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# FORK LIFT TRUCK DRIVERS

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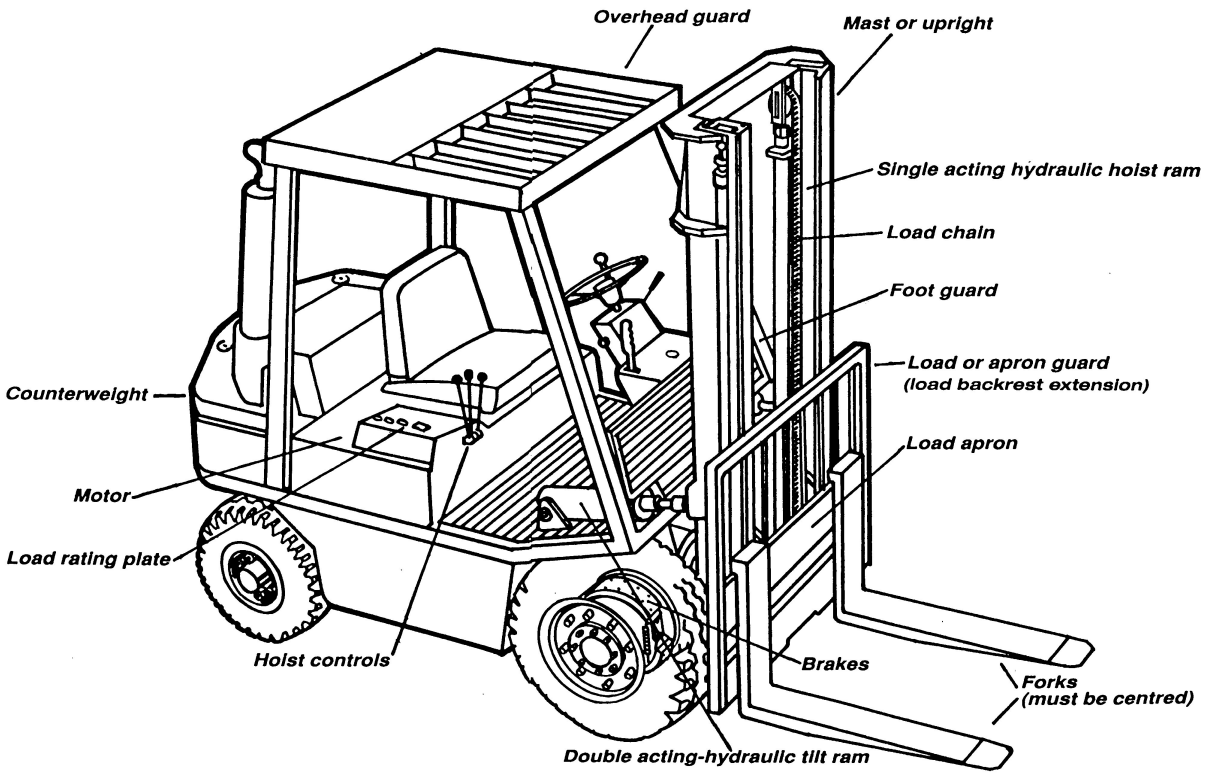
This publication may refer to NSW administered legislation that has been amended or repealed. When reading this publication you should always refer to the latest laws. Information on the latest laws can be checked at www.nsw.gov.au or contact (02) 9238 0950 or 1800 463 955 (NSW country only).

# Contents

# 1.
# Fork lift truck drivers must know:

- ❑ The capacity of their fork lift truck (FLT).
- ❑ The conditions of operating a FLT in their workplace.
- ❑ The features of FLTs.
- ❑ How to drive a FLT safely.
- ❑ Prechecks.
- ❑ Maintenance checks.
- ❑ Parking procedure.


Overhead guard
Mast or upright
Single acting hydraulic hoist ram
Load chain
Foot guard
Load or apron guard
(load backrest extension)
Load apron
Counterweight
Motor
Load rating plate
Hoist controls
Brakes
Forks
(must be centred)
Double acting-hydraulic tilt ram

## 2. The fork lift truck

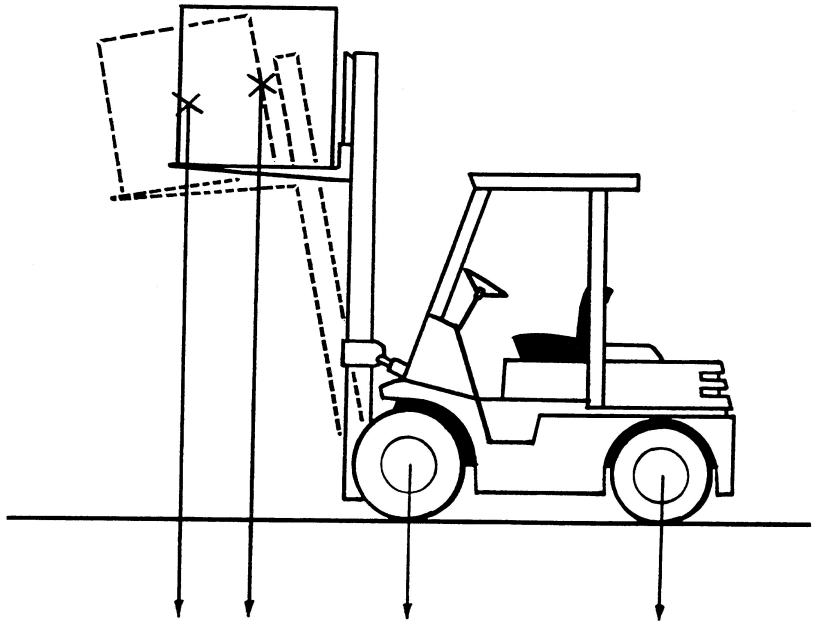
FLTs transport and stack materials. They are a short wheel based truck with a vertical mast.

There are two types, counterbalanced and noncounterbalanced fork lift trucks.

### Counterbalanced fork lift trucks

Counterbalanced FLTs use the front wheel axle in the same way as the fulcrum of a lever. The load is counterbalanced on one side by the weight of the machine on the other side. All the weight behind the point of balance acts as a counterweight.

*A counterbalanced FLT*

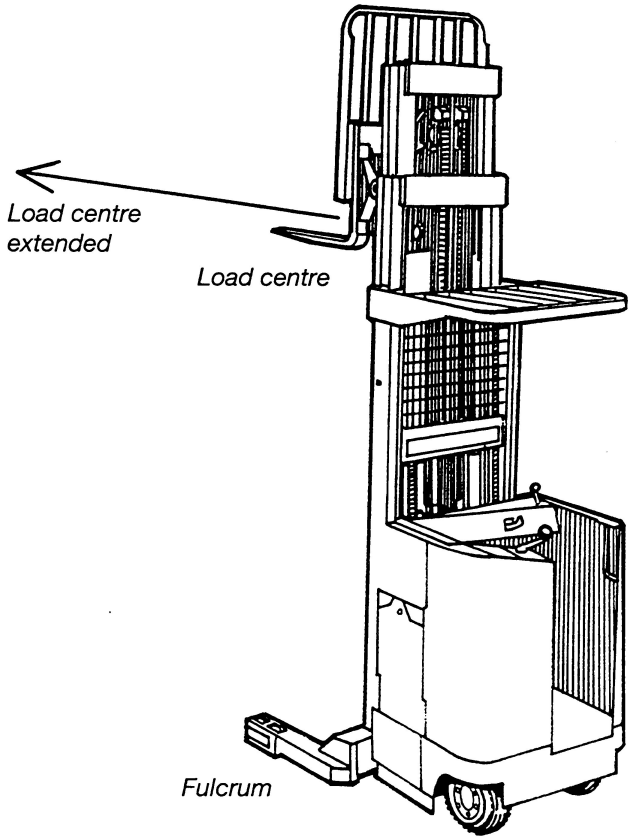


## Noncounterbalanced fork lift trucks

In noncounterbalanced FLTs the centre of the load is behind the fulcrum point. They are known as 'reach' or 'straddle' trucks.

This type of FLT reaches out to deposit the load or straddles the stack for depositing the load. They should not carry loads unless the reach is retracted. They are used for particular load stacking functions and are more versatile than the counterbalanced type in warehouse locations.

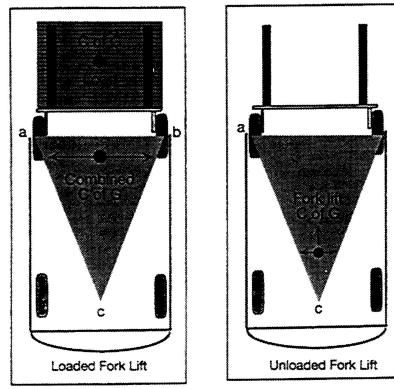
*A non-counterbalanced FLT*



## Stability

FLTs are unstable by design. They have no springs and even four wheel counterweighted FLTs only have three point suspension.

The two rear wheels are attached in the centre to the main body of the machine allowing the rear to hinge sideways affecting the lateral (sideways) stability of the machine. All FLTs have a high centre of gravity and a narrow wheel base which adds to their lateral instability.




**FLTs have three point suspension formed from the front drive axle (a & b) and the steering axle point at the rear of the base (c).**

Be aware of the factors listed below which can affect **lateral instability:**

- turning at speed
- driving over uneven surfaces
- an unevenly distributed load
- driving with a flat or under inflated tyre
- driving too fast
- travelling with the load raised
- braking too hard when turning
- side shift not centred
- lifting a load on one fork arm
- driving sideways across a slope
- dragging (snigging) a load sideways with a jib attachment.

The front wheels of FLTs act as a fulcrum with the forks on one side and the machine body on the other. If the weight at the fork ends is heavier than the counterweight it will cause longitudinal instability (the FLT will tip up).

Be aware of the factors listed below which can affect **longitudinal instability:**

- overloading
- severe braking
- incorrect use of the mast tilt (especially with the load carried at a higher level)
- load not positioned against the heel of the fork arms
- shifting the load centre forward
- dragging (snigging) a load in from the front with the jib attachment fitted
- lifting a load with a jib with the mast tilted forward.
- picking up an over-width load
- fitting slipper forks
- driving with reach extended.

## 3. Safe working load

Most FLTs have two safe working loads (SWL) stamped on the load rating plate. They are the:

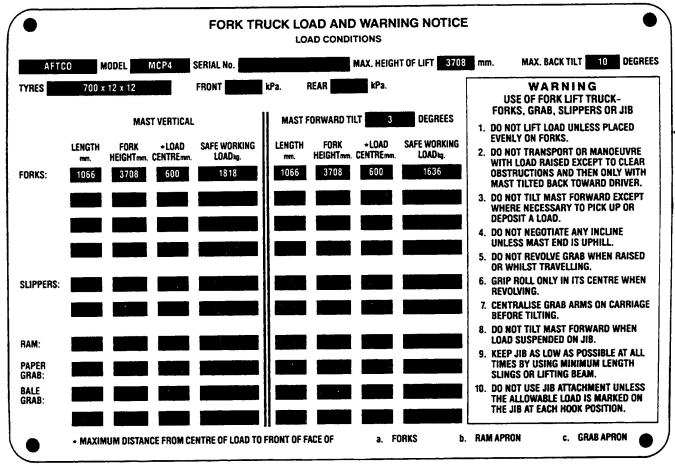
- mast vertical SWL
- mast forward tilt SWL.

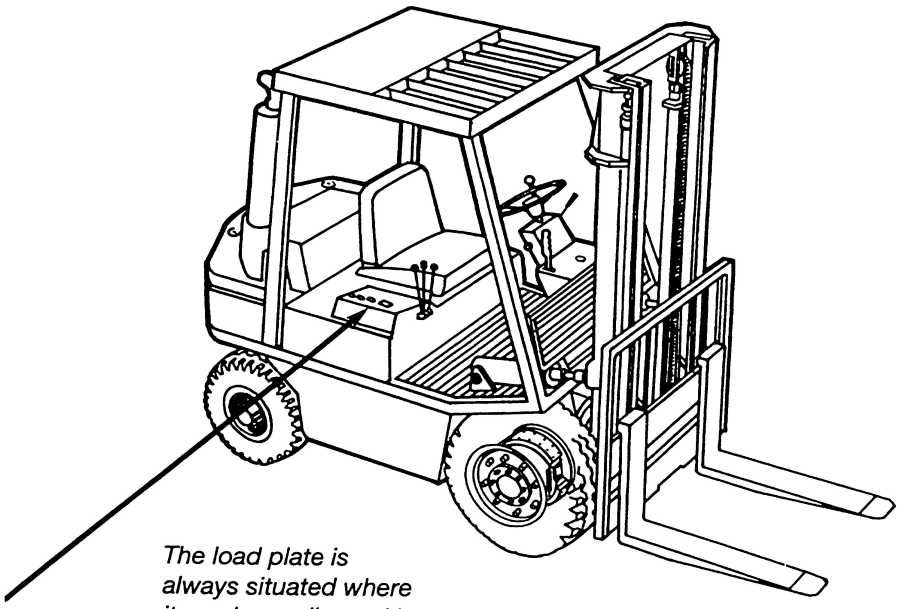
The load rating plate is usually found next to the driver's seat. If attachments are fitted a separate load rating notice needs to be displayed. To prevent accidents the weight of the load must be checked against the specifications of the FLT.

SWLs must not be exceeded. If the load weight is too great, the FLT can tip over. As the mast is tilted forward, the centre of gravity moves away from the fulcrum so that the SWL decreases.

Operators must be able to understand the load plate and the conditions of loading at all times. The load rating is taken from the front face of the load back rest to the centre of the load.

It is the responsibility of the owner to provide a load plate that displays the lifting capacity of the machine under all lifting conditions. Do not use a FLT that does not have a load plate.

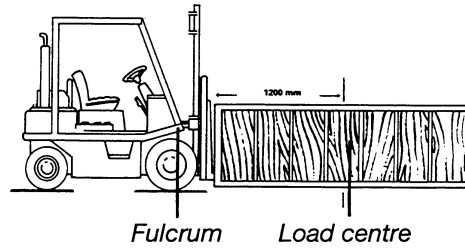




*The load plate is always situated where it can be easily read by the driver.*

If slippers are placed on the forks the load centre increases allowing larger pallets to be lifted. However this greatly reduces the load rating of the FLT.

For example, if a box 3,600 mm wide is lifted by a FLT the load rating is assessed 1,800 mm out from the apron giving a reduced SWL.




**In this case the load rating is assessed 1,800 mm from the front face of the forks.**

Some load plates give various load ratings according to the load height, load centre and mast tilt. FLT operators must know and understand the load rating for each different circumstance.

Operators should assess the load weight by checking the consignment details or by multiplying the number of articles on a pallet by their individual weight and then adding the pallet weight.

For example:

- 20 bags @ 20 kg per bag
- Weight of pallet 60 kg
- N$^{o}$ of bags x weight of each bag + weight of pallet = total load weight
- 20 x 20 + 60 = 460 kg

# 4. The hydraulic system

FLTs are powered by an electric motor or by an internal combustion engine.

The motor operates a hydraulic pump to raise the forks. The hydraulic pump pushes oil into a control box under pressure.

Hydraulic oil leaves the tank under low pressure. It passes through a pump, leaving the pump under high pressure and then it passes through the control box. The hydraulic oil tank must not be completely filled.

The driver can then direct the oil through the hydraulic lines under high pressure to the hydraulic rams to raise or tilt the mast. The driver uses a controller to allow the oil into the hydraulic cylinder. When the cylinder is filled with oil a ram inside the cylinder is raised, pushing the mast upwards. This raises the apron and forks.

There is a level marked on a sight gauge or a dipstick in the hydraulic tank. Do not fill the tank above the level marked. Make sure that the oil is kept at the correct level. Check the level before each shift.

Check the system for oil leaks. Leaking hydraulic oil can be very dangerous, especially if it is mixed with chlorine.

Any adjustment to the hydraulic relief valve which adjusts the pressure must be carried out by a qualified mechanic or competent person.

## Single acting rams

The lifting ram on most FLTs is a single acting ram. It directs the hydraulic pressure in one direction to raise the forks. Gravity lowers the forks.

To prevent the forks crashing down the single acting rams have a restricting valve at their base to limit the lowering speed to 0.6 metres per second.

## Double acting rams

FLTs fitted with a tilt mechanism are usually hinged at the base of the mast. Above the hinge are two hydraulic rams that work in both directions, called the double acting rams.

The combined action of the hinge and rams allows the mast to move safely backwards and forwards while supporting the weight of the load. Double acting rams have a check valve which stops them operating unless pressure is fed into them to give movement.

# 5. The motor

## Internal combustion engines

Internal combustion engines are powered by diesel fuel, petrol or LP gas. An LP gas motor is a petrol motor converted to use gas instead of petrol.

**Warning:** Internal combustion engines produce the odourless but poisonous gas, carbon monoxide. A person working in a confined space where carbon monoxide is present could become seriously ill. Carbon monoxide builds up in the body and can kill in 20 minutes. Make sure that there is adequate ventilation where FLTs with internal combustion engines are operating.

Do not refuel an internal combustion FLT unless the motor is stopped and the ignition is turned off.

## Changing LP gas bottles

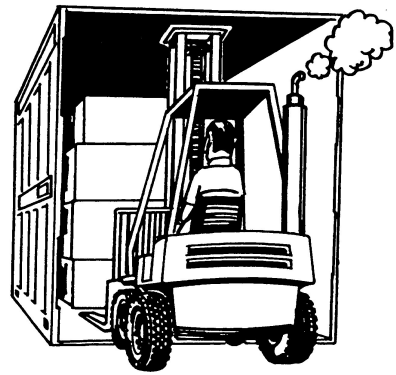
LP gas is a highly volatile explosive. Change gas bottles in a well ventilated area well clear of a naked flame or source of ignition. LP gas bottles must be changed only by those trained and authorised to do so.

Beware of burns from escaping gas. Always wear gloves and safety glasses and do not smoke while changing LP gas bottles.

Take the following steps in the order below when changing LP gas bottles:

1. turn off cylinder valve
2. switch off engine
3. disconnect takeoff hose
4. remove safety straps
5. change the bottle
6. connect the safety strap
7. reconnect takeoff hose
8. turn on cylinder valve
9. check for leaks-look, listen and smell.

LP gas bottles should be inspected and stamped by a competent person every 10 years. All LP gas FLTs must have an installer's compliance plate.



**Beware of exhaust fumes in confined spaces**

## Internal combustion diesel engines

Most diesel engines must warm up before they can start. When the ignition key is turned on, the glow plug is activated. This warms the motor so that it will fire.

There is a delay of several seconds from ignition until the engine is turned on by the starter motor. A light on the dashboard indicates that the engine is warming. It goes out when the motor is ready to fire.

Try to avoid allowing a diesel engine to run out of fuel. Diesel engines fire on compressed vaporised fuel and will not fire if there is air in the fuel lines. If a diesel engine runs out of fuel, a competent person must bleed the system of air before it can be restarted.

Diesel engines also emit carbon monoxide gas. A badly tuned diesel engine can emit more carbon monoxide than a petrol motor. Remember that carbon monoxide is odourless, will build up and can kill.

## Electric FLTs

Most electric FLTs are powered by a 500 amp battery. Amp = rate of flow of electric current. A 500 amp battery will in theory supply 100 amps per hour for five hours.

The battery will need recharging sooner if there is an increase in the use of electric current due to heavier work. The heavier the workload the more often a battery will have to be recharged.

Batteries are overworked by:

- steep inclines
- excess speed
- excess loads
- stalling and starting
- excessive use of the hydraulics.

## Charging batteries

Charging cables carry a heavy current. They are of a fixed length that must not be altered. Make sure that insulation on the cables is in good condition before use. The following precautions must be taken when recharging batteries:

- Charging must be carried out in a well ventilated, open area. Ventilation is important because highly explosive hydrogen gas is produced during charging.

- Each charger should have its own power source with clear access to the switch.

- Any cover over the battery should be held open to allow free escape of fumes.

- Cell vent caps should be kept in place to prevent spraying of electrolyte. Make sure that the vent caps are working.

- Do not smoke or allow a naked flame near charging batteries.

- Do not allow any metal objects (spanners etc) to rest on charging batteries.

- Wear rubber gloves and eye protection when setting up the batteries for charging. Battery acid can cause nasty burns.

# 6. Pre-checks

FLT drivers must check their machine before the start of each shift. Report any defects to your supervisor.

## Before starting the motor

Before starting the motor check that:

- the two safety guards are fitted:
  (1) the overhead guard
  (2) the load back rest extension.
- there is an approved load plate displaying all conditions of lifting.
- the tyres are in good condition:
  (1) pneumatic for correct pressure
  (2) hard rubber for good condition and that they are not lifting away from the rims.
- the forks are evenly spaced and without defects and the fork locking pins are in place.

- the lifting chains are an even length.
- the counterweight is secure.
- there are no oil leaks from the hoses to the rams.
- the transmission and engine oil level and the radiator water level is correct.
- the hydraulic oil level in the storage tank is correct.
- the fuel level or the LP gas pressure is correct.
- the windscreen is clean.
- the seat is in good condition and properly adjusted.
- if fitted, the mirrors are adjusted properly.
- the controls are clearly marked.
- the brake fluid level is correct.

## After starting the motor

After starting the motor check the:

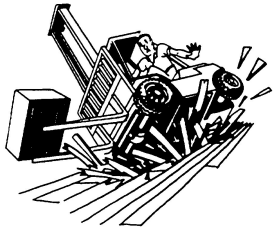
- brakes (hand and foot)
- hydraulics and controls
- horn, lights, gauges
- steering
- clutch
- motor
- adjustment of the forks.

# 7. Know your workplace

Each workplace has conditions that can contribute to dangerous situations. Operators should inspect the workplace for any potential hazards and make sure they are eliminated or minimised before operating the FLT. On some sites it may be necessary to obtain a work permit to operate a FLT as a safety control measure.

Be aware of:

- the direction of traffic flow
- blind corners
- blind alley ways with cross traffic
- inclines
- ceiling clearance, including low pipes etc
- doorway clearances
- types of load - flammable, fragile, unstable or hot
- excessive heat especially where LP gas is used
- the road surfaces
- the fumes produced by the FLT
- electric overhead wires.



**Make sure the floor can support the weight of your FLT**

Other workers and pedestrians should be aware of the need to keep clear of a FLT while loading and travelling. In particular, no-one should walk behind a FLT while it is loading or stacking or walk under an elevated load. If these dangerous practices happen you should report them to management. Safety signs, barriers and using the horn and warning lights are methods of warning personnel about FLT operations. These precautions must be taken when operating over roadways, footpaths and other public areas.

## FLTs and flammable liquid stores

Flammable liquid stores and areas where flammable liquids are used are usually zoned as having a 'hazardous atmosphere'.

FLTs must be modified or 'flameproofed' before they can be used in a hazardous atmosphere and have a compliance plate to that effect.

'Flameproofed' diesel powered FLTs have an exhaust waterwash box, which must be flushed out and refilled every shift.

'Flameproofed' battery powered FLTs must not be connected to the battery charger near to any area where flammable liquids are handled in open containers.

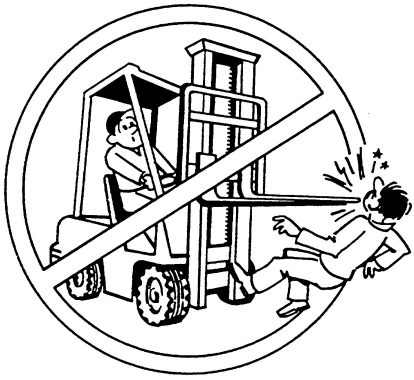
Petrol and LPG FLTs are never flameproofed because of their spark ignition system.

# 8. Safe operation

Fork lift trucks should only be used on hard level surfaces. Four-wheel drive or tough-terrain type should be used on unstable terrain.

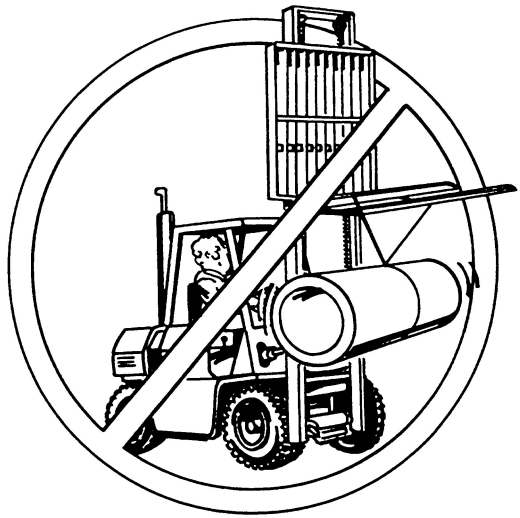
## When raising the load:

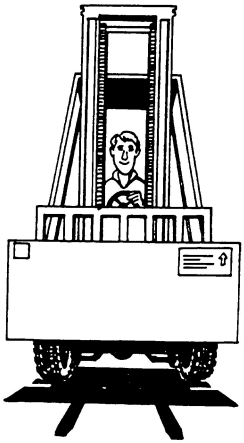
- Carry loads as low as possible at all times.



**To avoid this, drive with forks as low as possible**

- The handbrake should be applied when raising or lowering the load.
- Hydraulic controls should be 'eased in'. If the controls are plugged or pushed quickly the operation will be jerky.
- Make sure that the forks are centred when they are entering a pallet.





- **Do not put slings around forks.**
- Do not enter the pallet with the mast tilted back or forward. (This will bind the forks).
- Do not allow the forks to protrude through a pallet. They can damage what is on the other side of the stack.
- The load should always rest against the heel of the fork arms. This will ensure that the load centre is in the right place.
- If the load weight is unevenly distributed on the pallet put the heavy end of the load against the heel of the fork arms.
- **Make sure that the forks are centred on either side of the mast.**
- A properly constructed hardwood pallet weighs 60kg and has a SWL of 2000kg.
- Do not overload pallets.

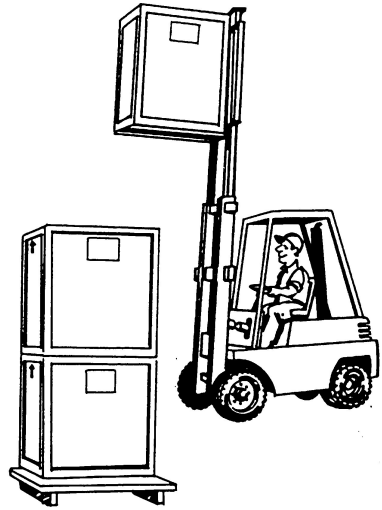
- Do not allow more than a third of the top section of an unwrapped load to stand above the top of the load backrest extension. A load not backed by the load apron can fall back and tangle with the mast, or if the load is very high, can topple back onto the driver.

- **Do not raise a load with just one fork.**

## When tilting the load:

- Raise the load clear of the stack before tilting the load backwards.

- Always travel with the load tilted backwards and low to the ground.



**Only begin to tilt forward when the load is over the stack**

- When putting the load down, always bring the load over the stack before tilting forward.

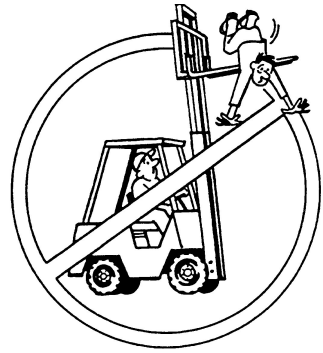
- Deposit the load with the mast vertical or tilted slightly forward.

## Travelling:

- FLTs are one person vehicles. Do not carry a passenger unless a special seat which places the passenger under the overhead guard with a protective side rail is fitted.

- You can only carry passengers in a WorkCover accepted work platform. You must also get WorkCover authorisation before you can lift people.

- Stay left in two way traffic aisles.

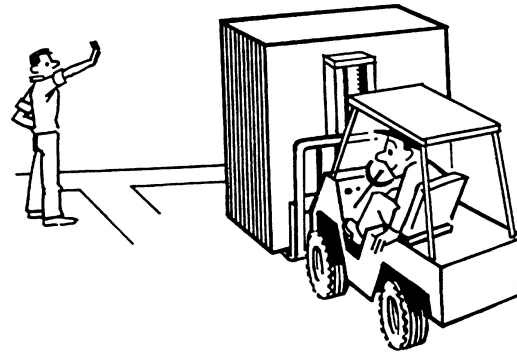


- **Do not lift or carry passengers**

- Reduce speed and proceed with caution on wet or greasy surfaces.

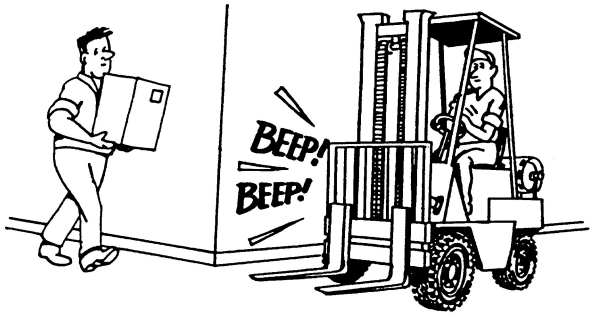
- Do not attempt to turn a FLT when it is on a sloping surface. (This could affect lateral stability and cause it to tip over sideways).

- Always drive up and down inclines slowly. (Check manufacturer's specifications for any special features that the FLT you are operating has for operating up and down hills).

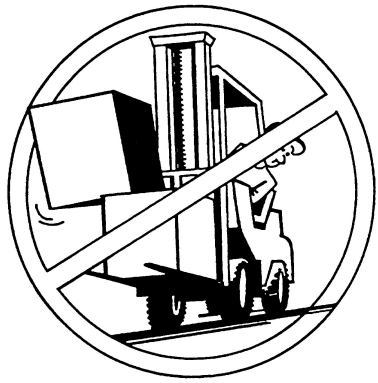


- **Have someone guide you when driving up a hill with a bulky load that blocks clear vision.**

- **Look over both shoulders before reversing.**
- When reversing LOOK behind you. Do not rely on rear vision mirrors.




- **Blow the horn and drive slowly when approaching a blind corner.**
- Make sure that no one is in the way or standing next to you before driving away.

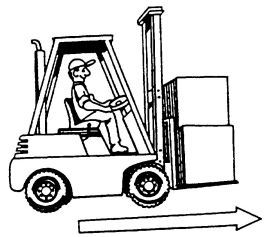


- **Do not drive across a slope.**

- Do not turn sharply at speed. FLTs overturn very easily. They are narrow wheel base trucks with a high centre of gravity.

- Face the forks downhilll when driving up or down an incline without a load.

- Do not jump out if your FLT is overturning. Stay seated and brace yourself. Make sure that no part of your body is outside of the FLT frame. (If you try to jump out the frame can cut you in half).



- **Face the load uphill when travelling up a slope**

- **Face the load uphill and look behind when reversing down a slope**

- Watch out for rear end swing. FLTs steer from the rear and the rear end will swing out on the side opposite to the direction of the turn. Stay as close as possible to the inside of narrow corners when turning and watch out for pedestrians or objects.

- Do not allow the FLT to run out of fuel. Power steering and brakes will immediately malfunction if the fuel runs out.

- Do not 'plug' the direction controller to stop. Use the brake provided. However today most modern FLTs have a regenerative feature which allows plug-in. Check with the manufacturer. In these cases the brake is only used to park or in emergencies.

- Gravity alone lowers the load. Revving the engine makes no difference.

- **Do not speed.**

- Do not drive reach trucks with the reach out as this alters the load centre.

- Give way to police, ambulance or other emergency vehicles at all times.

## Loading trucks:

- Always load pallets alternately on both sides of a truck. A truck can overturn if one side is empty and the other side has a full load.
- Make room by shifting the truck if there is no room to load both sides.

## Loading pantechnicons (large vans):

Make sure:
- that the mast is not too high to enter the van.
- there is sufficient ventilation.
- that the truck will support the combined weight of the FLT and load.
- that the bridge plate is in place and secure.
- that the van wheels are chocked.
- that the driver of the van has removed the keys from the ignition and has left the cabin during loading.
- the load is kept low during loading.

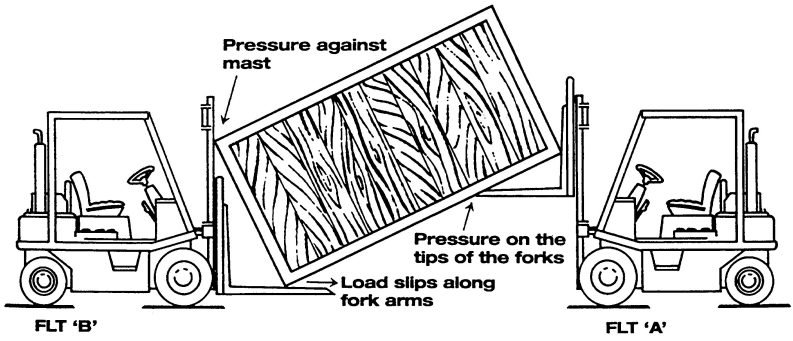
## Lifting loads with two FLTs

Lifting a load with two FLTs is very hazardous. The precautions listed below must be followed when lifting with two FLTs:

- Dual lifts should only be carried out by experienced operators.
- The operation must be controlled by an experienced third person who has responsibility.
- Each FLT must not lift more than 75 per cent of its rated capacity given stability, position of load centre and other factors affecting the SWL.
- The load must only be carried the distance necessary to clear the load carrier.
- Order picking and turret type high lift industrial trucks must not be used for dual lifts.
- Loads must be raised and lowered simultaneously.

If one FLT lowers more quickly than the other, the load becomes uneven. In the diagram it shows FLT 'B' lowering more quickly than FLT 'A' causing:

- The weight to move immediately to the tip of the fork arms on 'A'
- Pressure put on the mast of 'B' which could cause it to bend or break
- The load slips along the fork arms changing the position of the load centre.

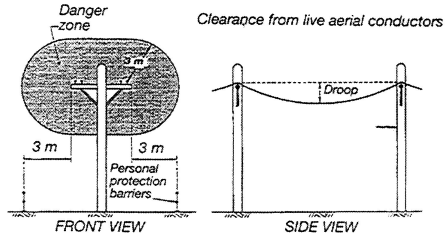


## Parking

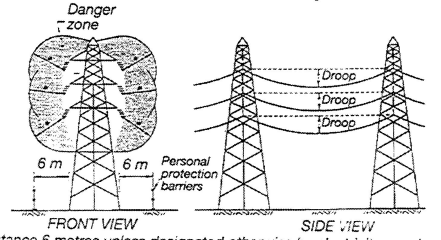
- Always find a level out-of-the-way place to park.
- Park clear of fire and emergency exits, power switches, fire fighting appliances, first aid facilities, gas fuelling stations and fuel pumps.
- Park with the tips of the forks on the ground and with the tilt forward.
- Turn the ignition off and remove the key.
- Engage low gear (for internal combustion FLTs).
- Engage handbrake.
- If the tips of the forks cannot be lowered to the ground park so that the forks do not create a tripping hazard.

## FLTs and electricity

Keep a safe distance from electric power lines. Find out where all power lines are located in your workplace. Do not unload a truck under power lines. (To avoid the mast making contact with the lines when the forks are raised).




**(a) Distribution lines on poles**




* Distance 6 metres unless designated otherwise by electricity supply authority

**(b) Transmission lines on towers**
**Dimensions in metres**

Stay at least 2m away from distribution lines on poles and at least 6m away from transmission lines on towers. These distances are quoted in Australian Standard AS1550.1 *Cranes, safe use - general requirements.* One precaution is the requirement to have appropriate earthing systems fitted and in contact with the ground.

Current *Construction Safety Regulations* Regulation 133A sets the following distances that operators of plant must stay clear of overhead power lines:

- 3m for voltages up to 132,000
- 6m for voltages above 132,000 and up to 330,000
- 8m for voltages above 330,000

Constant vigilance and an observer are required whilst working or travelling in the vicinity of live electrical apparatus. If you do not know the voltage stay at least 8m clear if power lines.

## If you do make contact with power lines:

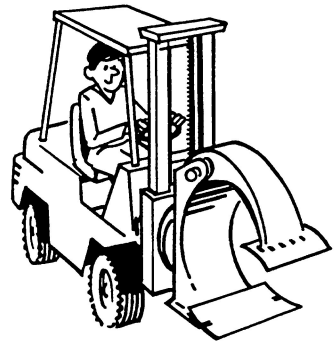
(1) Stay on the machine.
(2) Do not leave the FLT until the power has been turned off.
(3) If help fails to arrive, apply the handbrake, place controls in neutral and switch the FLT off.
(4) Then jump well clear and stand by the FLT until help arrives.
(5) Do not make contact with the ground and the FLT at the same time.

# 9. Attachments

Attachments will affect the stability and SWL of an FLT.

Make sure you use an approved jib attachment


Jib attachment



Grab attachment

When using an attachment:

- Do not revolve the load while moving if a load revolve mechanism is fitted.
- Use caution: jib attachments are more unstable than forks because they have a higher centre of gravity.
- The FLT should be operated as if it is partially loaded even if there is no load on the jib attachment.
- The jib should be kept as low as possible and the mast should be kept vertical or tilted backwards.
- Do not lift a load with a jib attachment if the mast is tilted forward.
- Do not tilt the mast forward when a loaded jib is attached.
- The load should be kept as low as possible.
- Travel at low speeds and make all turns slowly.

- Make sure that jib attachments are properly fitted with the locking bolt housed.
- Slings should be inspected before being used for lifting.
- Centre the hook directly over the load before lifting to ensure stability.
- The SWL must be displayed on all jib attachments above the lifting points where a lifting hook is attached.
- Hooks must be able to move at least 15° in all directions and swivel freely.
- Do not rotate the load on attachments when the FLT is moving.
- Slipper forks are often used and can alter the load centre.

# 10. Personal protective equipment (PPE)

FLT operators often have to wear PPE such as helmets, gloves, eye protection, face masks and respirators and steel capped boots to protect themselves from injury.

It is the responsibility of the employer to provide the necessary protective equipment. It is the responsibility of workers to wear and use the equipment properly and where and when necessary.

Clothing should not be too loose. Loose clothing can catch on controllers.

## Safety helmets

Safety helmets 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 marked as complying with AS 1801 *Industrial safety helmets.*

## Gloves

Gloves protect your hands from:

- Heat and abrasion
- Molten metal
- Sharp edges
- Chemicals (acids, alkalis, solvents, fats and oils)

## Eye protection

You must wear eye protection that conforms to AS 1337 *Eye protectors for industrial applications* if you are likely to be exposed to:

- Physical damage caused by flying particles, dust, molten metal.
- Chemical damage caused by toxic liquids, gases, vapours, dusts.
- Radiation damage caused by sunlight, visible light, infra red, laser and welding flashes.
- Acids from batteries

## Respiratory protection

Wear a face mask or respirator that conforms to AS 1716 *Respiratory protective devices* if you are likely to be exposed to:

- Toxic gases and vapours
- Toxic or disease-causing dusts, such as silica and asbestos.

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

## Hearing protection

Hearing damage is likely if you are exposed to long periods of industrial noise above 85 decibels. This is the noise level of a large truck or loader. A chainsaw for example has a noise level of about 92 decibels.

If you think it is likely that you are being exposed to dangerous noise levels ask your employer to provide you with hearing protectors complying with AS 1270 *Acoustics - Hearing protectors.*

## Safety boots

Choose boots which are comfortable, give maximum grip and give protection from pinching, jamming and crushing. A range of lightweight flexible boots with steel or plastic caps is available that comply with AS 2210 *Safety footwear.*

Do not wear thongs or sandals. They can get caught in the pedals.

## Sun protection

To prevent permanent damage caused by ultra violet rays always wear a hat, long sleeves, long trousers and use UV cream when working outside.

# 11. First aid

FLT operators work in a high risk industry. Not only are there many minor injuries but there are also serious injuries where the injured person will need first aid to restore breathing, heart beat or to stem blood flow.

Know the location of the first aid room and the nearest first aid kit. There must be a first aid kit on every floor of a multistorey building site or within 100 metres of any part of the workplace.

The standard first aid symbol in Australia is a white cross on a green background.

First aid kits on worksites should have a carrying handle. There must be a notice near to the first aid room with the name(s) of those in the workplace who hold an approved occupational first aid certificate.

It is recommended that FLT operators take the time to do an approved first aid certificate.

# 12. Slinging and safe working loads

The working load limit (WLL) of a sling is the maximum load that can be lifted by that sling making a straight lift.

The load factor for a straight lift = 1.

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. For example:

- A reeved sling around a square load will halve the lifting capacity of a sling. The load factor is 0.5.
- A basket hitch around a round load doubles the lifting capacity. The load factor is 2.0.

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

| Method of Loading | Direct Loaded | Choke Hitch | | Basket Hitch | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Round load | Rect. load | Round load | | | | | Rectangular load | | | | |
| Included angle α | – | – | – | 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 | 0.57 | 0.43 | 0.28 | 1.1 | 1.0 | 0.99 | 0.81 | 0.57 | 0.57 | 0.53 | 0.50 | 0.40 | 0.28 |
| 9 | 0.72 | 0.54 | 0.36 | 1.4 | 1.3 | 1.2 | 1.0 | 0.72 | 0.72 | 0.67 | 0.63 | 0.57 | 0.36 |
| 10 | 0.89 | 0.67 | 0.45 | 1.8 | 1.6 | 1.5 | 1.2 | 0.89 | 0.89 | 0.83 | 0.77 | 0.63 | 0.45 |
| 11 | 1.1 | 0.81 | 0.54 | 2.1 | 2.0 | 1.8 | 1.5 | 1.1 | 1.1 | 1.0 | 0.94 | 0.76 | 0.54 |
| 12 | 1.3 | 0.96 | 0.64 | 2.5 | 2.3 | 2.2 | 1.8 | 1.3 | 1.3 | 1.2 | 1.1 | 0.91 | 0.64 |
| 13 | 1.5 | 1.1 | 0.75 | 3.0 | 2.8 | 2.6 | 2.1 | 1.5 | 1.5 | 1.4 | 1.3 | 1.0 | 0.75 |
| 14 | 1.7 | 1.3 | 0.88 | 3.5 | 3.2 | 3.0 | 2.5 | 1.7 | 1.7 | 1.6 | 1.5 | 1.2 | 0.88 |
| 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 WLLs 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 WLL in kilograms of FSWR, square the rope diameter (D) in millimetres (mm) and multiply by 8.

**Formula: WLL(kgs) = $D^2$(mm) x 8**

For example:
Rope diameter (D) = 12mm

WLL(kgs) = $D^2$(mm) x 8
= D(mm) x D(mm) x 8
= 12 x 12 x 8
= 1152 kgs
WLL (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) =** $\sqrt{\frac{L}{8}}$

For example:

Load = 1152 kg

D(mm) = $\sqrt{1152 \div 8}$
= $\sqrt{144}$
= 12

Therefore an FSWR sling of at least 12mm is required to lift a 1152 kg load.

## Chain

The WLL 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 WLL. Return it to the manufacturer for WLL assessment and re-tagging.

To calculate the WLL of lifting chain in kilograms multiply the diameter(D) in millimetres(mm) squared, by the grade(G), by 0.3.

**Formula: WLL(kgs) = $D^2$(mm) x G x 0.3**

For example:

Chain diameter, 10mm. Chain grade (T) (ie grade 80)

WLL (Kgs) = $D^2$(mm) x G x 0.3
= D(mm) x D(mm) x G x 0.3
= 10 x 10 x 80 x 0.3
= 2400 kgs
WLL (t) = 2.4 tonnes.

## Fibre rope

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

**Formula: WLL(kgs) = $D^2$(mm)**

For example:

Diameter = 25mm

WLL(kgs) = $D^2$(mm)
= D(mm) x D(mm)
= 25 x 25
= 625 kgs
WLL(t) = 0.625 tonnes.

## Flat webbing and round synthetic slings

Flat webbing and round synthetic slings are labelled with the WLL. Do not lift if the label is missing and return to the manufacturer for testing and relabelling. Synthetic slings are colour coded (see table below).

**Label for a flat webbing synthetic sling**

| Colour No Stripes | Tonne | Vertical | Choke | Basket | 30° | 60° | 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 |

*(10 and >10)

**Indicator stripes - each stripe represents 1 tonne WLL - safety factor 8:1**

## Load factors and slinging

In the examples below all the load 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 WLL of the sling(s) by the angle factor by the reeve factor.

**Formula:**

**Max load = WLL(of sling) x angle factor**
**x reeve factor**

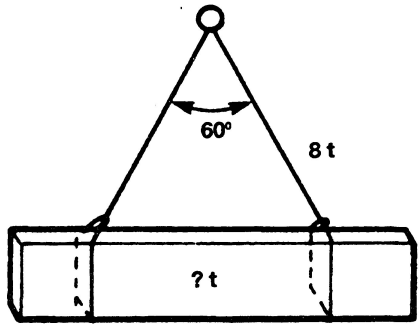
For example: The WLL of each leg of a multi-legged sling is eight tonnes, the angle between the two sling legs is 60° and they are reeved around a square load. This means a load factor of 1.73 for the angle and another factor of 0.5 for the reeve.

| | |
|---|---|
| Sling WLL | 8 tonne |
| Angle factor | 1.73 |
| Reeve factor | 0.5 |

Therefore:

Max load (SWL) = 8 x 1.73 x 0.5
= 6.92 tonnes

6.9 tonnes is the maximum weight that can be lifted



**2.**

To calculate the WLL of multi-legged slings needed to lift this load divide the weight of the load by the load factor.

**Formula for a calculator:**

**WLL = weight ÷ load factor**

**Formula can be written:**

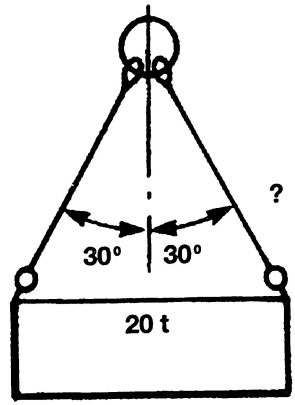
$$\text{WLL} = \frac{\text{weight}}{\text{load factor}}$$

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

Weight 20 tonnes
Load factor 1.73

Therefore: WLL = 20 ÷ 1.73
= 11.56 tonnes

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



**3.**

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

**Formula for a calculator:**

**WLL = weight ÷ angle factor ÷ reeve factor**

**Formula can be written:**

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

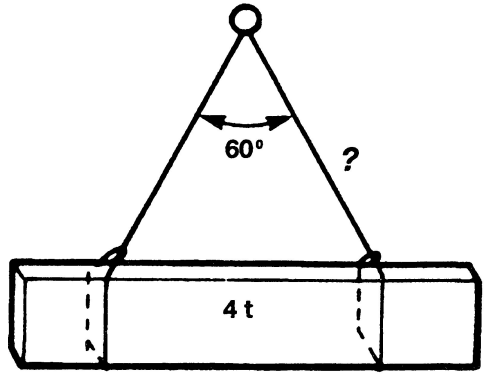
For example: Two slings have a 60° angle between them and are both reeved around a 4 tonne square load. This means a load factor of 1.73 for the angle and 0.5 for the reeve.

| | |
|---|---|
| Weight | 4 tonnes |
| Angle factor | 1.73 |
| Reeve factor | 0.5 |

Therefore:

WLL = 4 ÷ 1.73 ÷ .5
= 4.62 tonnes

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



**4.**

To calculate the WLL 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:**

**WLL = weight ÷ angle factor ÷ reeve factor**

**Formula can be written:**

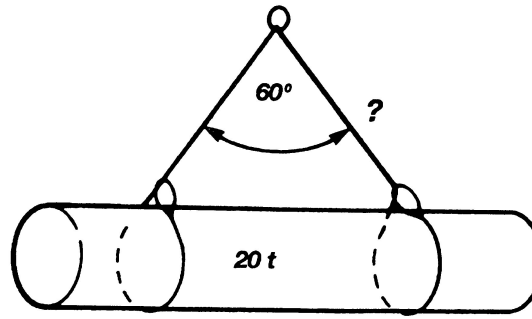
$$\text{WLL} = \frac{\text{weight}}{\text{angle factor x reeve factor}}$$

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

| | |
|---|---|
| Weight | 20 tonnes |
| Angle factor | 1.73 |
| Reeve factor | 0.75 |

WLL = 20 ÷ 1.73 ÷ 0.75
= 15.41 tonnes

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



**5.**

To calculate the diameter(D) in millimetres(mm) of FSWR needed to lift a load 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) = $\sqrt{\text{load} \div 8}$**

**Formula can be written: D (mm) = $\sqrt{\frac{L}{8}}$**

**D(mm) = $\sqrt{5000 \div 8}$**

**= $\sqrt{625}$**

**= 25**

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

**6.**

To calculate the diameter(D) in millimetres(mm) of two FSWR slings reeved around a 4 tonne load with an angle of 60° between the slings, convert tonnes to kilograms, divide by load by 8, then divide by the reeve factor of 1.73, divide by 0.5 and then find the square root of the answer.

**Formula:**

**D (mm) = $\sqrt{\text{load} \div 8 \div \text{angle factor} \div \text{reeve factor}}$**

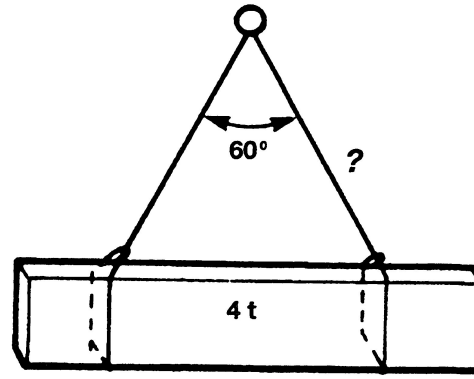
For example: Two slings have 60° angle between them and are both reeved around a 4 tonne square load. This means a factor of 1.73 for the angle and 0.5 for the reeve.

| | |
|---|---|
| Weight | 4 tonnes |
| Angle factor | 1.73 |
| Reeve factor | 0.6 |

Therefore

$$\text{D (mm)} = \sqrt{4000 \div 8 \div 1.73 \div 0.5}$$
$$= \sqrt{578.03}$$
$$= 24.04$$

Therefore 25 mm diameter slings are required for the lift.



## Weight of the load

Do not lift if the weight of a load is not stamped on the load or the delivery docket and 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 stamped on the load or delivery docket.

Timber for example, can be 50% heavier when wet. In foundries when large castings are raised from a mould there can be suction created by the sand adding substantially to the weight. Pipes are often weighed down by sludge.

Fuel and water tanks may not always be empty. Check for this.

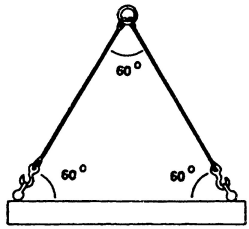
When lifting a load for the first time watch the lifting equipment carefully for signs of strain in case the stated weight is incorrect.

# 13. Rules to follow when slinging and handling a load

## A simple rule of thumb for a good safe working angle

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

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

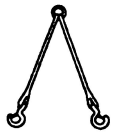
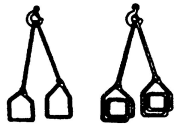



## Multilegged slings

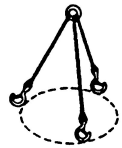
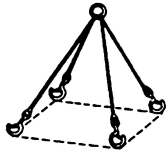
The recommended maximum angle between the two legs of a sling is 90°. The recommended maximum angle between the vertical and a leg of a sling is 45°. At the absolute maximum angle of 120° the SWL of the two slings must be halved.

| Direct Load | Choke Hitch | | Basket Hitch | |
|---|---|---|---|---|
|  |  Round load |  Rect. load |  Round load |  Rectangle load |

*2-Leg slings*

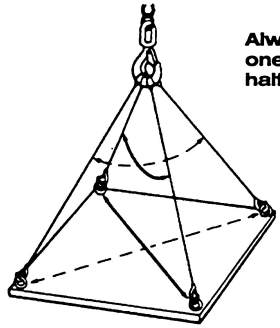
| Direct Load | Choke Hitch | |
|---|---|---|
| | Round load | Rectanglar load |
|  |  Single wrap Double wrap |  Single wrap Double wrap |

*3-Leg and 4-Leg slings*

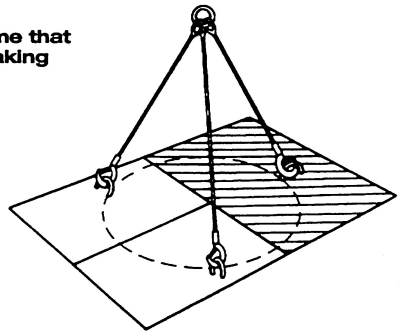
| 3-Leg assembly | 4-Leg assembly |
| --- | --- |
|  |  |

When slinging a rigid object with a multiple legged sling it must be assumed that only two of the sling legs are taking the load. Additional legs do not increase the SWL.

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



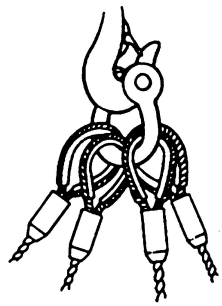
**Always assume that one sling is taking half the load**



Be careful when lifting irregular shaped objects as 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 sling's eyes are to slip to the bill of the hook.

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.



**Multiple sling eyes through a bow shackle**

## Direct lifting

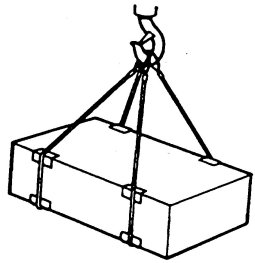
It is the duty of a dogman to direct the FLT operator to position the head of the jib directly over the load.

Then make sure that the load hook is positioned directly above a load before slinging and lifting.

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 jib especially if the load is dragged from the side.

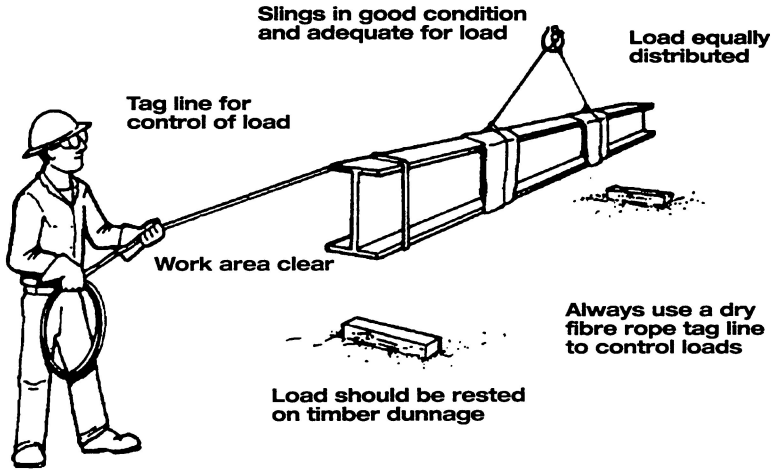
## General handling

Make sure that there is suitable packing or lagging at all sharp edges of steel beams, and other hard materials.



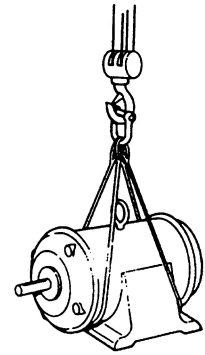
Use packing to prevent the sling from coming into contact with sharp edges. This will lengthen the life of the sling and prevent breaks.

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.



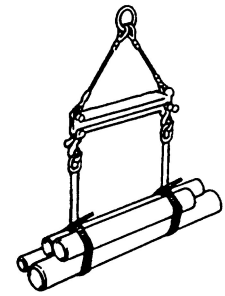

Machinery and plant with lifting lugs should be marked with the mass. Caution: Some lifting lugs are for use in assembly and dismantling, not for lifting the entire unit.

Machinery, plant and material boxes with lifting lugs must have the WLL clearly marked.

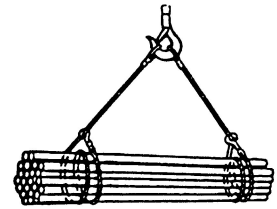


**Correct slinging method for an electric motor. Eyebolts are sometimes only used to lift the casing, not for lifting the motor.**

All loads delivered to a site that could be hazardous should be strapped or wrapped. For example, 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 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.

## 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 chains or straps if there are no restraining spikes in place is very dangerous.

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 for lifting after the load binder chains were secured.

Many serious accidents have occurred as load binding chains were removed from steel beams. Deep beams can inflict especially severe injuries.

Always lift steel reinforcing level. Do not lift it vertically or at a slope. It is not possible to make the inside steel in a bundle tight enough to prevent them falling out if the bundle is at an angle. Steel reinforcing can kill if it falls.

As the load is lifted keep hands well away. Steel beams 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 WLL or SWL.

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 sharps edges of the holes can cut through a sling.

Properly engineered drum lifting frames which offer full support for a full drum are available.

## Pallets

A wide variety of loads are delivered to worksites on pallets. Before a palleted load is lifted from a truck check that:

- the pallet is free from defects
- the load is secured so that nothing can fall off.

The WLL of a standard hardwood pallet is 2000kg. The WLL can be dramatically reduced if there are any missing boards or any other defects. Please note: Some pallets are designed for packaging not lifting.

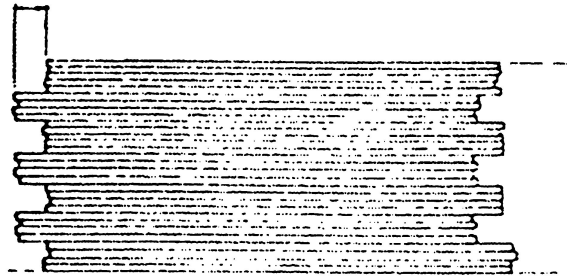
Do not lift a pallet that has defects. To lift a load on a damaged pallet raise the load just enough to slide an undamaged pallet underneath. Alternatively place an undamaged pallet beside the damaged one and then lift and move it onto the new pallet.

If no spare undamaged pallets are available send the load back to the supplier to be re-palleted.

## 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.
- so that there is access for people, FLTs, cranes, trains and so on.
- so that there is access to fire extinguishers.



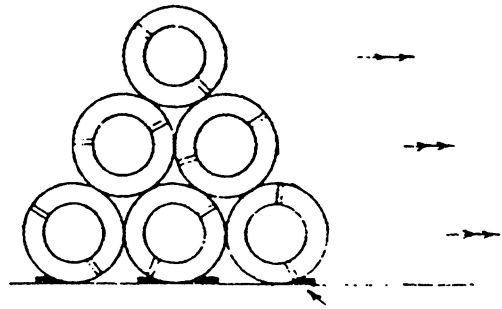
**Solid pile - lifts staggered laterally**

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.

## Stacking rolled steel, coils and other round loads

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.



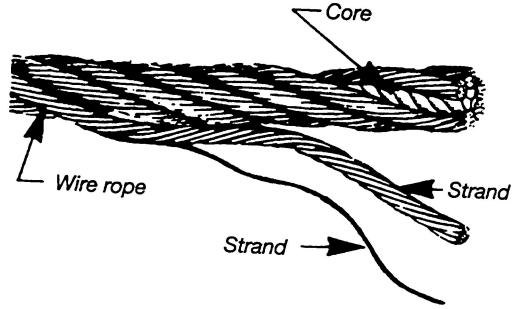
## Stacking timber

When stacking shorter lengths of timber place the alternate layers at right angles. This is called pigstying.

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.

# 14. Flexible steel wire rope

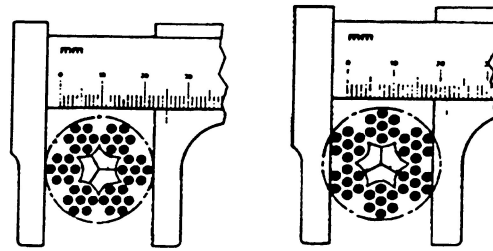
Flexible steel wire rope (FWSR) is constructed of wires and strands laid around a central core. In the illustration below there are 19 wires to the strand and 6 strands around the core making up the rope.




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

## Size

The size of a rope is determined by its diameter. The smallest diameter FSWR that can be used for lifting is 5 mm.




## Inspection and discard

It is important to check all rope for wear and tear 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:

- Determine 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 in a length of 8 x diameter, must not exceed 10% of the total wires.

Have broken wires checked by a competent person.

## When using FSWR:

Use suitable packing to protect the rope from sharp edges.

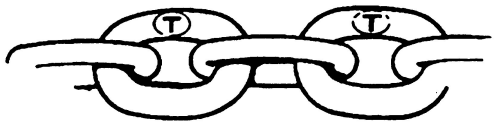
- Do not expose wire rope to temperatures exceeding 95°C.
- Do not lift with wire rope less than 5mm diameter.
- Do not use a rope that should be discarded.
- Do not allow kinks or knots to develop.

## 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. Make sure that wire rope is properly lubricated before storage to minimise the risk of corrosion.

## 15. Chain

Industrial lifting chain is not normally sold through general hardware outlets. Chain from general hardware outlets is usually not suitable for industrial lifting.



**Look for grade markings**

Do not use a chain that is not a proper graded lifting chain.

**MAXIMUM WORKING LOAD LIMITS (WLL) 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° | Reeved 120° | 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 |

**Working load limits for slings of special alloy chain (Marked "C.M.", "A", "T" or 8).**

## Safe use and maintenance

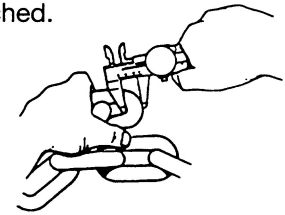
When making up a chain sling, always use chain, hooks, links, hammerlocks and couplers of the same grade and WLL and that are in a good state of repair.

## A chain sling is only as strong as its weakest link.

- Do not use a chain that is 5.5mm diameter or less for lifting
- Do not lift a load heavier than the WLL of the chain.
- Do not use a chain in which the links are stretched, locked or do not move freely.
- Do not use chain that is gouged or worn more than 10% 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 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°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 stuck together show that the chain has been stretched.



**Measure the links to check for wear**

Cracks can be found by dusting chain with fine powder. Dust any link that is suspect and then blow the loose particles away. Dust particles left will be lodged in any cracks making them more visible. Magnetic particles can also be used.

Any worn links should be measured for degree of wear which must not exceed that allowed for by the manufacturer.

- The maximum allowable chain wear is 10%.
- The maximum allowable elongation of a chain is 10%.
- The maximum increase in hook opening is 5% of the original throat opening.
- The maximum allowable wear in the bite of a hook is 10%.

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 couplings 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.

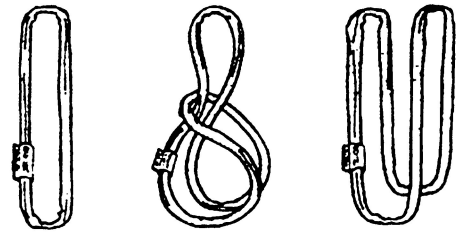
Destroy any chain that cannot be repaired.

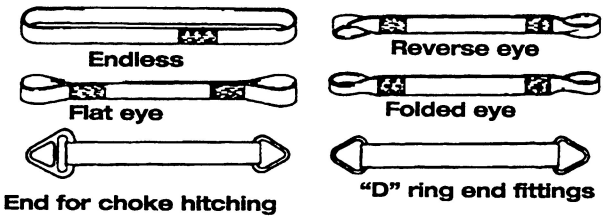
If the chain is not tagged or properly stamped it must be removed from service.

Enter all inspection details on an inspection record card.

# 16. Flat webbing and round synthetic slings

Flat webbing and round synthetic slings are used for lifting where it is necessary to protect the load from damage and for protection from electrical hazards. They are made from nylon, polyester, polypropylene or aramid polyamide. Each sling must be labelled with the WLL.






## Inspection

Synthetic slings must be inspected before each use. They must also be inspected at least once every three months. If a sling is subject to severe conditions the inspections should be more frequent. Send each sling for a proof load test at least every 12 months.

Look for:

- Any external wear such as abrasion 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 any 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:

- 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.

NB. A nylon sling will lose more than 10% of its strength when it is wet.

After six months continuous exposure to sunlight send a sling in for testing.

Synthetic slings must be stored:

- In a clean, dry, well ventilated place.
- Away from the ground or floor.
- Away from direct sunlight, ultra-violet light and fluorescent lights.
- Away from extremes of heat.
- Away from sources of ignition.
- Away from atmospheric or liquid chemicals.
- Away from the possibility of mechanical damage.

The working life of synthetic slings will be shortened if exposed to any of the above.

## 17. Fibre rope

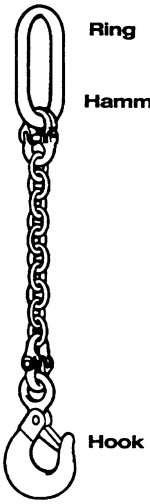
Fibre rope is not widely used for lifting. It does not have the strength or versatility of FSWR, chain or synthetic slings. Do not use a fibre rope that is less than 12mm for lifting.

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 16mm in diameter.

# 18. Lifting accessories

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

The WLL of lifting gear is only as great as the part of the sling with the lowest WLL. For example if the WLL of:

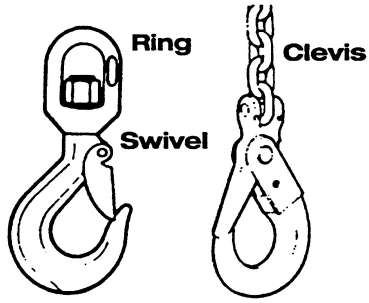



the hook is 2 tonnes, the shackle is 2 tonnes, the ring is 1 tonne and the rope is 2 tonnes, then the SWL for the lift is 1 tonne.

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

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

A wide variety of hooks is available for use with chain slings. Hooks are mostly 80 grade alloy steel and are stamped with the WLL. Make sure when selecting a hook for a chain sling that the hook has at least the same WLL 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 roller thrust bearing or ball between the trunnion and nut.

If a chain hook opening is stretched more than 5% 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

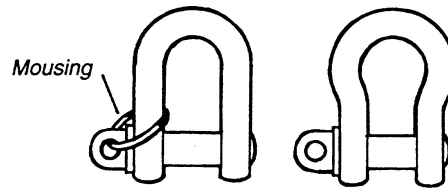
A ring must have at least the same WLL as the chain hook and other parts of a sling. The ring and the sling must have equal capacity.

Discard any ring which has been stretched by more than 5%. Do not place a ring (or shackle or eye bolt) over a crane hook unless it hangs freely.

## Shackles

There are two main types of shackle 'D'(Dee) and 'Bow'. All shackles used for lifting must be stamped with the WLL. Do not use a shackle that does not have the WLL marked. Make sure that the WLL 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. Mousing a shackle prevents the pin from unscrewing.




*"D" shackles* *Bow shackles*

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

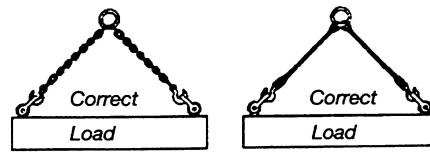
Do not use a screw shackle where the pin can roll under the load and unscrew.

## Eyebolts

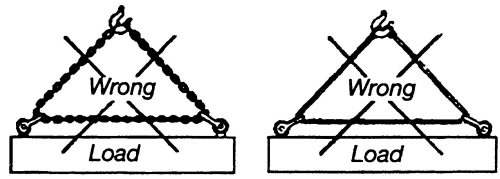
There are collared and uncollared eyebolts. Do not use uncollared eyebolts for any lifts other than vertical lifts because they can break off.

A typical use for an eyebolt is for lifting precast concrete panels which have ferrules cast into them. Make sure that eyebolts are securely screwed into the ferule 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 eyebolt and ferrule has a 'solid feeling'.




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




**Use of collared eyebolts**

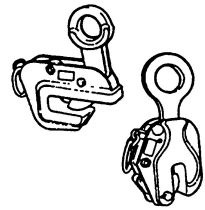
**Here the strain on the eyebolt is doubled.**

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.

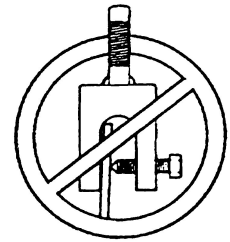
## Handling steel plate

Steel plate can be lifted with:

- plate clamps that are designed to increase the purchase on the plate as the plate is lifted.
- hooks or shackles where there are lifting holes in the plate.



**Typical steel plate clamps**



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

Remember that steel plate can injure or kill.

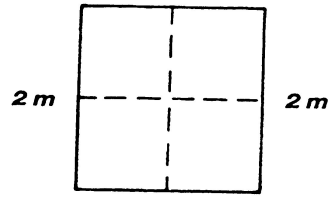
# APPENDIX 1 Areas and volumes

## Areas

**Area of a square = length x width**

For example:

2m x 2m = 4 square metres

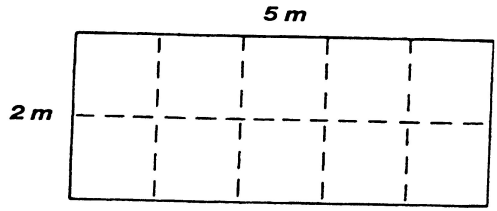



*Area 4 sq. m*

**Area of a rectangle = length x width**

For example:

2m x 5m = 10 square metres

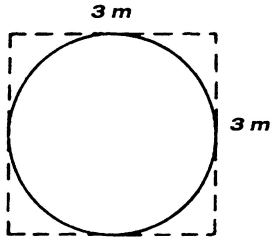



*Area 10 sq. m*

**Area of a circle = diameter² x .79**

For example:

3m x 3m x .79 = 7.1 square metres

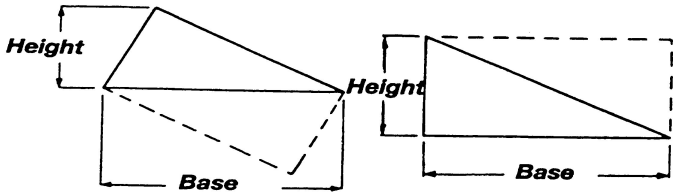



*Area 7.1 sq. m*

**Area of a triangle = base x height ÷ 2**

For example:

3m x 3m ÷ 2 = 4.5 square metres

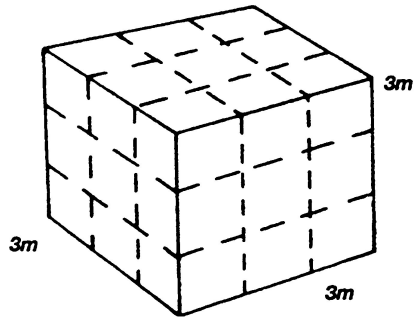


## Volumes

**Volume of a cube = length x height x width**

For example:

3m x 3m x 3m = 27 cubic metres

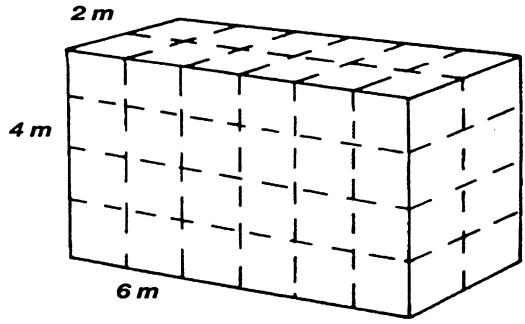



***Volume 27 cubic metres***

**Volume of a rectangular solid = length x height x width**

For example:

2m x 4m x 6m = 48 cubic metres

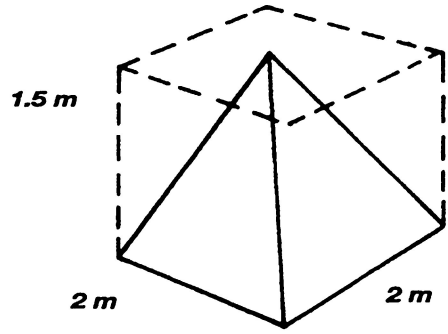



***Volume 48 cubic metres***

**Volume of a cone or pyramid = area of base x height ÷ 3**

For example (pyramid):

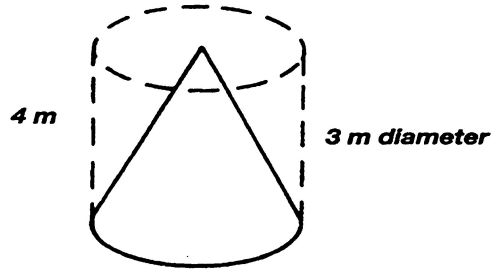
2m x 2m x 1.5m ÷ 3 = 2 cubic metres




***Volume 2 cubic metres***

For example (cone):

3m x 3m x .79 x 4m ÷ 3 = 9.5 cubic metres

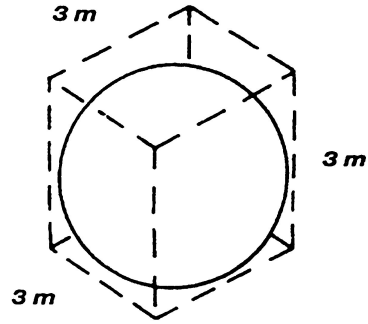



***Volume 9.5 cubic metres***

**Volume of a sphere = diameter$^3$ x 0.53**

For example:

3m x 3m x 3m x 0.53 = 14.3




**Volume 14.3 cubic metres**

## Calculating the weight of a load

To calculate the weight of a load, if it is unknown, 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**

3m x 1m x .5m = 1.5 cubic metres

**Unit weight of hardwood is 1120 kgs per cubic metre**

1.5 x 1120 = 1680

Therefore the total weight of the load is 1680 kgs.

# APPENDIX 2 Tables of masses

Acid (crated maximum.....200 kg
Ale, beer, 160 litre .....250 kg
Aluminium, cu m .....2.7 t
Aluminium ingot .....5-15 kg
Asbestos cement sheet, plain, 2m x 1m .....18kg
Ashes, coal, cu m .....800 kg
Asphalt, 200 litre, drum .....200 k

Barbed wire, coil .....50 kg
Blue metal, cu m .....2.0 t
Beer (see Ale).
Bitumen, 200 litre, drum .....200 kg
Bolts, various, bag.....50 kg
Brass, cu m ..... 8.5 t
Bricks, common, 1,000 ..... 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 .....20 or 40 kg
Coal, 1 cu m .....864 kg
Concrete, cu m .....2.4 t
Copper, cu m.....9.0 t
Copper, 3 mm thick, sq m .....27 kg

Doors, 50 .....1 t
Dog spikes, 100.....50 kg
Drums, empty 200 litre .....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 .....9 kg
Fibre board. sq m .....0.6 kg
Fibro cement sheets -
Flat -
4.5mm thick, sq metre .....7 kg
6mm thick, sq metre .....11 kg
Corrugated -
standard, sq metre .....11 kg
deep corrugations, sq metre .....12 kg
Compressed - 15mm thick, sq metre.....26 kg
Fish bolts, 24 mm dia .....1 kg

Fish plates, 4hole.....13 kg
Fish plates, 6hole.....18 kg

Galvanised flat iron 0.5 mm sheet, 1.8 m x 90 mm ..7 kg
Glass, 10mm thick, sq metre.....27 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).
Haematite ore, cu m .....5.4 t
Hemp, bale .....300 kg

Ice, cu m .....930 kg
Iron, cast m .....7.25 t
Iron, ore, cu m .....5.4t

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 .....22 kg
Lime, hydrated, 44 bags.....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 (except red and white lead) 4 litre .....0.4 kg
Palings, H.W. 1.5 m sawn, 400.....1 t
Palings, H.W. 2 m sawn, 360 .....1 t
Particle board 18mm thick, sq metre .....12 kg
Petrol (44 gal) 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 .....115 kg/m
300 mm pipe .....148 kg/m

Steel, galvanised -

8 N.B. O.D. 13.5mm .....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
Plasterboard (Gyprock) 13mm thick, sq metre ..27 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 | 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, 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 (11/2 in 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

# APPENDIX 3 Sample assessment

Below are examples of the questions you can be asked in an assessment for a fork lift truck driver's certificate.

1. What precautions should be taken by the operator when a leak in the fuel system is suspected or detected?

2. What important function does a backrest perform on a FLT?

3. What direction must the load face when travelling uphill?

4. Why is it unsafe to turn a FLT when it is on a ramp or a sloping surface?

5. What direction must the load face when travelling downhill?

6. What is the minimum distance you should keep your FLT away from power lines?

7. A pallet contains an unbalanced load with one end heavier than the other. Which end should be against the heel of the fork arms?

8. Why is it dangerous to use an internal combustion engine in a confined space such as a cold room?

9. Why must batteries be charged in a well ventilated area?

10. What type of fork truck should be selected for working in rough and unstable terrain?

11. What must be provided when a FLT is working over a roadway, footpath or areas open to the public?

12. Why is rear end swing dangerous?

13. Name two safeguard measures to protect personnel when loads are being transferred.

14. Why is a work permit to operate a FLT necessary at some worksites?

15. Is it permissible to carry passengers on the bare fork arms or load?

16. Is it permissible for additional counterweights to be added to FLTs? Explain your answer.

17. May a load be carried by only one fork arm of the fork lift truck? Explain your answer.

18. What precautions should the operator take when operating a FLT on wet or slippery ground?

19. Name three operating precautions that must be taken when using a jib attachment.

20. When using a jib attachment fitted to a FLT is it permissible to use the forward tilt of the mast?

21. What checks must be made before using a jib attachment on a fork lift truck?

22. Should the jib attachment lifting hook be fixed or able to swivel?

23. You are to lift a load with a jib attachment. For what reason do you ensure the hook is centred directly over the load before lifting?

24. What must be marked at each hook position on an attachment to indicate capacity?

25. When should slings be inspected?

26. What percentage wear in a shackle would require it to be discarded?

27. Is it safe to use slings to raise or lower loads near or over people?

28. How is the working load limit (WLL) determined for synthetic webbing slings?

29. Why is it important to mouse or secure the pin of a shackle?

30. What must a ring and the slings attached to it, have in common?

31. What must be provided on a FLT to allow a passenger to be carried?

32. By what means can personnel be raised on a fork lift truck?

33. Why is tyre pressure (for pneumatic type) and condition important to the stability of a fork lift truck?

34. Give three reasons why a pre-check is necessary before operating a fork lift truck.

35. Because of load length, two fork lift trucks are used to handle the same load (simultaneous use). Name two operating precautions that must be observed.

36. How would you establish the capabilities and limitations of the FLT and equipment you are required to use?

37. How does lengthening the load centre affect the capacity of a FLT?

38. Give two reasons why you check weight of load against the fork lift truck specifications.

39. State how the weighted unmarked loads such as containers, boxes and cartons are determined.

40. If the load is not against the heel of the fork arm how will the fork lift truck's capacity be affected?

41. Is all the weight behind the point of balance acting as a counter-weight?

42. Where is the forward point of balance (fulcrum) for a FLT?

43. When should forward tilt of the mast be used?

44. A pallet appears to be unsafely loaded. What would you do before attempting to lift it?

45. What are four things that may cause a FLT to tip over sideways? (lateral instability)

46. Name two things which may cause a FLT to tip forwards? (longitudinal instability)

47. What should be provided for the gap between truck and loading dock before shifting a load?

48. Which vehicles must you allow right of way during an emergency?

49. If the fork lift truck contacted power lines and nobody could assist by turning the power off, how would you dismount the machined?

50. Should your FLT be refuelled while the engine is running? Explain your answer.

51. Why should the fuel isolating valve be turned off after parking and leaving an LPG powered FLT?

52. Give three reasons for doing post-operational checks.

53. Name at least three areas where FLTs should not be parked.

54 During post operational check of the fork lift truck you notice a small crack in the heel of one of the fork arms. If you are a good welder would you fix it yourself?

55. What is the reason for removing the ignition key when leaving a FLT?

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