Department of Justice and Attorney-General
www.worksafe.qld.gov.au
Workplace Health and Safety Queensland

A Guide for doggers

Queensland Government

Workplace Health and Safety Queensland in publishing this document acknowledges the contribution of WorkCover New South Wales.

Introduction

What is a dogger?

A dogger is a person who:

- uses techniques, including the selection or inspection of lifting gear, to safely sling a load, or
- directs a crane or hoist operator in the movement of a load when the load is out of the operator's view.

Anyone with a dogger licence (DG) or rigger licence (RB, RI, RA) is permitted to perform dogging activities.

A qualified dogger must know how to:

- use the various types of ropes, slings, chains and accessories
- calculate the safe working load (SWL) of any rope, sling, or chain to be used for lifting
- assess the weight of loads to be lifted
- select and use appropriate safe slinging techniques
- safely sling loads of different weights and sizes
- direct a crane or hoist operator in the movement of a load when the load is in or out of the operator's view
- give the hand and whistle signals used for directing loads.

The weight of some loads to be handled may be printed on the delivery docket or marked on the load in some way.

The formulas and tables in this guide will help you to calculate the weight of loads.

Do not lift a load if you cannot make a reasonable estimate of the weight of a load.

Under the *Workplace Health and Safety Act 1995:*

- The **relevant person** who conducts a business or undertaking as an employer, self-employed person or otherwise must ensure that they and each of their workers and any other persons are not exposed to risks to their health and safety from the way they conduct their business or undertaking.
- **Workers and other people at workplaces** must follow instructions given by an employer or principal contractor. They must not deliberately put the workplace health and safety of anyone at risk, injure themselves or misuse anything provided for workplace health and safety. Workers must use personal protective equipment if it is provided by an employer and if they have been trained in its use.

Part one

1. Slinging and safe working of loads

The safe working load (SWL) of a sling is the maximum load that may be lifted after considering the SWL of the sling material, the reeving arrangement and the method of sling termination. For a flexible steel wire rope (FSWR) sling the SWL is given by:

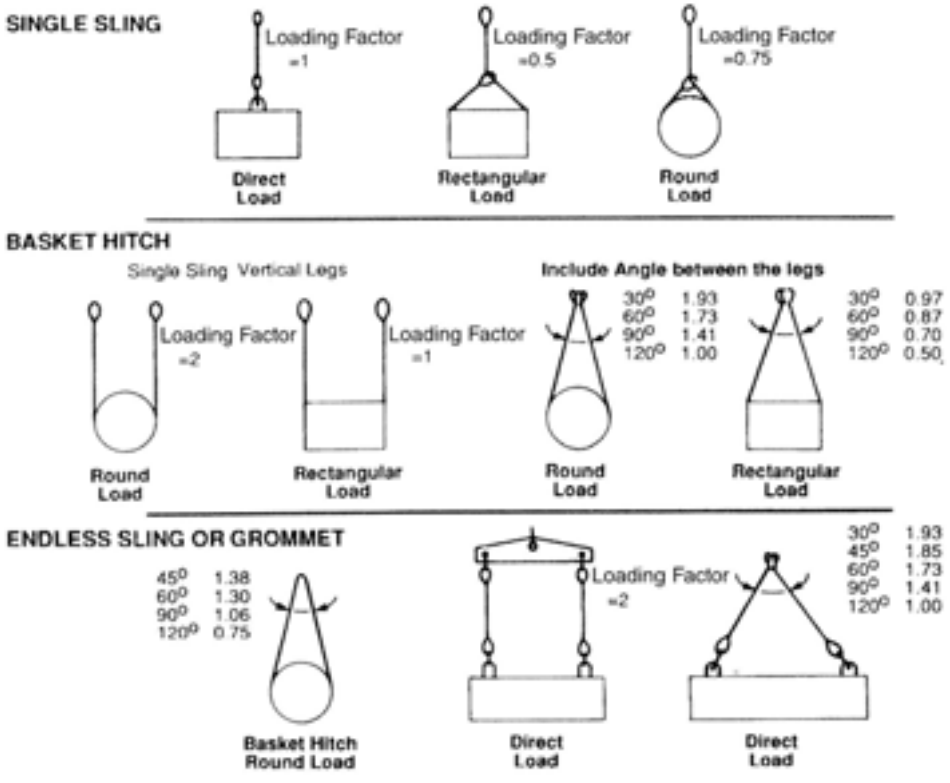
Sling SWL= SWL_R x F_L x F_T (Tonnes)
Where SWL_R = Safe working load for rope material in tonnes
F_L = Loading factor
F_T = Termination factor

The loading factor is a combination of the reeving factor F_R and the angle factor F_A. The loading factor is given by:

$F_L = F_R$ x F_A

Loading factors for various slinging methods are given in the following diagram which indicates the affect of reeving and sling angle.

For example, a reeved sling around a square load will halve the sling's lifting capacity. In this situation the loading factor is 0.5.



Loading factors for various slinging methods

Type of termination	Diameter of rope mm	Termination factor
Double-part slings and grommets	All	1.5
Ferrule-secured splice	≤80 >80	0.95 0.9
Hand-spliced eye	≤20 >20	0.9 0.8
Poured socket	All	1
Swaged fitting	All	1

Termination factors for commonly used termination methods

Sling termination factors depend upon the type of termination and rope size.
The table above provides termination factors for commonly used termination methods.

To simplify selection of the appropriate FSWR sling it is usual to combine the safe working load of the rope material with the loading factor to produce a safe working load chart.

The load chart below has been prepared for 6 x 24 – 1570 grade galvanised steel wire rope. The safe working load for various rope sizes and slinging configurations has been combined to enable the SWL to be taken directly from the chart.

The only correction which may need to be made to values taken from the chart will depend upon the method used to terminate the sling.

SWL charts are available for all types of slings and rope. Make sure that you consult the correct chart before lifting.

METHOD OF LOADING	DIRECT LOADED	CHOKE HITCH		BASKET HITCH									
		Round load	Rect. load	Round Load					Rectangular Load				
Included angle a	—	—	—	0°	45°	60°	90°	120°	0°	45°	60°	90°	120°
Loading factor	1.00	0.75	0.50	2.00	1.85	1.73	1.41	1.00	1.00	0.92	0.87	0.71	0.50
Nominal rope dia. mm	Safe working load — **kilograms** or tonnes												
	6 x 24 (15/9/F) 1570 GRADE — GALVANIZED												
8	**570**	**430**	**280**	1.1	1.0	**990**	**810**	**570**	**570**	**530**	**500**	**400**	**280**
9	**720**	**540**	**360**	1.4	1.3	1.2	1.0	**720**	**720**	**670**	**630**	**510**	**360**
10	**890**	**670**	**450**	1.8	1.6	1.5	1.2	**890**	**890**	**830**	**770**	**630**	**450**
11	1.1	**810**	**540**	2.1	2.0	1.8	1.5	1.1	1.1	1.0	**940**	**760**	**540**
12	1.3	**960**	**640**	2.5	2.3	2.2	1.8	1.3	1.3	1.2	1.1	**910**	**640**
13	1.5	1.1	**750**	3.0	2.8	2.6	2.1	1.5	1.5	1.4	1.3	1.0	**750**
14	1.7	1.3	**880**	3.5	3.2	3.0	2.5	1.7	1.7	1.6	1.5	1.2	**880**
16	2.3	1.7	1.1	4.6	4.2	4.0	3.2	2.3	2.3	2.1	2.0	1.6	1.1
18	2.9	2.2	1.4	5.8	5.4	5.0	4.1	2.9	2.9	2.7	2.5	2.0	1.4
20	3.6	2.7	1.8	7.2	6.6	6.2	5.0	3.6	3.6	3.3	3.1	2.5	1.8
22	4.3	3.2	2.1	8.7	8.0	7.5	6.1	4.3	4.3	4.0	3.7	3.0	2.1
24	5.1	3.8	2.5	10.2	9.5	8.9	7.3	5.1	5.1	4.7	4.4	3.6	2.5
26	6.0	4.5	3.0	12.1	11.2	10.5	8.5	6.0	6.0	5.6	5.2	4.2	3.0
28	7.0	5.2	3.5	14.0	13.0	12.1	9.9	7.0	7.0	6.5	6.1	4.9	3.5
32	9.1	6.8	4.5	18.3	16.9	15.8	13.0	9.1	9.1	8.4	7.9	6.4	4.5

Rule of thumb methods for calculating the SWLs of flexible steel wire rope, chain and fibre rope.

Please note that these methods only give approximate answers.

Flexible steel wire rope (FSWR)

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

Formula: SWL (kg) = D^2(mm) x 8

For example:

Rope dia (D) = 12 mm

SWL (kg) = D^2 (mm) x 8
= D (mm) x D (mm) x 8
= 12 x 12 x 8
= 1152 kg

SWL (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.

Formula: D(mm) = $\frac{\sqrt{L(kg)}}{8}$

For example:

Load = 1152 kg

D (mm) = √1152 ÷ 8
= √144
= 12 (mm)

Therefore a FSWR sling of at least 12 mm in diameter is required to lift a 1152 kg load for a straight lift.

Chain

The SWL 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 SWL. Return it to the manufacturer for SWL assessment and retagging.

To calculate the SWL of lifting chain in kilograms, multiply the diameter (D) in millimetres (mm) squared, by the grade (G), by either 0.3 or 0.4. For Grade 80 chain, use 0.4, and for Grade 30 or 40 chain, use 0.3.

Formula: SWL (kg) = D^2 (mm) x G x 0.4

For example:

Chain diameter, 10 mm. Chain grade (T) (i.e. grade 80)

SWL = D^2 (mm) x G x 0.4
= D (mm) x D (mm) x G x 0.4
= 10 x 10 x 80 x 0.4
= 3200 kg

SWL (t) = 3.2 tonnes

The above 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 0.4 and by the grade (G) and find the square root of the result.

Formula: D (mm) = √L (kg) ÷ 0.4 ÷ G
Load = 3200 kg
D (mm) = √3200 ÷ 0.4 ÷ 80
= √100
= 10 (mm)

Therefore a Grade 80 chain, 10 mm in diameter is required to lift a load 3200 kg for a straight lift.

Warning: The above formula must not be used for any other load lifting chain which is less than Grade 80.

To calculate the SWL of grade 30 or 40 lifting chain in kilograms, square the diameter (D) in millimetres (mm) and multiply the grade (G) by 0.3.

Formula: SWL (kg) = D^2 (mm) x G x 0.3
For example:
Chain diameter, 10 mm. Chain grade 30
SWL = D^2 (mm) x G x 0.3
= D (mm) x D (mm) x G x 0.3
= 10 x 10 x 30 x 0.3
SWL = 900 kg

Fibre rope

To calculate the SWL of fibre rope in kilograms, square the rope diameter (D) in millimetres (mm).

Formula: SWL (kg) = D^2 (mm)
For example:
Diameter = 25 mm
SWL (kg) = D^2 (mm)
SWL (kg) = D (mm) x D (mm)
= 25 x 25
= 625 kg
SWL (t) = 0.625 tonnes.

The above equation can be reversed to calculate the diameter (D) in millimetres of fibre rope needed to lift a given load. To do this, find the square root of the load in kilograms.

Formula: D (mm) = √Load (kg)
Load = 200 kg
D (mm) = √200
= 14.14 mm

Therefore a 15 mm diameter fibre rope sling is required to lift a 200 kg load for a straight lift.

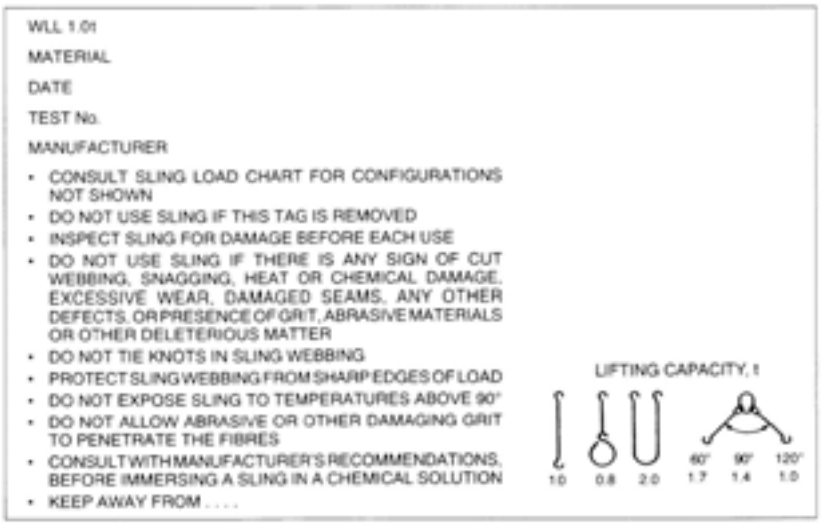
Flat webbing and round synthetic slings

Flat webbing and round synthetic slings are labelled with the SWL. **Do not** lift if the label is missing. Return the sling to the manufacturer for assessment and relabelling. Synthetic slings are colour coded (see table below).

Indicator stripes — each stripe represents 1 tonne W.L.L. — safety factor 8:1.

COLOUR NO STRIPES	TONNE	VERTICAL	CHOKE	BASKET	30°	50°	90°	120°
VIOLET 1	1	1	0.8	2	1.9	1.7	1.4	1.00
GREEN 2	2	2	1.6	4	3.8	3.4	2.8	2.00
YELLOW 3	3	3	2.4	6	5.7	5.1	4.2	3.00
GREY 4	4	4	3.2	8	7.6	6.8	5.6	4.00
RED 5	5	5	4.0	10	9.5	8.5	7.0	5.00
BROWN 6	6	6	4.8	12	11.4	10.2	8.4	6.00
BLUE 8	8	8	6.4	16	15.2	13.6	11.2	8.00
ORANGE 10	10	10	8.0	20	19.0	17.0	14.0	10.00

Synthetic slings are colour coded according to lifting capacity



Label for a flat webbing synthetic sling

Loading factors and slinging

In the examples below all the angle and reeve factors are for FSWR. The arithmetic is set out so that calculations can be easily worked out on a calculator.

1

To calculate the maximum weight of load that can be lifted, multiply the SWL of the sling (s) by the angle factor and by the reeve factor.

Formula:
Max load = SWL (of sling) x angle factor x reeve factor

For example: The SWL of each leg of a two-legged sling is 8 tonnes, the angle between the two sling legs is 60 degrees and they are reeved around a square load.

This means a factor of 1.73 for the angle and another factor of 0.5 for the reeve.

Sling SWL 8 tonne
Angle factor 1.73
Reeve factor 0.5
Therefore:
Max load = 8 x 1.73 x 0.5
= 6.92 tonnes

6.92 tonnes is the maximum weight that can be lifted.

2

To calculate the SWL of multi-leg slings needed to lift a load, divide the weight of the load by the angle factor.

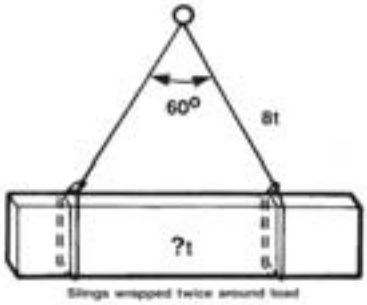
Formula for a calculator:
SWL = weight ÷ angle factor
Formula can be written:

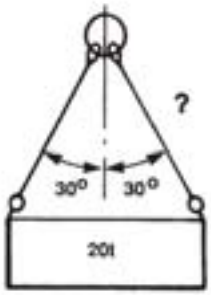
$$\text{SWL} = \frac{\text{weight}}{\text{angle factor}}$$

For example: The weight of the load to be lifted is 20 tonnes and the angle between the legs of a two-legged sling is 60 degrees. This means that the load factor is 1.73 for the angle.

Weight 20 tonnes
Angle factor 1.73
Therefore:
SWL = 20 ÷ 1.73
= 11.56 tonnes

Therefore, use a sling with a lifting capacity greater than 11.56 tonnes.





3

To calculate the SWL of a sling needed to lift a load, divide the load by the angle factor and divide by the reeve factor.

Formula for a calculator:

SWL = weight ÷ angle factor ÷ reeve factor

Formula can be written:

$$\text{SWL} = \frac{\text{weight}}{\text{angle factor x reeve factor}}$$

For example: Two slings have a 60° angle between them and are both reeved around a 4 tonne square load. This means a factor of 1.73 for the angle and 0.5 for the reeve.

Weight 4 tonnes
Angle factor 1.73
Reeve factor 0.5
Therefore:
SWL = 4 ÷ 1.73 ÷ 0.5
= 4.62 tonnes

Therefore use a sling with a lifting capacity greater than 4.62 tonnes.

4

To calculate the SWL of the sling needed to lift this load, divide the load by the angle factor and divide by the reeve factor.

Formula for a calculator:

SWL = weight ÷ angle factor ÷ reeve factor

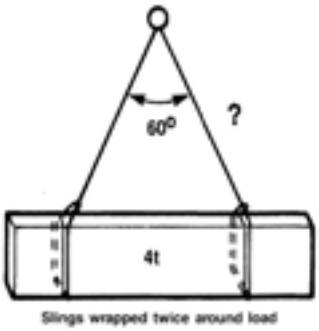
Formula can be written:

$$\text{SWL} = \frac{\text{weight}}{\text{angle factor x reeve factor}}$$

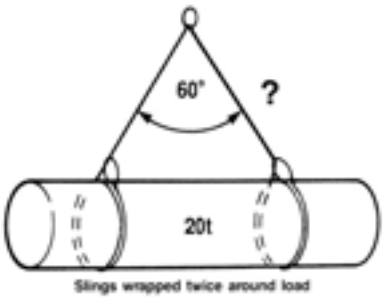
For example: Two slings have a 60° angle between them are reeved around a 20 tonne round load. This means a factor of 1.73 for the angle and 0.75 for the reeve.

Weight 20 tonnes
Angle factor 1.73
Reeve factor 0.75
SWL = 20 ÷ 1.73 ÷ 0.75
= 15.41 tonnes

Therefore, use a sling with a lifting capacity greater than 15.41 tonnes.



Slings wrapped twice around load



Slings wrapped twice around load

5

To calculate the diameter (D) in millimetres (mm) of FSWR needed to lift a load (L) of 5 tonnes as a straight lift, convert tonnes into kilograms, divide by 8 and then find the square root of the answer.

Formula: D (mm) = √Load ÷ 8
Formula can be written:

$$\textbf{D (mm)} = \frac{\sqrt{\textbf{Load}}}{\textbf{8}}$$

D (mm) = 5000 ÷ 8
= √625
= √25

Therefore a 25 mm diameter FSWR is needed for the lift.

2. Weight of the load

Do not lift if the weight of a load is not marked on the load or the delivery docket or it is not possible to calculate the weight.

It may be possible to calculate the weight of a load from the weighbridge certificate from the delivery vehicle.

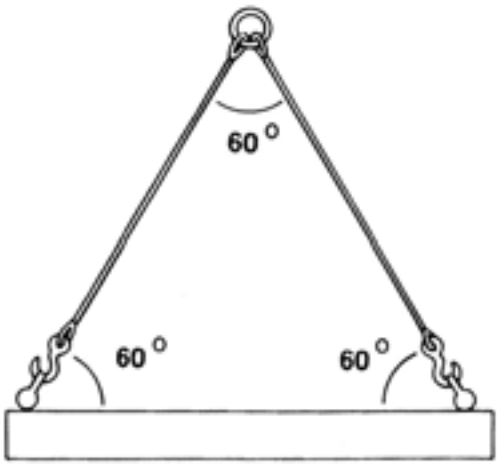
Be careful of the load weight marked on the load or delivery docket. Timber for example, can be 50 per cent heavier when wet. In foundries, when large castings are raised from a mould, suction created by the sand can add substantially to the weight. Pipes and tanks are often weighted down by liquids, sludge or other materials.

When lifting a load for the first time watch the lifting equipment carefully for signs of strain in case the stated weight is incorrect.

Evidence of overstressing may not always be apparent before failure occurs.

(See Part 3 for the formulas for calculating the volume of varying shaped objects and the Table of masses of different materials).

3. Rules to follow when slinging and handling a load



A simple rule of thumb for a good safe working angle

Make sure the horizontal distance between the points of attachment of the load does not exceed the length of the slings.

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

Multi-legged slings
The recommended maximum angle between the two legs of a sling is 90°.

The recommended maximum angle between the vertical and any leg of a sling is 45°.

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 SWL of the sling assembly.

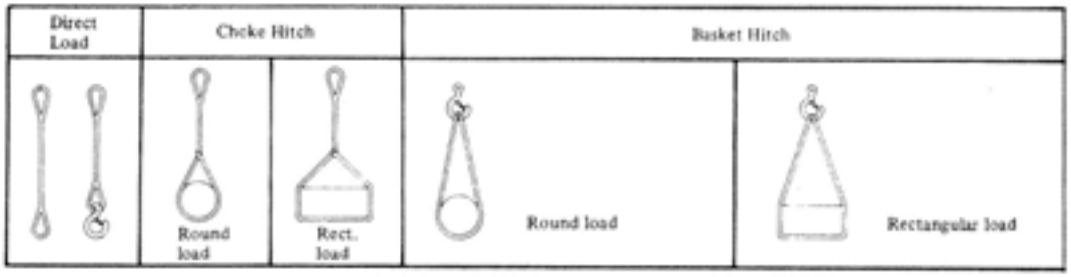
Limitation of the use of two leg slings

The maximum angle (a) between legs of slings should not exceed the following:

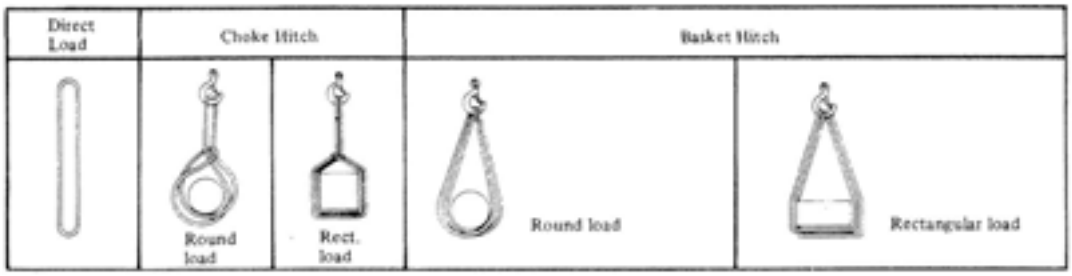
- 45° where the slings are wrapped once around the load
- 60° where the slings are wrapped twice around the load
- 120° where the slings are wrapped around the load and prevented from slipping inwards.

Common sling arrangements

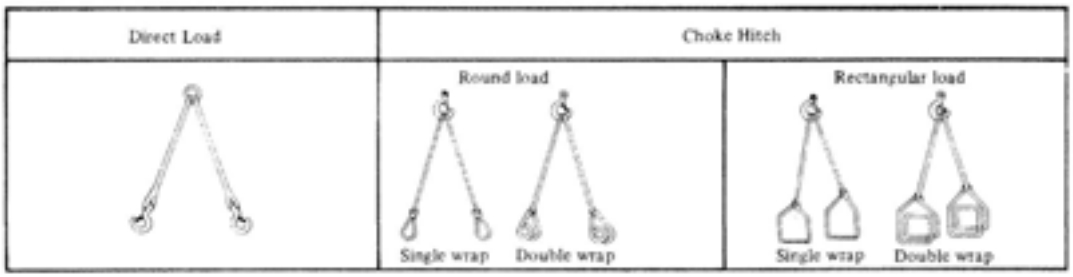
Single-part, Single-leg slings



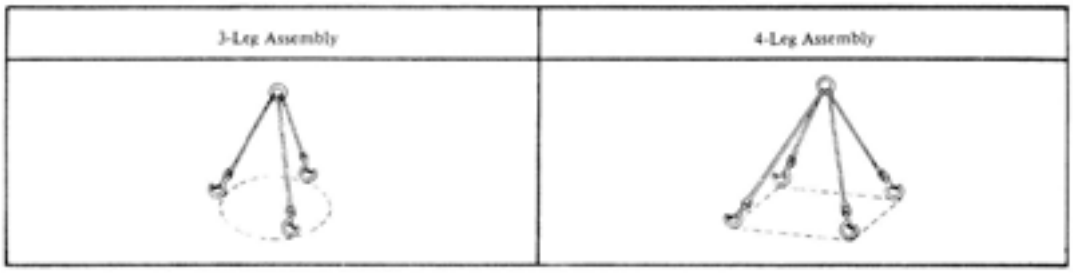
Double-part, Single-leg slings



2-Leg slings

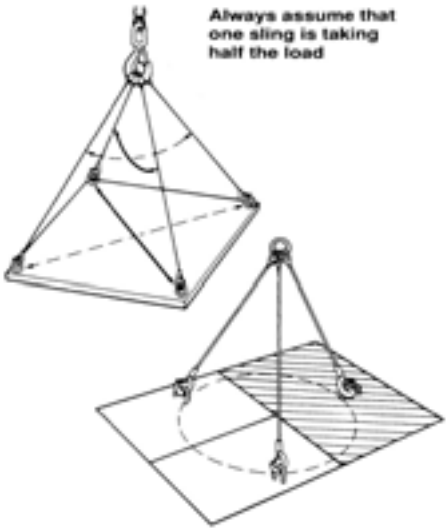


3-Leg and 4-Leg slings



The SWL of a multi-legged sling assembly is assessed on the diagonally opposite legs.

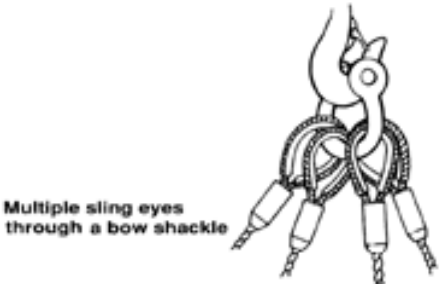
Where an object is flexible and the load is evenly distributed make sure that each leg takes an even share of the load.



Be careful when lifting irregular shaped objects – it is possible that only one leg of the sling is taking the whole load.

The larger the angle from the vertical made by slings on a hook the more likely the slings eye is to slip off the point of the bill.

In this case, put the eyes into a 'bow' shackle large enough so that they do not jam. Make sure that the shackle pin is resting on the hook.



Direct lifting

It is the duty of a dogger to direct the crane operator to position the head of the jib or the lifting assembly directly over the load.

Always lift vertically. If the hook is not directly over the load, the load will begin to swing dangerously as soon as it is raised.

Dragging a load can put undue strain on the lifting gear and crane boom especially if the load is dragged from the side.

General handling

Machinery, plant, personnel boxes, material safety boxes and fuel containers with lifting lugs, must have the SWL clearly marked.

All loads delivered to a site that could be hazardous should be strapped or wrapped.
Caution: Many serious accidents occur as strapping, wrapping or loading binding chains are removed.

For example:

- Sheets of plywood should be wrapped to prevent the wind picking up individual sheets. (Strapping can damage them).
- Loads of pipe, metal or timber should be strapped before lifting.

Spreaders are recommended for lifting lengths of timber, pipe or steel. If a spreader is not available, double wrap the sling around the load before lifting.

Do not bash the eye of a sling down at the nip point. This practice will decrease the SWL and damage the sling.

Sling protection

Use packing or lagging to prevent the sling from coming into contact with sharp edges. This will lengthen the life of the sling.

When using synthetic lifting slings, packing should be used for all loads.

Make sure that packing or lagging is secure so that it will not fall out when the slings go slack. Before lifting a load make sure that it is not caught or trapped in some way.

Basket hitch

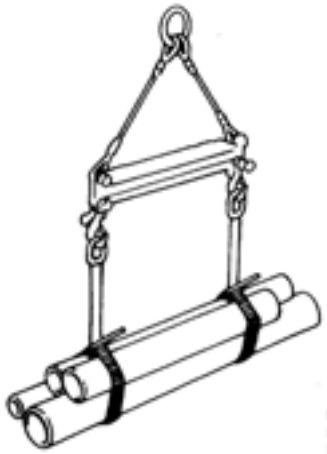
Basket hitches should not be used where people may be located near a lifted load, unless the sling is positively restrained from sliding along the load.

Plasterboard

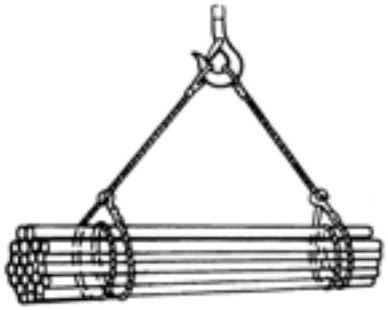
Sheets of plasterboard may be lifted in a specifically designed material box.

If a material box is not used, then the lifting system must:

- be certified by an engineer
- specify the minimum and maximum number of sheets
- specify the number and locations of lifting slings
- specify the capacity of lifting slings.



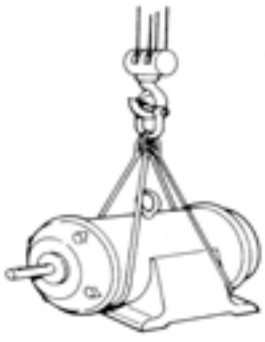
Spreaders are recommended for lifting lengths of timber, pipe or steel



If a spreader is not available double wrap before lifting

Structural steel

Loads of structural steel (universal beams, RSJ's) on trucks must have restraining spikes fitted in the truck to prevent them from falling out. Removing the securing chains or straps if there are no restraining spikes in place is very dangerous.



Correct slinging method for an electric motor. Do not rely on eyebolts.

Structural steel can be very dangerous. When a load arrives on site, walk around the truck and check that the steel has not shifted into a dangerous position. Many serious accidents occur as load binding chains are removed from steel beams.

Deep beams that are narrower in width than height are unstable and can inflict severe injuries.

Always lift bundles of steel level. Do not lift vertically or at an angle. It is not possible to make the inside lengths of steel in a bundle tight enough to prevent them falling out if the bundle is at an angle.

Steel can kill if it falls.

As a load of steel is lifted keep hands well away. Steel sections tend to snap together or roll up as the sling bites into the nip.

Loose items

Loads of loose items such as scaffold clips must be raised in properly constructed boxes branded with the SWL.

Materials should not be stacked higher than the side of the material box unless they are adequately secured, but at no time should the material box become top heavy.

Do not lift loads of this kind in 200 litre drums because:

- These drums have no rated lifting capacity.
- It is not possible to know the condition of the base of the drum. (They have usually been discarded because they are unfit to hold liquid).
- The holes cut into the sides for the sling or hooks often pull through under the weight.
- The sharp edges of the holes can cut through a sling.

Rubbish bins

Rubbish bins should have proper lifting lugs and be branded with the SWL. Rubbish bins that are overloaded must not be lifted. Where rubbish can be blown out or spill from a bin, secure the load before lifting, especially in windy conditions.

Sling rubbish bins with a four-legged sling. To tip the bin, release the two front slings and raise the bin with the two back slings.

Do not stand behind a bin when tipping rubbish out. It could whip back suddenly as it clears the ground.

Handling steel plate

Steel plate can be lifted with:

- plate clamps that are designed to increase the purchase on the plate as the plate is lifted

Note: *plate clamps should never be used to lift loads over people*.

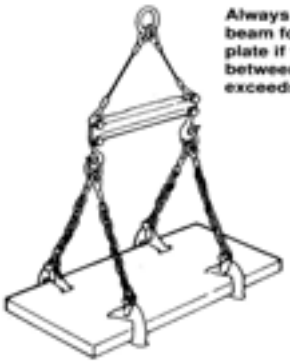
- hooks or shackles where there are lifting holes in the plate.

Typical plate clamps.

Do not use home-made type plate clamps or plate dogs.
Remember that steel plate can injure or kill.

Do not use home made type plate clamps or plate dogs.

Use a spreader beam if the angle between the legs of a sling is likely to be more than 60°.



Steel plate can be lifted vertically or horizontally.

Lifting horizontally

It is recommended that a minimum of four plate clamps and a spreader beam are used for lifting steel plate horizontally. For horizontal lifts, use appropriate plate clamps. Use a spreader beam for long thin plates to prevent dangerous flapping, sagging and vibration.

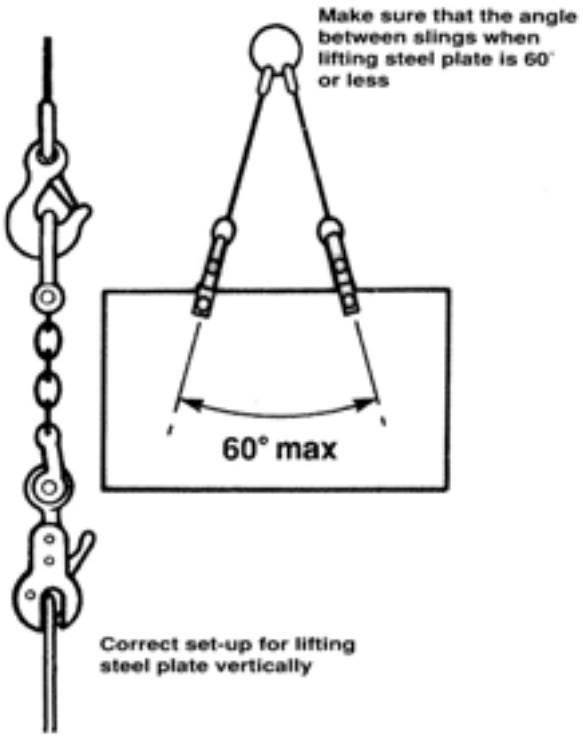
Lifting vertically

Use an appropriate plate clamp where a sling cannot be attached and there is no lifting hole. An example is the dished and flanged end-plate for a pressure vessel.

Note: It can be difficult to remove or attach a sling where plate is stored vertically in a rack or is to be fed into bending rolls.

As a plate touches the ground and the tension is released from the slings, a single hook can come out of the hole causing the plate to fall. To prevent this, lift with a hook through a ring that is attached to a short length of chain shackled to an approved plate clamp.

Always make sure that the tension remains in the slings until the plate is in place.



Pallets

A wide variety of loads are delivered on pallets. Before a paletted load is lifted check that the:

- pallet is in good condition
- load is secured so that nothing can fall off
- load is properly slung.

The SWL of a standard hardwood pallet is 2000 kg. The SWL can be dramatically reduced if there are any missing boards or any other defects. **Note:** some pallets are designed for packaging not lifting.

To lift a load on a damaged pallet, raise the load and pallet to reposition onto an undamaged pallet. Then lower the load and sling properly before lifting and moving the load to the desired place.

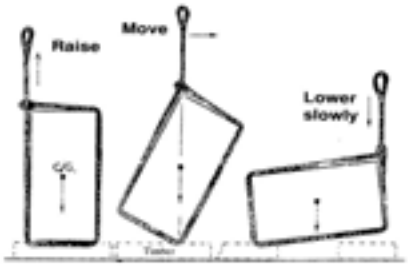
If no spare undamaged pallets are available, do not lift the load; send it back to the supplier to be re-paletted.

Always raise paletted bricks inside a brick cage to prevent loose bricks falling.

Placing concrete

When placing concrete from a kibble into formwork, spread the flow out. Dumping the whole load in one spot can overload the formwork, especially if it is also taking the weight of workers and vibrating equipment. Formwork is only designed to take concrete spread out evenly over the whole area.

Make sure that the concrete is poured gradually. The sudden release of concrete from a kibble attached to a mobile or tower crane can cause a 'whip back' causing the kibble to bounce dangerously.



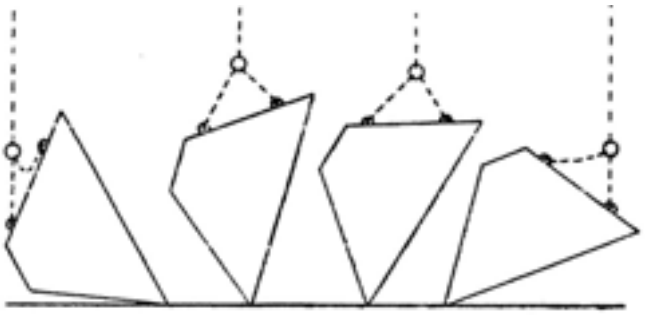
Turning over loads

When turning over a load such as a steel beam, the sling must be attached to the hook on the side of the load that is to be lifted. This will ensure that it is raised on a diagonal through the centre of gravity.

It is then a simple matter to lower the lifting medium turning the load over in a safe and controlled manner.

Sling the load so that when the load is lowered, the nip will pull against the eye.

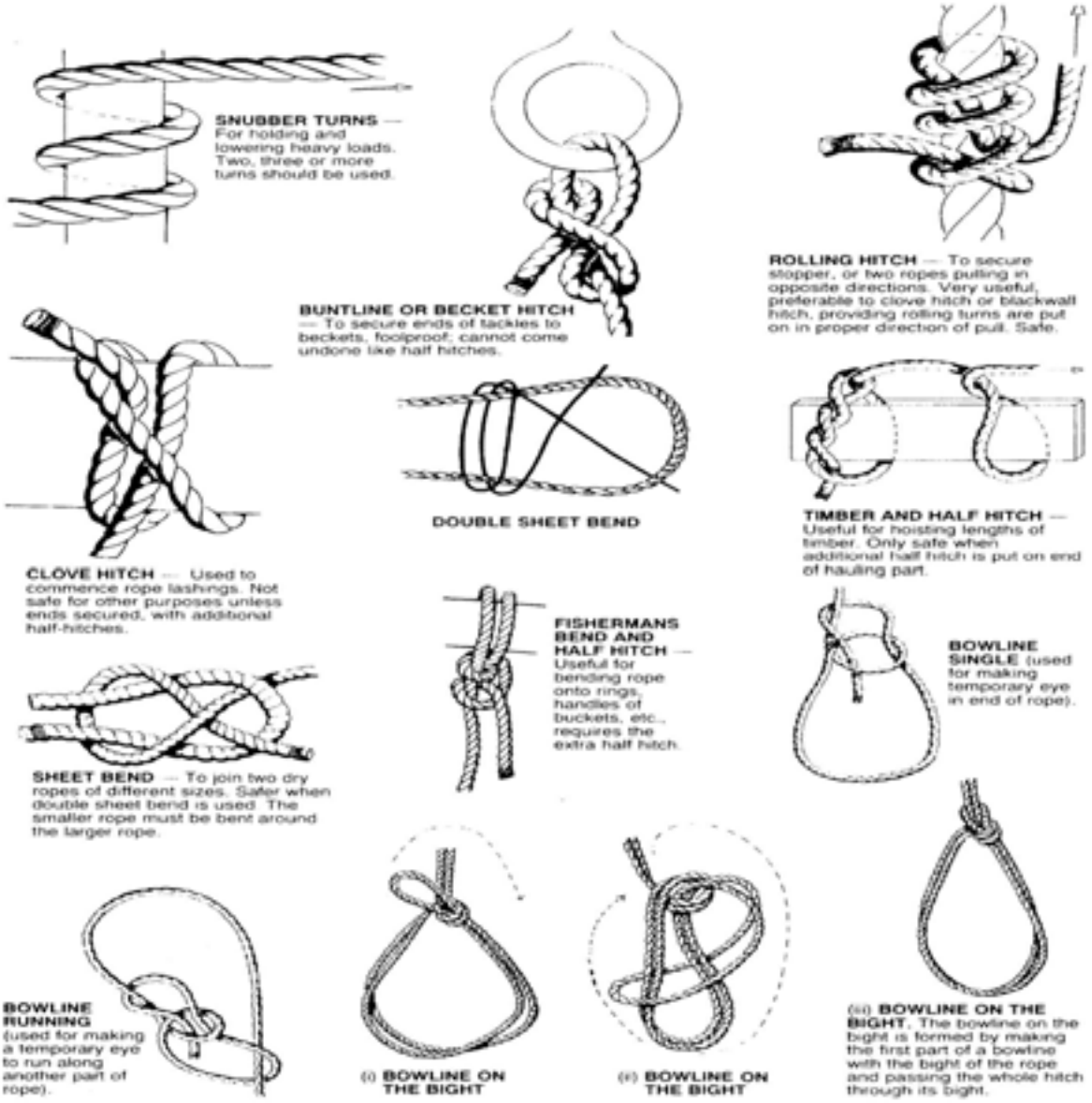
A long narrow load such as a steel beam (RSJ) has a high centre of gravity and a narrow base when it is standing on its flange. If a dogger nips the sling incorrectly to turn the beam (or any other load) it will flop, topple over and possibly break the slings.



Turning over a steel bin

Bends and hitches

Doggers must know how to secure loads and tag lines with bends and hitches. Learn those described and illustrated below.



SHORTENER FOR SINGLE-PART ROPE OR SNOTTER — To join rope to hook of tackle, etc. and does not damage the rope. At least two full turns of the standing part are to nip the two bights before the bights are placed on the hook.

(i) Single Snotter Shortener partly made. Two bights ready to be placed on hook.

(ii) Single Snotter Shortener with both bights fitted on hook.

ROUND TURN AND TWO HALF HITCHES Widely used, for securing running ends of tackles, etc., the more turns made before hitches are made the more control is possible. Safe.

FIGURE OF EIGHT KNOT — As for an overhand knot, but easier to untie.

OVERHAND KNOT — To make a stop on a rope, to prevent the ends from fraying or to prevent it slipping through a block.

DOUBLE SHORTENER — Each of the two parts of the bale-sling or strop is turned back on itself, sc that two bights are formed at a suitable length. The bights are then turned about each other as in a simple overhand knot and placed on the hook. N.B.: When shortening synthetic rope slings it is usually advisable to twist the bights twice about each other because of the slippery nature of many synthetic ropes.

(ii) "Double Shortener for sling on hook".

(i) "Double Shortener for sling partly made".

MARLIN SPIKE HITCH — Should not be used for sending tools or materials aloft. A better method for tools is to open up the rope and push tool through.

4. Stacking

Make sure that on completion of moving a load, all materials are securely and safely stacked.

Stacks of materials must be arranged so that:

- There is adequate clearance from machinery that could topple a stack.
- There is access for people, forklifts, cranes and trains.
- The sling can be removed as each unit is placed on the stack (always pull a sling out by hand to prevent the possibility of the crane toppling a stack).
- There is access to fire extinguishers and other emergency services.

Before stacking, make sure that the ground is stable, level and not likely to flood in the event of rain. If there is heavy rain, check the ground for signs of it giving way.

If the ground is not level make sure that the stacks are chocked level and secure.

When a stack is removed check the ground for signs of it giving way before placing another stack in the same position.

Clearance

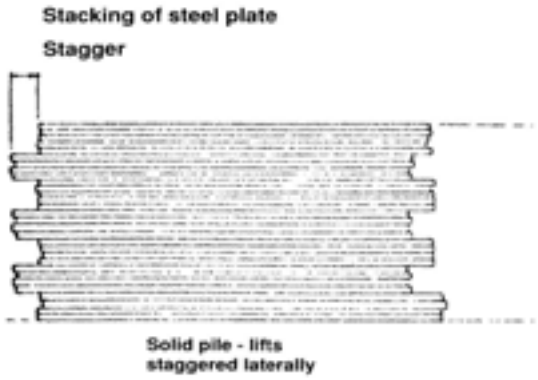
There should be clearance of:

- not less than 3 metres from railway tracks
- not less than 3.5 metres for truck access
- not less than 1 metre for walkways
- not less than 1.5 metres for access for an overhead travelling crane operator.

There must be access to carry out the work normally carried out on site and for stretcher access in the case of emergency.

Stacking steel plate

Stagger plates stored horizontally with no packing and wider than 0.75 metres, into groups of plates that make up a suitable lift.

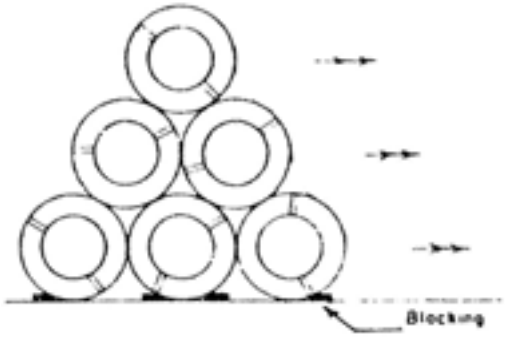


When steel plate is stacked upright in racks the plate can easily swing (and could crush someone) when the crane takes the weight of the plate.

Use adequate packing and the proper plate clamps to avoid having to stand inside a rack. Do not lift a plate from a rack if someone is inside the rack under any circumstances.

To avoid high, horizontal stacks of steel plate becoming unstable, tie together with interlocking packing.

Stacking rolled steel, coils and other round loads

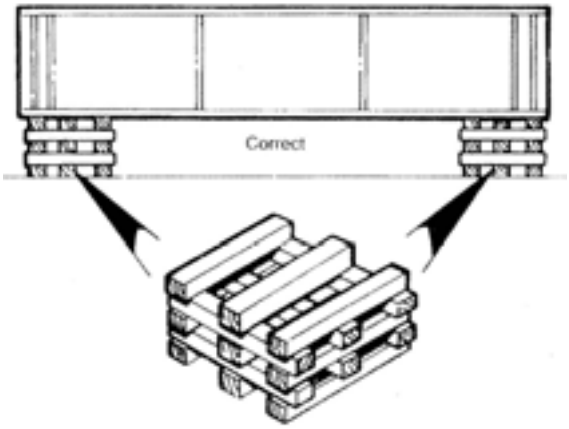


Stacking of rod-stock coils.

Round loads must be blocked or chocked at the bottom to prevent the whole stack rolling away. Every round load must be blocked.
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 the alternate layers at right angles. This is called pigstying.



Pigstying

Bundles of timber must be strapped and have dunnage under and between the bundles. When stacks are high they must be straight and set on level beds. Check for movement in the ground after rain.

Ladders must be provided for access to the top of high stacks.

To avoid high stacks of timber becoming unstable, tie stacks together with interlocking packing.

5. Loads and mobile cranes

Before commencing a job with a mobile crane, go to the work site with the supervisor and the crane operator and assess the crane suitability for the whole job. Assess access, room, soil, lift capacity, lifting equipment and electrical hazards.

Decide where and how to set it up.

Travelling (pick up and carry loads)

Some mobile cranes are better suited than others to travel over rough surfaces. Always check the load chart and the manufacturer's recommendations before travelling.

Cranes are more likely to overturn 'off-road'. Before leaving the road check for:

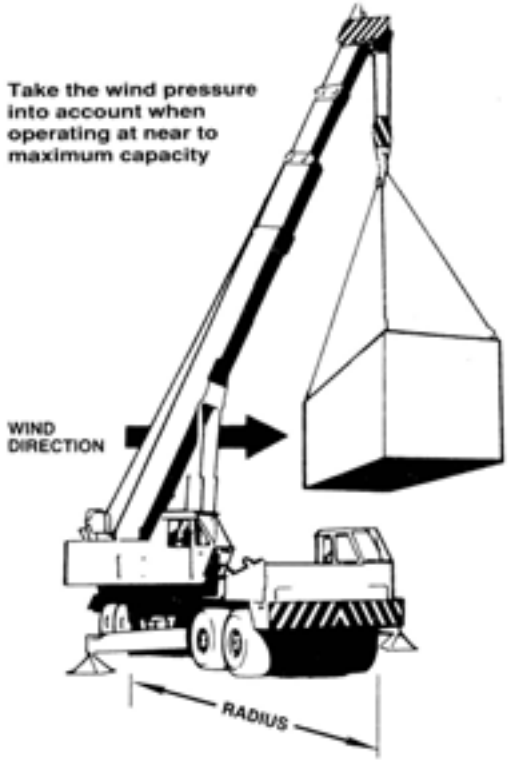
- potholes and soft or rough ground
- overhead obstructions
- powerlines
- personnel working in the area
- blind corners
- traffic flow
- underground services.

Always check grassy surfaces for potholes hidden by long grass. Walk over the whole area before guiding a crane across.

Make sure spring lockouts (where fitted) are set before travelling a load.

Do not direct the driver to slew unless the surface is firm and level. Booms are not made to withstand sideways forces.

Slewing if the crane is attached in any way to another crane or tackle can be very dangerous. The whole operation must be under the control of one person.



The load should be connected to the crane by a tail rope to prevent sway that could cause the crane to overturn. Do not walk heavy loads with crawler cranes unless the ground is firm and level.

Take extreme caution walking a load into position with the load high and close to the boom. The load can swing back and hit the boom causing it to collapse as the crane moves forward.

All mobile cranes with wire rope luffing gear must have a luffing overwinding limit device.

Where a crane has sprung road wheels, it must be fitted with stops to prevent excessive movement of the springs.

The load must be secured in a fore and aft position unless the load is too long. Long loads must be secured in a diagonal position with the boom fore and aft.

Warning lights (where fitted) must be turned on when the crane is moving.

Travel slowly to prevent excessive swing.

Always carry the load as close to the ground as possible. Do not direct the load higher until it is almost in position.

Avoid travelling the crane over potholes, depressions, soft ground or across a slope, road cambers or shoulders, rail tracks, any objects or dunnage wood, which could destabilise the crane or load.

Observe traffic rules, watch intersections, and avoid pedestrians. Instruct the driver to use the warning horn or whistle when approaching pedestrians or workers.

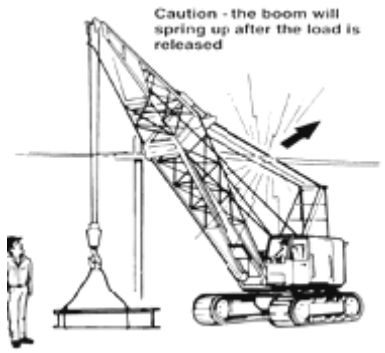
Warn everyone in the area of your intention before moving the load. A person can be easily knocked from a structure or crushed by a moving load.

General rules for travelling up and down slopes:

- Take the slope and angle of the boom into account when moving up or down a slope.
- When travelling on a slope with the boom facing uphill ensure that the boom angle does not become too close to vertical. This is to prevent the boom toppling over backwards.
- Do not travel across a slope with a load.
- Crawler cranes are very dangerous on sloping ground. Direct the driver to boom down before walking a crawler crane up a slope. Once the crane reaches the top the driver must boom up to compensate.

Electrical hazards

Always maintain a safe distance from powerlines when travelling with the boom raised.

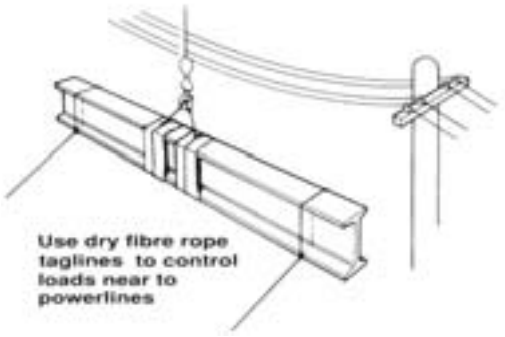


The head of a long boom will spring up when the load is released. Make sure there is a safe distance from any electrical conductors (powerlines) or other obstructions before releasing the load.

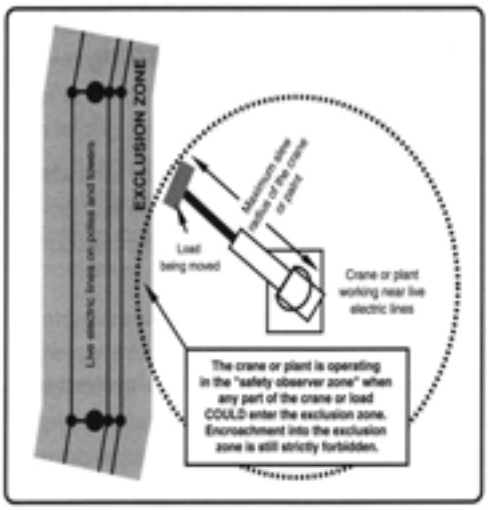
Do not set cranes up close to any energised electrical equipment or powerlines unless the applicable exclusion zone is maintained.

To avoid potential contact between the boom and powerlines, equipment should never be stored under or close to powerlines.

No lifting should be attempted with the crane boom under powerlines and never closer than the applicable exclusion zone.



Work around overhead powerlines is regulated by the *Electrical Safety Regulation 2002*. Practical guidance on such work is provided in the *Code of Practice – Working Near Exposed Live Parts*. One of the requirements is that people, vehicles and operating plant (e.g. a crane) maintain an exclusion zone around live overhead powerlines. For low voltage powerlines (less than 1000 volts) and/or low voltage service lines connecting properties to the powerlines along a road, the exclusion zone is **generally** three metres. Exclusion zone distances for high voltage powerlines (over 1000 volts) vary. If you are unsure of the voltage of the powerlines, the safest option is to assume the exclusion zone to be eight metres.



Keep a look out for possible contact with powerlines at all times while operating or travelling the crane. If the crane or its load could come within the exclusion zone during operation, then the crane is located in a 'safety observer zone' and a safety observer should be appointed. The safety observer's role is to keep watch and warn the crane driver and dogger if the crane or its load gets too close to an exclusion zone (the applicable exclusion zone must not be entered).

Where possible, arrange for electrical equipment or powerlines to be de-energised before commencing work.

Always use a 16 mm dry natural fibre rope as a tag line. Some synthetic fibre rope can become conductive in some circumstances.

Further information on electrical safety matters can be found on the department's website: **www.worksafe.qld.gov.au** or by calling **1300 650 662**. Electronic copies of the *Electrical Safety Regulation 2002* and the *Code of Practice – Working Near Exposed Live Parts* are also available for download from the website.

6. Personal protective equipment

Doggers often wear helmets, gloves, eye protection, face masks and respirators, safety vests and steel capped boots to protect them from injury.

Where personal protective equipment is provided by your employer, you must use it.

Safety helmets

Safety helmets with chin straps must be worn wherever there is a risk of objects falling from above and on any work site where the hard hat sign is displayed.

Make sure that you wear a helmet that conforms to the Australian Standard.

Gloves

Gloves protect your hands from:

- heat and abrasion
- molten metal
- sharp edges
- chemicals (acids, alkalis, solvents, fats and oils).

Eye protection

You should wear eye protection that complies with AS 1337 if you are likely to be exposed to:

- physical damage caused by flying particles, dust and molten metal
- chemical damage caused by toxic liquids, gases, vapours and dusts
- radiation damage caused by sunlight, visible light, infrared and laser.

Respiratory protection

You should wear a face mask or respirator that complies with the Australian Standard if you are likely to be exposed to:

- toxic gases and vapours
- disease-causing dusts such as silica and asbestos
- an oxygen deficiency.

Inhalation of some chemical vapours and gases can cause a wide range of unpleasant symptoms including narcosis, headaches and in some cases death.

Common dusts such as silica can cause lung disease later in life and is found wherever there is excavation, i.e. building sites, road works, tunnelling and mining.

Hearing protection
Hearing damage is likely from exposure to long periods of industrial noise above 85 dB (A). This is the noise level of a large truck or loader.

A chainsaw, for example, has a noise level of about 92 decibels.

Where excessive noise cannot be reduced, personal hearing protectors should be worn. Ask your employer to provide you with hearing protectors that comply with the Australian Standard.

Safety boots
Doggers should be careful to choose boots which are comfortable, give maximum grip and protection from pinching, jamming and crushing.

A range of lightweight flexible boots with steel or plastic caps that comply with AS 2210 is available.

Safety vests
Safety vests make doggers clearly visible to passing traffic or crane drivers moving loads. They must be provided and worn for work at road sides, rail sides, or shipping terminals where there is site traffic or wherever visibility is poor.

7. Communication
Doggers communicate by two-way radio or whistle signals when they are out of earshot and line of sight from the crane driver. This is often the case on large city building sites. Hand signals may also be used when the dogger is in sight of the driver.

Two-way radios
It is important that the two-way system provides clear and immediate signals without interference.

There are two types of two-way radio — conventional and trunked.

Conventional radio
Great care is taken when allocating frequencies to make sure that there are no other operators using the same frequency in the area. It is not possible, however, to control radio users in the field who may be using the frequency in the wrong area.

Always use a good quality system from a reputable company with a properly allocated frequency for the area.

Interference on your frequency can be a safety hazard. If there is continual interference, have the system checked or a new frequency allocated.

Trunked radio
Trunked radio is a computer controlled two-way system that locks other radio users out of your frequency. No other operator can cut in and overpower your signal.

With trunked radio it is possible to have several separate groups on one building site communicating by radio without interfering with each other.

Trunked radio is recommended for large city building sites.

Fail safe

Stationary cranes often use a separate buzzer system as a backup. The dogger has a buzzer to press connected to the crane cabin by a wire.

Radio directions for crane drivers

A dogger must give crane drivers clear verbal signals when directing crane movements. The noise of the crane motor and distortion over the radio can make it difficult for the crane driver to hear directions.

The following are the standard directions for crane drivers from doggers:

Hook movement	'Hook up' and 'Hook down'
Boom movement	'Boom up' and 'Boom down' 'Boom extend' and 'Boom retract'
Slewing	'Slew left' and 'Slew right'
OK to raise	'All clear'
Do not move	'Stop'

Speak clearly and say the name of the part of the crane to be moved first – then the direction of movement.

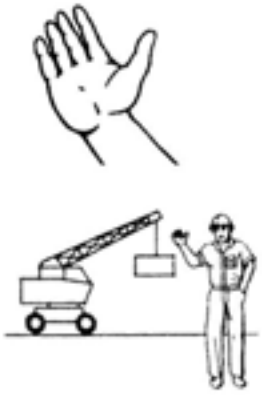
Bell or whistle code

Stop:	1 short
Hoist:	2 short
Lower	1 long
Swing left:	1 long, 1 short
Swing right:	1 long, 2 short
Boom up:	3 short
Boom down:	4 short
Boom extend:	1 long, 3 short
Boom extract:	1 long, 4 short

:

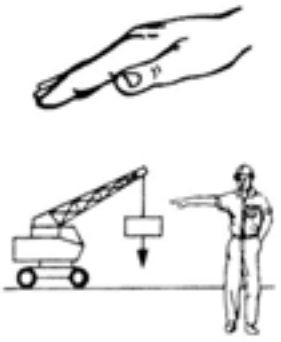
HOISTING MOTION

TO STOP
Hand held head high, palm towards driver.



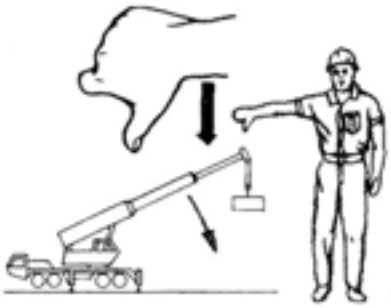
RAISE
First finger pointing up,rest of hand closed. The whole hand to be moved to indicate upward movement.

LOWER
Hand fully extended, palm down. Move in downward direction.



BOOM MOVEMENT

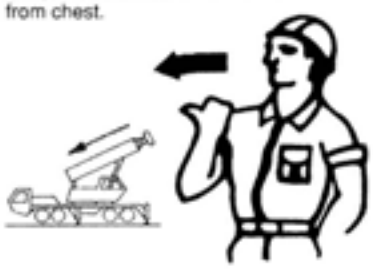
BOOM DOWN
Thumb pointing downwards, rest of hand closed - whole hand to move downwards.



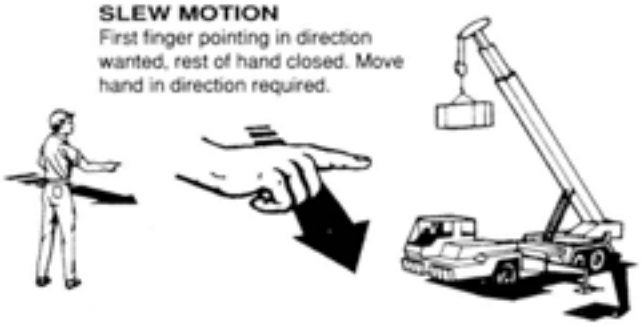
BOOM EXTENDED
Fist in front of chest, thumb pointing at chest and moving fist towards the chest.

BOOM UP
Thumb pointing upwards, rest of hand closed - whole hand to move upwards.

BOOM RETRACT
Fist in front of chest, thumb pointing away from chest and moving fist from chest.



SLEW MOTION
First finger pointing in direction wanted, rest of hand closed. Move hand in direction required.



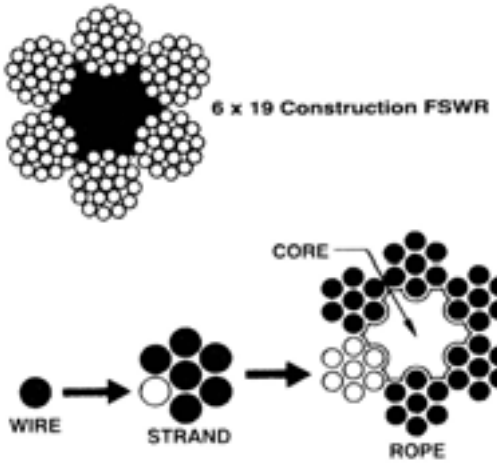
Hand signals for crane hoist motion and boom movement. Hand signals can be made with either the left or right hand.

Part two

8. Flexible steel wire rope (FSWR)

FSWR is constructed of wires and strands laid around a central core. In the illustration below there are 19 wires to the strand and six strands around the core making up the rope.

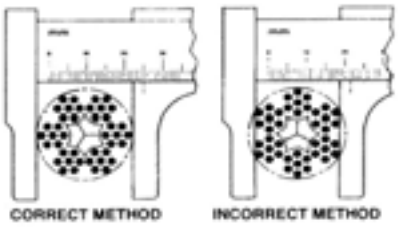
It is important not to confuse wires and strands. If a strand is broken, the rope is unusable. A single broken wire in a sling is not as important.



The core can be:
Fibre Core (FC)
Independent Wire Rope Core (IWRC)

The tensile strength of FSWR ranges from 1220 megapascals (Mpa) to 2250 Mpa. The most commonly used tensile strengths are 1770 Mpa and 1570 Mpa.

A 6/19 (six strands of 19 wires each) is the minimum FSWR construction that can be used for slings.



Size

The size of a rope is determined by its diameter.

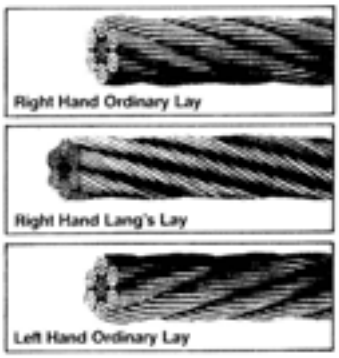
The smallest diameter FSWR that can be used for lifting is 5 mm.

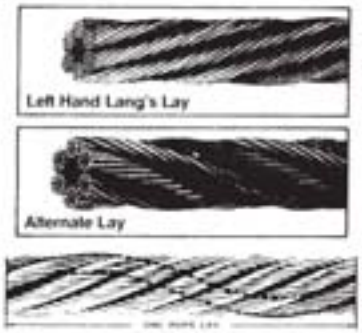
Lay

Lay is the direction the wires are formed into strands and the strands are formed into the finished rope.

The strands can be laid either left or right around the core. In left hand lay the strands are laid anti-clockwise, and in right hand lay they are laid clockwise.

Ordinary lay is where the wires are laid in the opposite direction to the strands.





Lang's lay is where the wires are laid in the same direction as the strands. There is therefore:

Right hand ordinary lay – RHOL
Left hand ordinary lay – LHOL
Right hand Lang's lay – RHLL
Left hand Lang's lay – LHLL

Lay does not affect the working load limit of the rope but it does determine characteristics such as the spin of the rope.

Lang's lay is used where both ends are fixed to prevent rotation such as for luffing. It must not be used for lifting. (Inspection for birdcaging at the anchorage point must be done regularly).

Most rope available in Australia for lifting is right hand lay.

Inspection and discard

It is important to check all rope for wear and damage before use. Rope can deteriorate due to several factors.

These factors include abrasion, fatigue, corrosion, stretching (from overloading and shock loading) and mechanical damage.

When inspecting:

- Observe the construction and lay of the rope.
- Check for signs of stretching.
- Check the whole rope for broken wires. Where broken wires are present count the number of broken wires in a length of rope eight times the rope diameter. The total number of broken wires must not exceed 10 per cent of the total wires.

For example:
In a 6 x 24 rope (6 strands of 24 wires) the total number of wires is 144. The diameter of the rope is 12 mm.

Length of rope to inspect = 12 (mm) x 8
= 96 mm
Number of wires = 6 x 24
= 144
10% of 144 = 14.4 wires

Therefore, 14 broken wires in a 96 mm length would indicate that the rope is unfit for use.

There are also many new types of rope construction for special purposes. Manufacturers will advise about the best type of rope for a particular application.

Discard FSWR slings if there is:

- a single broken wire below a metal socket, end fitting or a machine splice
- abrasion and core collapse
- corrosion — red oxide powder and loose and springy wires can indicate serious corrosion. Check the valleys between the wires for corrosion beneath the surface
- kinks, knots or fractures from bending or reeving
- crushed or jammed strands
- birdcaging — faulty whipping of bare ends allows the strands to loosen from their proper tight lay. It can be caused by rotation of the end of a rope or a sudden release from high loading
- high stranding — where a strand has slipped around the lay and projects above the surface due to faulty whipping and cutting of the rope ends.

Check splices for damage, tucks, corrosion and drawing out. Never allow a splice to pass around a sharp object, remain in the 'nip' of a reeved sling or be pulled roughly from under or through an object.

Check the swaged splices for fatigue, corrosion, wear and broken wires where the rope enters a splice.

Further guidance on the inspection of wire rope is provided in AS 2759.

When using FSWR:

- avoid reverse bends
- use suitable packing to protect the rope from sharp edges
- do not expose wire rope to temperatures exceeding 95°C
- do not lift with wire rope less than 5 mm in diameter
- do not use a rope that should be discarded
- do not use Lang's lay unless the ends are fixed to prevent the rope unlaying
- do not allow kinks or knots to develop.

Storage

Store wire rope clear of the ground in a clean, dry place.

Make sure that wire rope is not in contact with corrosive substances when it is stored.

Discard criteria for FSWR

1. Mechanical damage due to rope movement over sharp edge projection whilst under load.

2. Localised wear due to abrasion on supporting structure. Vibration of rope between drum and jib head sheave.

3. Narrow path of wear resulting in fatigue fractures, caused by working in a glossy oversize groove, or over small support rollers.

4. Severe wear in Lang's Lay, caused by abrasion at cross-over points on multi-layer coiling application.

5. Corrosion of severe degree caused by immersion of rope in chemically treated water.

6. Typical wire fractures as a result of bend fatigue.

7. Wire fractures at the strand, or core interface, as distinct from 'crown' fractures, caused by failure of core support.

8. Typical example of localised wear and deformation created at a previously kinked portion of rope.

9. Multi-strand rope 'bird-caged' due to torsional unbalance. Typical of build-up seen at anchorage end of multi-fall crane application.

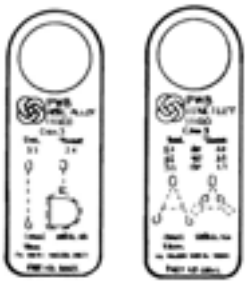
10. Protrusion of IWRC resulting from shock loading.

9. Chain

Chain is considerably heavier than FSWR of the same lifting capacity but is more durable. It can better withstand rough handling and can be stored without deterioration.

Chain used for lifting

Always check that the grade on the tag matches the grade markings on the chain. Do not use if there is no tag on the chain.



Each chain sling must have a tag stating manufacturer, grade, SWL of different applications and conditions of use

Grade (T)

Most chain being manufactured today for lifting is Grade (T) or 80 alloy steel. It is stamped (T), 800, 80 or 8, HA PWB, or CM and various combinations of the above. It has become the most commonly used chain for lifting in industry.

Look for the grade marking

Grade (P)

Usually stamped (P), 40, 4, or 04.

Grade (L)

Grade (L) or 30 mild grade steel. Can be stamped (L), 30 or 3.

Special grade

Some manufacturers of chain have lifting chain with greater strength than Grade (T). Follow manufacturers load ratings when using this chain.

Other chain you may encounter

Transport chain

Some chain is specifically designed as lashing chain for securing loads in the transport industry. This chain may be classified as Grade 60, 70 or 75. Do not use these chains for lifting.

HERC-ALLOY 800-MAXIMUM SAFE WORKING LOADS (SWL) IN TONNES OF 1000 KG

	Single leg slings			2, 3 or 4 slings						Endless slings			
Chain size mm	Straight sling	Adjustable sling	Reeved sling	Straight sling 60°	90°	120°	Reeved sling 60°	90°	120°	Basket sling 60°	90°	120°	Reeved sling
6.0	1.2	1.2	0.95	2.2	1.7	1.2	1.6	1.3	0.95	1.6	1.3	0.95	1.9
7.1	1.6	1.6	1.2	2.8	2.3	1.6	2.1	1.7	1.2	2.1	1.7	1.2	2.4
8.0	2.0	2.0	1.5	3.5	2.9	2.0	2.6	2.1	1.5	2.6	2.1	1.5	3.0
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
13.0	5.4	5.4	4.0	9.4	7.6	5.4	7.0	5.7	4.0	7.0	5.7	4.0	8.1
16.0	8.0	8.0*	6.0	13.9	11.4	8.0	10.4	8.5	6.0	10.4	8.5	6.0	12.1
20.0	12.8	12.8*	9.6	22.2	18.1	12.8	16.6	13.6	9.6	16.6	13.6	9.6	19.2
22.0	15.8	11.8*	11.8	27.4	22.3	15.8	20.5	16.7	11.8	20.5	16.7	11.8	23.7
25.4	20.6	15.5*	15.5	35.8	29.2	20.6	26.8	21.9	15.5	26.8	21.9	15.5	31.0
31.7	32.2	24.2*	24.2	55.9	45.6	32.2	41.9	34.2	24.2	41.9	34.2	24.2	48.4

Wrought iron chain and proof coil are not graded and must not be used for lifting.

Safe use and maintenance
Do not use an approved alloy chain that is less than 5.5 mm in diameter for lifting.

A chain sling is only as strong as its weakest link
When making up a chain sling, always use chain, hooks, links and hammerlocks or couplers of the same grade and SWL that are in a good condition.

- do not lift a load heavier than the SWL of the chain
- do not use a chain in which the links are stretched, frozen or do not move freely
- do not use chain that is gouged or worn more than 10 per cent of the diameter
- do not twist, kink or knot chain
- do not drop a chain from a height
- do not roll loads over a chain
- do not use a chain with a link that is cracked, or that has been spot welded other than by the manufacturer
- use protective padding when using chain around sharp corners
- do not attempt to use chain when the temperature exceeds 260 degrees C unless heat reduction charts are used.

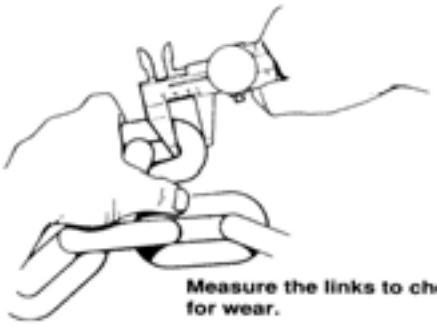
Inspection and discard

- Inspect your chain slings regularly.
- If necessary clean the chain before inspection.
- Inspect each link for signs of wear, twisting, stretching, nicks or gouging.
- Links that are frozen together show that the chain has been stretched.
- Find cracks by dusting chain with fine powder. Dust any link that is suspect and then blow the loose particles away. Dust particles will lodge in any cracks making them more visible. Magnetic particles can also be used.
- Measure all worn links for the degree of wear. Wear must not exceed that allowed for by the manufacturer.
- The maximum allowable chain wear is 10 per cent.
- The maximum allowable elongation of a chain is 10 per cent.
- The maximum increase in hook opening is 5 per cent of the original throat opening.
- The maximum allowable wear in the bite of a hook is 10 per cent.
- Inspect upper and lower terminal links and hooks for signs of wear at their load-bearing points and for any signs of distortion.
- Inspect links and fittings for signs of wear at their load bearing points and for excessive play in the load pin between the body halves.

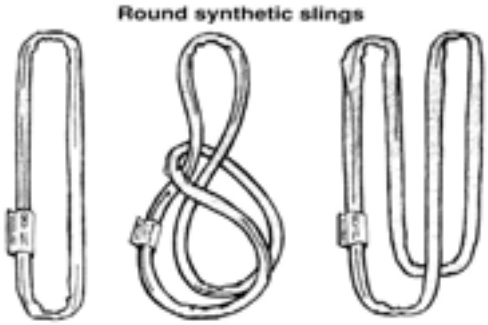
Withdraw any chain from service immediately if it has defects. Clearly mark the chain with a tag stating that it must not be used until it has been inspected by the manufacturer.

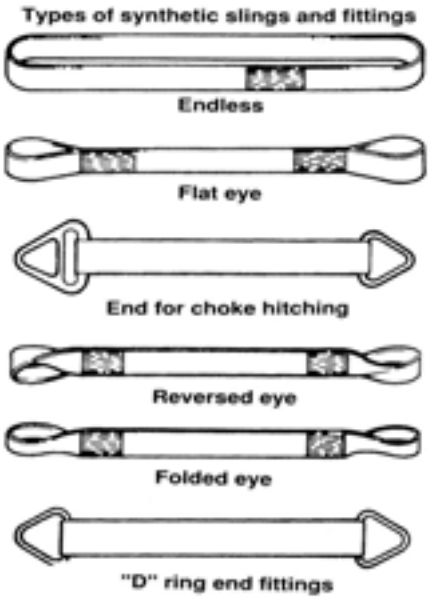
Destroy any chain that cannot be repaired.

If the chain is not tagged or properly stamped, it must be removed from service.


Measure the links to check for wear.

Enter all inspection details on an inspection record card.





10. Flat webbing and round synthetic slings

Flat webbing and round synthetic slings are in common use for lifting in Australian industry.

They are made from nylon, polyester, polypropylene or aramid polyamide.

Each sling must be labelled with the SWL.

Flat synthetic slings must comply with AS 1353. 1. Round synthetic webbing slings must comply with AS 4497. 1.

Inspection

Synthetic slings must be inspected before each use.

They must also be inspected by a competent person at least once every three months. If a sling is subject to severe conditions the inspections should be more frequent.

(For more information, refer to *AS 1353.2: Flat synthetic – webbing slings – Care and use* and *AS 4497.2: Round slings – Synthetic fibre – Care and use).*

Look for:

- any external wear such as abrasions or cuts and contusions
- internal wear which is often indicated by a thickening of the sling or the presence of grit and dirt
- damage to the protective coating of the sling
- damage caused by high temperatures, sunlight or chemicals (indicated by discolouration)
- damage to the label or stitching
- damage to the eyes or any terminal attachments or end fittings
- where the sling is covered by a sleeve, the sleeve must cover the sling for the full length from eye to eye.

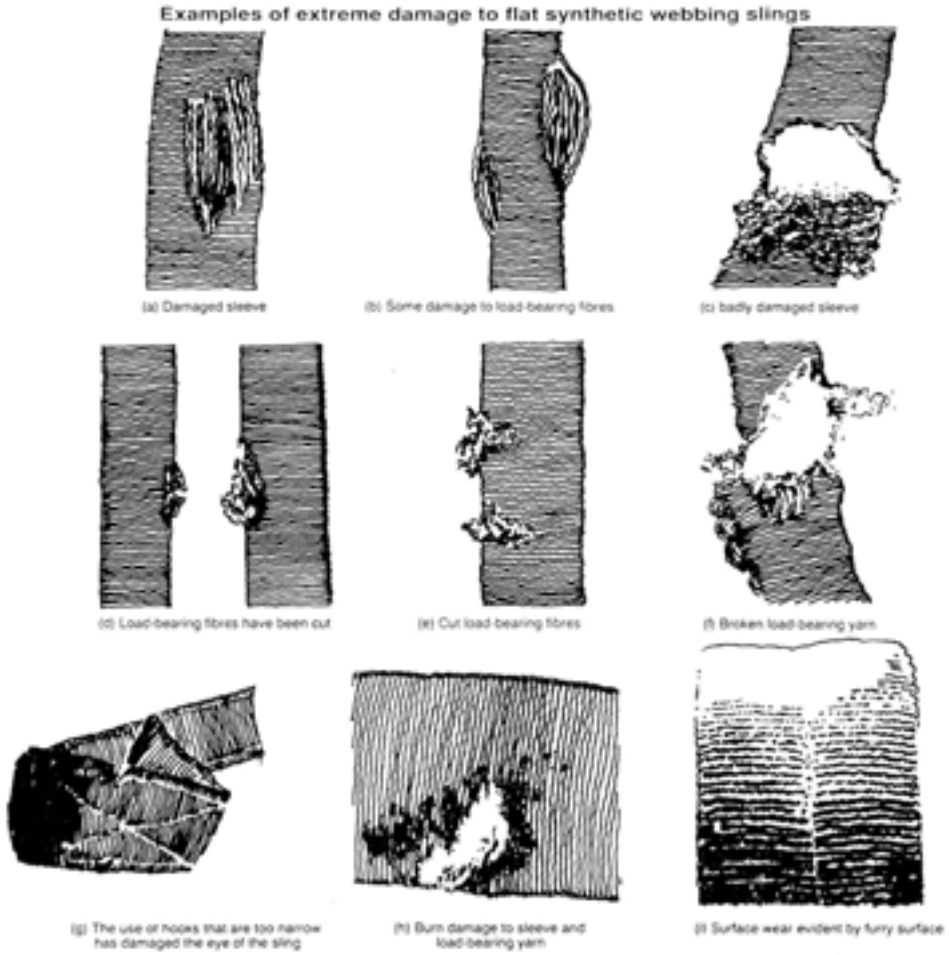
Discard a synthetic sling if:

- it is considered that it has lost more than 10 per cent of its original breaking strength (send the sling to the manufacturer for regular testing)
- the label has been removed or destroyed
- there is any damage to the sleeve or protective coating.
- a nylon sling comes into contact with acid.
- a polyester sling comes into contact with alkaline substances.
- a polypropylene sling comes into contact with an organic solvent such as paint, coal tar or paint stripper.
- there are any visible cuts on the sling.

Note: A nylon sling will lose more than 10 per cent of its strength when it is wet.
After six months exposure to sunlight, send a sling in for testing.

Synthetic slings must be stored in a clean, dry and well ventilated place and away from:

- the ground or floor
- direct sunlight
- ultra-violet light and fluorescent lights
- extremes of heat
- sources of ignition
- atmospheric or liquid chemicals
- the possibility of mechanical damage.



11. Fibre rope

Fibre rope is not widely used for lifting. It does not have the strength or versatility of FSWR, chain or synthetic slings. Do not use a fibre rope that is less than 12 mm in diameter for lifting.

It is most commonly used as a tagline for guiding or steadying a load because it is flexible and non-conductive. Fibre rope taglines must be at least 16 mm in diameter.

Maintenance

Keep fibre rope neatly coiled in a clean, dry and well ventilated place when stored and protected from:

- falling objects
- fire and excessive heat (max. 65 degrees C)
- acids and other chemicals
- sparks and molten metal
- water and rust
- sand, ashes and dirt
- rats and mice.

Inspection

When inspecting fibre rope look for:

- signs of brittleness, charring or brown discolouration due to excessive heat
- a dirty grey colour, loss of weight and brittleness due to sun rot
- signs of mildew by opening the strands and looking and smelling for mould
- discolouration and powdery fibres due to the effects of acid and other corrosive agents
- a decrease in diameter and an increase in the length of the lay due to overloading
- one strand standing out higher than the others — called high stranding, it can be caused by faulty splicing or whipping.

All of the above defects make the rope unfit for lifting purposes.

12. Accessories

From the hook to the load the lifting gear can be made up of many parts.

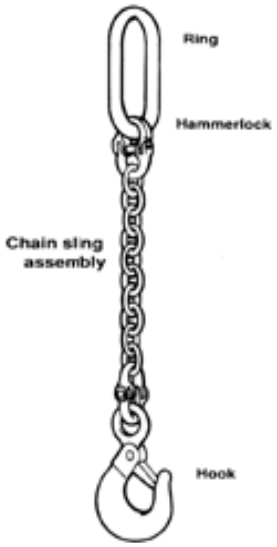
The SWL of lifting gear is only as great as the part with the lowest SWL.

For example if the SWL of:

the hook is 2 tonnes
the shackle is 2 tonnes
the ring is 1 tonne
the rope is 2 tonnes

then the SWL for the lift is 1 tonne.

Always use accessories with at least the SWL of the sling to avoid errors.



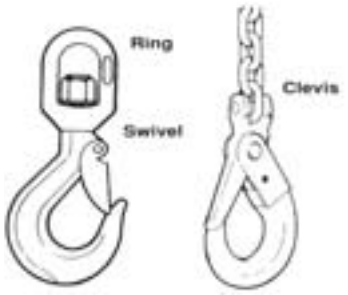
Hooks

Hooks should be fitted with a safety catch particularly where there is a chance of the slings being displaced.

There are a wide variety of hooks in use for chain slings. Hooks are mostly 80 grade alloy steel and are stamped with the SWL.

Make sure that when selecting a hook for a chain sling that the hook has at least the same SWL as the chain.

Make sure that the opening is wide enough to accept the largest rope, ring, link or shackle that has to be placed over the hook.



Make sure that the inside of the hook or 'bight' is rounded so that it does not cut into or damage slings and fittings.

Crane hooks must freely rotate at all times. If the load exceeds two tonnes, there must be a ball or roller thrust bearing between the trunnion and nut.

If a chain hook opening is stretched more than 5 per cent, it must be withdrawn from service.

Discard bent or distorted hooks. Do not attempt to weld or repair them. Hooks must not have any fittings welded to them.

Rings

A ring must have at least the same SWL as the chain, hook and other parts of a sling.

Discard any ring which has been stretched by more than 5 per cent.

Do not place a ring (or shackle or eyebolt) over a crane hook unless it hangs freely.

Shackles

There are three main types of shackle – 'D', 'Bow' and 'Plate' shackles.

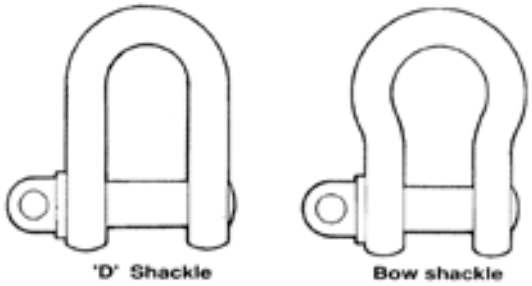


Plate shackles are mainly used for joining lengths of luffing rope (pendants) when extra lengths of boom are added to any wire rope luffing boom crane.

All shackles used for lifting must be stamped with the SWL. Do not use a shackle that does not have the SWL marked.

Make sure that the SWL of the shackle is at least as great as the chain, links and rings in the sling you are using.

Do not use a bolt and nut in place of the proper shackle pin. A bolt that does not fit tightly is likely to bend and break.

Discard any shackle that is worn in the crown or pin by more than 10 per cent.

Do not use a shackle that is bent, deformed or damaged. Deformed shackles probably have microscopic cracks which can lead to complete failure during lifting.

To prevent jamming, tighten shackle pins finger tight and then release a quarter turn.

Use washers or ferrules to centre thimbles and hooks on the shackle pin to prevent unnecessary side strain.

Where several sling eyes are to be connected to a lifting hook, use a large bow shackle so that all the sling eyes can be safely accommodated. The pin must rest on the hook and the sling eyes in the bow section.

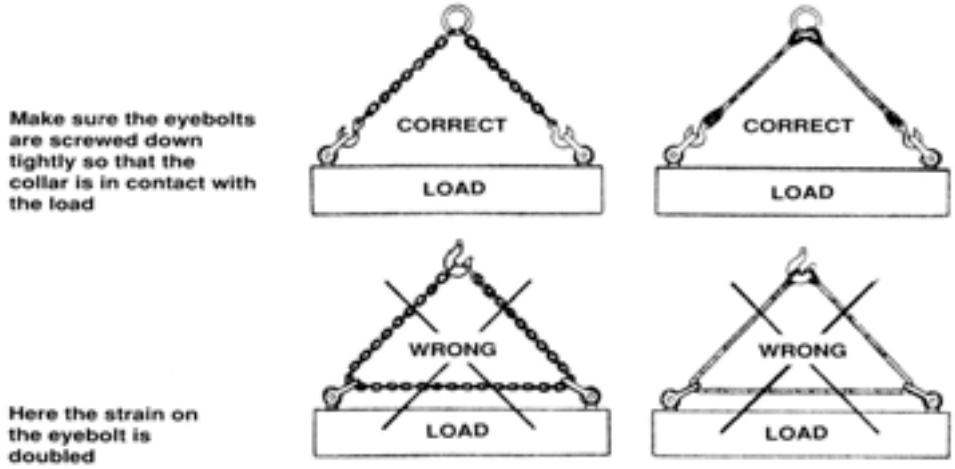
Do not use a screw shackle where the pin can roll under the load and unscrew. Mouse the pin of the screw shackle or use a shackle fitted with a nut and bolt.

Eyebolts

There are collared and uncollared eyebolts. Do not use uncollared eyebolts for any lifts other than vertical lifts because they can break off when side strain is applied.

It is recommended that only collared eyebolts are used for lifting.

A typical use for an eyebolt is for lifting pre-cast concrete panels which have ferrules cast into them. Make sure that eyebolts are securely screwed into the ferrule or nut before use.



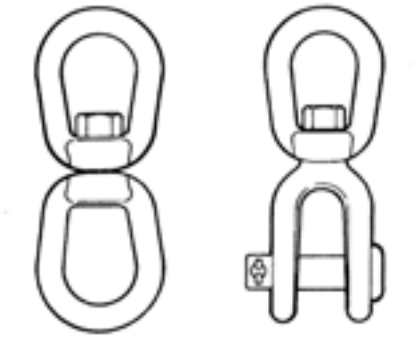
Do not lift if the ferrule is loose.

Do not hammer an eyebolt to tighten. Use a podger bar.

Make sure that the crown of a collared eyebolt is in line with the strain when using multi-legged slings.

80 grade high tensile eyebolts are 8-sided to indicate the grade.

Do not put a sling through two or more eyebolts. Use two slings attached to the eyebolts with shackles. Do not attach slings to eyebolts with hooks because the hook is usually too small.



Swivel for use with hammerlock.

Swivel with clevis.

Swivels

Swivels both prevent chain or rope from twisting and allow it to untwist.

Swivels can have two eyes (eye and eye swivel) or have an eye attached to a shackle (clevis and eye swivel).

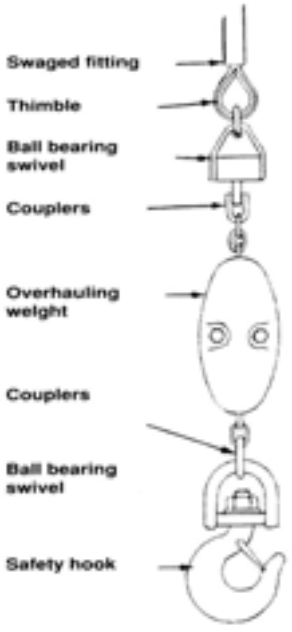
Overhauling weights

The overhauling weight assembly provides extra weight to the crane hoist wire and hook when there is no load attached. It is often called the 'baby' or ponder ball.

To minimise the spinning of the overhauling weight and assembly, it is preferable to have a ball or roller bearing swivel between the rope and overhauling weight.

Make sure that where a hoist limit is fitted, the crane is set so that the swaged fitting at the top of the overhauling weight assembly does not come into contact with the boom head sheave.

Check for signs of corrosion and fatigue where the overhauling weight is attached to the rope, i.e. around the edges of a wedge or socket or other attachment. The overhauling weight assembly should never be set up to rest on a swaged rope fitting.



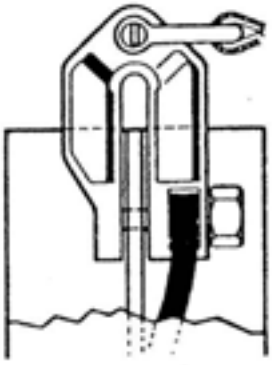
Overhauling weight assembly.

Ratchet release shackles

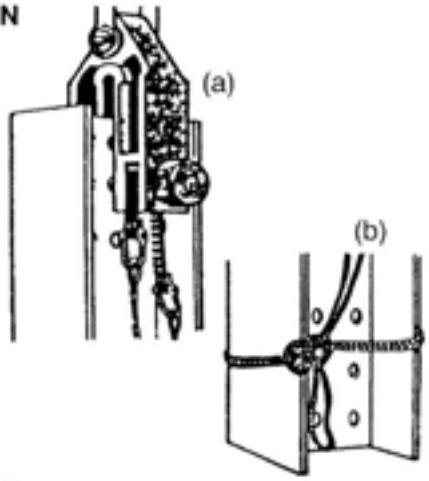
These devices allow doggers to erect steel columns without having to climb the columns to release the lifting shackle used by the crane to lift the column into place.

They use a ratchet system that can be operated from below to release the shackle.

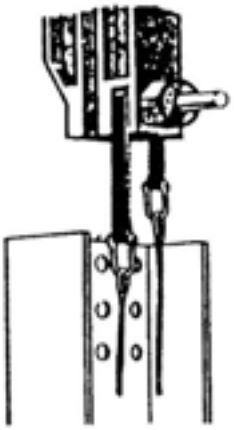
METHOD OF OPERATION



1. With the pin retracted slide the shackle over the material to be lifted until the pin is approximately over the lifting hole. Press the ratchet spring down with the thumb of one hand and turn the hexagon knob of the shackle with the other hand.



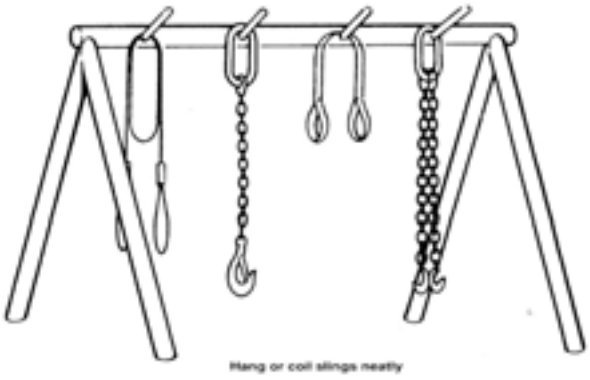
2. Two soft ropes should be attached to the 'D' shackles at each end of the toothed belt. The material may then be lifted. It is prudent to tie the ends of the shackle release ropes to the bottom on the member **2a** to prevent the ropes becoming snagged or being caught on the wind and become inaccessible.



3. After lifting the material the shackle is released by pulling the release ropes first one way and then the other five or six times. The ratchet action withdraws the pin. The stroke of the pull is limited by the 'D' shackles at the end of the toothed belt (450 mm maximum length).

13. Storage

Store all slings in a clean dry storage cabinet or area and hang or coil them neatly. Details of use and maintenance for all gear must be logged on a record card by a certificated dogger.



Hang or coil slings neatly

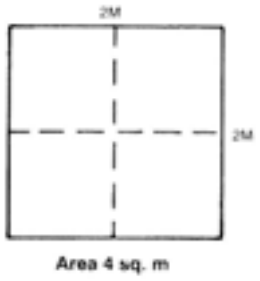
(See storage requirements for individual slings).

Part three

14. Areas and volumes

Areas

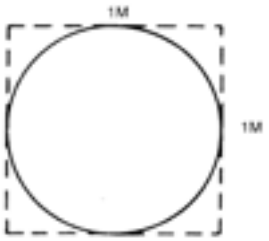
Area of a square = length x width
For example:
2 m x 2 m = 4 square metres



Area 4 sq. m

Square

Area of a circle = π x (radius)^2
π = 3.14
For example:
π x 0.5^2 = 0.785 square metres



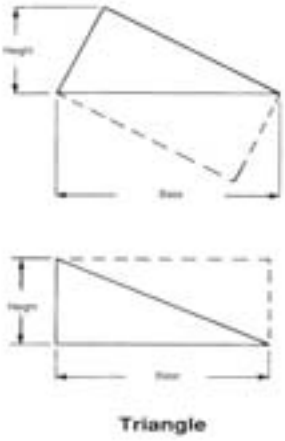
Area 0.785 sq m

Area of a rectangle = length x width
For example:
2 m x 5 m = 10 square metres

Area of triangle = base x height ÷ 2
For example:
3 m x 3 m ÷ 2 = 4.5 square metres

Area 10 sq. m

Rectangle

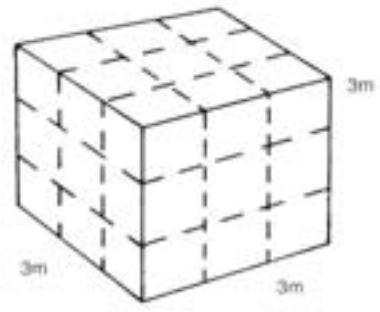


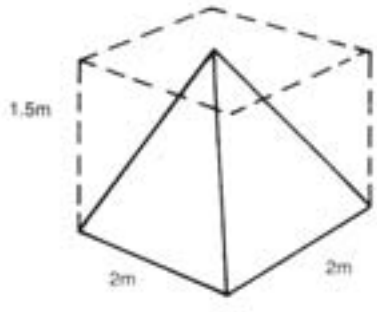
Triangle

Volumes

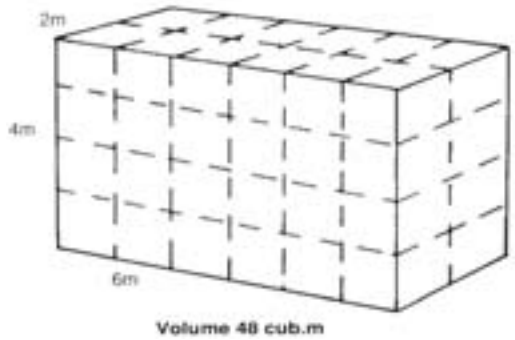
Volume of a cone or pyramid = area of base x height ÷ 3
For example (pyramid):
2 m x 2 m x 1.5 m ÷ 3 = 2 cubic metres

Volume of a cube = length x height x width
For example:
3 m x 3 m x 3 m = 27 cubic metres

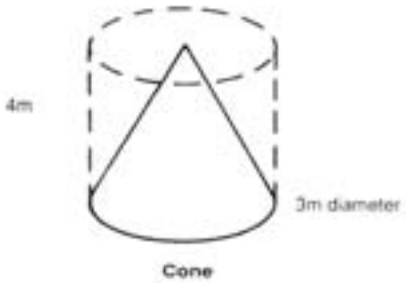




Pyramid



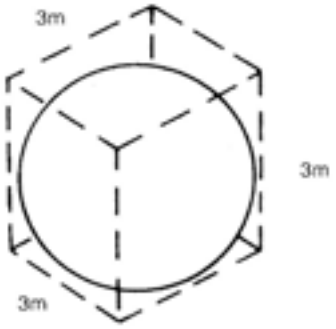
Volume 48 cub.m



Cone

Volume of a rectangular solid = length x height x width
For example (cone):
2 m x 4 m x 6 m = 48 cubic metres

Volume of a sphere = $^4/3\ \pi r^3$
π = 3. 14
For example:
$^4/3$ x 3.14 x $(1.5)^3$ = 14.3 m^3



Sphere

Calculating the weight of a load

To calculate the weight of an unknown load, you must multiply the volume of the load by the unit weight of the material.

For example:

A rectangular stack of hardwood 3 metres long – 1 metre high – 0.5 metre across.

Volume of rectangular solid
= length x width x height
3 m x 1 m x. 5 m = 1.5 cubic metres

Unit weight of hardwood is 1120 kg per cubic metre
1.5 x 1120 = 1680

Therefore the total weight of the load is 1680 kg.

15. Table of masses

Acid (crated maximum)	200 kg
Aluminium, cu m	2.7 t
Aluminium ingot	5-15 kg
Ashes, coal, cu m	800 kg
Asphalt, 200 litre drum	200 kg
Bath, porcelain	100 kg
Barbed wire, coil	50 kg
Blue metal, cu m	2.0 t
Beer 160 litre	250 kg
Bitumen, 200 litres drum	200 kg
Blood and bone, 20 bags	1 t
Bolts, various, bag	50 kg
Brass, cu m	8.5 t
Bricks, common, 1,000	4 t
Bricks per pallet	2 t
per 1000	4 t
Bronze, cu m	8.5 t
Cast iron, cu m	7.2 t
Cast steel, cu m	7.9 t
Clay, cu m	1.9 t
Cement, 1 bag 0.2 cu m	40 kg
Cement, 25 bags	1 t
Coal, 1 cu m	864 kg
Concrete, cu m	2.4 t
Corn sacks, bale	300 kg
Copper, cu m	9.0 t
Copper, 3 mm thick, sq m	27 kg
Cotton bale	250 kg
Doors, 50	1 t
Dog spikes, 100	50 kg
Drums, empty 200 litre (44 gal)	13 kg
Earth, 1 cu m	1.9 t
Fat, tallow, etc (44 gal barrels)	
200 litre	200 kg
Fencing wire, coil	50 kg
Fibrous plaster, sq m	1.6 kg
Fibre board, sq m	0.6 kg
Fibro cement corrugated sheets –	
Standard, per m run	10.5 kg
Super six, per m run	15 kg
Fibro cement plain sheet 2 m x 1 m	18 kg
Fish bolts, 24 mm dia	1 kg
Fish plates, 4-hole	13 kg
Fish plates, 6-hole	18 kg
Galvanised flat iron 0.5 mm sheet,	
1.8 m x 90 mm	7 kg
Granite, cu m	2.6 t
Grease (44 gal) 200 litre	200 kg

Gypsum, cu m	2.3 t
Gypsum, 1 bag	50 kg
Hardwood (see Timber)	
Hermatic ore, cu m	5.4 t
Hemp, bale	300 kg
Ice, cu m	930 kg
Iron, cast cu m	7.25 t
Iron, ore, cu m	5.4 t
Jute, bale	150 kg
Kerosene (44 gal) 200 litre	200 kg
Lead, cu m	11.4 t
Lead, 3 mm thick, sq m	34 kg
Lead, pig or ingot	36 kg
Lime (stone), 12 bags	1 t
Lime (stone), cu m	2.6 t
Lime, hydrated, 1 bag	22kg
Lime, hydrated, 44 bags	1 t
90 masonry blocks (390 x 190 x 190)	1 t
60 masonry blocks (390 x 190 x 290)	1 t
Nails, case	50 kg
Netting, wire 1 m roll, 50 m	25 kg
Oils, all types (44 gal drum) 200 litre 200 kg	
Paint 5 litre	10.5 kg
Palings, H. W. 1.5 m sawn, 400	1 t
Palings, H. W. 2 m sawn, 360	1 t
Petrol 200 litre	200 kg
Pig iron, pig	50 kg
Pipes –	
Glazed stoneware –	
100 mm 55 m	1 t
150 mm 32 m	1 t
225 mm 20 m	1 t
300 mm 15 m	1 t
Cast iron, 3.6 m long, lined –	
80 mm nominal inside dia	18 kg/m
100 mm pipe	28 kg/m
150 mm pipe	54 kg/m
200 mm pipe	84 kg/m
225 mm pipe	100 kg/m
250 mm pipe	115 kg/m
300 mm pipe	148 kg/m
Steel, galvanised –	
8 N. B. O. D. 13.5 mm	0.7 kg/m
10 N. B. O. D. 17.0 mm	0.9 kg/m
15 N. B. O. D. 21 mm	1.28 kg/m
20 N. B. O. D. 27 mm	1.69 kg/m
25 N. B. O. D. 34 mm	2.5 kg/m
32 N. B. O. D. 42 mm	3.2 kg/m

40 N. B. O. D. 48 mm	3.8 kg/m
50 N. B. O. D. 60 mm	5.3 kg/m
Copper, 13 g internal diameter – approx.	
12.7 mm O. D	0.35 kg/m
16 mm O. D	0.5 kg/m
25 mm O. D	0.8 kg/m
38 mm O. D	1.25 kg/m
50 mm O. D	1.7 kg/m
Pitch and tar, (44 gal) 200 litre	200 kg
Plywood 6 mm, 2 m x 1 m	7 kg
Plaster, 1 bag	38 and 72 kg
Rails, steel (masses are branded on side)	
HEIGHT mm BASE width mm	
157 229	192 kg/m
102 165	86 kg/m
157 146	73 kg/m
173 140	59 kg/m
137 127	41 kg/m
94	22 kg/m
65 60	10 kg/m
Sand, beach, dry, 1 cu m	2.0 t
Sand, beach, wet, 1 cu m	2.3 t
Sand, river, dry, 1 cu m	1.3 t
Sand, river, wet, 1 cu m	1.5 t
Screws case	50 kg
Shale, cu m	2.6 t
Sisal, bale	200 kg
Sleepers, 225 mm x 114 mm x 2.4 m	80 kg
Sleeper plates, 200	1 t
Tallow, (44 gal), 200 litre	200 kg
Tar, (44 gal), 200 litre	200 kg
Terra cotta, cu m	1.8 t
Tiles, Marseilles, terra cotta, 100	350 kg
Tiles, Marseilles, concrete, 100	375 kg
Tin, cu m	7.3 t
Tin, ingot	32 kg
Timber, ironbark, cu m	1.4 t
Timber other hardwoods, cu m	1.1 t
Timber, softwoods, cu m	640 kg
Tubular scaffolding (1.5in bore) 48 mm O. D	
4.8 mm thick	5.2 kg/m
Water, fresh, 1 litre	1.0 kg
Water, fresh 1 cu m	1.0 t
Weatherboards, rusticated –	
Hardwood,	
180 mm x 25 mm x 200 m	1 t
Woolpacks, pack average	150-160 kg
Zinc, cu m	7.0 t
Zinc, ingot	26 kg

16. First aid

Doggers work in a high risk industry. The likelihood of injury is high because of the nature of the work being performed.

It is important that every person on a multi-storey building site has ready access to first aid and that they know what to do, where to go and who to contact in the event of an accident.

The relevant person who conducts a business or undertaking as an employer or self-employed person is responsible for determining and providing first aid requirements at a workplace. On a multi-storey building site this includes providing first aid kits, equipment and first aid rooms. Trained first aid personnel should also be provided.

First aid kits on construction sites should be able to be carried quickly to the scene of an accident.

The names, locations and work shifts of first aid personnel should be prominently displayed near first aid rooms.
Access by emergency vehicles to and from a large site such as a multi-storey construction site should also be considered when determining first aid requirements.

It is recommended that all those who work in the construction industry take the time to do an approved first aid certificate.

17. Terms used in this guide

Boom: A member attached to the crane structure from which the load is suspended and which can be raised or lowered.
Diameter: The length of a straight line drawn from one side to the other through the centre of a circle.
Dogger: A person qualified to sling and direct loads.
Dunnage: Packing under loads.
Eyebolt: Lifting ring attached to a load.
Grade: Indicates the strength of chain or FSWR.
Hammerlock and Couplers: Attachable chain links.
Jib: An extension fitted to the head of the boom of a crane which extends the lifting radius. Sometimes called a 'fly' or 'fly jib'.
Loading factor: The fraction of the safe working load created by a particular slinging method.
Luffing: Raising or lowering the boom of any luffing crane.
Overhauling weight: Counterweight to overhaul the weight of the hoist wire of a crane where no load is applied.
Reeve (Nip): A method of slinging where the sling passes back through itself reducing the safe working load.
Ring: End link of a chain assembly.
Safe working load: The maximum load that can be safely lifted by a particular sling, attachment or machine.
Shackles: Attachment for joining a sling to a load or a hook..
Sheave: A pulley through which flexible steel wire rope moves.
Slewing: The left and right movement of a crane boom pivoting on its base.
Sling: Lifting gear made from steel wire rope, chain or synthetics.
Snigging: Dragging a sling or a load.
Snotter: Fibre rope sling.
Spreader: A beam with a central lifting attachment that reduces the strain on the lifting gear.
Swivel: A rotating sling attachment that rotates without spinning the wire, hook or load.

Appendix 1

Further information

For more information about your responsibilities under the *Workplace Health and Safety Act 1995*, call **1300 369 915** or for electrical safety, call **1300 650 662** or visit **www. worksafe. qld. gov. au.**