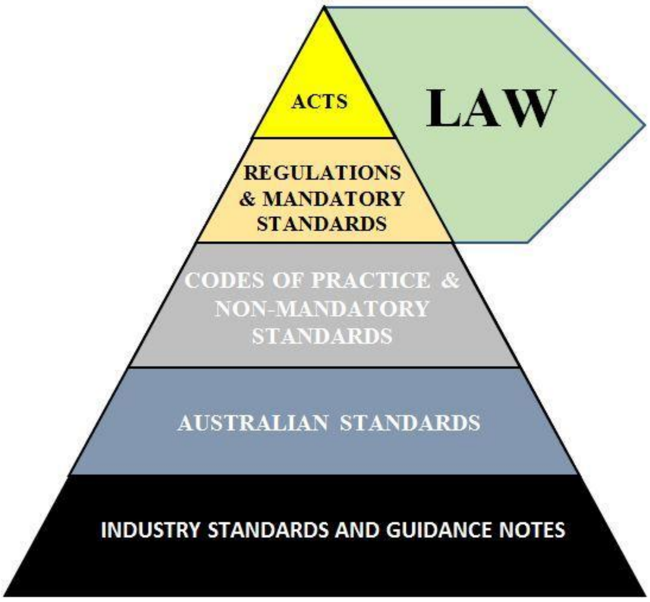


Figure 1 – Legislation Hierarchy

WHS Legislation and Regulations

Workplace Health and Safety (WHS) are laws and guidelines to help keep your workplace safe.

These can be broken down into four main types:

- Acts & Regulations.
- Codes of Practice.
- Australian Standards.
- Regulations.

Legislation/Acts	Acts of Parliament and laws to protect the health, safety and welfare of people at work. For example the Work Health and Safety Act (the WHS Act) 2011.
Regulations	More details or information on particular parts of the Act.
Codes of Practice/Compliance Codes	Practical instructions on how to meet the terms of the law. For example the Code of Practice "Managing the Risk of Falls in Workplaces".
Australian Standards	The minimum levels of performance or quality for a hazard, work process or product. For example AS/NZS 1891

Table 1 – Legislation Descriptions

Harmonisation of Workplace Health & Safety Legislation

In 2011, Safe Work Australia developed a single set of WHS laws to be implemented across Australia. These are known as 'model' laws. For the model WHS laws to become legally binding, the Commonwealth, states and territories must separately implement them as their own laws.

The model WHS laws include:

- The model WHS Act.
- The model WHS Regulations.
- Model Codes of Practice.

These elements are supported by the National compliance and enforcement policy, which sets out principles of how WHS regulators monitor and enforce compliance with their jurisdictions' WHS laws. WHS regulators in the Commonwealth and in each state and territory are responsible for regulating and enforcing the laws in their jurisdictions.

The model WHS laws have been implemented in the Australian Capital Territory, New South Wales, the Northern Territory, Queensland, South Australia, Tasmania and the Commonwealth. Some jurisdictions have made minor variations to make sure the legislation is consistent with their relevant drafting protocols and other laws and processes.

Model WHS Act

The Model WHS Act forms the basis of the WHS Acts that have been implemented in most jurisdictions across Australia.

The main object of the Act is to provide for a balanced and nationally consistent framework to secure the health and safety of workers and workplaces. It does this by:

- Protecting workers and other persons from harm by requiring duty holders to eliminate or minimise risk.
- Providing for fair and effective representation, consultation and cooperation.
- Encouraging unions and employer organisations to take a constructive role in promoting improvements in WHS practices.
- Promoting the provision of advice, information, education and training for WHS.
- Securing compliance with the Act through effective and appropriate compliance and enforcement measures.
- Ensuring appropriate scrutiny and review of actions taken by persons with powers or functions under the Act.
- Providing a framework for continuous improvement.
- Maintaining and strengthening national harmonisation of WHS laws and facilitating a consistent national approach to WHS.

Codes of Practice and Australian Standards

Model Codes of Practice are practical guides to achieving the standards of health and safety required under the model WHS Act and Regulations.

To have legal effect in a jurisdiction, a model Code of Practice must be approved as a code of practice there. To determine if a model Code of Practice has been approved in a particular jurisdiction, check with your local WHS regulator.

An approved code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in a jurisdiction's WHS Act and Regulations.
Like regulations, codes of practice deal with particular issues and do not cover all hazards or risks that may arise. Health and safety duties require you to consider all risks associated with work, not only those risk that regulation and codes of practice exist for.

While approved codes of practice are not law, they are admissible in court proceedings. Courts may regard an approved code of practice as evidence of what is known about a hazard, risk or control and may rely on the relevant code to determine what is reasonably practicable in the circumstances.

Duty of Care

Employers/PCBUs, self-employed persons, persons in control of the workplace, Supervisors, Designers, Manufacturers, Suppliers, Workers and Inspectors, have a legal responsibility under duty of care to do everything reasonably practicable to protect others from harm by complying with safe work practices. This includes activities that require licences, tickets or certificates of competency or any other relevant state and territory OHS/WHS requirements.

Organisational and Site Requirements

During your site induction your employer will tell you where to find the compliance documentation relevant to your site and duties.

All work needs to be conducted in accordance with organisational policies and procedures and site requirements.

Procedures exist to ensure that all work is completed in a way that is safe and achieves the required outcomes efficiently without causing harm.

Manufactures Guidelines and Specifications

These requirements will be documented in operator's manuals, equipment specifications and work instructions.

Designers and manufacturers have a responsibility to ensure that structures, plant and equipment meet strict criteria for the safe operation and protection of workers while also meeting relevant environmental standards.

ENVIRONMENTAL PROTECTION REQUIREMENTS

When performing dogging operations, you should always aim to reduce environmental risk and waste.

To do this you need to:

- Identify the environmental management plans, requirements and constraints.
- Confirm any aspect of the environmental protection requirements that may be unclear.
- Apply and comply with the project environmental protection requirements of all tasks undertaken in and around the worksite.

Some environmental requirements are:

- Organisational/project environmental management plans – These outline the steps and processes required to prevent or minimise harm to the environment due to work operations.
- Waste/clean-up management – This covers the disposal of site waste materials and rubbish as well as the recycling and re-use of waste materials.
- Water quality protection – This can include methods for directing run-off away from the stormwater system or other waterways. Spills of chemicals or other materials and the use of spill kits are included.
- Noise, vibration and dust management – These plans aim to limit or avoid creating noise pollution and vibration for people in and around the worksite. Dust management includes the use of screens, tarpaulins and other dust suppression methods.

The NSW Environmental Protection Authority (EPA) can investigate and issue fines for sites that do not meet the state and federal environmental protection arrangements that are in place.

If you have concerns, questions or queries about the exact requirements you must meet, you should speak to your supervisor, the site environmental officer or contact the NSW EPA for more information.

REVIEW TECHNICAL INFORMATION BEFORE YOU START

Before starting you need to make sure you obtain all the relevant technical information appropriate for your worksite. This will enable you to conduct your work in the safest and most efficient way. This may include:

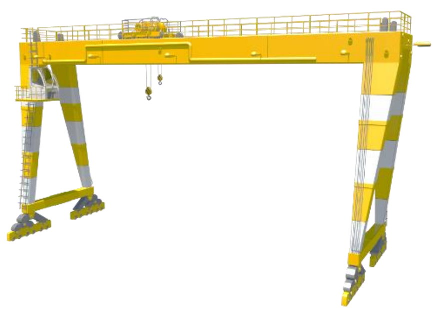
- Identification and description of the work site (e.g. site details).
- Assessment of conditions and hazards (e.g. hazard report).
- Work requirements from work orders and supervisor instructions.
- Identifying equipment defects (e.g. fault reports or isolation systems).
- Accessing diagrams or plans.
- Safety Data Sheets.
- Consignment notes (items and weights).

TYPES OF CRANES

Cranes that you may work with include.

TYPE	DESCRIPTION	EXAMPLE
Tower Cranes	A boom or jib is mounted on a tower structure.	

TYPE	DESCRIPTION	EXAMPLE
Self-Erecting Tower Cranes	A tower crane where the tower structure and boom/jib elements are not disassembled into component structures and can be transported between sites as a complete unit. The erection and dismantling processes are an inherent part of the crane's function.	
Portal Boom Cranes	The boom/jib is mounted on a portal frame, which is supported on runways along which the crane may travel.	
Mobile Cranes (Slewing)	A crane capable of travelling over a supported surface without the need for fixed runways. Relies only on gravity for stability.	

TYPE	DESCRIPTION	EXAMPLE
Non-Slewing Mobile Cranes	A mobile crane incorporating a boom/jib that does not slew.	
Vehicle Loading Cranes	A vehicle-mounted crane. Principal purpose of loading and unloading the vehicle.	
Bridge Cranes	Consists of a bridge beam or beams that are mounted to end carriages at each end. Capable of travelling along elevated runways and has one or more hoisting mechanisms arranged to traverse across the bridge.	
Gantry Cranes	Consists of a bridge beam supported at each end by legs mounted on carriage ends. Gantry cranes are capable of travelling on supporting surfaces or deck levels, whether fixed or not and has a crab with one or more hoisting units arranged to travel across the bridge.	

TYPE	DESCRIPTION	EXAMPLE
Derrick Cranes	Has a slewing strut-boom with the boom pivoted at the base of a mast which is either guyed (guy-derrick) or held by backstays (stiff-leg derrick) and which is capable of luffing under load.	

Table 2 – Types of cranes

Crane Movements

Different cranes have different capabilities and move in different ways. These capabilities will affect the way loads are moved around the site, and the way you direct the crane operator.

- **Slewing –** The side to side, rotating movement of the boom.
- **Luffing –** The up and down movement of the boom.
- **Telescoping or Trolley In/Out –** Telescoping is the extension and retraction movement of a hydraulic type boom. Trolley in/out refers to the movement of a hoist assembly along the length of a boom (relevant to bridge, gantry and some tower cranes).
- **Hoisting –** The raising and lowering of the hook block using the hoist rope.

INENTIFY AND MANAGE HAZARDS

If you can remove or at least control a hazard you can reduce the risk involved. Each worksite has its own specific risks and hazards. Always check to see what systems and procedures are in place before conducting a risk assessment at a worksite, as they may affect the outcomes of the risk assessment.

- A **RISK** is the chance of a hazard hurting you or somebody else or causing some damage.
- A **HAZARD** is the thing or situation that causes injury, harm or damage.

It is important that personnel/workers with the required relevant skills are involved in the risk identification process.

Consult with other workers about hazards

Make sure you talk to the right people. This can include:

- Safety officers.
- Site engineers (where applicable).
- Supervisors.
- Colleagues.
- Managers who are authorised to take responsibility for the workplace or operations.

These people may have information about site hazards. It is important to communicate with other personnel and safety officers before starting on a worksite to ensure that any workplace policies or site-specific procedures are followed.

When looking for hazards ensure you look:

- **Above head height** - remember the load will be moving above your head.
- **At eye level** – look around to see if there is anything in the way of where you want to move the load.
- **On the ground (and below)** – Have a look at the ground conditions and think about where the load is being moved to. Will it support the weight of the load?

Common workplace hazards include:

- Ground Conditions:
    - Surface condition
    - Underground Services
    - Weight bearing ability
- Poor lighting.
- Overhead Hazards:
    - Electricity/Powerlines
    - Overhead service lines
    - Obstructions
    - Trees
- Surrounding Structures:
    - Buildings
    - Obstructions
- Traffic:
    - Pedestrians
    - Vehicles
    - Other plant
- Weather:
    - Wind
    - Lightning
    - Rain / Storms

- Site hazards:
    - Other workers
    - Equipment and machines
    - Facilities
    - Other equipment
- Other hazards:
    - Dangerous materials
    - Chainsaws
    - Pressure washers
    - Tidal areas

Make a note of any hazard you identify in the area. Remember, a hazard can also be a situation so keep an eye on how the people around you are working too.

Each task/procedure/function needs to be evaluated for risks, as well as the work area where the work is being carried out.

You should also check records of injuries and incidents, safety tags and talk to other workers.

Safety Data Sheets (SDS) can be useful tools in identifying potential hazards so make sure you check the SDS documents for your site.

Talk to other workers, your manager, supervisor, team leader or health & safety representative to find out if the risk has already been addressed, and what techniques are available to you to resolve it.

If you find that there is no documentation or guideline in place to resolve an identified risk, you need to assess the risk and identify a feasible course of action to deal with it.

It is important that all records, policies and procedures are kept up to date so that the most relevant information is available and used.

CRANE SAFETY

The following should be observed when working with cranes:

- The load should be carried as close to the ground as conditions permit.
- Crane travel should only be as fast as conditions permit. Fast operation on rough or uneven ground can cause machine damage and injury.
- Derating of the crane capacity will be required when performing crane lifts; for example, in windy conditions or on soft and uneven ground. The load ratings are the maximum WLL for a machine levelled to within 1% grade.
- Ensure that no danger to personnel or bystanders exists when operating a crane. Keep all no essential personnel away from the operating area.

- Exercise caution when conducting operations in wet or slippery conditions.
- Exercise extreme caution when conducting crane operations on grades.
- Do not overload a crane.
- Do not use the boom of a crane and lifting equipment for anything other than the intended purpose.
- Do not walk under or work on a raised load.
- Do not ride the load or on the crane hook.

WINDY CONDITIONS

Wind directly affects load stability and decreases the Working Load Limit (WLL) of the lifting equipment, crane stability and lifting methods. Stop operations when wind speed exceeds 45kph and wait until the wind reaches a safe working level. If possible, avoid lifting in windy conditions.

Consider for operating in windy conditions:

- Winds speeds are usually greater at higher levels than at ground level.
- High wind speed guts are common in windy conditions.
- Derate the crane capacity and lifting equipment to suit conditions.
- Maintain effective communications with all team members.
- Use restraining lines to limit any load swing.
- Avoid handling loads that have large wind catching surfaces.

WORKING NEAR ELECTRICITY/POWERLINES

Working near powerlines can be dangerous if you are not careful.

It is vital that you are aware of the safe operating distances for different types of electricity/power lines and the steps you must take if the task requires you to work closer than these prescribed distances.

Generally, if you are required to work closer than the prescribed safe work distance you must:

- Contact the relevant local electrical authority for exemption.
- Have the electricity/power lines shut off (or insulated if this is not possible).
- Use a safety observer - A safety observer is a competent person who watches and guides plant and equipment around electricity/power lines. Check with each state authority for their safety observer requirements.

Distances vary depending on the voltage of the electricity/power lines. You should refer to the local electrical authority for information and advice to determine the voltage of electricity/power lines in your work area.

Figure 2 – Typical Powerlines

SA / TAS / ACT (AS2550.1)

In South Australia, Tasmania and the ACT, equipment must not be closer than the following distances to electric/power lines:

Electricity/Powerline Type	Distance
Distribution lines up to and including 133kV (usually poles)	6.4m or 3.0m with a qualified 'safety observer'
Transmission lines greater than 133kV (towers)	10m or 8m with a qualified 'safety observer'

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 electricity/power lines:

Electricity/Powerline Type	Distance
Distribution lines up to and including 66kV (power poles)	6.4m or 3.0m with a qualified 'safety observer'
Transmission lines greater than 66kV (towers)	10m or 8m with a qualified 'safety observer'

New South Wales

In New South Wales, equipment operation may not be any closer than the following distances to electric/power lines:

Electricity/Powerline Type	Distance
Up to 132kV	3.0m
132kV up to 330kV	6.0m
More than 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.

Queensland

The Queensland Electrical Safety Regulation breaks down the distances in detail. Exclusion zones are broken down not only by size of electricity/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 Code of Practice gives the following minimum distances as guidance:

Electricity/Powerline Type	Distance
Up to 132kV	3.0m
132kV up to 330kV	6.0m
330kV to 500kV	8.0m

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

Electricity/Powerline Type	Distance
Less than 33kV	3.0m
Over 33kV	6.0m
Over 133kV	8.0m

Northern Territory
In the Northern Territory safe electric/power line working distances falls under the Electricity Reform (Safety and Technical) Regulations. Table 2, Schedule 3 gives the following minimum distances:

Electricity/Powerline Type	Distance
Up to 33kV	1.5m
Above 33kV to 132kV	3.0m
Above 132kV to 275kV	4.0m
275kV to 330kV	6.0m
Above 330kV to 500kV	8.0m

Table 3 – Powerline clearance distances

Tiger Tails

Tiger tails are used as a visual aid to identify the location of overhead electricity/power lines. It is important to note that tiger tails DO NOT insulate the electricity/power lines so exclusion zones and safe operating distances must still be maintained, even when tiger tails are present.

Figure 3 – Tiger Tails

RISK AMANGEMENT

Risk Management is the process of reducing or managing the risks when working with a hazard or in a hazardous situation and should take into consideration the context of the organisation and work site.

Risk Management must be conducted in accordance with:

- Legislative, organisational and site requirements/procedures.
- Australian Standards.
- Codes of Practice.
- Employment and workplace relations legislation.
- Equal employment opportunity and disability legislation.

Consultation, communication, monitoring and review should be planned for and carried out at every stage of the risk management process.

Identifying risks and hazards and establishing ways of controlling them usually includes talking to the people with knowledge of the situation, or who are directly affected by any action you may take.

Controlling a hazard should be a team effort and it's important that everybody not only has input, but knows what they need to do and how/if they need to change their work processes to suit.

Monitoring and review are an important part of the risk management process and should be planned for at every stage. Monitoring and review involves regular surveillance and checking and clearly identifying the responsibilities of those involved.

It is important that monitoring and review results are recorded, reported and stored for future reference.

PRE—WORK HAZARD ASSESSMENT E.G. SWMS/JSEA'S ETC

A Risk Assessment to identify hazards is to be undertaken prior to commencing work. Such Risk Assessments as an example may include:

- Personal Risk Assessments;
  - Take 5, and
  - SLAMS.
- Group Risk Assessments;
  - Safe Work Method Statements (SWMS), and
  - Job Safety and Environment Analysis (JSEA's).

SWMS/JSEA's may also have been used in the development of as Safe Work Procedures (SWP) and Standard Operating Procedures (SOP). They detail the steps required to carry out a task as well as how specific hazards and risks related to a task will be managed.

They fulfil a number of objectives:

- They outline a safe method of work for a specific job.
- They provide a documented set of steps / processes that workers must read and understand before starting the job.
- They assist in meeting legal responsibilities for the risk management process, hazard identification, risk assessment and risk control.
- They assist in effectively coordinating the work, the materials required, the time required and the people involved to achieve a safe and efficient outcome. They are a quality assurance tool.

How do you complete a SWMS/JSEA?

Each organisation will have different forms and documents to manage risk, some called SWMS, JSEA, JSA etc. The fundamental steps remain the same as follows:

- Break the job down into its basic steps.
- Identify the workplace hazards associated with each step.
- Identify controls to eliminate or control those hazards.

- Rate / rank the risk with the controls in place, this is called the residual risk.
- Once agreement to the hazards and risk ratings has been achieved, the residual risk must be as low as reasonably achievable.
- Each person signs the SWMS/JSEA acknowledging that they have understood its contents.
- Put controls in place.
- Proceed with job, monitoring the controls for effectiveness and looking for new hazards.

The SWMS/JSEA must be available for inspection at any given time and must be reviewed as conditions change.

Risk / Hazard Assessment

Risk/Hazard Assessment has 2 stages:

(1) Risk/Hazard Analysis.

Risk analysis is used to determine the seriousness of a hazard based on how likely it is to happen and the consequences if it does happen. The risk level of each identified hazard should be worked out. Risk analysis comprises of 3 factors Likelihood, Consequence and Risk level.

Using a table similar to the one below, you can analyse how high the risk level is.

Likelihood	Consequence				
	Insignificant	**Minor** First Aid required	**Moderate** Medical attention and time off work	**Major** Long term illness or serious injury	**Severe** Kill or cause Permanent Disability or Illness
Almost certain	M	H	H	VH	VH
Likely	M	M	H	H	VH
Possible	L	M	H	H	VH
Unlikely	L	L	M	M	H
Rare	L	L	M	M	M

Table 4 – Likelihood vs Consequence Matrix

(2) Risk/Hazard Evaluation.

Risk evaluation is based upon the outcomes and results of the risk analysis.

Risk evaluation involves making decisions about:

- Have all the hazards been controlled.
- Is the residual risk acceptable.

- Is it safe to proceed.

Your evaluation should be used to determine how soon you should act to remove or control the hazard to achieve an acceptable level of risk.

You can do this using a table similar to the one shown below:

Risk Level	Action
Very High	Act immediately: The proposed task or process activity must not proceed. Steps must be taken to lower the risk level to as low as reasonably practicable using the hierarchy of risk controls.
High	Act today: 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 control. 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 Safe Work Method has been prepared. 5. The supervisor must review and document the effectiveness of the implemented risk controls.
Medium	Act this week: The proposed task or process can 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 Safe Work Method has been prepared.
Low	Act this week: The proposed task or process can 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 Safe Work Method has been prepared.

Table 5 – Hazard Evaluation Level example

Note: <u>Any hazard with a residual risk level of high or very high should have further risk treatment measures (controls) in place to reduce the risk to an acceptable level. They will also require a higher level of approval in most cases and a higher level of risk management processes.</u>

RISK/HAZARD TREATMENT

Once hazards have been identified, risk treatment options (controls) need to be considered and applied. Risk treatment involves selecting one or more controls to modify and reduce a risk and then implementing the control. Controls act as a barrier or layers preventing the unwanted event from happening. Every control has its limitations or holes in each layer and can be likened to a piece of Swiss cheese, the more layers / controls the more effective.

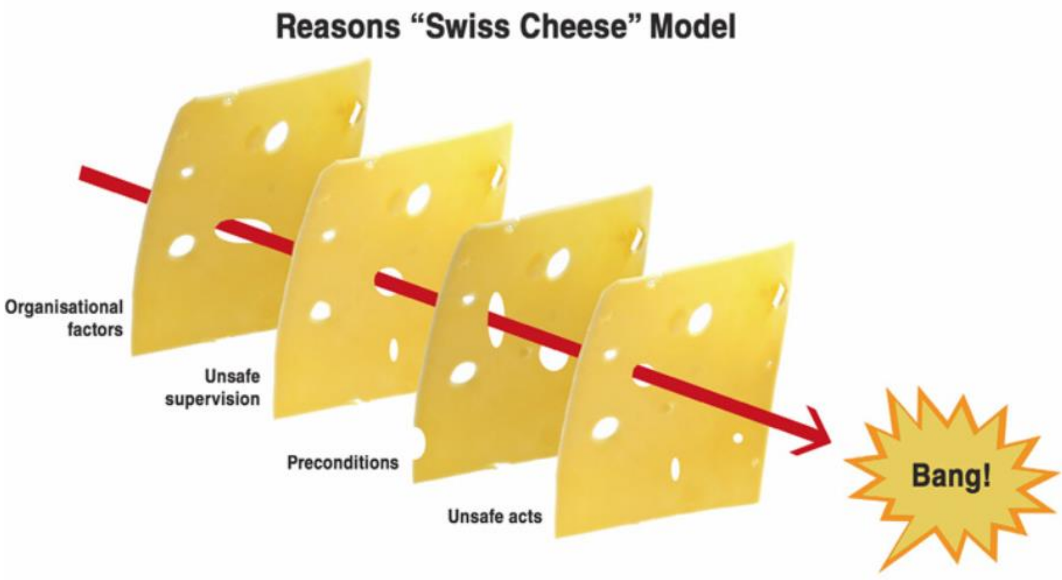


Figure 4 – "Swiss Cheese" model

Hierarchy of Control

Control measures can be ranked from the highest level of protection and reliability to the lowest. The WHS Regulations require duty holders to work through this hierarchy to choose the control that most effectively eliminates or minimises the risk in the circumstances. This may involve a single control measure or a combination of two or more different controls.

The hierarchy of control is as follows:

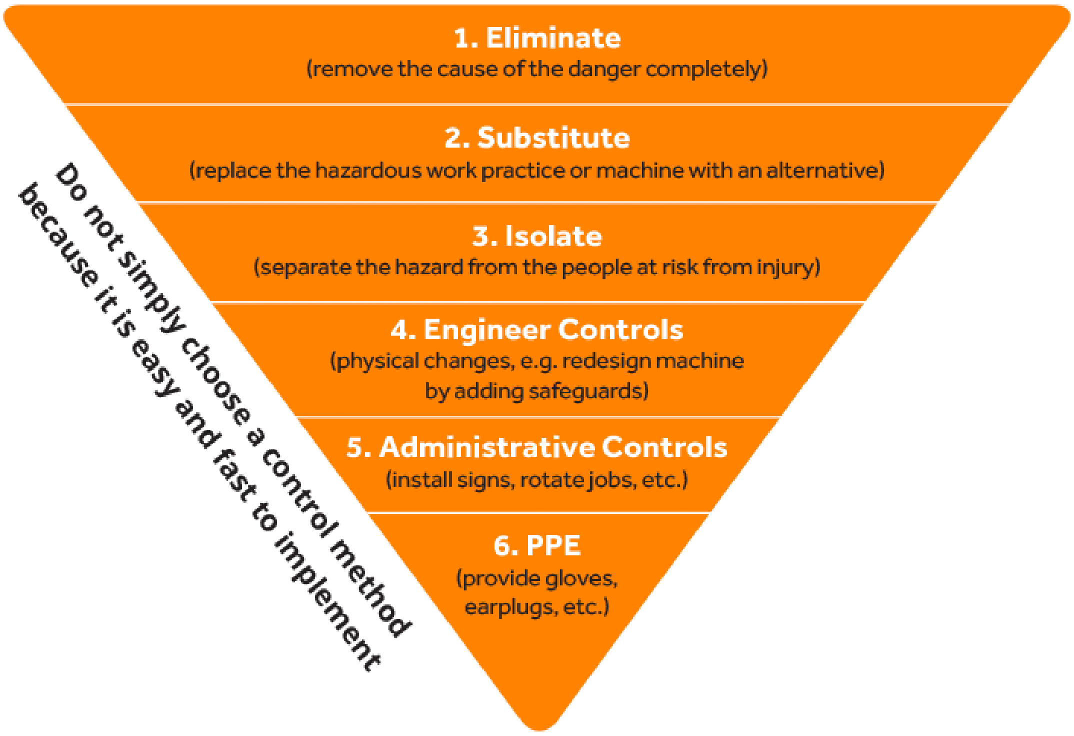


Figure 5 – Hierarchy of Control

SAFE WORK PRACTICES

Safe work practices are methods that must be implemented to make sure a job is carried out as safely as possible. Safe work practices are governed by legislative requirements and workplace procedures and relate to such things as drugs and alcohol at work, requirements for safe work at heights, including safety devices, general requirements for use of personal protective equipment and clothing just to name a few.

The scope of tasks and the safe work practices you are going to apply should be referred to, and documented, when completing Safe Work Method Statements (SWMS) or Job Safety and Environment Analysis (JSEA).

This will provide a guideline for how to carry out all tasks safely in accordance with WHS requirements.

APPLY CONTROL MEASURES

Control measures need to be implemented before you start work, or as soon as a hazard is identified during the work.

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

Control measures could include:

- Disconnecting power when working near power lines or overhead services.
- Putting safety tags on electrical switches or isolators to stop somebody from turning the power back on while you are working on or near power lines.
- Insulating power lines.
- Using a safety observer (also known as a spotter) inside the exclusion zone to make sure you don't get too close to power lines.
- Setting up barricades and traffic control to keep the area clear.
- Placing pedestrian controls (barricades, signs, etc.) to limit the number of people in the area.
- Moving any obstructions out of the way.
- Wearing PPE such as high-visibility clothing and non-slip work boots.
- Setting up additional lighting in the work area.
- Put excavation safeguards in place (if applicable).

Check the situation after you have applied a control measure to see if more controls, or different controls are needed to make the job safe. If more controls are needed, make sure they are applied before you start or continue the work.

Personal Protective Equipment (PPE)

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.

You should select and inspect your PPE before you start work. This could include but not limited to:

- A safety harness and fittings.
- Hard hat.
- Rubber soled shoes.

Fall Restraint

A fall-restraint system controls a person's movement by physically preventing the person reaching a position at which there is a risk of a fall. It must be set up to prevent the wearer from reaching an unprotected edge.

Fall Arrest

A fall-arrest system is intended to safely stop a worker falling an uncontrolled distance and reduce the impact of the fall. This system must only be used if it is not reasonably practicable to use higher level controls or if higher level controls might not be fully effective in preventing a fall on their own.

- Hand protection – gloves.
- Eye protection – goggles, visors or glasses.
- Ear protection – plugs or muffs.
- Breathing protection – masks or respirators.
- Hi-visibility clothing – clothing that makes you stand out and lets other people know where you are.
- Weather protection – clothing that protects you from the sun or from the cold.

Make sure any PPE you are wearing is in good condition, fits well and is right for the job.

If you find any PPE that is not in good condition, tag it and remove it from service. Then tell your supervisor about the problem and they will organise to repair or replace the PPE.

Strategies for Traffic Control

If the work area is going to be shared with pedestrians, site personnel, vehicles or mobile plant, you will need to make sure you have control measures in place before you start.

These may include:

- Using a flag person or traffic controller to control traffic.
- Setting up flashing hazard lights.
- Setting up warning signs and barriers.
- Setting up pedestrian and vehicle exclusion zones.
- Using a Traffic Management Plan.

Strategies for operation in darkness

If dogging operations are being carried out at night, or in darkened areas, adequate lighting needs to be provided across the entire work area.

This is to make sure that the all workers can see properly and carry out their work safely.

Working around people

If personnel are working around a slewing crane and are close to the outriggers or chassis there is a risk that they might be struck or crushed by the crane or load as it is being slewed.

An exclusion zone should be set up to keep personnel a safe distance away from the crane during operations.

REPORTING AND RECORD KEEPING

Make sure you record any action you have taken and talk to your supervisor and WHS officer about the control strategies in place. Keeping records is important as they can help ensure that any risk management activities are traceable.

Records also provide a basis for improving methods and tools in the risk management process, as well as improving the overall process.

ASSESS THE LOAD

Before you try to shift a load you (the dogger) will need to assess the following:

- The weight of the load (to decide what crane and slings to use). To determine the weight of the load you can:
    - Obtain content or weighbridge notes or other information.
    - Weigh the load.
    - Estimate the load through calculations.
    - Check whether the weight appears on the load itself or the packaging that it is delivered in.
- The dimensions of load (to decide what slinging techniques to use).
- The centre of gravity of the load (so that you can have the crane positioned correctly to pick up the load).

The crane/plant operator is responsible for telling you what the capacity of the crane is.

BASIC CALCULATIONS

You are required to perform calculations to determine the weight of loads and the Working Load Limit (WLL) of lifting equipment. Always round numbers up to provide an extra safety margin when calculating any measurements for lifting. This also accounts for slight differences in calculations when measurements are calculated to a number of decimal places. The precision of a calculation is only as accurate as the measurements taken.

When calculating areas, volumes and weight you must be careful to work in the same units of measure. For material size the units are usually meters (m), centimetres (cm) or millimetres (mm). For weight the units are usually kilograms (kg) or tonnes (t).

Calculation of an Area

The following formula and calculations assist you in determining the area of a plane figure. Plane figures are flat – they have length and breadth but no depth.

Rectangle

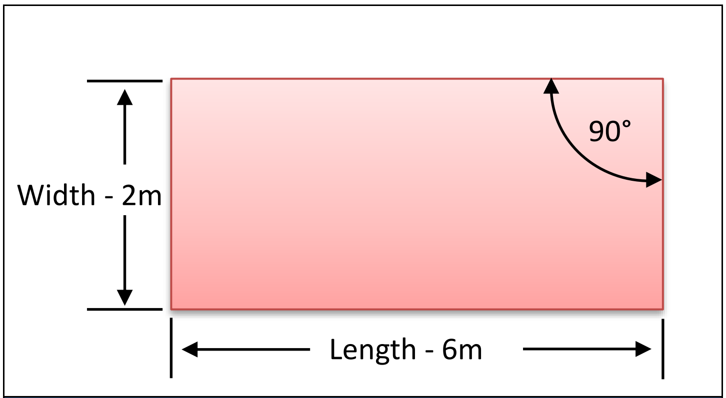
- All angles contained within a rectangle are right angles (90°).
- The area of a rectangle is calculated by multiplying the width (W) by the length (L).

Example:

W x L = Area

2m x 6m = 12m^2

The area of the rectangle is 12m^2



Rectangle

Square

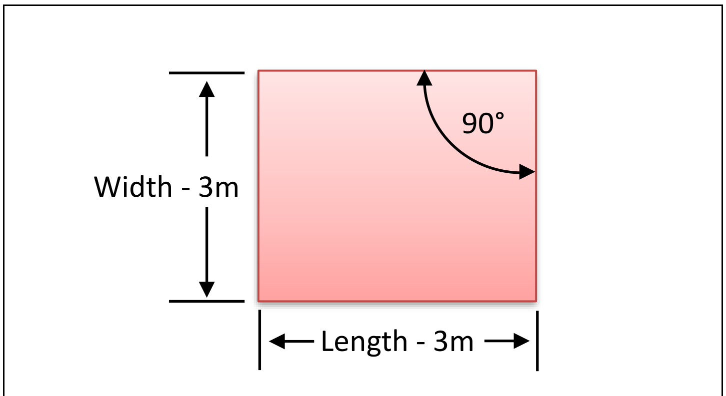
- A square has four sides of equal length and contains four 90° angles.
- The area of a square is calculated by multiplying the width (W) by the length (L).

Example:

W x L = Area

3m x 3m = 9m^2

The area of the square is 9m^2



Square

Circle

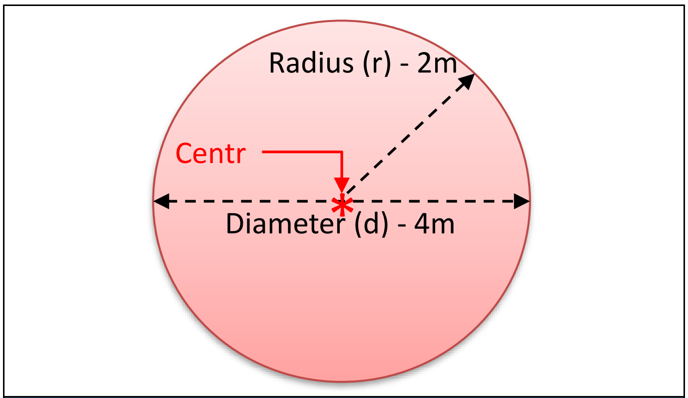
- A circle is a closed curve in which the centre is equal distances from every point of the curve.
- The Circumference (c) is the distance around the outer edge of the circle.
- The Diameter (d) of a circle is a straight line that passes through the centre of the circle and divides the circle I two equal parts.
- The Radius (r) of a circle is a line from the centre of the circle to any point on the circumference. The Radius is equal to half the diameter.
- The area of a circle is calculated by multiplying pi (π) (3.14 approximately) by the radius $(r)^2$. The formula is πr^2.

Example:

πr^2 = Area

3.14 x 2m x 2m = 12.56m^2

The area of the circle shown is 12.56m^2



Circle

Calculations of volume

Solid have length, breadth and depth. A solid figure takes up a volume of the space.

Cube

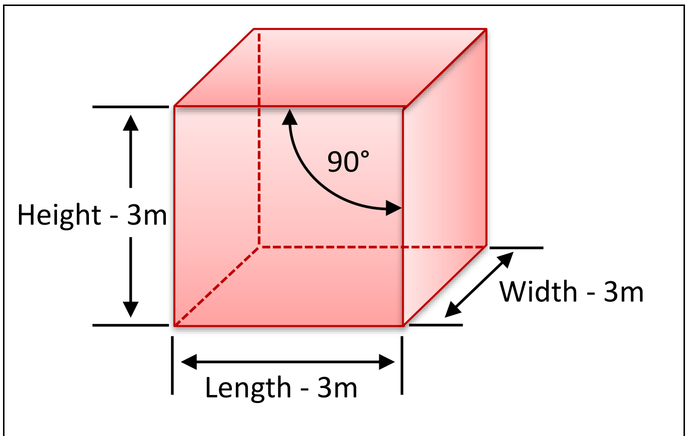
- A cube has six square faces and the angle between adjoining faces is a right angle.
- All sides are equal.
- The volume of a cube is calculated by multiplying the height (H) by the width (W) and by the Length(L)

Example:

H x W x L = Volume

3m x 3m x 3m = 27m^3

The volume of the cube shown is 27m^3



Cube

Cuboid

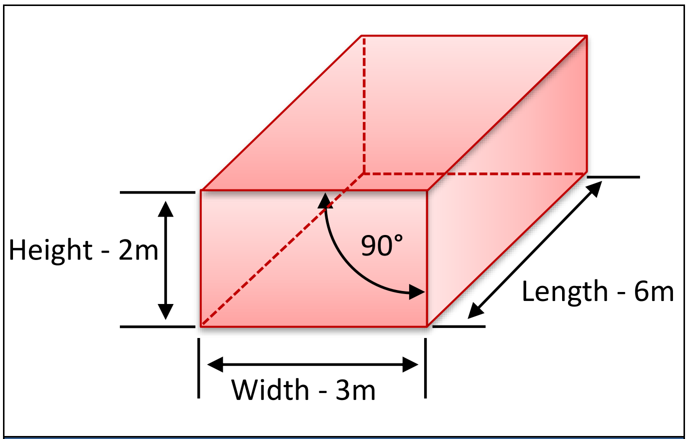
- A cuboid has six rectangular faces and the angle between adjoining faces is a right angle.
- All opposing faces are identical.
- The volume of a cuboid is calculated by multiplying the height (H) by the width (W) and by the length (L).

Example:

H x W x L = Volume

2m x 3m x 6m = 36m^3

The volume of the cuboid shown is 36m^3



Cuboid

Pyramid

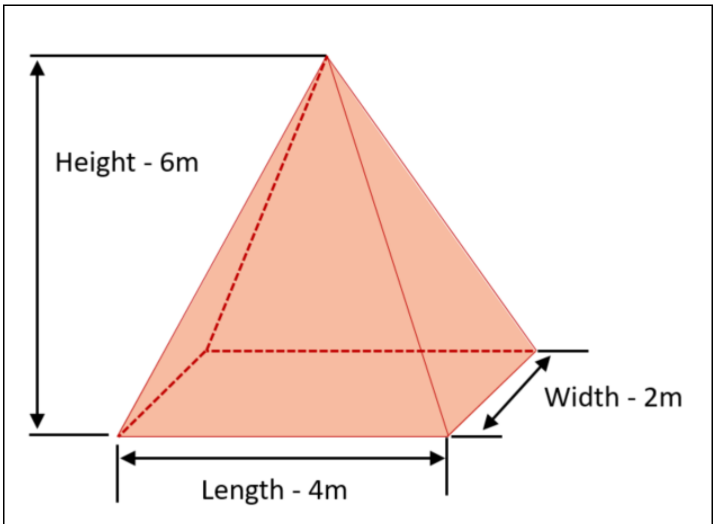
- A pyramid has a straight sided base and triangular sides that converge to an apex.
- To calculate the volume of a pyramid multiply the area of the base (B) by one third of the height (1/3 H).

Example:

B x 1/3 H = Volume
(2 is 1/3 H)

4m x 2m x 2m = 16m^3

The volume of the pyramid shown is 16m^3



Pyramid

Cone

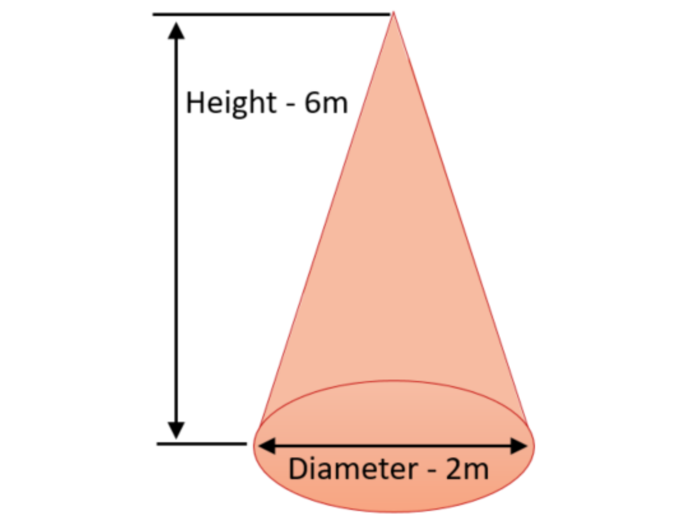
- A cone has a circular base and one continuous side that converges at an apex.
- To calculate the volume of a cone, multiply the base area (B) by one third of the height (1/3 H).

Example:

B (πr^2) x 1/3H = Volume
(2 is 1/3 H)

3.14 x 2m = 6.28m^3

The volume of the cone shown is 6.28m^3



Cone

Cylinder

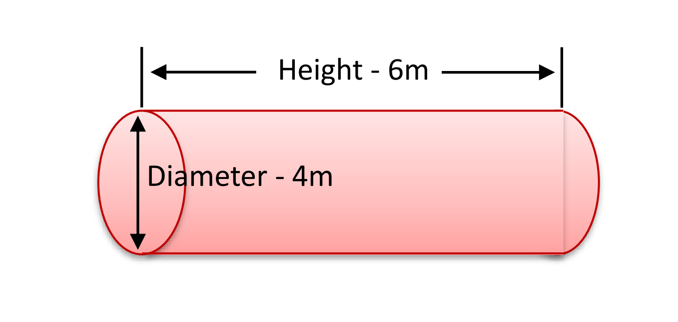
- A cylinder has two parallel identical circles that are joined by a continuous face.
- To calculate the volume of a cylinder, multiply the base (B) by the height (H).

Example:

B (πr^2) x H = Volume

12.56 x 6m = 75.36m^3

The volume of the cylinder shown is 75.36m^3



Cylinder

Sphere

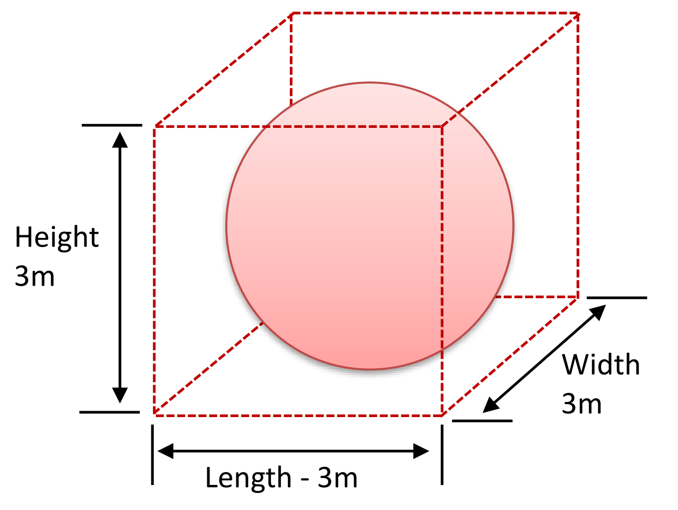
- A sphere is a three-dimensional circle or ball.
- The volume of a sphere is 0.53 (or just over half) of the cube in which it fits.
- To calculate the volume of a sphere multiply the volume of a cube (based on the diameter of the sphere) by 0.53.

Example:

H x W x L x 0.53 = Volume

3m x 3m x 3m x 0.53
= 14.31m^3

The volume of the sphere shown is 14.31m^3



Sphere

CALCULATING LOAD WEIGHT

If you are required to calculate the load of the weight you should have an understanding of the weights of common loads. The following table is a guideline of the density of common load materials:

Materials all have different properties, including density and weight per cubic meter. This means that not all materials weight the same even though the physical size of an object may be identical. To calculate the weight of an object you must first know the weight of the material from which it is made.

Always conduct a trial lift when lifting a load for the first time and watch the lifting equipment carefully for signs of strain to confirm the weight has not been underestimated. Overstressed lifting equipment may not be obvious and may fail without warning.

The table below shows the weight of common construction materials per cubic meter.

Remember that 1 tonne = 1,000kg

Material	Mass	Material	Mass
1 cubic meter of Aluminium	2.7t	1 cubic meter of Hardwood	1.1t
1 cubic meter of Ashes	0.8t	1 cubic meter of Sand (dry)	1.3t
1 cubic meter of Blue Metal	2.0t	1 cubic meter of Sand (wet)	1.5t
1 cubic meter of Cast Iron	7.2t	1 cubic meter of Softwood	0.75t
1 cubic meter of Steel	7.9t	1 cubic meter of Terra Cotta	1.8t
1 cubic meter of Clay	1.9t	1 cubic meter of Water	1.0t
1 cubic meter of Coal	0.846t	25 bags of Cement	1.0t
1 cubic meter of Concrete	2.4t	1000 Bricks	4.0t
1 cubic meter of Copper	9t	200 litre (44 gal) drum (full)	200kg
1 cubic meter of Earth	1.9t	200 litre drum (empty)	10kg
1 cubic metre Bronze	8.5t	1 cubic metre Granite	2.6t
1 cubic metre of Iron Ore	5.4t	1 cubic meter of Lead	11.2t
1 cubic meter of Poly Pipe	1.1t		

Table 6 – Material Weight examples

To determine the weight of a number of items, for example 10 bags of cement use the table and the following method.

Example:	Look at the weight table and find the weight factor 25 bags of cement weigh 1000 kg (1.0 tonne) Find the weight of one bag, this will be: • 1000 kg ÷ 25 = 40kg per bag of cement Weight of 10 bags will be: • 10 x 40 kg = 400kg **The weight of 10 bags of cement is 400 kg**

If you had a load containing 3 cubic metres of steel you could work it out using this table.

Example:	Look at the weight table and find the weight factor 1 cubic meter of steel weigh 7.9 tonne Therefore 3 cubic meters: ○ 3 x 7.9t = 23.7t **The weight of 3 cubic meters of steel is 23.7 tonne or 23,700 kg**

If you are working with a load of water then the ratio to work out the weight of the load is one kg to every litre.

For example, if you have 400L of water in a load then the load would weigh approximately 400kg. It is important to note that this ratio does not apply to all liquids.

In most cases loads aren't always a perfect cubic metre and if this is the case you will need to find the volume of the load before obtaining the weight.

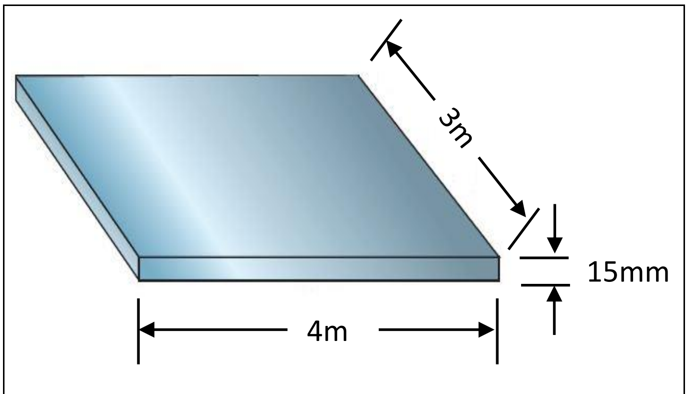
Solid Objects
To calculate the weight of an object, multiply the volume (V) of the load (in cubic meters) by the weight of the material per cubic meter.

To find the volume:

- Square/Rectangular - Length x Width x Thickness/Height = Volume (m3)
- Round/Circular - Radius x Radius x π x Thickness/Height = Volume (m3)

For example, to find the weight of the plate shown, firstly ascertain the weight per cubic meter of the material from which it is made. In the example shown, the plate is made of steel, which weights 7.9t per cubic meter.

Example:	Volume/weight of plate = L x W x H x 7.9 = 4 x 3 x 0.015 x 7.9 **= 1.422t** The weight of the plate shown is: 1.422 tonnes.



Plate

Pipe

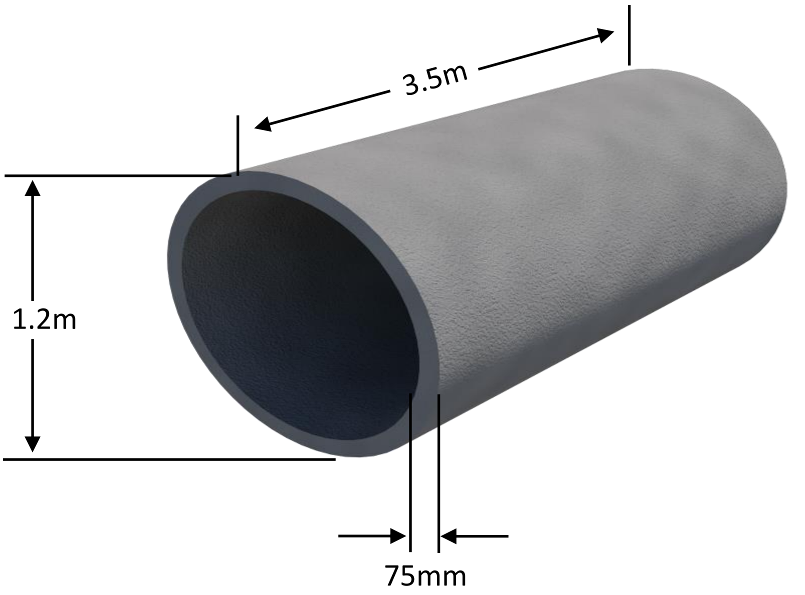
There are two methods of calculating the weight of hollow objects such as pipes. One method is discussed here with the other method discussed in the following section on empty tanks.

For hollow objects, such as pipes, the weight can be determined by:

1. Calculate the volume as if it's a solid object.
2. Calculate the volume of the hollow section as if it's a solid object.
3. Then subtract the volume of the hollow section from the solid. This will give the volume of the pipe.
4. Multiply the volume of the pipe with the weight per cubic meter of the material.

This will determine the weight of the pipe.

For example, the pipe is made of concrete which weighs 2.4t per cubic meter.



Pipe

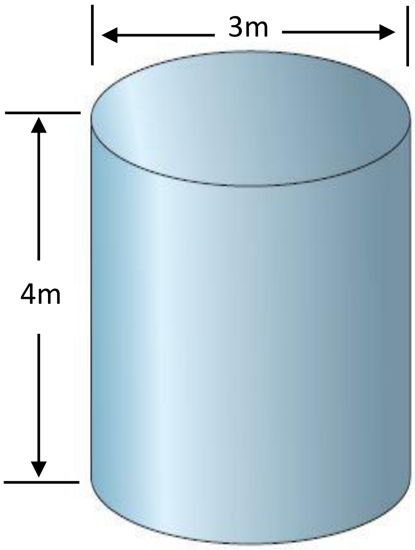
Example:	**Outside Volume (solid):** Radius = 0.5 x diameter = 0.5 x 1.2 **= 0.6m** Radius x Radius x π x Length = 0.6 x 0.6 x π x 3.5 **= 3.96m^3**	**Inside Volume (hollow):** Internal Diameter = Outside diameter – 2 x thickness =1.2 – (0.075 + 0.075) **= 1.05m** Radius = 0.5 x diameter =0.5 x 1.05 **= 0.525m** Radius x Radius x π x Length = 0.525 x 0.525 x π x 3.5 **= 3.029m^3**
	Overall volume Outside volume – inside volume = 3.96 – 3.029 **= 0.931m^3** **Weight of the pipe** volume x density of material = 0.931 x 2.4 **= 2.235t or 2,235kg**	

Empty tank

To calculate the weight of an empty tank, calculate the weight of the material separately ie:

- Side.
- Top.
- Bottom.

You can calculate the weight of the side by imagining the side as one sheet of steel plate that has been rolled up. To do this you need to calculate the circumference of the tank. The formula to calculate the circumference of a circle is 2πr. This method can also be used for pipes instead of the method shown previously. In the example shown, the tank is made of steel, which weighs 7.9t per cubic meter.



Tank – Walls, top and base are all made from 5mm steel plate

Empty Tank

Example:

Volume of Top and Bottom:

Radius x Radius x π x 2
= 1.5 x 1.5 x π x 2
= 14.13m²

Volume/weight of Top and Bottom
= Area x thickness x density
= 14.13 x 0.005 x 7.9
= 0.558t

Overall volume
Top and Bottom + Walls
= 0.558 + 1.49
= 2.048t

Volume of Walls:

Circumference of Tank
= 2πr
=2 x π x 1.5
= 9.42m

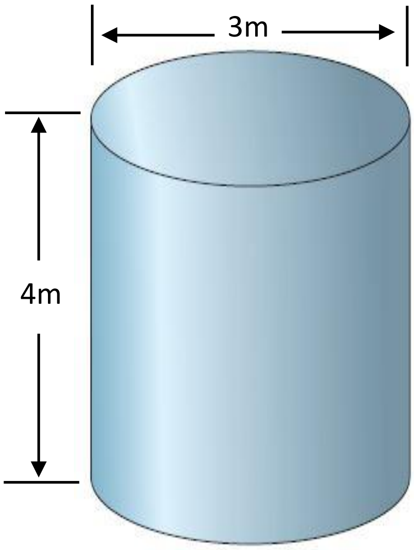
Volume/weight of Walls (rectangle)
= L x W x H x 7.9
=9.42 x 4 x 0.005
= 1.49t

Combining Calculations

When conducting a lift the weight of the total load must be calculated. When calculating total loads, the calculations are rarely simple shape calculations. In these situations calculations need to be broken down step-by-step. For example, to calculate the weight of a tank full of water you would need to take the following steps.

- Calculate the weight of the tank (Top, Bottom, Walls).
- Calculate the volume of the tank ((area of the base x height of the tank).
- Calculate the weight of the water in the tank (volume x mass of the contents per cubic meter).
- Add the weight of the tank and the weight of the water.

Use the following method to calculate the weight of a tank full of water. For a partially full tank, adjust the height measurement to suit the height of the fluid level rather than the height of the tank. Using the tank from the previous section, the weight of the empty tank is 2.048t. Next you need to calculate the weight of the water.



Tank – Walls, top and base are all made from 5mm steel plate

Empty Tank

Example:	**Volume of Tank: Weight of tank + Weight of volume** First find Internal radius = External diameter – Wall thickness ÷ 2 = 3 – 0.010 ÷ 2 = **1.495m** Internal Radius x Internal Radius x π x length x Mass + weight of tank = 1.495 x 1.495 x π x 3. 990 x 1 + 2.048 **= 30.050t**

You may also be required to calculate the weight of a load that is made up of different parts. In this situation it is important to calculate the weight of each item and add all of these together to work out the total weight.

For the example below you have the following information:

- The bin weighs 300kg.
- The universal beams weigh 145kg per meter.
- The scaffold planks weigh 6.5kg per meter.
- The steel plate weights 156kg per meter squared.

A Bin contains the following materials:

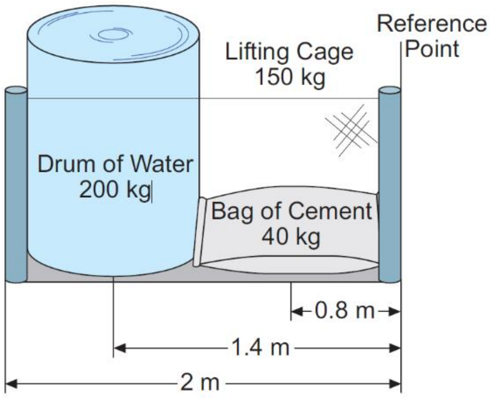
- 3 universal beams each 6m long
- 12 scaffold planks each 3m long
- 3 mild steel plates 3.5m long x 0.7m wide

Bin of mixed materials

Example:	**Item**	**Calculation**
	Bin Weight	1 x 300 = 300kg
	Universal beams weight	3 x 6 x 145 = 2610kg
	Scaffold planks weight	12 x 3 x 6.5 = 234kg
	Steel plate weigh	3.5 x 0.7 x 156 x 3 = 1146.6kg
	Total weight of load	**300 + 2610 + 234 + 1146.6 = 4290.6kg**

DETERMINING THE LOAD CENTRE OF GRAVITY

Some loads may be heavier at one end than the other. Loads like this will tilt to one side when lifted if this is not taken into account. This may cause the load to slip out of the slings or can overstress slings causing the sling to break. It is important to determine the centre of gravity (CoG) of the load so that the load can be lifted evenly. The centre of gravity is the point in which the weight of the object is equally balanced in each axis. Some loads will be marked with the CoG by the manufacturer. You will need to determine the CoG for other loads, particularly loads consisting of several items. The CoG for solid even loads, such as a steel beam or a plasterboard pack, will be at the centre point of each axis. For uneven loads, you will need to calculate the CoG of the length and width axis using the following formula.

For example, to calculate the CoG of a lifting cage containing a 200L drum full of water and a bag of cement, use the following method.	 **Bin of mixed materials**

- Work in only one axis at a time, for example the longitudinal (horizontal) axis.
- Determine the weight (W) of all items (the lifting cage, drum and cement).
- Measure the distance (D) from one end of the load (the reference point) to the centre of each of the items in meters.
- Multiply the distance from the reference point by the weight of each of the objects to get the 'moment' (M) for each item.
- Add each of the moments (M) to get the 'total moment' (TM).
- Add the weight of all the objects to get the total weight (TW).
- Divide the total moment by the total weight.
- This is the distance from the reference point (DRP) where the CoG is located on one axis.
- Repeat the procedure for the other axis.

In the example shown, the lifting cage weighs 150kgh, the drum of water weighs 200kg and the bag of cement weighs 40kg.

Example:	D x W = Moment of the object (M) **Lifting Cage** 1 x 150 = **150** is the moment (the centre of the cage is 1m from the reference point) **Bag of cement** 0.8 x 40 = **32** **Drum of Water** 1.4 x 200 = **280** **M Cage + M Drum + M Cement = TM** 150 + 32 + 280 = **462 TM** **W Cage + W Drum + W Cement = TW** 150 + 200 + 40 = **390 TW** **TM ÷ TW = DRP** 462 ÷ 390 = **1.184 DRP** The CoG of the load is located 1.184m from the reference point on the longitudinal axis.

DETERMINE SPECIAL REQUIREMENTS AND LIFTING POINTS OF LOADS

You need to check and see if the load has any specific lifting points. This will give you a better idea of the types of lifting gear you should use and how you should sling 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.

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.

LIFTING GEAR

The load and working environment will determine the type of lifting gear that you need to use.

Mark in your plan the lifting gear that you intend to use along with the details of how you intend to sling and control the load during the lift. Lifting gear includes all equipment associated with the lifting and moving of the load from the hook down.

Lifting gear includes:

- Ropes.
- Chains.
- Slings.
- Attachment hardware (Shackles, Eye bolts, Hooks etc).
- 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 you select the correct lifting gear 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.

Table7 – Load vs Lifting Gear

It is extremely important that you carefully inspect all lifting gear before you use it to ensure that all items are safe to use and are appropriate for the task. As a licenced dogger you are responsible for the inspection of lifting equipment.

NATURAL FIBRE ROPE, SYNTHETIC ROPE

Fibre rope is used extensively for taglines, whips, tackles and lashings.

There are two main types of fibrous ropes:
- Natural fibre rope.
- Synthetic fibre rope.

NATURAL FIBRE ROPES

Natural or vegetable fibre ropes are grouped into those made from hard fibres and those made from soft fibres.

Fibre ropes are most commonly used to restrain load movement, rather than for lifting loads. Most fibre rope is constructed of threads or fibres to form a yarn. There are several yarns to a strand, and several strands in a finished rope.

At each stage, the strands or yarns are twisted, or laid so that the lock together in the finished rope. This type of construction is called Hawser Laid Rope, which is available in hard, ordinary and soft lay. The lay for the rope can be either right or left hand. In a right hand lay rope the strands are laid clockwise around the core. In a left hand lay rope the strands are laid counter clockwise around the core.

When using natural fibre ropes for dogging there are a few things you need to remember:

- Manila and sisal are the only types of natural fibre rope that can be used for dogging and rigging purposes.
- Other natural fibre ropes such as cotton, jute, flax and hemp can only be used for lashing and tying.
- Minimum 16mm dry natural fibre rope is used as a tagline as it is non-conductive.
- 12mm is the smallest diameter rope that can be used for lifting purposes, always check the WLL of the rope.

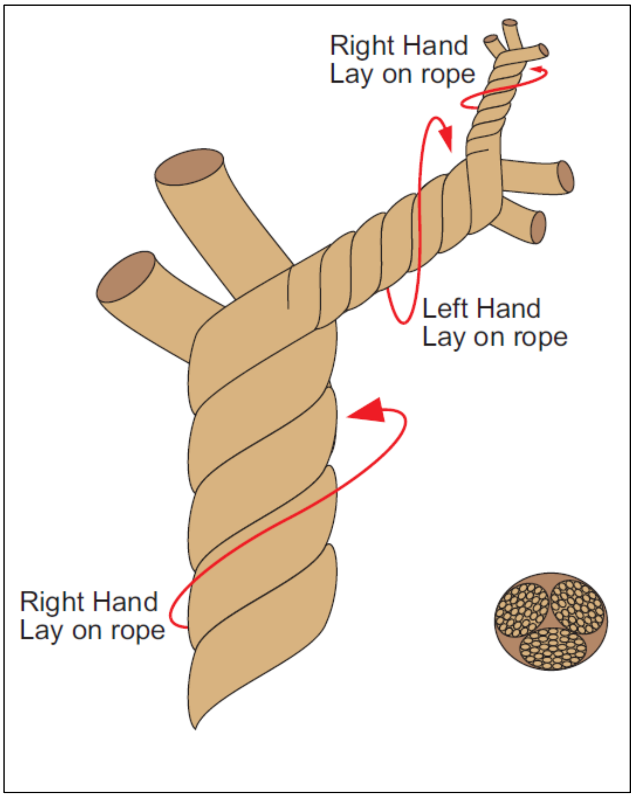


Figure 6 – Three Strand Rope

Storage of Natural Fibre Rope

- Store in dry place.
- Do not store in closed containers.
- Do not store on the ground or floor.
- Do not store in direct sunlight or exposed to the elements.
- Never store rope near fire, excessive heat, acids and other chemicals.

Safe Working Rules for Fibre Ropes

- Fibre rope less than 12mm diameter not to be used for lifting.
- Always calculate the WLL before using for lifting.
- Minimum 16mm diameter rope used for taglines.

- Don't use if rope has been exposed to temperatures exceeding 65°C, impact, severe shock or been unduly stretched.
- For good sound rope – the WLL of the sling is reduced by one-third (1/3).
- For sound old rope – WLL is reduced by one-half (1/2).
- When a fibre rope sling is reeved around a round load the WLL of the sling reduces by one-third (1/3).
- When a fibre rope sling is reeved around a square load the WLL of the sling is reduced by one-half (1/2).
- Do not use a rope sling if included angle between any two legs is greater than 90°.

Rope Diameter	Single Sling or Snotter	Nip or Reevable Sling		2 leg slings and unequally loaded 3 or 4 leg slings			4 leg sling Flexible Leads Only
		Squared Load	Round Loads	30°	60°	90°	
Nominal Dia. mm	Working Load Limit - Kilograms or Tonnes						
12	150	70	110	290	270	220	440
16	290	140	220	560	510	410	830
20	460	230	350	880	810	660	1.3
24	660	330	490	1.3	1.1	930	1.8
28	880	440	660	1.7	1.5	1.2	2.5
32	1.1	560	850	2.1	1.9	1.6	3.2
40	1.7	850	1.2	3.3	2.9	2.4	4.8
48	2.4	1.2	1.8	4.4	4.1	3.4	6.8
56	3.2	1.6	2.4	6.2	5.6	4.6	9.2
65	4.1	2.0	3.1	7.9	7.2	5.9	11.8
72	5.2	2.6	3.9	10.0	9.0	7.3	14.7
80	6.4	3.2	4.8	12.3	11.1	9.0	18.1
90	7.7	3.8	5.7	14.8	13.3	10.8	21.7
100	9.1	4.5	6.8	17.5	15.8	12.9	25.8
Load factor	1.0	0.50	0.75	1.93	1.73	1.41	2.82

Table 8 – WLL of Natural Fibre Ropes

SYNTHETIC ROPE

Synthetic fibre ropes are generally made from filaments twisted into yarns, the yarns twisted into a strand then three strands into the rope, similar to natural fibre ropes.

Australian Standard AS/NZS 1380-1998 Fibre Rope Slings deals with ropes made from both natural and synthetic fibres.

Synthetic ropes can be much thinner and yet have a greater rated capacity than natural fibre rope because they do not have overlapping fibres and some filaments are also stronger than natural fibres of the same thickness.

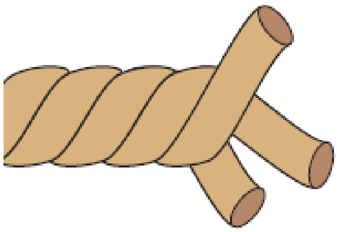
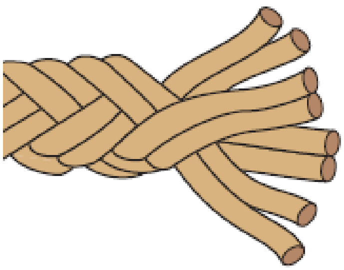
Synthetic fibre ropes have a smooth slippery surface, which can cause slip and failure of most bends and hitches. They are therefore not suitable for hand haulage. Prevent slip and failure with additional half hitches or seize the tail with yarn, twine or marline.

Under some conditions synthetic fibre rope can conduct electricity and therefore should not be used as taglines near power lines – only non-conductive ropes should be used.

Synthetic Rope Construction
Each type of synthetic rope requires its own specification for manufacture, testing, usage and WLL.

Synthetic ropes, fibres, yarns and strands are twisted or laid up into a finished rope, similar to natural fibre rope. In synthetic rope, the term fibre should more correctly be called filament as synthetic fibres are continuously spun in long lengths.

The finished appearance of flat split fibre rope is similar to natural fibre rope in that the ends of the fibres protrude outwardly, and the rope does not have the same smooth outward surface as filament rope.

Three Strand Hawser Laid Rope Three strands twisted or laid together to form the rope. This construction is the most commonly encountered. Commonly available in 3mm diameter upwards.	
Eight Strand Square Rope The balance achieved by platting four right hand and four left hand strands results in a tough kink resistant rope providing increased flexibility wet or dry. Normally available in 16mm diameter and upwards.	

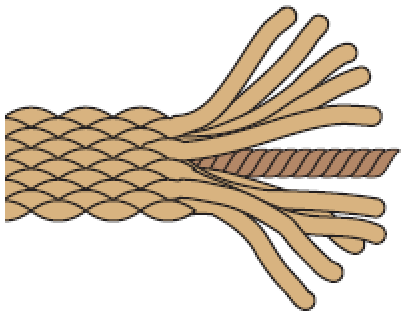
Solid Braided Cords Solid braded cords are constructed from either 12 or 18 strands braced together normally over a centre core. Unlike platted cords, the strands lie in one direction in a spiral direction. Normally available in 3 to 12mm diameter.	

Table 9 – Synthetic Rope Construction

Type	Guide only
Nylon (Polyamide filament)	Has approximately 2.25 times the breaking strength of natural fibre rope (size for size). It is not resistant to all chemicals and can be affected by linseed oil and mineral acids such as sulphuric or muriatic acid. Alkalis do not affect it to any great degree. Heat resistant is higher (250°C) than natural rope, which begins to char at 150°C. Synthetic rope, although subject to melting or 'fusing' with excessive heat will not continue to smoulder when a heat source is removed. Nylon is very elastic with about four times more stretch than natural rope. This characteristic is good for shock loads but has little value in lifting gear. Nylon is resistant to rot and mildew.
Dacron-terylene (Polyester filament)	Has about twice the breaking strength of natural fibre rope, but is not as elastic as Nylon. It is resistant to mild acid conditions, rot and mildew. Resistance to heat or flames is the same as with Nylon rope. Exposure to alkaline conditions should be avoided.
Taniklon Polyethylene filament)	Has about 1.45 times the breaking strength of natural fibre rope and has similar characteristics to Terylene.
Kuralon (Polyvinyl Alcohol)	Has about 1.25 times the breaking strength of natural fibre rope and has similar features to Terylene.
Silver Rope (Flat Split Taniklon fibre)	Has about 1.6 times the breaking strength of natural fibre rope, but is 30% lighter than natural fibre rope or Nylon and does not absorb moisture or slip as easily as Taniklon, Polyethylene and other synthetics.

Type	Guide only
Polypropylene (laid shattered film type)	This rope will float in water and is unaffected by water, alkalis or acid except in very concentrated form. It is affected by heat (approximately 15% to 30% at 65°C). The breaking strength is approximately 1.6 times that of natural fibre rope.

Table 10 – Synthetic Rope Comparison

When using synthetic fibre ropes, you need to remember:

- Synthetic Fibre Ropes are widely used for slinging, however, to be used for any sling they must have a rated capacity tag attached. **NO TAG** means **NO USE**.
- Most synthetic rope slings can and will stretch under load.
- The primary types of synthetic fibre ropes are Poly Propylene, Polyester and Nylon.
    - Organic solvents will destroy **Polypropylene** rope.
    - Alkalis will destroy **Polyester** rope.
    - Acids will destroy **Nylon** rope. Nylon rope can also lose 10% of its strength when wet.

Inspection for Fibrous Rope

Rope must be checked before each use. Examine the entire length of the rope at intervals of about 30cm, checking all sides and carefully untwisting the strands slightly. Do not kink them. You should look for:

- Cut or broken fibres, yarns or strands.
- Knots.
- Signs of over-stretching, including broken yarns and reduced diameter.
- Discolouration due to excessive heat.
- Sun rot.
- Scorched rope.
- High stranding
- Brittle yarns or strands.
- Faulty splices.
- Mildew.
- Acid burns or effects from corrosive agents.
- Powdery dust, which is a sign of internal wear.

If you are in doubt, Don't use, Tag out and Report.

TERMINATING AND JOINING ROPES

There will be times when you are required to tie knots to secure ropes, join ropes together or terminate a rope to prevent fraying. Some of the techniques for joining, securing and terminating ropes are in the following sections.

Splicing

Splices are used to join ropes together, from an eye at the end of a rope or end a rope to prevent fraying. The most common forms of splicing are:

- Eye splice (either bald eye or with a thimble inserted).
- Short splice, for joining two ends of a rope (as in an endless rope 'strop') where rope does not pass around a sheave.
- Back splice, for preventing the end of a rope unlaying instead of using whipping.

Note: the eye and back splices must be performed by a qualified dogger or rigger.

Eye Splice

1. Unravel enough rope sufficient for at least five tucks (about 15 times the rope diameter)
2. Tape the rope ends and arrange the strands.
3. Pas the centre strand under the standing strand.
4. Pass the lower strand under the lower adjacent standing strand.
5. Pass the upper strand under the upper adjacent standing strand.
6. Repeat the process with the centre strand, lower strand and upper strand.
7. Continue until you have completed three complete tucks in natural fibre or five tucks in synthetic fibre.
8. Pull the rope tight.

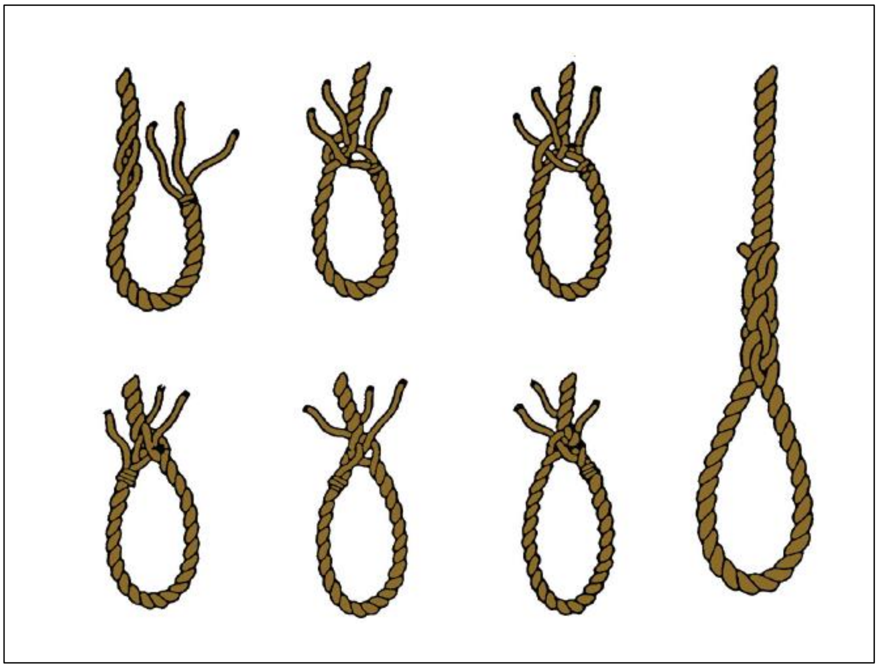
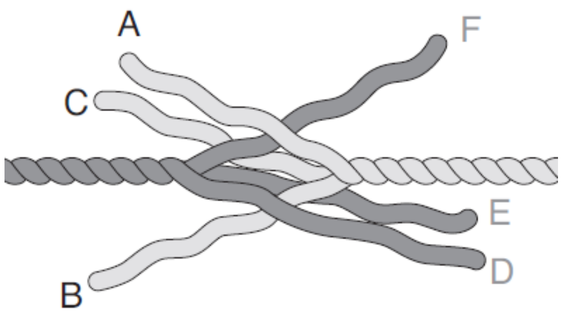
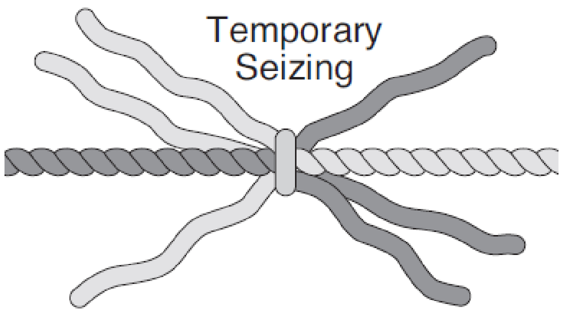
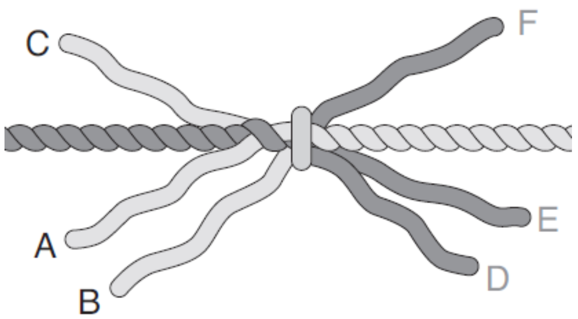
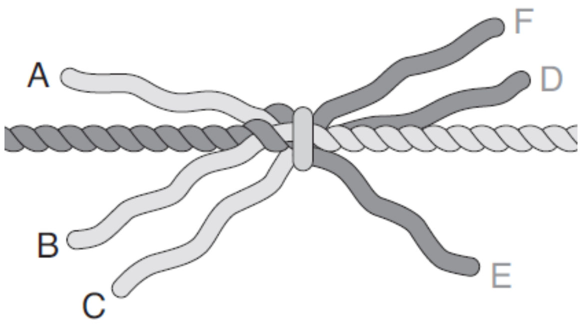


Figure 7 – Eye Splice

Short Splice

1. Unravel the strands of each rope and alternate the strands.	
2. Seize the strands to prevent further unravelling.	
3. Pass strand 'A' over and opposing strand and under the next, if necessary using a spike to open the rope strand.	
4. Tuck of strand 'B' goes over strand 'E', under the second and out between the second and third.	

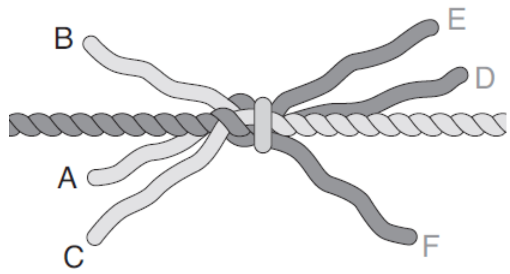
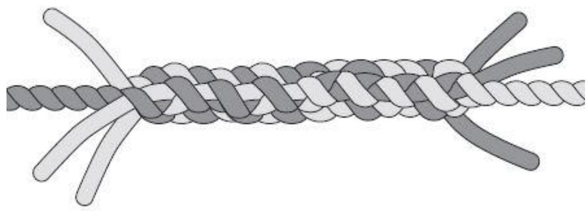
5. Repeat the operation with strands 'A' and 'C' from the same rope end.	
6. Remove the temporary seizing and repeat the operation on the other rope end. Make two or more tucks for each strand, then roll the tucks and cut off the ends.	

Table 11 – Short Splice

Back Splice

1. Unravel enough rope sufficient for at least five tucks (about 15 times the rope diameter).
2. Tuck each strand over its neighbour and back beside the standing end to from a crown.
3. Splice each strand into the rope by passing it over and under alternate strands in the standing end.
4. Continue until you have completed three complete tucks in natural fibre or five tucks in synthetic fibre.

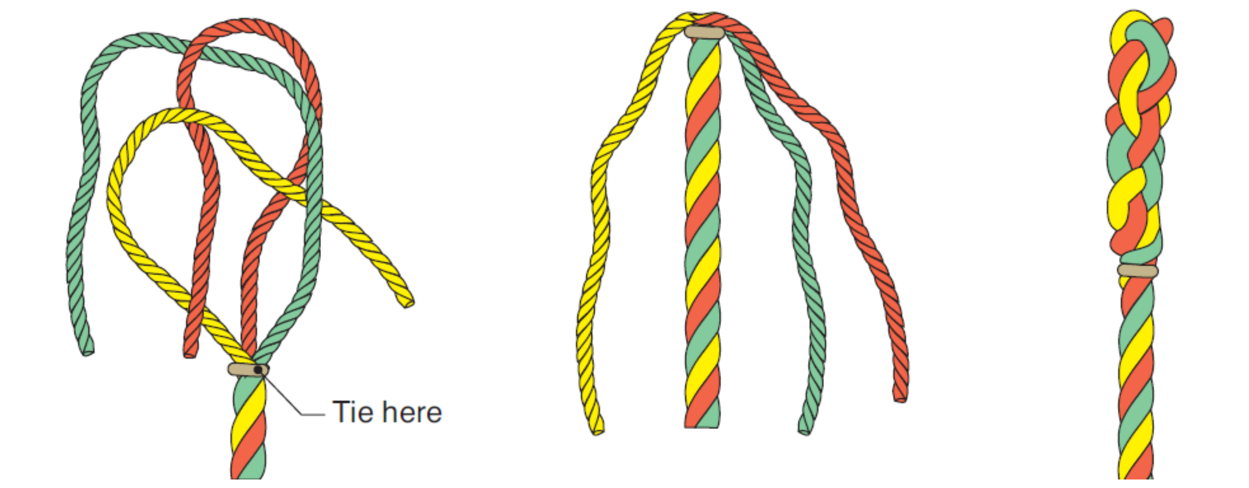


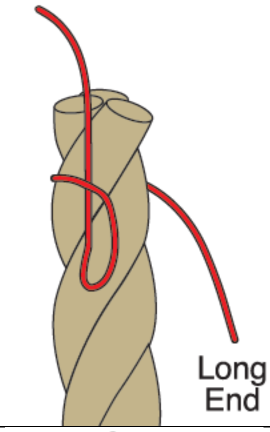
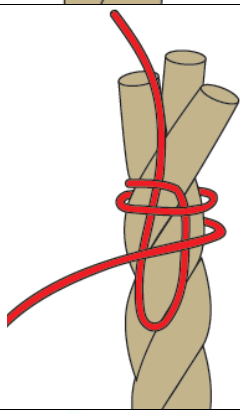
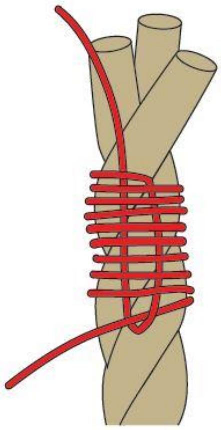
Figure 8 – Back Splice

Whipping

Whipping is used to prevent strands of a rope from unlaying. Waxed twine or rope yarn is normally used for whipping a larger rope. Whipping should be at least equal to the diameter of the larger rope in length.

Common Whipping

Common Whipping is a temporary whipping used to prevent rope unlaying while measuring or strands unlaying while splicing.

1. Form a loop facing away from the end of the rope, leaving one short end and one long end of whipping twine.	
2. Pass the long end of the twine over the short end and around the rope.	
3. Keep passing the twine around the rope until the correct length is achieved. Pass the long end of the twine through the loop.	

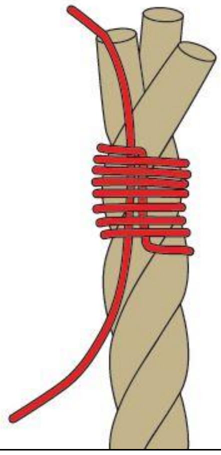
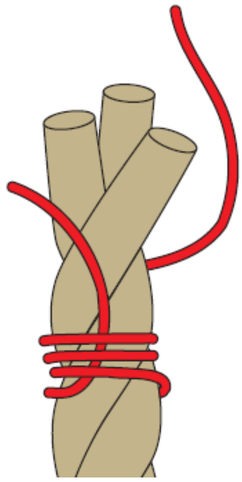
4. Pull the short end of the twine until the long end is buried about half way under the whipping. Now pull each end of the twine with equal strength until the whipping is tight. Trim off the loose ends.	

Table 12 – Common Whipping

American and West Countryman's and Sailmaker's Whipping

American and West Countryman's whipping are more complicated versions of Common whipping, while Sailmaker's whipping is used when a permanent whipping is required, in the ends of tackle falls for example. When using the more complicated forms of whipping, a second 'preventer' whipping is usually made about nine rope diameters in distance from the whipping end of a rope.

1. Lay the end of the twine down and take a number of turns over the end and around the rope.	

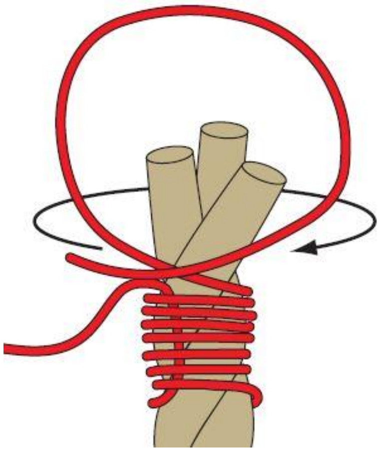
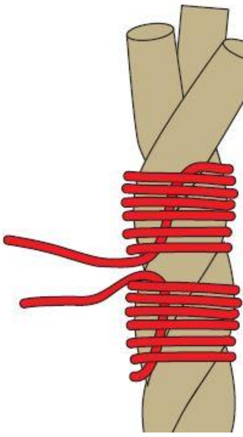
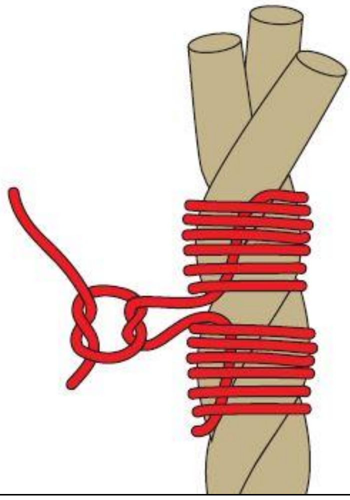
2. Now lay the other end down and hold the two ends together. Make several turns around the rope with one side of the loop covering the other side of the loop and rope.	
3. Tighten the whipping by pulling the two ends.	
4. Tie a reef knot with the two ends to secure and finish the whipping.	

Table 13 – American Whipping

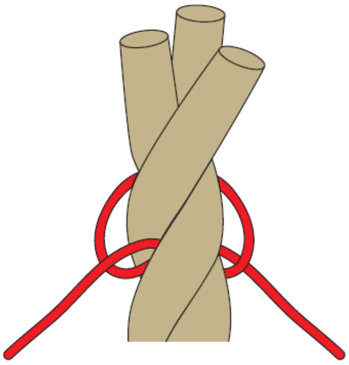
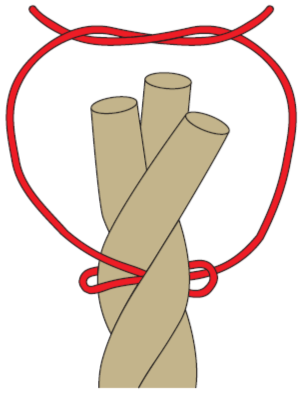
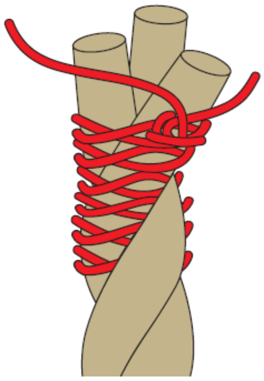
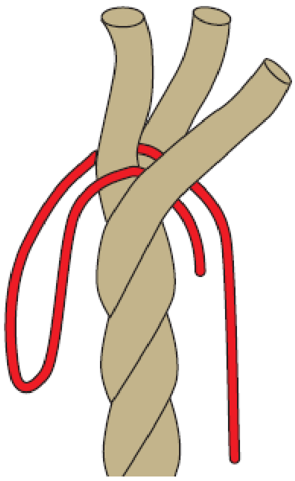
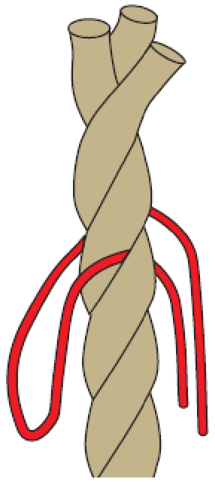
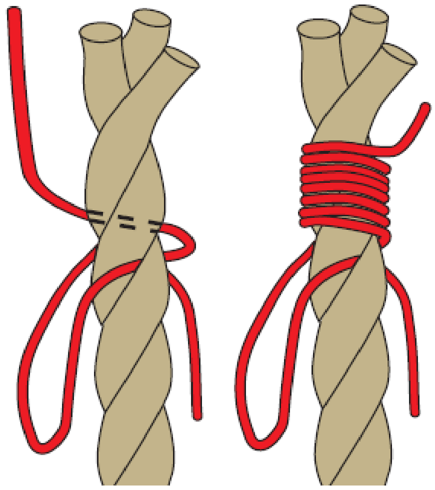
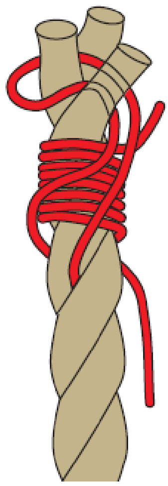
		
1. Take a turn around the rope with the twine and form the first overhand knot, ensuring that the two ends of twine left are of roughly equal length.	2. Take another half turn around the rope with each length of twine and form a second overhand knot on the other side of the rope.	3. Continue tying overhand knots in such a way that the knots alternate all the way up the rope. Finish off with a reef knot, i.e. two overhand knots, one on top of the other.

Table 14 – West Countryman's Whipping

1. Underlay the rope for about 50mm and form a loop around a strand with the whipping twine. The two ends of the twine should emerge together opposite the strand with the loop.	

2. Lay the rope back up and adjust the twine so that the loop and one end of the twine are approximately 100mm in length. The other end should be about 400mm in length.	
3. Holding the loop and short end of twine with the rope in one hand, use the other hand to wind the long end of twine around the rope away from the loop and short end of twine.	
4. Pass the loop around the end of the strand in such a way that the twine rests in the space between the strands.	

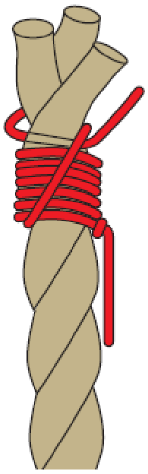
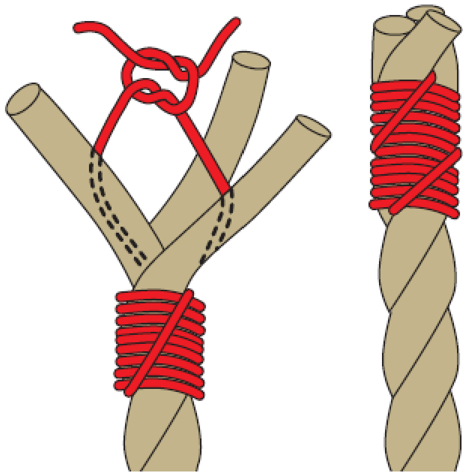
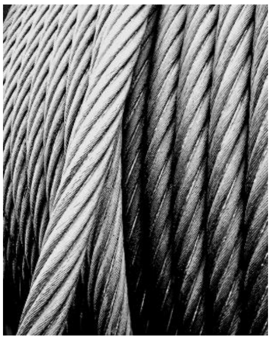
5. Tighten the loop by pulling the short end of twine.	
6. Now follow the groove left between the strands with the short end of twine and join the ends of twine with a reef knot in the middle of the rope.	

Table 15 – Sailmaker's Whipping

FLEXIBLE STEEL WIRE ROPE

Flexible Steel Wire Rope (FSWR) sizes are shown by nominal diameter in millimetres (mm). The tensile strengths are given in MegaPascals (MPa).



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 (1570MPa).
- **Grade 1770** – This rope is blackish in appearance and usually has an independent wire core (1770MPa).

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.

Rope Construction

FSWR is made up of a number of wires laid into a strand, then a number of strands laid around a core.

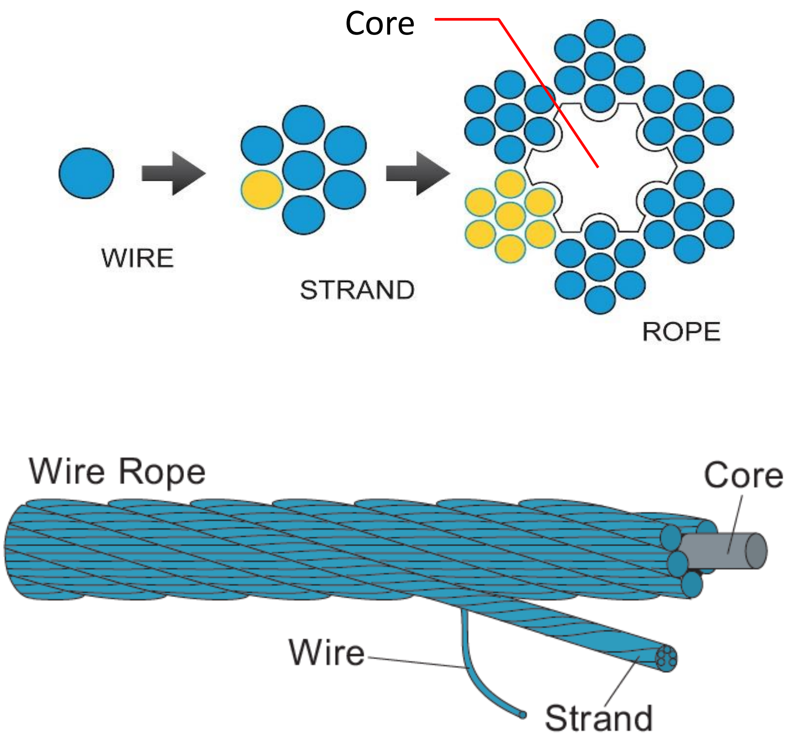


Figure 9 – Main Components of FSWR

The specification FSWR is documented using a coding system consisting of a number of abbreviations. Pre-formed ropes have a spiral shape bent into each wire before the wires are fitted into position in the finished rope. Post-formed ropes are compressed or twisted into shape after the rope has been made.

Abbreviation	Description	Abbreviation	Description
6	Number of strands	IWR	Independent Wire Rope
19	Number of wires per strand	IWRC	Independent Wire Rope Core
FC	Fibre Core	FW	Filler Wire
J	Jute	TS	Triangular Strand
RH	Right Hand Lay	S	Seale
LH	Left Hand Lay	SF	Seale Filler Wire
OL	Ordinary Lay	SW	Seal Warrington
LL	Lang's Lay	W	Warrington
FSWR	Flexible Steel Wire Rope	WF	Warriflex
GSWR	Galvanised Steel Wire Rope	WS	Warrington Seale

Table 16 – Wire Rope Abbreviations

Using the above abbreviations, a 6 strand, 19 wires per strand, fibre core, left hand ordinary lay, galvanised steel wire rope would be identified as, 6x19 (or6/19) FC LHOL GSWR. The most common types of rope are developed from basic 6/19, 6/24 and 6/37 constructions.

Lay of Wire Rope

Lay describes the manner in which either the wires in a strand, or the strands in the rope are laid in a helix. To determine the lay of a rope, you view the rope as it points away from you. If the strands appear to turn in a clockwise direction as they progress away from you, the rope has a right hand lay. If the strands appear to turn in an anti-clockwise direction then it has a left hand lay, the lay of the rope does not affect the WLL but does affect the spin of the wire rope.

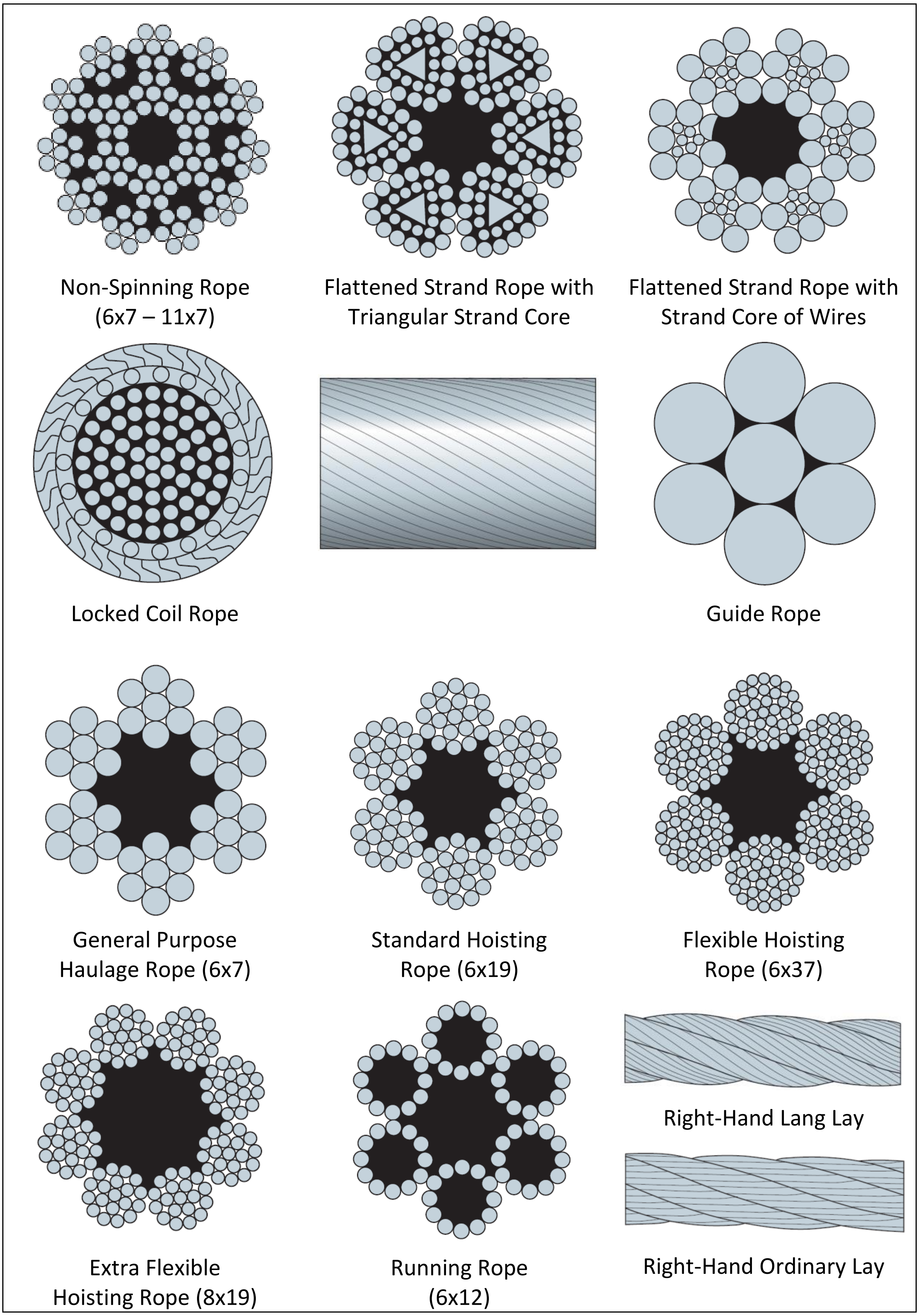


Figure 10 – Wire Rope Types

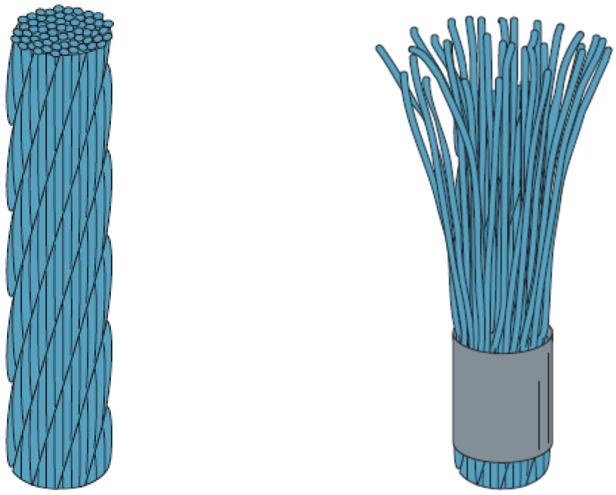
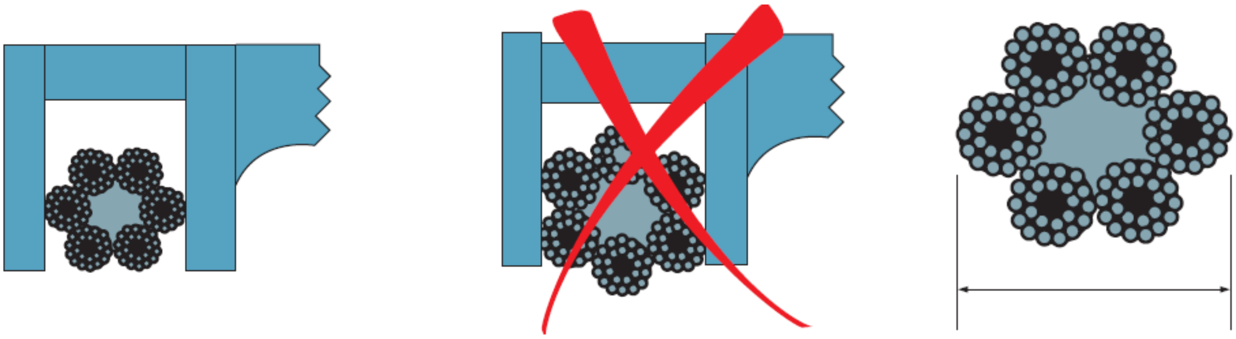


Figure 11 - Pre-formed Rope & Non Pre-formed Rope

Measuring FSWR

The diameter of a wire rope is the diameter of the circle that encloses all of the wires. It is important to take the greatest distance of the outer limits of the crowns of the two opposite strands.



Correct Incorrect Rope Diameter

Figure 12 – Measuring Wire Rope

Lay length is the distance along the rope in which one strand makes a complete revolution of the rope.

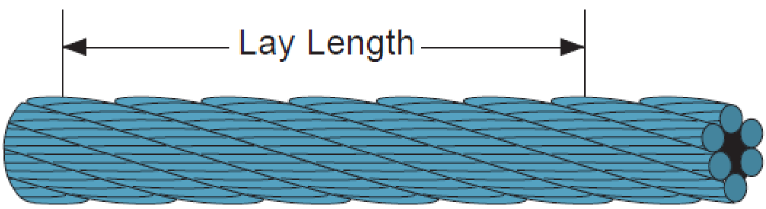


Figure 13 – Wire Rope Lay Length

Cross Laid and Equal Laid Ropes

Where strands are made up of two or more layers of wires around a centre wire, the wires in these layers may be crossed-laid. That is, the pitch or length of lay will be longer for the outer layer. This construction is limited to small ropes and cords, to some ship ropes and to standing ropes in larger sizes.

For all other purposes, ropes of equal-laid construction are preferable. By this method, all layers of wires have the same pitch or length of the lay. Therefore, each wire in the layer lies either in a bed formed by the interstices or valleys between the wires of an under layer, or alternatively along the crown of an underlying wire. Because no layer of wires ever crosses over another, an equal-laid rope maintains its diameter in service, has a more solid cross section and improved fatigue life compared to ropes of the cross-laid type. When wires are laid up in a strand in equal-laid construction, the arrangements of wire are referred to as Warrington, Seale or Filler, depending on the way in which the wires are arranged.

Warrington (also known as Warriflex)	A number of large wires are laid over the king wire. Then pairs of wires, one large and one small are laid around these. Each large outer wire lays in the valleys formed by the two inner wires, and each small outer wire rests on the crown or top of an inner wire. This prevents crossing of wires in the rope. The alternate small and large outer wires combine to give great flexibility with resistance to abrasion.
Seale	A number of small sized wires are laid over a central king wire. A similar number of larger wires are laid over these inner wires. Each outer wire lays in the valley formed by two of the inner wires. The small wires give flexibility to the rope while larger outer wires provide resistance to abrasion. Seale rope 6x19 construction requires larger sheave and drum diameters than other 6x19 construction ropes. Only use this type of rope for jobs where recommended by a crane or rope manufacturer.
Filler	A number of wires laid over a king wire. In the valleys formed by these, are laid very small ‘filler’ wires. These filler wires, with the first layer, then make double the number of valleys. The outer wires (usually the same size as the first layer) are laid in the valleys, and the length of lay of all the wires is equal, with no crossing of the wires.

Table 17 – Laid Rope Descriptions

Selection and Use of FSWR

- A rope made of a small number of heavy wires in the strands better withstands abrasion, but more quickly fails from bending.
- A rope made of many small wires better resists bending, but is more susceptible to abrasion.
- Longest rope service life results from the correct compromise of resistance characteristics to meet the forces in the particular rope use.

As a general rule, FSWR are used as below:

- Ordinary lay Independent Wire Rope Core (IWRC) is used mainly for hoist ropes with multiple fall reeving and multiple layering on the drum, IWRC is sometimes recommended for boom hoist ropes by manufactures.
- Ordinary lay fibre core is used mainly for slings and sometimes as a hoist rope when crushing is not a factor (i.e. single layer hoist drums.
- Lang's lay has a tendency to twist in operation and must be anchored for boom suspension ropes and is not suitable for hoist ropes.
- No-rotating rope is normally used for reeving where rope spin is a factor.
- IWRC rope is stronger and resistant to crushing.
- Fibre core rope is more flexible, but is prone to crushing and deformation.
- All crane ropes should be pre-formed.

Rotation Characteristics of FSWR

FSWR will try to rotate under load, or when the load is released. The likelihood of twisting increases in proportion with the diameter of the rope because:

- Different loads apply varying forces on the strands as the rope bends around a sheave.
- The groove on the sheaves force the rope to twist due to friction against the side of sheave.

To prevent load rotation, swivels are used at the load end. The swivel is usually built into the hook.

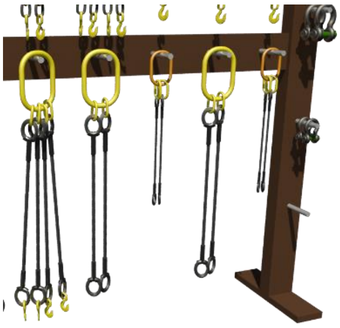
The structure and dynamic characteristics of FSWR means that under load, the different types of FSWR behave very differently when used with swivels.

- Non-rotating FSWR – use swivels with non-rotating FSWR to avoid overstraining the rope. Twisting forces may force the rope to unlay if the rope is prevented from rotating.
- Other FSWR – Never use swivels with other FSWR. Using swivels on other FSWR will cause the rope to unlay, decrease the rope's effective WLL, and significantly accelerate material fatigue.

Slings

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.



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.

To calculate the rated capacity in kilograms of FSWR, square the rope diameter (D) in millimetres (mm) and multiply by 8.
The number **8** is used because FSWR is eight times stronger than Dry Natural Fibre Rope

Example:	Rope diameter = 12mm **Rated Capacity (kg) = 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

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.

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.

CARE OF FSWR

FSWR should be stored on racks or reels and should be coiled and uncoiled in the correct way. Keep FSWR stored under cover in a cool dry location in accordance with manufacturer guidelines. Do not expose to temperatures over 95°C.

Inspection

A wire rope is not to be used for lifting if it displays signs of:

- Kinks.
- Core slippage.
- Crushing.
- Knots.
- Corrosion.
- Stretching.
- Heat exposure.
- High stranding.
- Damaged splice.
- One broken wire near a fitting or socket.
- Bird caging.
- Wear.
- Distortion.
- Reduction in rope diameter.
- 10% of wires are broken over a length of 8 x diameter of the rope.

Example: (Broken Wires)	10mm diameter. 6/19 FSWR – 6 x 19 = **114 wires** **10% of 114** 114/10 = 11.4 = **11 wires** **11 Broken wires over a distance of 8 x 10mm = 80mm**

Statutory regulations govern the inspection and discarding or wire ropes. All ropes should be inspected before use and ropes left idle should be inspected monthly.

You must comply with the relevant standards for the use of steel rope. Keep sufficient records of inspections and rope condition to provide a reliable history of the rope.

Look for evidence of wire breaks in the valley between the strands on running ropes. Breaks occurring on the crowns of the outside wires indicate normal deterioration. Breaks in the valleys between strands indicate an abnormal condition, possibly fatigue or breakage of other wires not readily visible. You should discard any rope with more than one break in one lay.

Spliced Wire Rope

Splicing is where two wire rope ends are joined end to end and the strands are intertwined to merge the two individual rope ends. Because wire rope splicing is a multi-step labour intensive process, the manufacturer or a specialist usually performs it.

Although you will probably not splice rope on site, you should have basic knowledge of inspecting spliced wire rope so that you can make informed decisions when inspecting gear for serviceability and safety.

Slings and Ropes	Ropes up to 24 mm in diameter require at least three full tucks with each whole strand of rope and two alternate tucks made by tucking alternate strands twice. Ropes over 24 mm in diameter and up to 32 mm in diameter require at least four full tucks and two alternate tucks. Ropes over 32 mm in diameter require at least four full tucks and two split, reduced, or tapered tucks made with all strands, with one-half of the wires in the fifth tuck and one-quarter of the wires in the sixth or final tuck.
Crane Ropes	Ropes up to 24 mm in diameter require at least four full tucks, with each whole strand of rope and two alternate tucks made by tucking alternate strands twice. Ropes over 24 mm in diameter require at least four full tucks and two split, reduced, or tapered tucks, with all strands with one-half of the wires in the fifth tuck and one-quarter of the wires in the sixth or final tuck.
Lang's Lay Ropes	Ropes of all sizes require at least six full tucks, with each whole strand of rope and two split, reduced, or tapered tucks with all strands.

Table 18 – Spliced wire rope inspections

ANCHORING AND SECURING FSWR

Anchorages are used for attaching the wire rope to the head of the boom, the crane hook or the drum. The eye on the anchorage for a rope must have a thimble. Approved methods of fixing a hoist wire to the boom head of a crane are:

- A hambone wedge socket.
- A machined swaged eye with thimble.
- A button socket.

If the hook of a crane spins rapidly, it indicates that the rope:

- May be incorrectly fixed at the head of the boom.

- May be the wrong type.
- Has been twisted when running onto the drum.
- May be incorrectly fitted to the winch drum.

Take severe twists out of hoist lines by discharging the weight off the hoist rope, releasing the anchorage from the boom head and untwisting the hoist rope.

Wedge Socket

It is essential to use a wedge and socket that is the correct size for the rope. Under no circumstances should the wedge protrude at the narrow end of the socket. An incorrectly sized wedge and socket may result in the rope pulling through the fitting when a load is applied. Ensure that the wedge and rope are properly seated in the socket before the lifting device is put into service. The tail on the dead end of the rope should project at least 200 mm. A bulldog grip must be applied to the tail of the rope below the socket to indicate slippage.

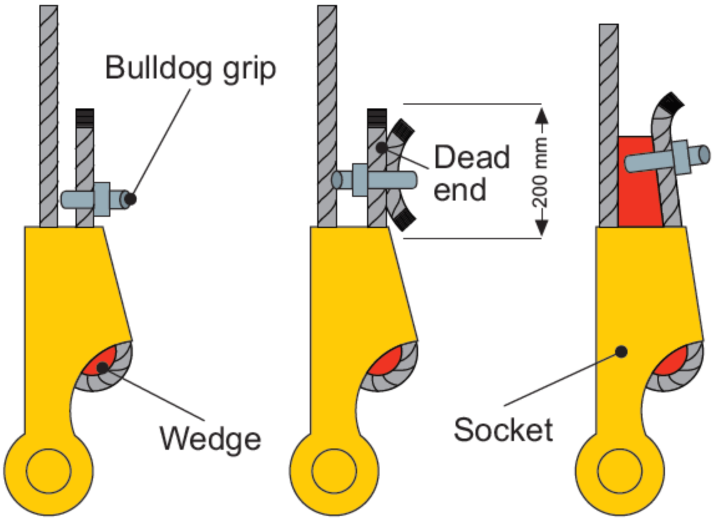


Figure 14 – Correct Clamping

Bulldog Grips

Bulldog grips are only suitable for permanent fixed stays or guys and must never be used for hoisting loads. At least three grips should be used for each fitting and they should be spaced at least six rope diameters apart. Grips should be fitted with a saddle on the load side of the rope and be the correct size for the rope being used. Grips should not be used to directly connect two straight lengths of rope as the rope could be crushed or pulled through the grip. Correctly applied, grips can form an eye capable of developing 80% of the rope's original strength.

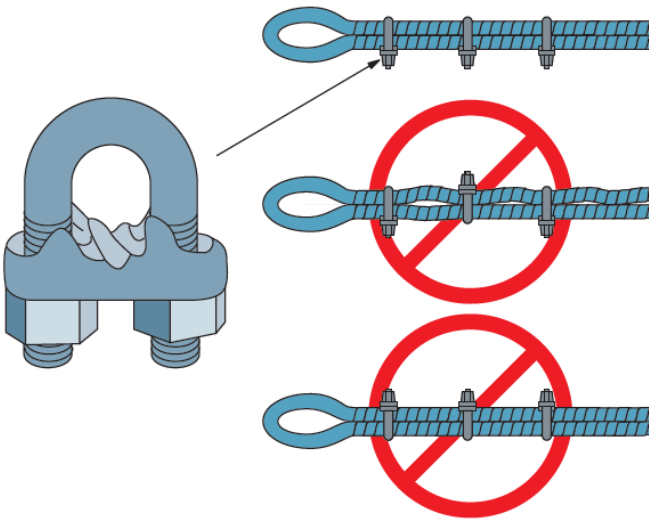


Figure 15 – Wire Rope Grips

Saddle Grips

Saddle grips are considered safer than bulldog grips, but should not be used for hoisting or direct loading. They can be used for guying, lifelines and span ropes. Single base clamps comprise two saddles and two bolts, which provide protection from crushing. As with bulldog grips, saddle grips are used on a rope to form eyes that develop 80% of the rope's strength. Double base clamps extend at least six rope diameters in length and provide greater clamping ability without causing rope damage. Double clamps form an eye that can develop up to 95% of a rope's original strength.

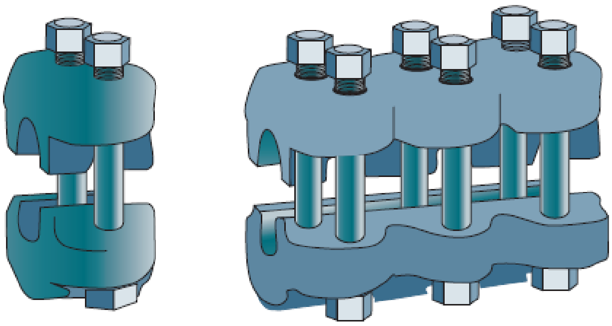
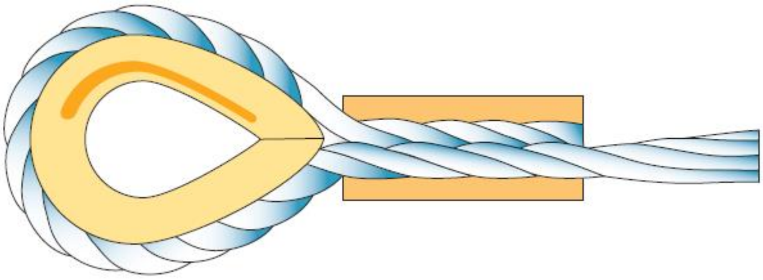


Figure 16 – Saddle Grip Single Saddle Grip Double

Thimbles

Thimbles are designed to protect the load bearing area inside the crown of the eye from chafing and distortion and to form a hard eye in a rope. Do not use thimbles or swages with the following defects:

- The tail of FWSR has slipped inside the swage fitting.
- The thimble is loose on the rope.
- The swage fitting is loose.
- There is a broken wire at either end of the swaged fitting.



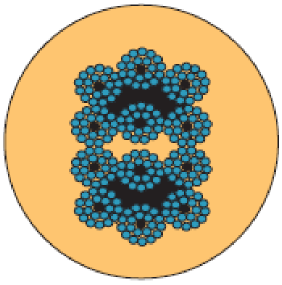


Figure 17 – Longitudinal section of a splice showing how the metal of the ferrule 'flows' round the strands of the rope.

Figure 18 – Cross section of a splice showing how rope and ferrule form one strong, homogenous mass.

Reduced or Flemish Eyes

Reduced or Flemish eyes are used for securing falls or whips to drum anchorages and must be capable of withstanding 90% of the guaranteed breaking strength of the rope to which they are attached. They are not to be used for hoisting loads with cranes. They are laid from a single strand and finished in the same manner as a long splice. Making endless grommet strop slings, while essential in shipping work, is not essential elsewhere, but like splicing, expert knowledge can be gained with experience.

UNCOILING FSWR

Wire rope is usually delivered from the manufacturer in coils or wound around wooden reels, in which the length supplied depends on the size and weight of the rope. There is always a danger of kinking a wire rope if it is improperly unreeled or uncoiled. Careful handling will prevent kinks, which are impossible to remove and may result in permanent damage to a rope. If a loop forms in slack rope, the loop should be thrown out at once, because a kink will develop if this loop is drawn tight. When a kink develops, the strands of a rope are distorted and become permanently set at this position. Excess wear occurs and wires will fracture at this point.

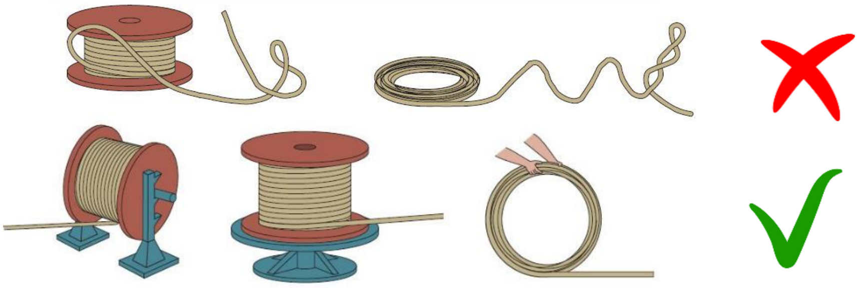


Figure 19 – Uncoiling FSWR (incorrect & Correct)

Precautions for Uncoiling

- Mount wooden reels on a spindle or shaft set upon jacks or stands, so that the reel will revolve as the rope is pulled off. Where there is danger of the reel running too freely and permitting the rope to run off uncontrolled, fit the reel with a brake.
- Alternatively, secure the end of the rope, stand the reel on its edge, and roll the reel along the ground in a straight line away from the free outside end. Ensure that the rope does not strike rocks or other sharp objects. The latter method should be used when a rope is delivered in a coil.
- Coils and reels can be laid flat on a turntable. A coil, however, should be laid on a turntable so that for a right hand lay rope, the turntable revolves clockwise as the outside end of the coil is pulled off. Use the opposite direction for a left-hand lay.
- When transferring a rope directly from a reel to a rope drum of a crane, hoist or haulage winch, or from one reel to another, it is important that the rope is taken from the top of the full reel and wound over the top of an empty drum or reel. Or alternatively, from the bottom of a full reel to the underside of an empty drum or reel. By using these methods, reverse bends, which would cause twisting, looping and kinking of the rope, are avoided and the rope will be easier to handle.
- Always take care to prevent wire rope from running over sand, ash, grit, clinker, earth or mud. Never take a rope off one side of a reel laid flat on the ground, as a loop and a possible kink will be produced for each wrap of rope taken off.

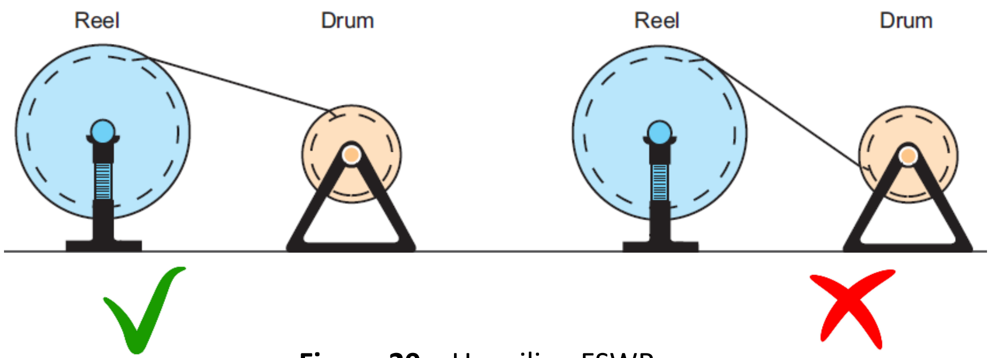


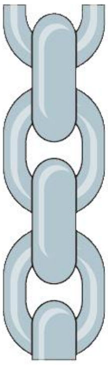
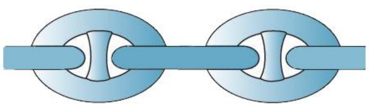
Figure 20 – Uncoiling FSWR

CHAINS

Chain gives no warning of failure, but it is better suited than wire rope for some jobs. Chains can be used to lift hot loads or heavy objects with sharp edges that could cut wire. When chain is used as a sling, it has little flexibility, but grips the load well. Load chain is heavier than wire rope used for the same application; however it can handle rougher treatment. Chain can be stored without serious deterioration and has a longer effective life than wire rope. Subject to good maintenance, the greater endurance and convenience of chain in many cases compensates for its greater weight and higher cost. Some of the advantages of chain over wire rope are:

- Withstands rough handling.
- Not likely to tangle or knot.
- Very flexible when not under load.
- More resistant to abrasion and corrosion.
- Wear in the links is easily seen.
- High working load limit.

Types of Chains

Type	Description
Short Link chain 	The size of the chain is determined by the diameter of the material in the actual link. Short link chain is made in short links to provide greater strength. The link length does not exceed five times the diameter of the link or 3.5 times the diameter in width. Short link chain is the only chain to be used for lifting when the chain is not required to be calibrated.
Stud Link Chain 	Stud link chain has a stud across the centre of each link. It is not suitable for lifting purposes and is used mostly in the marine industry.

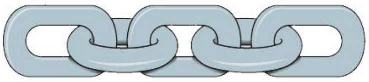
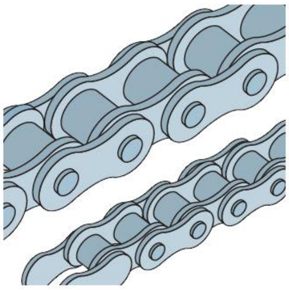
Type	Description
Calibrated Chain 	Calibrated chain has the link sides parallel to prevent stretch under load and is pitched so that the links are a constant and accurate length. Calibrated chain rides smoothly in the groove of a sheave or drum, or in the pockets of a load sheave (gypsy). This chain is principally used on chain blocks. Chain length will not exceed six times the diameter of the material used, and width does not exceed 3.5 times the diameter of the material used. Welds must be smoothly finished, free from fins or flashes. Weld diameter must not exceed the diameter of the material from which the chain is made.
Brush and Roller Chain 	Bush and roller chains are parallel or flat chains, commonly seen on the drive sprockets of cycles or forklifts. Because of their inability to bend sideways, they cannot be used as load chains to suspend loads except where the loads run in guides.

Table 19 – Chain Type Examples

Lifting Chain Grades

Chains are made in various grades and marked on a link at regular intervals. The word 'grade' means tensile strength of chain. Grade 80 chain is the only chain suitable for overhead lifting. Chain slings must have permanently affixed durable identification tag stating size, grade, rated capacity and reach. If there is no WLL tag attached to the chain, look for the grade markings as shown in the table below and arrange to have the identification tag replaced. If the grade markings are unclear or if there are no marks or stamping, the chain should not be used for lifting.

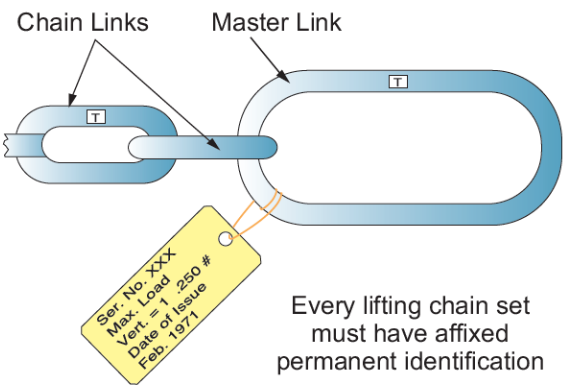


Figure 21 – Lifting Chain Identification

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

Grade	Description
30(L)	30(L) or 30 or 3. This is the minimum grade chain used for safe lifting of loads. Industrial and agricultural applications including guard rail chain, logging and load securement. Not recommended for overhead lifting.
40	M or 40 or 4 or 04 (High tensile chain). Approximately 50% stronger than grade 30. Typical uses are load binding, tie downs and towing.
50	P or 50 or 5 or 05.
60	S or 60 or 6 or 06. May be used in rigging and lifting applications.
70	Links are heat treated. Ideal for transport, load binding, logging and towing. 20% stronger than grade 40 chain and about 60% stronger than grade 30. Not recommended for overhead lifting.
80	T (Higher tensile/High grade Herc-Alloy chain used extensively for all load lifting uses). Most common chain for lifting. Widely used for slings, magnets, heavy duty dragging and pulling.
100	V (Very high tensile chain – Usually pink in colour). Approximately 25% stronger than grade 80.

Table 20 – Chain Grades

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.

Safe use of Chains

When using chains always check that the chain is suitable for the task. Grade 80 chain is the only chain that should be used for overhead lifting. The smallest diameter high tensile Grade 80 chain that should be used for safe load handling is 5.5 mm. For Grade 30 chain the smallest diameter chain that can be used is 8 mm; however Grade 30 chain is not to be used for overhead lifting.

Chains can be exposed to higher operating temperatures than wire or synthetic rope. Chains do still have limits and must be discarded when exposed to temperatures exceeding those limits. The maximum temperature for mild steel (Grade 30) chain to be exposed to is 260°C, and then it must be discarded. For high tensile Grade 80 chain the maximum temperature for exposure is 400°C. Discard any chain that has been exposed to temperatures above these limits. Any lifting chain exposed to temperatures above 200°C must have the WLL reduced.

Temperature Range	WLL Reduction Factor
260°C to 350°C	0.85
350°C to 425°C	0.66

Table 21 – Grade 80 Temperature Reduction Factors

Precautions When Using Chains

- Make sure the chain is of the correct size and grade for the load.
- Make sure all attachments and fittings are of a type, grade and size suitable for service with the chain used.
- Inspect each link regularly for wear, nicks, gouges, stretch, localised bending and shearing.
- Take damaged chains out of service and send to the manufacturer to be repaired.
- Arrange for any non-repairable defective chain to be destroyed so that others cannot use it.

- Never exceed the rated working load limit.
- Know the weight of all loads to avoid accidental overload.
- Avoid impact (sudden) loading.
- Store chains where they will not be damaged or corroded.
- Never shorten a chain by twisting or knotting it or with nuts and bolts.
- Never wrap chain around sharp corners without padding, packing or corner pads.
- Never hammer a chain to straighten the links or to force the links into position.
- Avoid crossing, twisting, kinking or knotting a chain.
- Never use the tip of a chain hook to carry a load.
- Never re-weld alloy steel chain links. Return it to the manufacturer for repair.
- Do not drag a chain from under a load.
- Do not drop a chain from a height.
- Do not roll loads over a chain.
- Do not place a ring, shackle or eyebolt on a crane hook unless it hangs freely over the bow of the hook.

Special precautions should be taken and a larger size chain or sling should be used:

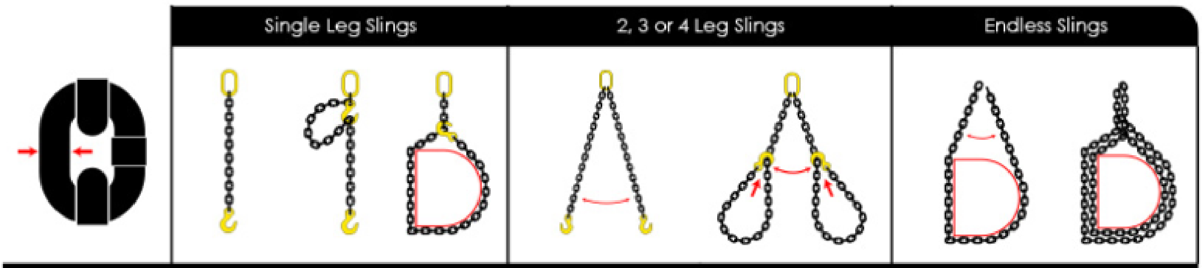
- Where the exact load is in doubt.
- When there is liability of shock loads.
- When the conditions are abnormal or severe.
- When there is exceptional risk to personnel or equipment.

Note: Never use a chain when it is possible to use wire rope. Chain does not give any warning that it is about to fail. Wire rope on the other hand fails a strand at a time, giving you warning before failure actually occurs.

Working Load Limit

Where a chain is reeved around an object, the bending action greatly weakens the nipped link or links, therefore a chain must be selected that is strong enough to lift twice the weight of the object. This allowance is made in addition to all other allowances made, for example, in addition to that for angles between legs and other reeving points. Use packing or corner pads if the chain is bent around tight bends or if there are sharp corners on the load. This will protect and reduce stress on the chain.

Always calculate the WLL of the chain and all lifting equipment. The WLL of lifting equipment may be reduced depending on the slinging configuration. Ensure that all situations and reductions are accounted for when calculating the WLL.



Part Code	Size mm	Single Leg Slings: Straight	Single Leg Slings: Adjustable	Single Leg Slings: Reeved	2, 3 or 4 Leg Slings: Straight 60°	Straight 90°	Straight 120°	2, 3 or 4 Leg Slings: Reeved 60°	Reeved 90°	Reeved 120°	Endless Slings: Straight 60°	Straight 90°	Straight 120°	Endless Slings: Reeved
ACN06	6.0	1.1	1.1	0.8	1.9	1.6	1.1	1.5	1.2	0.8	1.5	1.2	0.8	1.7
ACN08	8.0	2.0	2.0	1.5	3.5	2.8	2.0	2.6	2.1	1.5	2.6	2.1	1.5	3.0
ACN10	10.0	3.2	3.2	2.4	5.5	4.5	3.2	4.1	3.4	2.4	4.1	3.4	2.4	4.8
ACN13	13.0	5.3	5.3	4.0	9.2	7.5	5.3	6.9	5.6	4.0	6.9	5.6	4.0	8.0
ACN16	16.0	8.0	8.0	6.0	13.8	11.3	8.0	10.4	8.5	6.0	10.4	8.5	6.0	12.0
ACN20	20.0	12.5	12.5	9.4	21.6	17.6	12.5	16.3	13.3	9.4	16.3	13.3	9.4	18.8
ACN22	22.0	15.0	15.0	11.3	26.0	21.2	15.0	19.5	15.9	11.3	19.5	15.9	11.3	22.5
ACN26	26.0	21.2	21.2	15.9	36.7	29.9	21.2	27.6	22.5	15.9	27.6	22.5	15.9	31.8
ACN32	32.0	31.5	31.5	23.6	54.5	44.4	31.5	41.0	33.4	23.6	41.0	33.4	23.6	47.3

Table 22 – Chain WLL Chart example

Inspection Criteria for Chains

You must check any chains carefully before using them. The below outlines what you are looking for. If a chain shows any of these then it is unsuitable for dogging.

- Missing rated capacity tag.
- Cracks in link welds, spot-welding.
- Exposure to excessive heat.
- Pitting.
- Twists and/or kinks and/or knots.
- Stretching, locked, movement restricted.
- Gouged/cut more than 10% of original link diameter.
- 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.

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.

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). The below is an example for a Chain diameter of 10mm and Grade 80(T).

Example:	**Rated Capacity (kg) = 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 **= 3200kg** Therefore: Rated Capacity (t) = 3.2 tonnes or 3200kg

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. The below example is for a chain load of 3,200kg using a chain grade of 80(T).

Example:	**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.

SYNTHETIC WEBBING SLINGS

Synthetic webbing slings should only be used where an ordinary chain or rope sling is likely to damage the item being lifted. Synthetic webbing slings should never be used for general lifting applications.

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

Webbing slings may be sleeved to protect against the ingress of dust, or they may be close woven or treated in some manner to give the same protection. Webbing slings wrap around loads with smooth contacting surfaces. As the area of contact is greater than with round slings, it reduces the pressure applied to the load by the sling. They may be used in conjunction with wire rope or other slings.

There are three types of synthetic-webbing flat slings:

- Endless.
- Single or double-part with an eye at each end.
- Single or double-part with a terminal attachment at each end.

Endless	
With Flat Eyes	
With Reversed Eyes	
With Formed Eyes	
Single-Part or Double-Part with terminal attachment at each end	

Table 23 – Synthetic Webbing Sling Types

Specified webbing materials are high-tenacity, continuous multifilament polyamide (nylon), polyester (terylene, Dacron) or polypropylene yarns. Each type of webbing has different properties based on the material from which it is made. Always use the appropriate sling for the conditions of the lift. The properties of the most common slings are shown below.

- Polyamide, or nylon, is alkaline resistant but is damaged by acids.
- Polyester, or terylene/Dacron, is resistant to acid but is damaged by alkaline.
- Polypropylene is resistant to acid and alkaline but is damaged by organic solvents.

The use of these materials ensures high wet and dry strengths, abrasion resistance and resistance to attacks by microbes and many chemicals.

Flat sling lifting capacity is expressed in terms of maximum mass in tonnes that may be lifted in a straight pull. The breaking strength of webbing is measured in kiloNewtons per decimetre width.

Note: The elastic nature of the sling material allows high energy absorption, but slings which are stretched may take some time to recover. For this reason they should not be measured soon after use.

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.

Webbing Sling Selection

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 you check these types of slings 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.

Consider:

- Type of sling required — endless, single-part or double-part with an eye at each end, or single-part or double-part, with a terminal attachment at each end.
- Width and effective length.
- Material suitable for conditions (chemicals, heat, moisture).
- Maximum load and manner of use i.e. direct loading, basket hitch or choke hitch.
- Size of hook or details of other lifting devices with which the sling is to be used.
- The nature of loads to be handled.

Webbing Sling Markings

Synthetic-webbing slings have permanent markings with the Working Load Limit, the type of material from which the sling is made and any cautionary warnings. This information may be colour coded into the sling. The lifting capacity of a synthetic-webbing sling can be determined by the colour coding or by the SWL/WLL tag on the sling. Any flat webbing synthetic sling that does not have an information tag/label attached must be tagged as unserviceable, removed from service and returned to the manufacturer for testing and re-tagging.

Colour	WLL (Tonnes)
Violet	1 Tonne
Green	2 Tonne
Yellow	3 Tonne
Grey	4 Tonne
Red	5 Tonne
Brown	6 Tonne
Blue	8 Tonne
Orange	10 Tonne

Table 24 – Webbing Sling Colour Chart Example

Synthetic-webbing slings may be marked using:

- A printed label of woven fabric attached to a sewn joint.
- In some types of webbing, a single black line around the entire length indicates each tonne of WLL; this is a mandatory requirement of endless round slings.
- Stamping on the terminal attachment when fitted.
- A durable and corrosion-resisting plate permanently fixed to a terminal attachment when fitted.

The marking shows the following information:

- Manufacturer’s name or trademark.
- Lifting capacity - WLL direct (straight) loaded.
- Type of webbing material - i.e. polyamide or polyester.
- Limitation of application - e.g. ‘keep away from acids’.
- Month and year of manufacture.
- Identification marking correlating the sling with a warranty certificate.

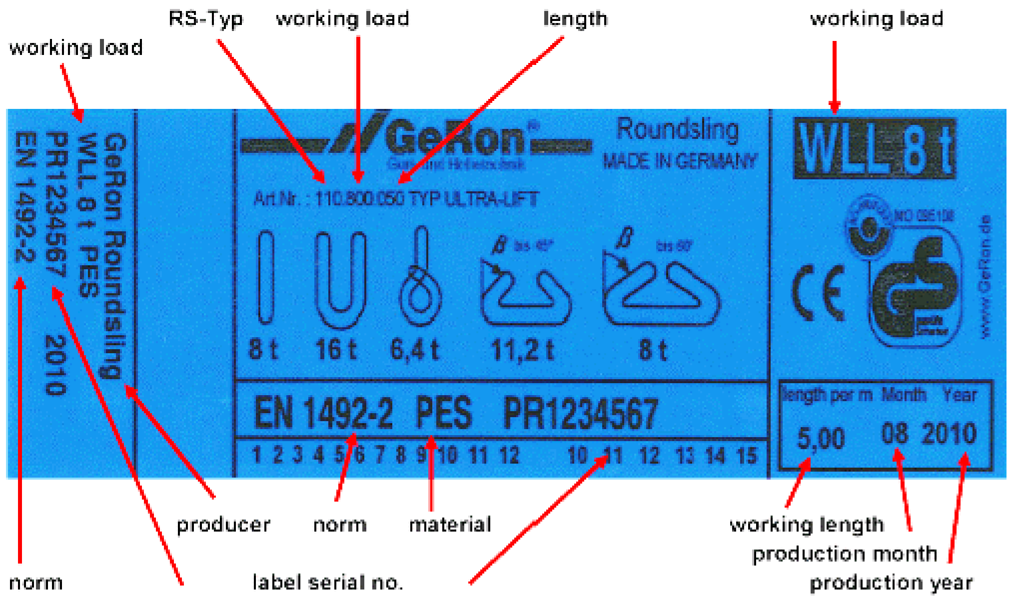


Figure 22 – Identification Label Example

Safety Checks When Using Webbing Slings

When using webbing slings always ensure that:

- The sling material will resist chemicals, heat and exposure to sunlight to the degree necessary in the circumstances of its use.
- The lifting capacity (WLL) consistent with the method of lift and reeving is not exceeded.
- Allowance is made for shock loading, unusual or severe working conditions and particular dangers.
- Slings are placed around the load so that it is balanced.
- The sling must be straight, untwisted and not crossed as this will decrease the WLL.
- The splice of endless slings must not be bent around the hook or load.
- When used in pairs, the slings are as close to vertical as possible. Use a spreader beam if necessary.
- The sling is protected where necessary from abrasion or cutting by the load which may cause serious loss of strength.
- Slings are fitted with a non-destructive tag.
- Slings are not dropped from a height.
- Slings are not pulled from under a load when the load is resting on the sling.
- Lagging, edge chaffers or other adequate protection are used on sharp corners or edges.
- Choke hitched slings are located so that the nip of the choke is not on the load bearing seam.
- The angle between the legs of choke hitches, basket hitches or multi-leg slings does not exceed 120°.

Note: Nylon slings can suffer a loss of strength of up to 18% when wet, but regain that loss of strength after drying. This is allowed for in its WLL.

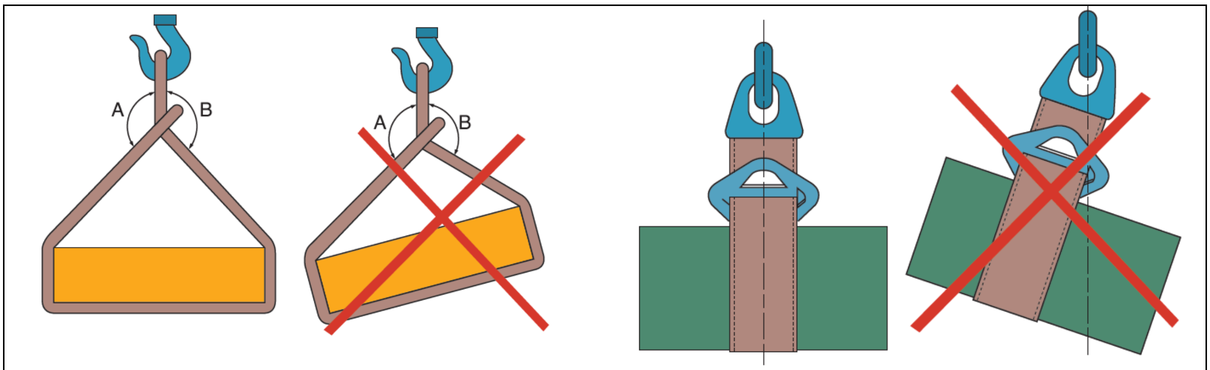


Figure 23 – Balancing the load

Working Load Limit

The WLL of webbing and round slings depends on application and capacity, which are coded and shown adjacent. The maximum working load applied to a synthetic webbing flat sling when reeved is determined by multiplying the sling's lifting capacity (WLL) for direct loading by the appropriate factor.

	M = 1.0	M = 0.8	M = 2.0	M = 1.9	M = 1.7	M = 1.4	M = 1.0
SLING TYPES	VERTICAL WLL	CHOKE WLL	BASKET WLL	30° WLL	60° WLL	90° WLL	120° WLL
	KG	KG	KG	KG	KG	KG	KG
Violet	1000	800	2000	1900	1700	1400	1000
Green	2000	1600	4000	3800	3400	2800	2000
Yellow	3000	2400	6000	5700	5100	4200	3000
Grey	4000	3200	8000	7600	6800	5600	4000
Red	5000	4000	10000	9500	8500	7000	5000
Brown	6000	4800	12000	11400	10200	8400	6000
Blue	8000	6400	16000	15200	13600	11200	8000
Orange	10000	8000	20000	19000	17000	14000	10000

Table 25 – Webbing Sling WLL Example

Inspection Criteria for Synthetic Slings

You must check any synthetic slings carefully before using them. The checklist below outlines what you are looking for. 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.

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

Storage of Synthetic Slings

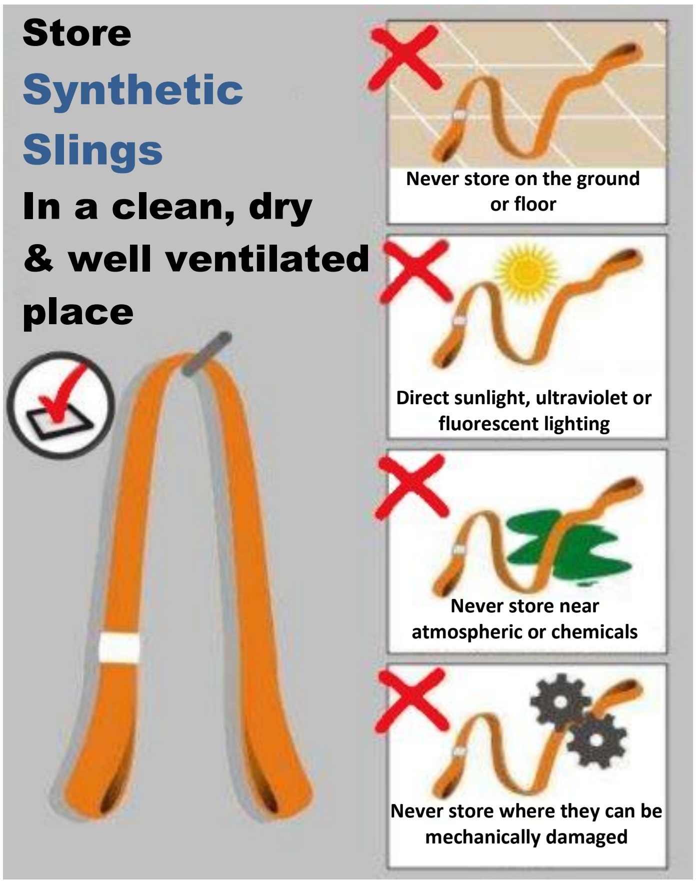


Figure 24 – Sling Storage

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.

Figure 25 – Bow Shackle

Figure 26 – Dee Shackle

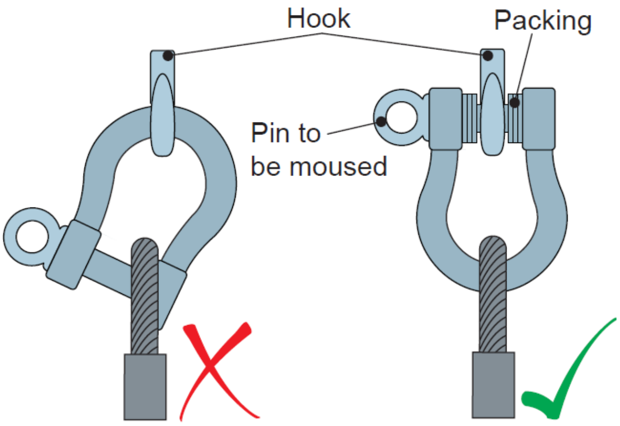
Almost all shackles are made of round bar and have circular eyes. The pin of the common shackle screws directly into one eye and should preferably have a collar.

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 their rated capacity stamped on the shackle (not on the pin).

The WLL of a shackle is marked on the shackle. Do not use a shackle if the WLL is missing or is not legible. Never allow a shackle to be pulled at an angle, as this will open the legs up and severely reduce the WLL. When fixing a shackle to a crane hook the shackle should be positioned so that the pin rests on the crane hook. Pack the shackle pin with washers so that the hook is centred and the load is carried evenly.



Always inspect shackles for defects before carrying out any lift. Never use a shackle or pin that is bent or damaged in any way.

A shackle is to be removed from service and discarded if it is:

- Bent.
- Cracked.
- Damaged.
- Deformed.
- Missing the WLL or the WLL is illegible.
- Nicked, cut or gouged deeper than 10% of the diameter.
- Missing its pin or has a pin that fits incorrectly.
- Wear of the pins or shackles equal to, or more than, 10% of the diameter.

EYEBOLTS

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

Figure 27 – Un-Collared Eyebolt

Figure 28 – Collared eyebolt

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.

USING SHACKLES AND EYEBOLTS

A shackle is used to couple an eyebolt to a hook or chain. The safest eyebolts have collars that prevent bending when the eyebolt is pulled at an angle. The tension in any leg of a sling attached to an eyebolt will always be applied with the eye, so that it does not tend to bend the eye sideways.

Never insert the point of a hook into an eyebolt, always use a shackle. Do not use a sling reeved through an eyebolt or reeved through a pair of eyebolts. One single sling leg should be attached to each eyebolt. Eyebolts must be kept in line with each other. Where eyebolts cannot be kept in line with each other and at the same time tightened, thin washers or shims may be inserted under the collars to allow the eyebolts to be tightened and turned in line with each other.

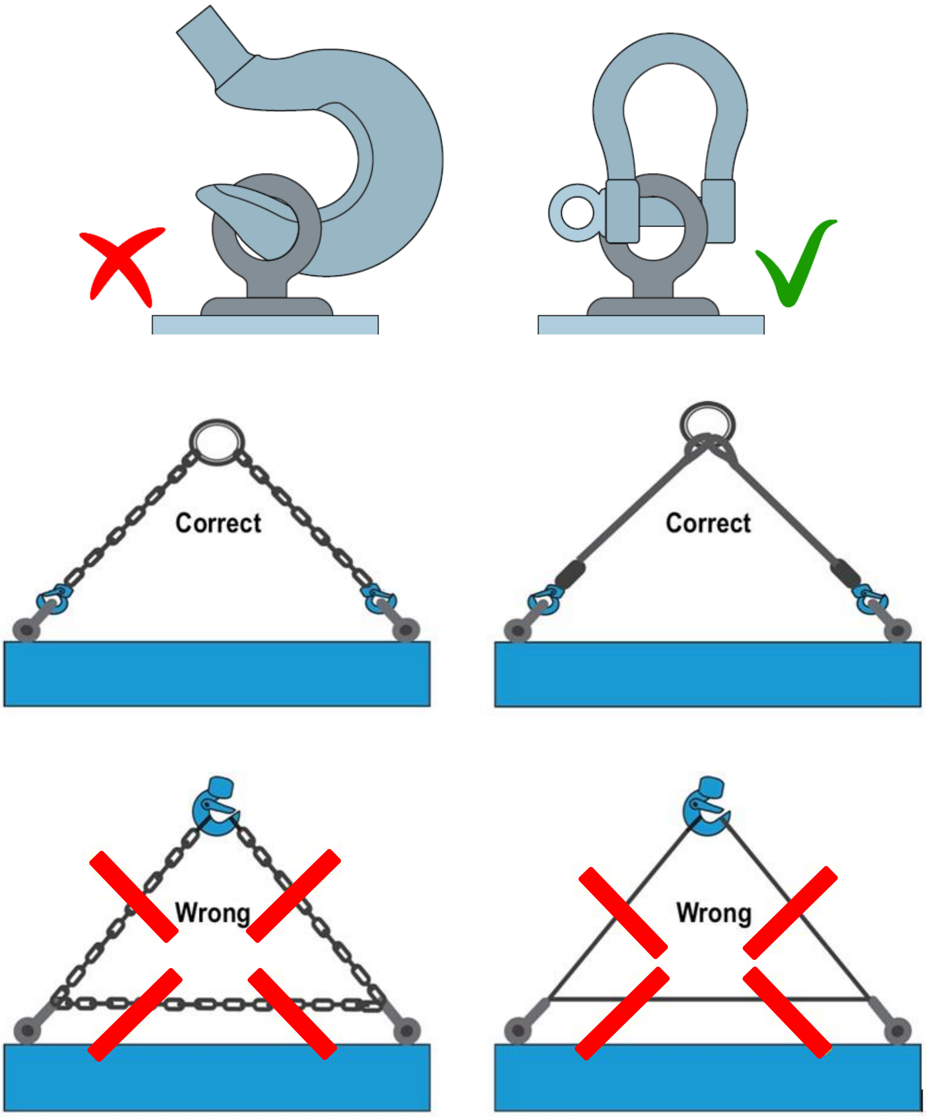


Figure 29 – Attaching to Eyebolts

Collarless eyebolts are only to be used for direct steady vertical lifts, and then only where the eyebolt is of sufficient size. Pulling a collarless eyebolt at an angle will bend or break the shaft of the eyebolt. Collared eyebolts can be used for slinging and lifting at an angle. Collared eyebolts are used when lifting with multiple leg slings where the pull on the slings is not directly vertical. Angular pull must only be applied in the plane of the eye and not at right angles to it.

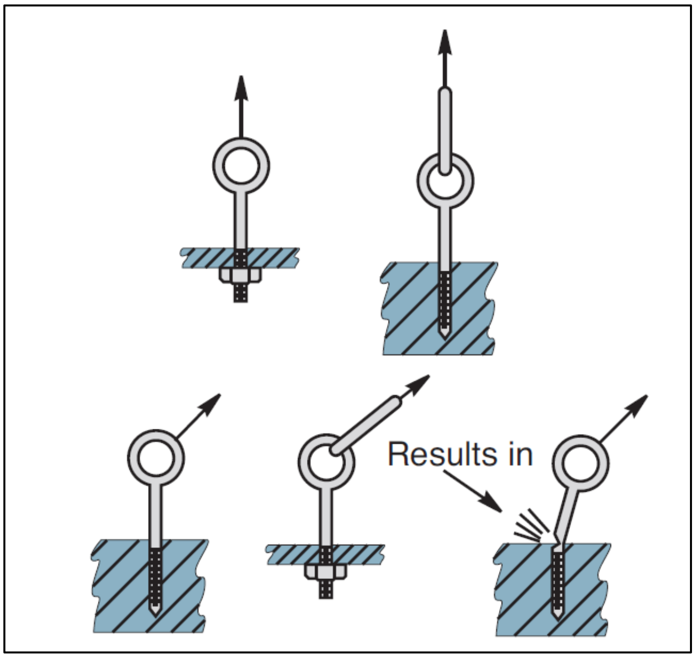


Figure 30 – Use of Un-Collared Eyebolts

Never heavily hammer an eyebolt on the crown to tighten it. A light hammer may be used after tightening to check the 'solid feeling', which indicates a properly fitted eyebolt.

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 are used to safely connect the chain sling to the load. Do not use a hook directly onto an eyebolt. Always connect the hook to a shackle on the eyebolt. Hooks should have a safety catch or should be moused to stop the hook slipping off the load when the load is released. Hooks should be inspected before use. Do not use a hook if the throat, or opening, has more than 5% wear or if the bite of the hook has more than 10% wear.

Shorteners are short chains with a hook at each end. They are used to shorten the length of a chain to a suitable length. The hooks on the shortener are hooked into the longer chain at a greater distance apart, effectively shortening that distance to the length of the shortener.

- When shorteners are used for shortening a multi-leg or single leg chain at the chain head, impose a 25% reduction on the WLL of that leg.
- If a pinlock is used, no reduction is needed.
- If a chain is reeved at the load, you still include the reduction at the multi-leg chain head.

Swivel Latchlok - (7mm to16 mm chain, up to 55 mm diameter rope or wire). Used for straight lifts as the swivel will untwist a sling without a spinning the load. Ideal for mobile, gantry or derrick cranes.	
Latchlok - (7 mm to 22 mm chain, up to 55 mm diameter rope or wire). Most commonly used in high rise work. It is self-locking under load.	
Clevis hook with safety latch	

Clevis Grab Hook	
Clevis Shortener Shortening clutches are similar to shorteners as they are used to shorten the effective length of a lifting chain. Care must be taken when using shortening clutches. The chain carrying the load must always lead out of the bottom of the clutch. If the direction is reversed so that the load carrying chain leads out of the top of the clutch, the front portion of the clutch may be pulled off and the load released.	 

Table 26 – Types of Hooks Example

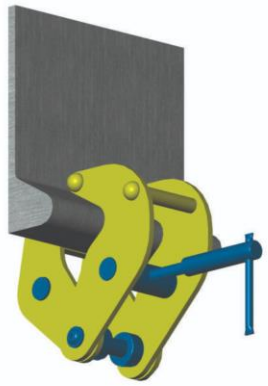
PLATE AND BEAM CLAMPS

Plate clamps can be used to lift plates or sheets. Plate clamps are designed to increase the purchase on the plate when the plate is lifted. Using plate clamps enables the load to be lifted and turned in one smooth operation. Plates can be turned over or lifted from the horizontal to the vertical position. The jaws of the plate clamp are of hardened steel and the clamp has a locking mechanism. Plate clamps can be supplied with moving jaws and fixed pads that incorporate wear indicators. When using plate clamps:

- Do not use the clamps to lift loads that weigh less than 20% of the WLL.
- Excessive damage can be caused to the teeth of the moving jaw of a clamp that is used continuously to lift the same thickness of material. Clamps used for this purpose must be inspected weekly to check for wear on the one or two teeth continuously in contact with the load.

Do not use home-made type plate clamps or plate dogs. Do not move an unbalanced load and do not exceed clamp rated load.

Note: Never use plate clamps when lifting over people.

Vertical Plate Clamp	
Bulb Bar Clamp	

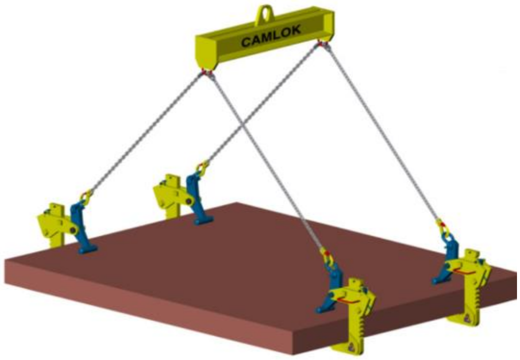
Adjustable horizontal plate clamp	
Beam Clamp	

Table 27 – Types of Clamps Example

Prior to use check for:

- 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.

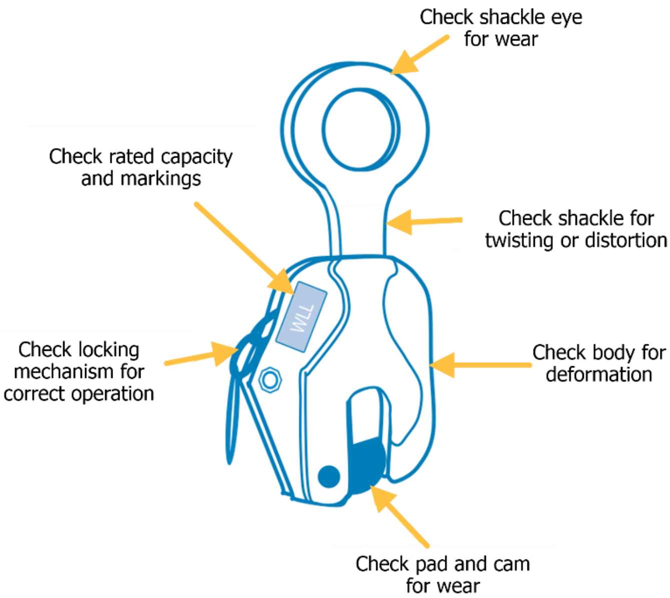


Figure 31 – Plate Clamp checks

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.

Lifting Beam

A lifting beam performs the same role as a spreader bar. The difference is the crane connection method. The lifting beam connects directly to the crane or with the use of a short sling (snotter), and the load may be connected at any point on the lower edge of the beam.
The beam must be engineer designed and load stamped.

Because of its capacity to hold a load rather than divert sling angles, a lifting beam is heavier and far more robust.

A second use for a lifting beam is for equalising a load to be lifted by two cranes. This is achieved by inverting the beam, connecting each end to a crane and suspending the load from the centre of the beam.

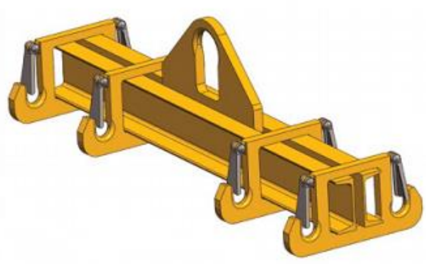


Figure 32 – Lifting Beam Examples

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.

Figure 33 – Spreader Beam Examples

Note: A spreader bar must be engineer designed and have the WLL and self weight permanently marked on it.

Lifting slings must be connected to the spreader at the same distance as the slings to the crane hook.

Where long loads are to be lifted, it is possible to use two identical spreaders to lift a load using four slings attached to the crane hook. Spreaders designed for this type of use have provision for a bar to be fitted to each end to keep them a set distance apart. This becomes what is referred to as a box spreader.

LIFTING PERSONNEL

Never, under any circumstances, allow a person to ride on the hook of the crane. If workers are required to carry out work whilst suspended from a crane, they should be lifted in an approved suspended workbox that meets all of the necessary requirements of the workplace, crane manufacturer and AS 2550 and AS1418.17. If a workbox is used to hoist a worker, the person dogging must be positioned in the workbox with them.

COMMUNICATION REQUIREMENTS

Before starting work you will need to determine the best communication methods for the situation.

Talk to the crane operator before you start and select the methods that you are going to use to communicate during the lift. This may include:

- **Hand signals** – should be used only when the crane operator is always in direct view of the person dogging the load.
- **Whistle signals** – may be used if the crane operator is in or out of view of the person dogging the load.
- **Fixed channel two-way radios** – should be used if:
    - Hand signals can't be seen.
    - Whistle signals cannot be heard or they may be confused with other whistle signals where multiple cranes are in use in the area.
    - It is more efficient than other methods.

Hand and whistle signals used in Australia.

ACTION	WHISTLE, BELL or BUZZER	HAND SIGNAL
Hoist Raising	2 Short ● ●	
Hoist Lowering	1 Long ▬	
Luffing Boom up	3 Short ● ● ●	

Luffing Boom Down	4 Short ● ● ● ●	
Slew Right	1 Long, 2 Short — ● ●	
Slew Left	1 Long, 1 Short — ●	
Jib/Trolley Out **Telescoping Boom Extended**	1 Long, 3 Short — ● ● ●	
Jib/Trolley In **Telescoping Boom Retract**	1 Long, 4 Short — ● ● ● ●	
Stop	1 Short ●	

Table 28 – Hand & Whistle Signals

Inspect Communication Equipment

If you are using any communication equipment (such as fixed channel two-way radios) make sure that it works before starting the job. This includes checking that radios are charged up and will not stop working half way through the task.

DEFECTS

If you identify any equipment that is defective, damaged or faulty you must not use it. The equipment needs to be isolated from use to stop anybody from accidentally using it and the defect needs to be reported to an authorised person.

Make sure you complete any isolation procedures as required.

This may include tagging or locking out equipment and completing fault reports or other documentation.

Faulty lifting equipment may need to be labelled and rejected, destroyed or returned to the manufacturer (depending on the type and severity of the fault).

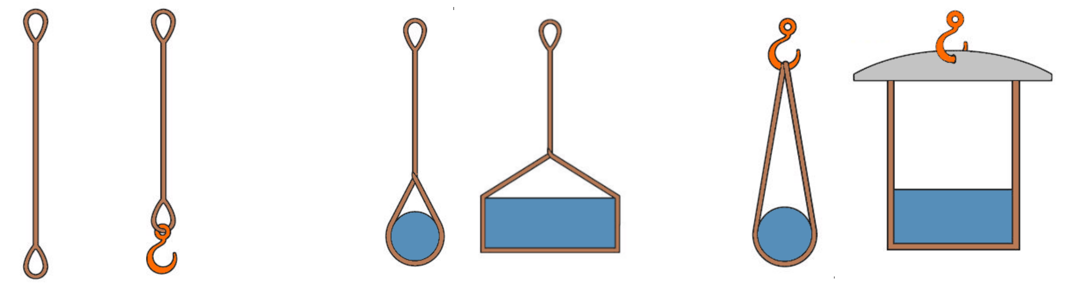
- Do not use.
- Tag out.
- Report to supervisor.

Figure 34 – Danger and Out of Service Tags

SELECT SLINGING METHODS

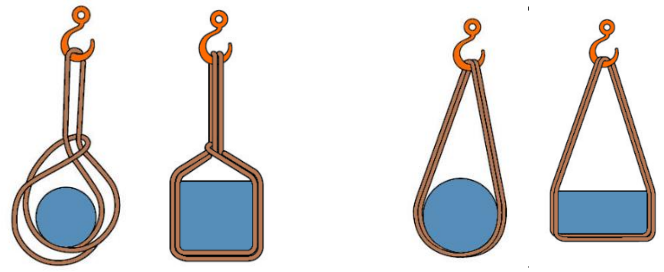
The way you sling the load will depend on the size, shape and requirements of the load. Some slinging techniques reduce the rated capacity of the slings. Make sure you have allowed for the reduction when you are selecting the slings and lifting equipment for the job.

Single Part, Single Leg Slings



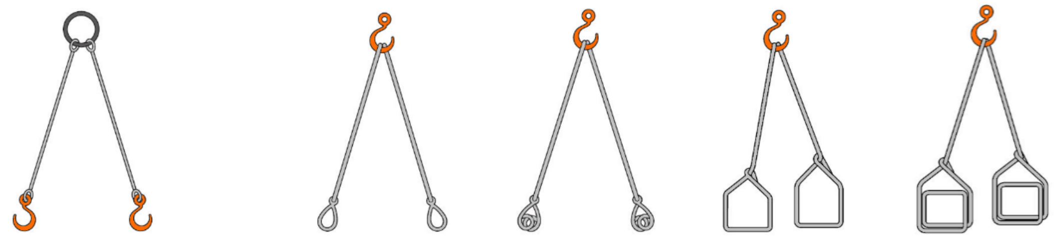
Direct Load | Choke Hitch | Basket Hitch

Double Part, Single Leg Slings



Direct Load | Choke Hitch | Basket Hitch

Two Leg Slings



Single Wrap | Double Wrap | Single Wrap | Double Wrap

Direct Load | Choke Hitch

Three and Four Leg Slings

Three Leg Assembly | Four Leg Assembly

Table 29 – Sling Methods

LOAD FACTORS AND SLINGING

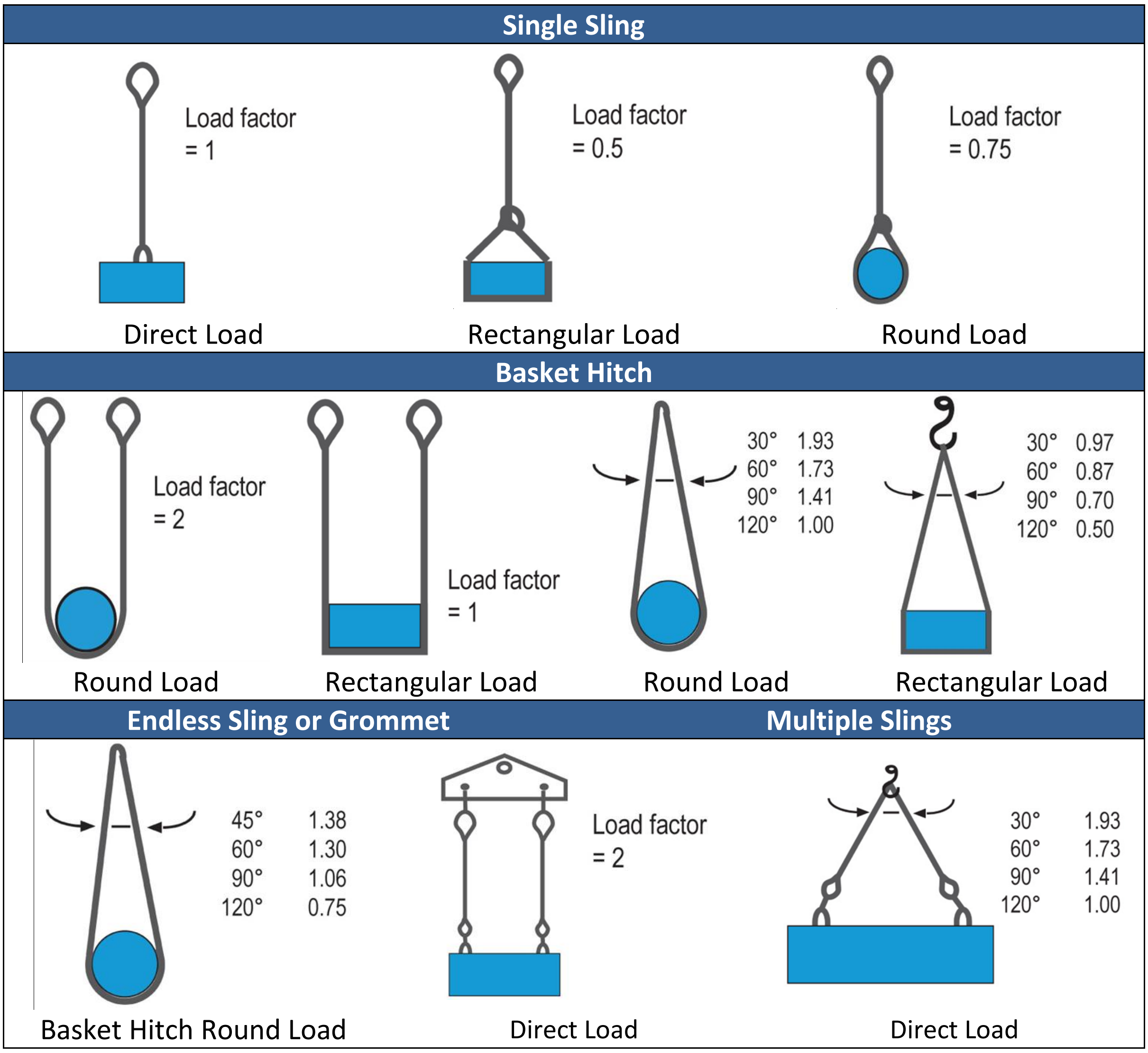
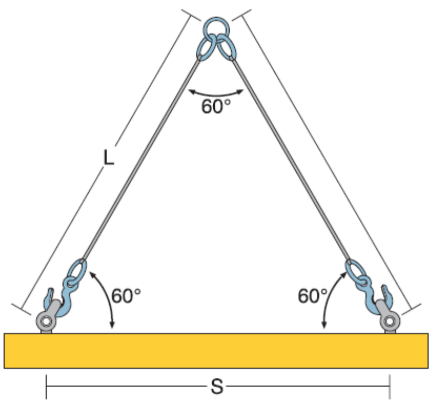


Table 30 – Load Factors

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 i.e. if 'L' is greater than 'S' the angle is OK.



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

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

When you are using two slings to lift a load and are determining the length and capacity of the slings required, ensure that you 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

Table 31 – Degrees and Load Factor

SAFE SLINGING TECHNIQUES

You can determine the safest slinging points on a load 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 make sure that you consider:

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

DO'S AND DON'TS OF SLINGING AND LIFTING

Do's	Don'ts
✓ Place packing/dunnage under loads to allow for easy sling removal after setting down. Make sure loads and base is firm if loads are to be stacked. ✓ Use bow shackles where more than two slings are placed on a hook, particularly if the hook is large. ✓ When using more than one sling on a load which is heavy at one end, ensure that the sling at the heavy end is rated for the larger load. ✓ If possible, position the crane so that you can always see the load. ✓ Watch for hazards that the crane driver may not see. ✓ Wherever possible position yourself so that the crane driver can clearly see you and your signals. ✓ Ensure that the crane hook is directly over the load. If the hook is not directly over the load, the load will swing when lifted. Swinging overloads slings and can put excessive side loading on the boom, causing boom failure.	× Don't use worn or broken gear. × Don't leave unused sling legs or hooks dangling when the crane is travelling. × Don't trail slings along the ground, or pull slings from beneath loads with a crane. × Don't use bricks, concrete blocks, or other crushable objects when packing under loads or between stacks. × Don't leave the pins out of shackles when not in use. × Don't use bolts when the pins are lost. × Don't knot wire rope and chains, or join chains with nuts and bolts. × Don't cross, twist, or kink any chain. × Don't drop a chain from a height. × Don't roll loads over a chain. × Don't place a sling, shackle or eyebolt on a crane hook unless it hangs freely over the bow of the hook. × Don't place several slings on the same hook without a safety latch or mousing. × Don't leave wire rope slings attached to the load and crane during welding.

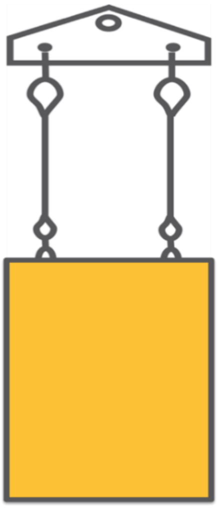
Do's	Don'ts
✓ Always close latchhooks after attaching or releasing them. ✓ Keep hands and fingers clear when a crane is first taking the strain on a load. ✓ Conduct a test lift. ✓ Check that support personnel are clear of the load prior to taking up the strain. ✓ Ensure no personnel are standing close to the chassis or outriggers of a slewing mobile crane. They can become jammed or crushed by the rotating counterweight. ✓ Check slings, and balance the load before lifting load further. Continue to check the slings and balance as the load is being lifted. ✓ Carry loads as close to the ground as possible, just high enough to clear any obstacles. ✓ Constantly monitor the load and lifting area as the lifting operation proceeds. ✓ All personnel must stand clear of loads, particularly when they are being moved. Heavy loads should be tied, as a person attempting to hold them steady may easily be crushed against the crane or other object. ✓ Use sling protection, for example a conveyor belt, car tyre rubber, timber or purpose built protector. Do not use material, cloth bags or similar materials.	Earthing through a shop crane may damage both the wire rope slings and the crane. ✗ Don't guess at the weight of loads or the capacities of cranes, or of any lifting gear. Refer to manufacturer documentation. ✗ Don't overload hooks or lift loads on the point of hooks. ✗ Don't reeve slings on wide heavy loads. ✗ Don't impose angular pull on the ferrule of a mechanical splice. ✗ Don't reeve a sling around an open top load, without using a spreader to prevent crushing. ✗ Back hooking is not recommended (passing a leg of a sling around a load back onto the crane ring). ✗ Do not ride on a lifting hook, sling attachment or suspended load, with the exception of riding in a suspended workbox that meets all statutory and necessary requirements.

Table 32 – Slinging Do's & Don'ts

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:

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



- The weight of the load is 1500kg.
- The lifting beam weighs 400kgwith a WLL of 4 tonne.

Drum Filled With Water

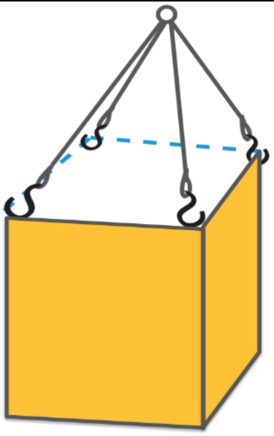
Calculations:	Rated Capacity = Weight of load divided by angle factor. = 1500 ÷ 2 = **750kg** Diameter of FSWR sling (mm) = Square root of (Rated Capacity (kg) ÷ safety factor 8) = √ (750 ÷ 8) = √93.75 = 9.682 Therefore: **FSWR diameter = 10mm** (rounded up from 9.682)

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.

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



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

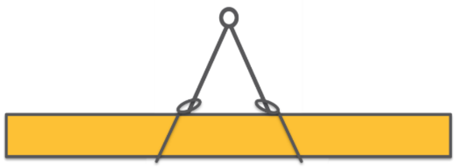
Box with Built in Lifting Lugs

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) = **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** Therefore: This is then converted to tonnes and rounded down to the nearest 0.1t. **Maximum load = 6.4t** (rounded down from 6497.28kg)

SLINGING TECHNIQUE 3

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

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



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

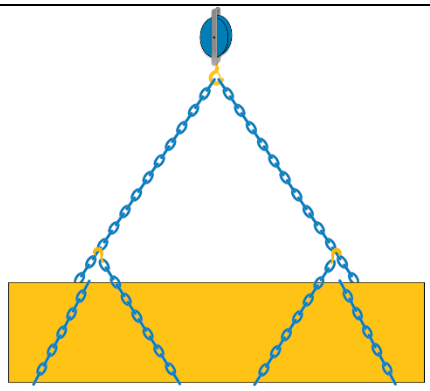
Steel Beam

Calculations:	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)

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.

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



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

Square Load

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.**

PREPARE SITE AND LIFTING EQUIPMENT

Once you have selected the equipment and slinging techniques that you will use, you need to make sure the work area is prepared in line with plans and site requirements.

This may include:

- Applying hazard prevention/control measures to the work area such as:
  - Barriers, signage and traffic control.
  - Adequate lighting.
  - Insulation or isolation of power lines.
  - Removal of dangerous/hazardous materials from the work area.
- Letting the appropriate personnel know that you are ready to begin the dogging work.
- Ensuring that the work area and path of movement for the load are clear of any obstructions.

Once the site is prepared you should assemble any lifting equipment as required.

This could include:

- Attaching slings to lifting beams or frames using shackles.
- Adjusting the length of chain slings.

PREPARE LOAD DESTINATION

You should ensure that the destination for the load is also prepared and ready for the load to be landed.
The load destination could be:

- The ground.
- Loading platforms.
- Suspended floors.
- Vehicles.

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, you should use site information gained from engineers or authorised site personnel.

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

DETERMINE PATH OF TRAVEL

As well as preparing the load destination, you should also ensure that the path of movement is appropriate to the task. The path of movement should be selected in the planning stage of the dogging task – before you move the load.

When determining the path of movement you should think about:

- The size of the load.
- The dimensions of the crane.
- The suitability of the pickup and landing sites.
- Preventing others from accessing the pathway.
- Spotters.
- Communication arrangements with the crane operator.
- Overhead power lines.
- Obstructions.

Check for any uneven or dangerous terrain and other obstructions or hazards. Where possible, ensure that the path is on a firm, level surface in order to maintain the stability of the plant and to minimise load swing.

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

LOAD HANDLING

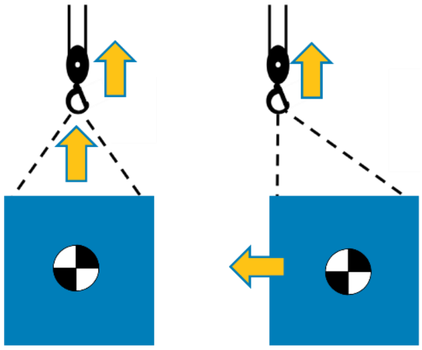
Before the load can be shifted, you need to make sure it is correctly connected to the crane hook and secured to prevent unwanted movement during the lift.

The lifting equipment needs to be attached and secured to the crane hook (or lifting hook).

The hook should be fitted with a safety latch to prevent the slings from dislodging. If the lifting gear does not fit over the bill of the hook, use a shackle or lifting rings to attach the gear to the hook.

Make sure the shackle or lifting ring is large enough to comfortably hang from the hook with enough space for slings or other equipment.

Position the Crane Hook



The crane hook should be positioned above the centre of gravity of the load. This will help to keep the load from swinging out of control or slipping from the sling arrangement when it is lifted. It will also prevent dragging or snigging of the load.

The centre of gravity may be marked on an item that is going to be lifted however, if it is not marked, you may have to conduct a test lift to determine the centre of gravity of the load.

Attach Lifting Equipment

Attach and secure the lifting equipment to the load, making sure that any sharp corners are packed to prevent any unnecessary damage to slings or the load.

Check that all shackles or eye bolts are secure and, if necessary, lashed or moused.

Mousing is done by passing a couple of turns of wire through the hole provided for this purpose in the unthreaded end of the pin and around the body of the shackle's hoop.

Attaching a Tagline

A tagline is used to assist in the safe landing and control of the load. It is appropriate to use taglines when working near overhead power lines and at any time where the load may become easier to control in the landing process.

Taglines may also be necessary if the load is liquid with a moving centre of gravity, if it is windy, or if there are obstacles or obstructions that need to be avoided during the move (that could not be removed).

Natural fibre ropes are commonly used for taglines as they are strong and non-conductive.

The minimum diameter fibre rope you can use as a tagline is 16mm. DO NOT use a wet rope as a tagline – it could conduct electricity if coming into close range of power lines.

When using a tagline, do not wrap the rope around yourself as you may be dragged by a sudden movement of the load. Always wear gloves when using a tagline.

Loose Bundles

The correct method of lifting loose bundles is with two slings, double wrapped with a basket hitch. Double wrapping compresses the load and prevents it from slipping out of the slings. When wrapping a load do not force the eye of a sling down at the nip point. This practice will decrease the WLL and damage the sling. Avoid using a choke hitch as it does not provide full support for loads and material can slip out. Always chock, or block, round loads before releasing them to prevent them from rolling away.

The safe methods for slinging and lifting loose pipes or a loose bundle of steel are:

- Use two slings.
- Double wrap the slings.
- Reeve the eye.
- Ensure that bites are in same direction.
- Maximum 60° angle.
- No pressure on safety latches.
- Appropriate sling angle (for a loose bundle of steel).
- Adequate packing to protect the slings (for a loose bundle of steel).

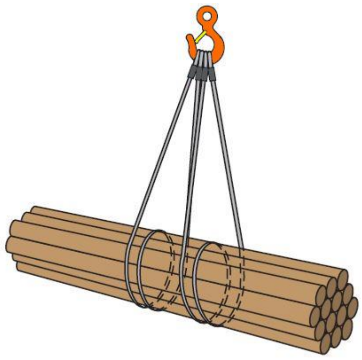


Figure 35 – Pair of double wrap basket hitches

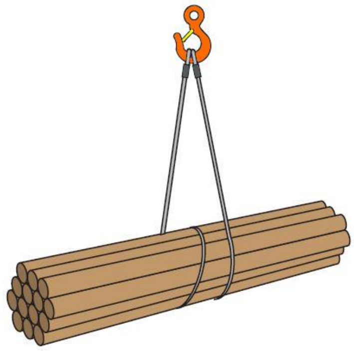


Figure 36 – Single double wrap basket hitch

Loose Items

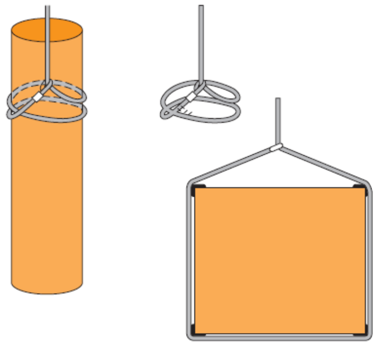
Loose items such as scaffold clips must be raised in properly constructed boxes branded with the WLL. Do not stack items higher than the side of the material box unless they are properly secured. Ensure that the lifting box is stable and is not top heavy.

Do not lift loose items in 200 litre drums or makeshift containers because:

- There is no rated lifting capacity.
- You cannot reliably know the condition of the base of the drum (drums are usually discarded because they are unfit to hold liquid).
- Holes cut into the sides for the sling or hooks are likely to pull through under the load weight.
- Sharp edges on the holes are likely to cut through a sling.

Vertical Loads

When lifting round vertical loads always use a round turn and reeve the sling, with two full turns and nip. Use pads to protect slings from sharp edges on square or irregular shaped objects. Padding will also prevent the slings damaging the load.



Structural Steel

Structural steel can be very dangerous. When a load arrives on site, walk around the truck and check that the load has not shifted. Serious injury or death can occur if steel beams fall when the restraining chains are removed. Trucks must have restraining spikes, or a frame, fitted when carrying steel beams to prevent them from falling off the truck.

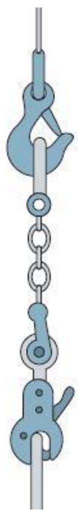
NOTE: Do not removing the securing chains or straps if there are no restraining spikes in place.

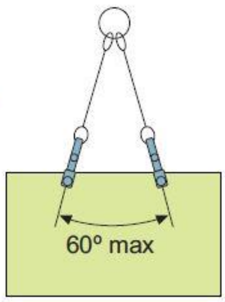
Deep beams are unstable and can topple because they are narrower in width than height. Keep bundles of steel straight and level when lifting. Do not lift the bundles vertically or at an angle as slings do not give sufficient hold to prevent them falling. Steel sections are likely to move as the load is lifted and the sling bites into the nip. Keep your hands well clear when a load of steel is lifted.

Steel Plate

Steel plates are usually thin and many are long and wide. The plates tend to sag and buckle during a lift, so methods have been developed to prevent this from happening. Some of the correct lifting methods and equipment for handling steel sheet plate include using:

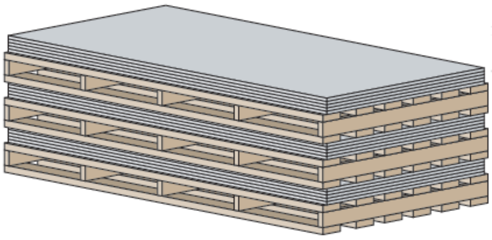
- Two leg slings.
- Maximum sling angle of 60%.
- Plate clamps.
- Shackles.
- Spreader beams.
- Lifting lugs, welded to the plate by a competent person.





Take care when setting plate down that has been lifted vertically. When the vertical plate touches the ground and tension is released from the slings, the hook can slip out of the hole in the plate. To prevent this, use a plate clamp attached to a shackle and hook with a safety latch. Keep the tension in the slings until the plate is in place and secure.

Plasterboard

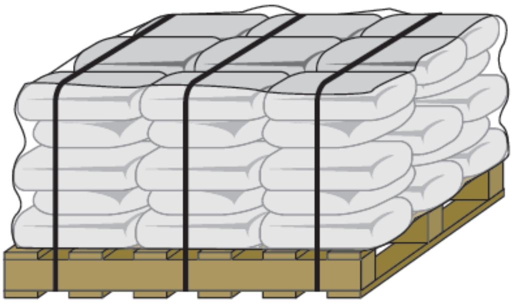


Sheets of plasterboard are usually delivered on site in plasterboard packs. Plasterboard packs should be lifted in a specifically designed lifting cage. If a suitable lifting cage is not available, wrap the load in metal strapping and lift with the slings in a choke hitch configuration. Use additional padding or packing to prevent the strapping and slings from damaging the load. Another method of lifting plasterboard packs is to wrap the pack in plastic and place metal strapping around the load. If wrapped this way, the packs can be lifted using two slings in a basket hitch configuration.

Pallets

Pallets are used to deliver a wide variety of loads. Before lifting a loaded pallet check that the:

- Pallet is in good condition.
- Load is secured so that nothing can fall off.
- Load is properly slung.



The WLL of a standard hardwood pallet is 2000 kg. This WLL is greatly reduced when there are any missing boards or other defects.

NOTE: Some pallets are designed for packaging not lifting.

To lift a load on a damaged pallet, raise the load and pallet only enough to reposition it onto an undamaged pallet, then lower the load and sling properly before further lifting or moving. If no spare undamaged pallets are available, do not lift the load; send it back to the supplier to be re-palleted.

Brick Cage

Lifting bricks can be extremely dangerous if they are not properly secured. To prevent loose bricks falling from height, always lift a pallet of bricks or blocks inside a brick cage. Brick, or block, cages are designed to safely hold pallets of bricks, or other loose objects, as they are lifted. The brick cage fits over the load and is attached securely to the pallet. Always check the WLL of the brick cage and the pallet before lifting loaded pallets with a brick cage.

Personnel Cages

Often there is a need to lift or lower personnel using a crane. Personnel are not to be lifted by a crane unless they are within a suitably rated personnel cage or lift box. Never lift personnel on a sling or hook. When hoisting a worker in a lift box, the person dogging the load rides in the box with the worker. Cages are normally rated to hold a number of personnel and extra for tools and equipment. Always check that the personnel cage and all lifting equipment are rated for the combined weight of the cage, lifting gear, tools and materials as well as the personnel within the cage. The cage is not to be lifted unless the door of the cage is closed and secured.

NOTE: Safety harnesses must be worn at all times within the cage.

Rubbish Bins

Rubbish bins must have proper lifting lugs and be branded with the WLL. Overloaded rubbish bins must not be lifted. Secure the load before lifting when rubbish can spill or be blown from a bin, especially in windy conditions. Use a four-legged sling for slinging rubbish bins. Release the two front slings and raise the bin with the two back slings to tip the bin. Do not stand behind a bin when emptying rubbish because it may suddenly whip back when it clears the ground.

TURNING LOADS OVER

When turning over a load, such as a steel beam, box or bin, the sling must be attached to the hook on the side of the load that is to be lifted. This ensures that the load is raised on a diagonal through the centre of gravity. When the load's centre of gravity crosses over the balance point, lower the load in a safe and controlled manner.

Sling the load so that when the load is lowered, the nip will pull against the eye. A long narrow load such as a steel beam standing on its flange has a narrow base and a high centre of gravity. If you nip the sling incorrectly the load may topple over and break the slings.

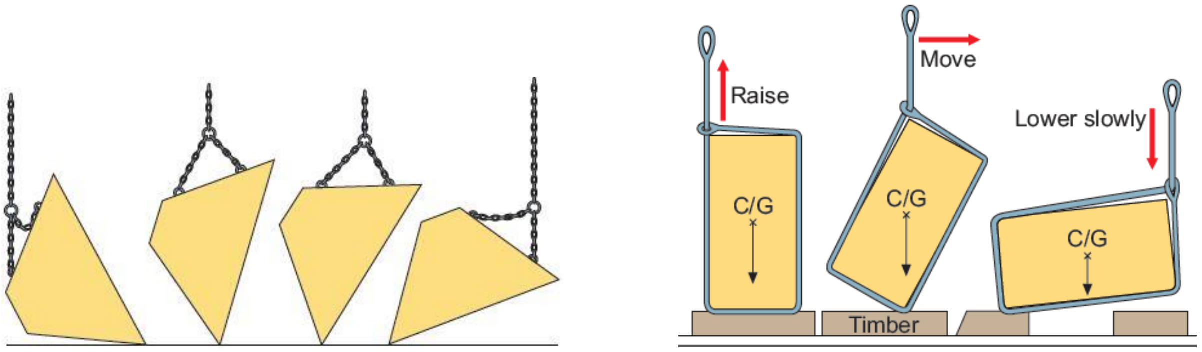


Figure 37 – Turning Load Over

STACKING

Stack all materials safely and in a location where the stack will not interfere with other operations. Stacks of materials must be arranged so that:

- The stack is even and will not fall.
- There is adequate clearance from moving machinery.
- There is access for people, forklifts, cranes and trains.
- The sling can be removed as each unit is placed on the stack. Do not use the crane to remove the sling as it can topple the stack. Remove the sling by hand.
- There is access to fire extinguishers and other emergency services.

NOTE: Always remove a sling by hand as a crane may topple the stack.

Before stacking ensure that the ground is stable, level and not prone to flooding. If there is heavy rain, ensure that the stack is raised off the ground and check for signs that the ground may give way. Chock the stack level if the ground is sloping. When a stack is removed check for ground stability before placing another stack in the same location. Stack materials in a safe location away from operations and personnel. There are clearance zones around operational areas where materials must not be stacked.

The minimum clearance that should be kept between stacked loads and the following structures are:

- 3 metres from railway tracks.
- 3.5 metres around the stack for truck access.
- 1 metre for walkways.
- 1.5 metres for access for an overhead travelling crane operator.

There must be enough access around the stack for normal work and for stretcher access in the case of emergency.

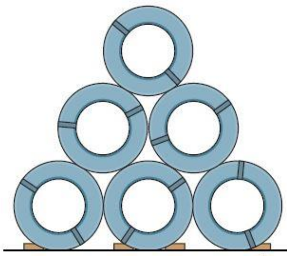
Stacking Steel Plate

Steel plate can be stored in racks or in piles. Plates wider than 0.75 metres can be stacked horizontally by staggering groups of plates to make a suitable amount to lift. Plates of different sizes can be stacked with the largest at the bottom so that the markings are visible.

Take care moving plate when it is stored vertically in a rack. When steel plate is stacked upright in racks the plate can easily swing and crush someone when the crane takes the weight of the plate. Never lift a plate from a rack if someone is inside the rack. Use plate clamps and adequate packing to avoid standing inside a rack. To avoid high, horizontal stacks of steel plate becoming unstable, tie together with strapping.

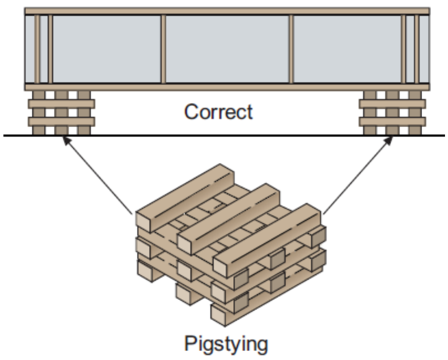
Stacking Rolled Steel, Coils and Other Round Loads

All round loads must be blocked or chocked at the bottom to prevent them rolling or moving. Each layer of the stack must be one unit less than the layer below. The stack will then resemble a pyramid.



Stacking Timber

When stacking shorter lengths of timber, place alternate layers at right angles. This is called pigstying. Bundles of timber must be strapped and have dunnage under and between the bundles. Keep stacks straight and set on a level surface. Check for ground movement after rain.

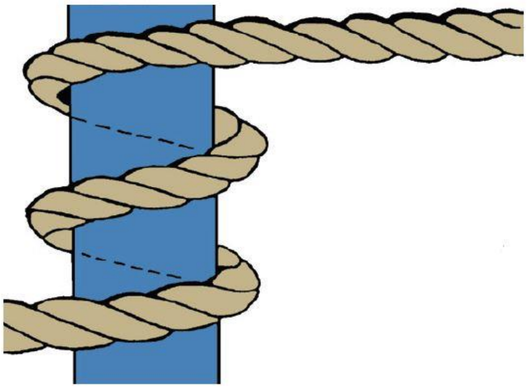
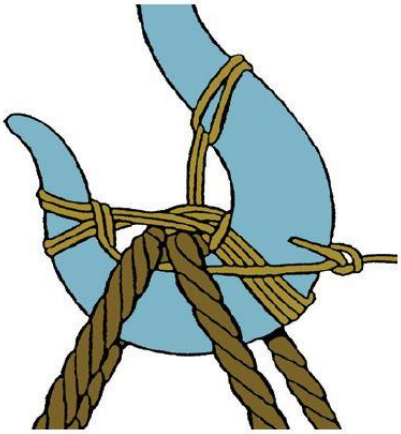
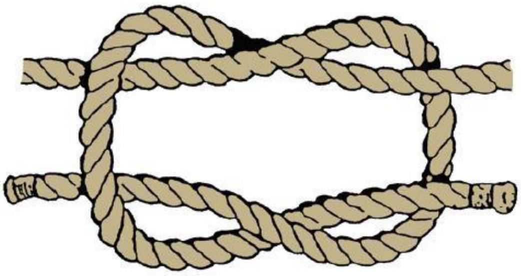


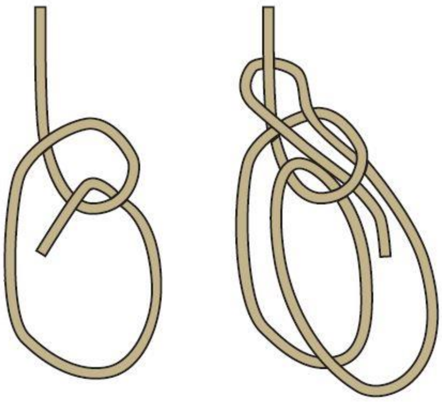
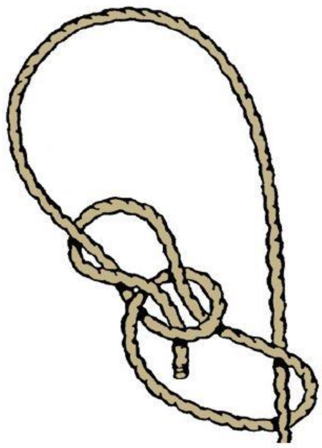
Ladders must be provided for access to the top of high stacks. Tie high stacks together with interlocking packing to avoid the stack becoming unstable.

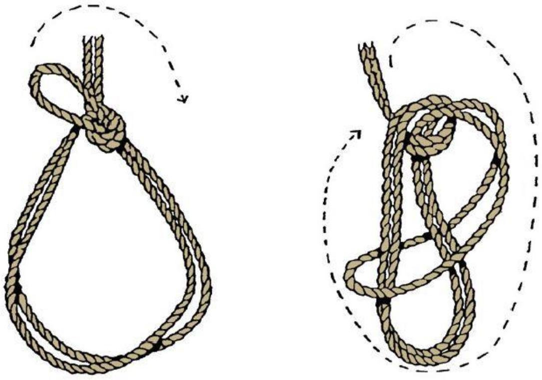
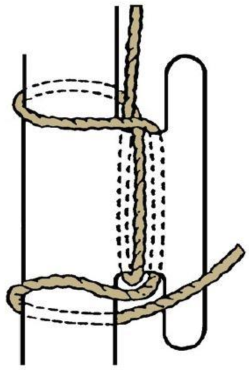
TEMPORARY ROPE CONNECTIONS

Knots, bends and hitches are used for securing ropes. Bends are used to tie one rope to another. Hitches tie a rope to another object. The most common forms of bends and hitches used for various applications are in the following table.

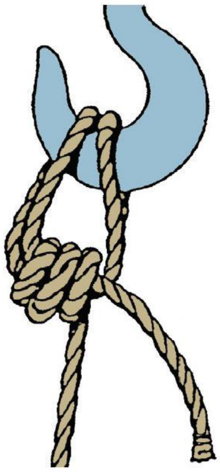
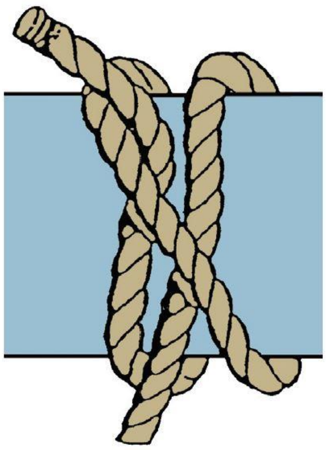
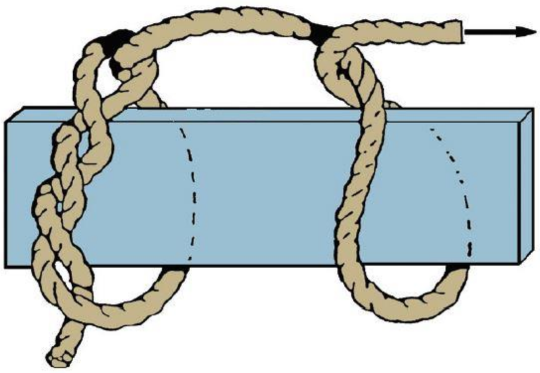
Note: Bends and hitches underload will reduce the WLL of the rope.

Snubber Turns Snubber Turns are used for holding and lowering heavy loads. Two or more turns should be used. More turns will give greater control over the load.	
Mousing Mousing finishes with the essential frapping turn(s) around the top parts and through the eyes of rope slings to prevent the diagonal turns being pulled up and over the tip of the hook.	
Reef Knot The Reef knot is used to join two open ends together. The ends are to be seized back to prevent the knot failing under load. **Note:** This knot may turn inside out.	

Bowline Single The Bowline provides a reasonably secure loop in the end of a rope. Under load it does not slip or bind.	
Bowline Double The Double Bowline provides a more secure attachment than a single bowline.	
Bowline Running Used for making a temporary eye to run along another part of rope.	

Bowline on the Bight The Bowline on the Bight is formed by making the first part of a bowline with the bight of the rope and passing the whole hitch through its bight.	
Davit Lowering or Belaying Pin Hitch This hitch is used in conjunction with lowering cleats on davits. It is a safe practice when the turn is made around a davit.	
Unseized Buntline or Becket Hitch This is the recommended procedure to secure ends of tackles to beckets. This method of securing cannot come undone like half hitches.	

Rolling Hitch A Rolling hitch is used for lifting tubular objects, It grips tightly when under load and slackens when the load is released. This hitch is very useful and is preferable to the clove hitch or blackwall hitch, providing rolling turns are put on in the proper direction of pull.	
Back Hitch This hitch is used on scaffolds.	
Fisherman's Bend and Half Hitch These hitches are useful for bending rope onto rings or handlines of buckets. To ensure the hitch is secure it should always be tied with an extra half hitch.	

Shortener for Single-Part Rope or Snotter The Shortener is used to join rope to a hook or tackle, and does not damage the rope. At least two full turns of the standing part should nip the two bights before the bights are placed onto the hook.	 Single Snotter shortener with both bights fitted onto the hook.	 Single Snotter shortener partly made. Two bights ready to be placed on the hook.
Clove Hitch Use the Clove Hitch to start rope lashings. Secure the ends with additional half hitches.		
Timber Hitch and Half Hitch These hitches are useful for hoisting and lowering lengths of timber by hand. It is only safe when an additional half hitch is tied to the hauling end.		

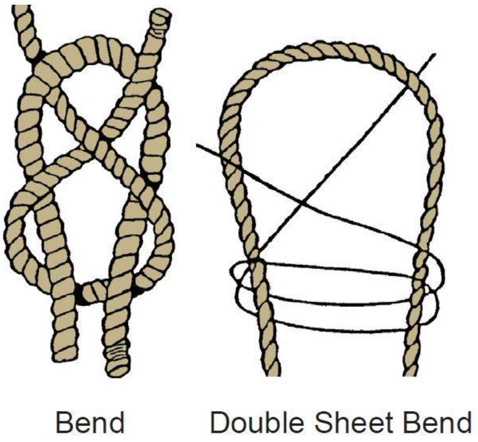
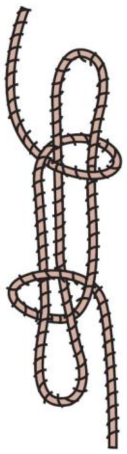
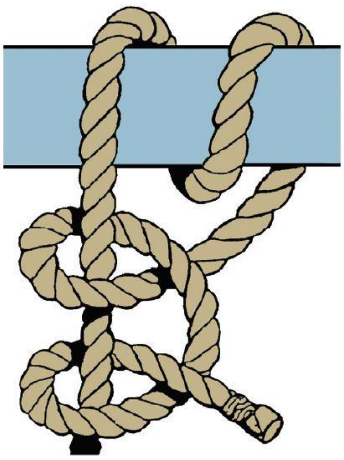
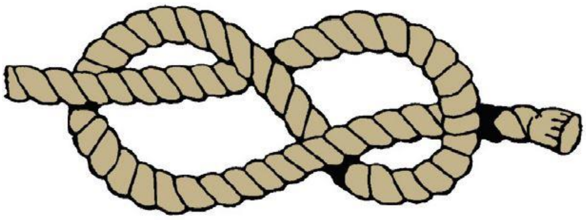
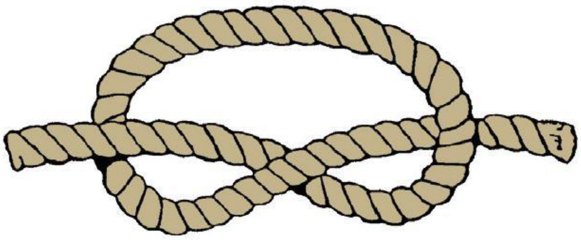
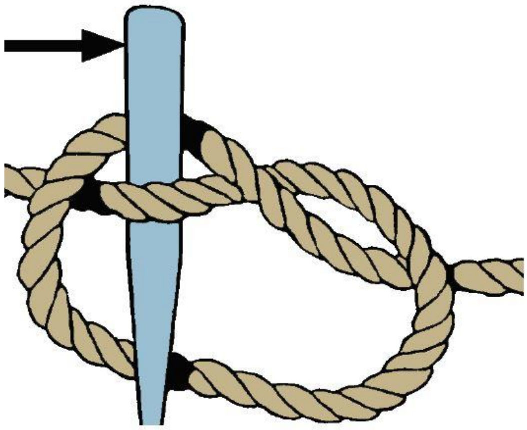
Sheet Bend A Sheet Bend joins two ropes of different sizes. It is safer when a double sheet bend is used. The smaller rope must bend around the larger rope.	
Sheepshank A Sheepshank knot is use3d to shorten a rope or take up the slack in a rope. This knot is not stable and can fail under too much or too little load.	
Round Turn and Two Half Hitches The Round Turn and two Half Hitch is a safe method that is widely used for securing ends of tackles. The more turns made before the hitches are made, the more control is possible.	

Figure Eight Knot The Figure Eight knot is used for an overhand knot, but is easier to untie.	
Overhand Knot An Overhand knot is used to make a stop on a rope, to prevent the ends from fraying or to prevent it slipping through a block.	
Marlin Spike Hitch The Marlin Spike Hitch should not be used for hoisting tools or materials aloft. A better method for hoisting tools is to open up the rope and push the tool through.	

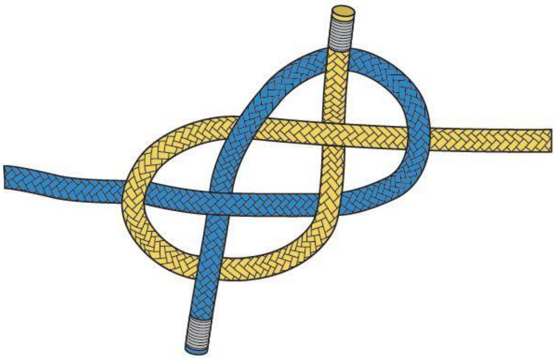
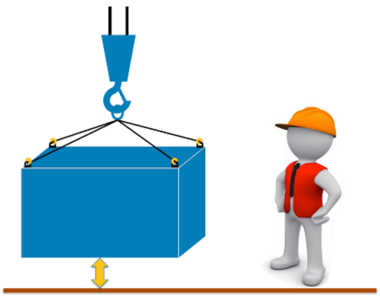
Carrick Bend The Carrick Bend is used to join two rope ends together.	

Table 34 – Temporary Connections (Knots)

CONDUCTING A TEST LIFT

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



Test lifts enable you to check the stability and security of the load as well as ensuring all the crane functions are operating correctly and that the crane is stable.

A test lift is done by lifting up the load slightly. You will be able to determine if the load is correctly slung by the amount of movement of the load as it is lifted.

When conducting the test lift, make sure you check that:

- The slinging method is correct and safe.
- There are no obstructions under the load.
- There are no loose parts under the load.

If the load dramatically shifts to one side you can identify where the centre of gravity is.

Signal for the crane driver to lower the load, adjust the slinging arrangement as required and conduct another test lift.

Continue this process until you are satisfied that the load can be moved safely.

Sometimes the only way of determining the load's centre of gravity is to conduct a test lift.

SHIFT LOAD

Once you are satisfied that the load is ready to be moved safely, signal the crane operator to begin the lift.

Constantly monitor the movement of the load and be aware of any other hazards in the path of the load. Also be ready to implement any control strategies.

If at any time the load becomes unstable, signal for the crane operator to stop and lower the load if safe to do so.

It is not safe to raise or lower the boom or load over workers as it can put them at risk of serious injury or death.

Use appropriate communication techniques for the situation. If the crane driver can see you clearly, use hand signals. If you are out of view, use whistle signals or a two-way radio.

Keep an eye on the weather conditions while the load is being moved.

Extreme wind can be dangerous to operate in and can cause:

- Load swing and spin.
- Crane instability.

To minimise the effect of the wind on loads, you should talk to the crane operator and consider:

- Applying the slew brake (where applicable).
- Applying guide ropes and braces (where appropriate).
- Stopping the work until conditions change.

EMERGENCY AND UNPLANNED SITUATIONS

If an unsafe incident does occur you should:

- Stop.
- Assess the situation and resolve the issue if possible.
- Seek advice and assistance (if and when required).
- Report the unsafe incident or event according to state/territory requirements.

If an emergency situation arises it is important that you carry out the appropriate communications tasks.

These may include:

- Alerting personnel including safety officers, management, supervisor and any other people at the work site. You may also need to alert emergency services (dial 000).

- Communicating the nature of the emergency.
- Informing personnel of unsafe areas.
- Providing directions to emergency services.

In emergency situations you should always follow any organisational and site-specific procedures and adhere to the relevant legislation.

LANDING THE LOAD

Direct the crane operator to land the load at the prepared load destination. The load destination should have been 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.

Before being released, round loads should be chocked to secure the load and prevent the load from rolling or shifting once the lifting gear is removed.

If the load is very heavy the crane operator will need to lower the boom/jib slightly once the load is in position to allow for any boom deflection (slight bending of the boom under the weight of the load).

Remove Lifting Equipment

Once the load has been landed and is stable and secure in its resting place, you can disconnect the lifting equipment.
Once removed, the lifting equipment should be properly stored or prepared for the next task.

INSPECT LIFTING EQUIPMENT

Inspect all equipment after you have finished using it to make sure that it is in proper safe working order for the next person to use.

Record and report any defects that you find to your supervisor or another authorised person.

Defects could include:

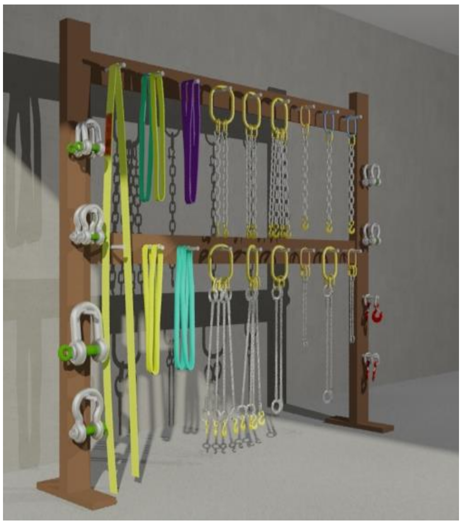
- Excessive wear.
- Damage.
- Stretching.
- Broken wires.
- Cut/damaged fibres.

Tag and isolate any defective equipment that you find to prevent anybody using it by mistake. Your supervisor will organise for defective equipment to be destroyed, repaired or returned to the manufacturer.

STORING EQUIPMENT

When storing lifting equipment you should consider if the location is:

- Clean and dry.
- Out of direct sunlight, ultraviolet light or fluorescent lighting.
- Well ventilated.
- Under cover.
- Away from chemicals, oils, sand/grit, and machinery.
- In a vermin free environment.
- In accordance with manufacturers' specifications.



Store all slings in a clean dry storage cabinet or area and hang them or coil them neatly according to site procedures.

REMOVE HAZARD CONTROL MEASURES

Once the job is completed, or a hazard no longer exists, you may need to remove some of the hazard control measures you put in place (if they are no longer required).

The equipment used should be:

- Cleaned by removing all dirt, mud, moisture or other contaminants.
- Checked for any damage. If anything is wrong, report it; then, if possible, carry out any repairs.
- Stored correctly in the appropriate location so that they are kept free from damage and can be easily found the next time they are needed.

Talk to other workers in the area to let them know that you are removing the hazard control measures as it may impact on the way they perform their own work.

TIDY WORK AREA

Remove any excess materials from the work area as soon as practicable. A tidy work area is a safer work area!

Worksite requirements for clearing the work area may include disposing of or recycling certain materials. Details will be outlined in the project environmental management plan, quality requirements or site-specific procedures.

Other housekeeping procedures may include:

- Cleaning and storing tools and other equipment in line with standard work practices and other requirements.
- Removing any potential hazards such as leftover materials or debris, which could be a tripping hazard. Duty of care means not leaving a possible source of accident or danger for other people.
- Making sure you use appropriate PPE when dealing with waste or possible hazardous materials as you clean up.

Make sure you know and follow the procedures for your worksite. If in doubt, ask your supervisor or put things back where you found them.

APPENDIX 1 – EXAMPLES OF WHEN A DOGGER IS REQUIRED

Example	Is a Dogger required	
	Yes/No	**Why**
An excavator configured to lift loads is used to place pipes in a deep trench. The lifting gear has been specifically chosen by an engineer to lift pipes which are all of a similar size and weight, therefore no judgement is required by the person slinging the pipes. The pipes cannot be seen by the excavator operator when they are being placed in the trench.	**Yes**	A dogger is required because the plant operator cannot see the load throughout the lift and a dogger must be used to direct them.
A mobile crane is used to lift beams to the second storey of a building under construction. The beams are dissimilar and various slinging techniques are required. The mobile crane operator cannot see the landing area for the steel beams. No safe work lifting procedures have been documented.	**Yes**	A dogger is required because: • The plant operator cannot see the load throughout the lift and a dogger must be used to direct them, and • Judgement on slinging techniques is required as safe work lifting procedures have not been documented.
A multi-purpose tool carrier—telescopic handler— with a jib attachment is used to lift pallets of bricks to the first storey of a building under construction. The pallets are all of the same size and weight. No safe work lifting procedures have been documented.	**Yes**	A dogger is required because judgement on slinging techniques is needed as safe work lifting procedures have not been documented.
A factory making aluminium panels uses a bridge and gantry crane to move the panels around the workplace. The panels are always in view of the plant operator. Safe work lifting procedures have been documented and signed off by a competent person. All workers involved in the lift have been trained in the safe work lifting procedures.	**No**	A dogger is not required because: • The load is always in view of the plant operator. • Safe work lifting procedures have been documented and signed off by a competent person, and „ all workers involved in the lift have been trained in the safe work lifting procedures.
A hospital patient lifting sling and trolley is used to move a patient from one bed to another.	**No**	A dogger is not required because: • No judgement is required on slinging techniques, and • Specific slinging and moving techniques for handling patients (safe work lifting procedures) are standardised, well documented and taught to workers undertaking patient handling tasks.