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A.B.N.- 80712611497

A GUIDE FOR FRONT END LOADER AND EXCAVATOR DRIVERS

Disclaimer

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This publication may refer to NSW administered legislation that has been amended or repealed.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.legislation.nsw.gov.au or contact (02) 9238 0950 or 1800 463 955 (NSW country only).

A guide for front end loader and excavator drivers

This guide provides the information necessary to operate earthmoving equipment safely and to pass an examination for a front end loader or excavator driver's certificate.

Front cover: Front end loader/backhoe combination (foreground). Excavator (background).

ISBN 0 7305 8426 7

IES 827 3/93

A guide for front end loader and excavator drivers

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Second edition 1si94

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ISBN 0 7305 8426 7

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Contents

Acknowledgements

is grateful to the following for their assistance in developing the text and illustrations for this guide:

Hunter Plant Operator Training School (HPOTS).

Concrete Constructions

6. (NSW}.

Gough and Gilmour, Alexandria NSW.

7.

National Building and Construction Industry Training Council Limited.

NSW Building and Construction Industry Training Council Limited.

Association of Employers of Waterside Labour (AEWL) Training Centre.

1. Introduction

Operating earthmoving equipment is skilled work which can be very dangerous.

Earthmoving equipment can become unstable and many people have been killed or injured using or working near front end loaders and excavators.

This guide provides the information necessary to operate earthmoving equipment safely and to pass an examination for a Front End Loader and Excavator Driver's Certificate.

The guide has been written in consultation with industry and individual operators and covers the common problems which operators come across in their everyday work.

How to get a Certificate of Competency

To gain a Certificate of Competency for a front end loader or excavator you must have completed the required practical hours of training for that equipment and pass a theory and practical examination conducted by the Authority or approved trainers.

The certificate is called a Power Crane Driver's Certificate and is graded according to the type of loader or excavator operated at the time of the examination.

When you are learning to operate a loader/excavator, you must have a valid learner's permit which allows you to drive the machine under the supervision of a certificated driver or competent person.

Applicants must be at least 17 years old to be eligible for a learner's permit and at least 18 years old to gain a certificate.

These are the categories of Power Crane Driver's Certificates for loaders and excavators:

* 16 Any excavator ”

17 Small excavator
(Bucket size less than O.6 cubic metre).

* 18 Loader

It is your responsibility to ensure that a loader or excavator of the right class is available for the examination at your workplace.

These are all requirements of the *construction and Safety Act 191d and* ***Regulations 1950.***

Please note: will be adopting the National OHS Certification Standard for Users and Operators of Industrial Equipment by early 1995. Under the Standard the classifications of
Power Crane Driver's Certificate will change.

2.
Abbreviations

(in alphabetical oróer)

F WR = flexible steel wire rope

kg = kilogram

kPa = kilopascals

mm = millimetres

MPa = megapascals

PPE = personal protective equipment

rpm = revolutions per minute SWL = safe working load WLL = working load limit

3. Safe operation

Know the machine

There are many makes, types, models and sizes of loaders and excavators. Each of them has been designed for a range of work under certain conditions. They can be fitted with various attachments.

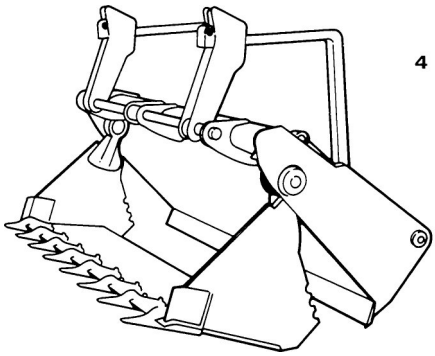
Two types of buckets are used with loaders:

1. General purpose (fixecl, does not open)

2.4 in 1 which has 4 positions:

loader scraper
clamp (for clam-shelling)
clozer blade

All types of earthmoving machines can be overturned. Be very careful it working on uneven, soft or sloping ground.



4 in 1 loader bucket.

Operating an earthmoving machine

The operator must:

- Know how to operate the machine safely.
- Know the limits of the machine.
- Regularly inspect the machine and fix or report any safety problems.
- Not start or use a clefective machine.

Know the site

After reporting at a new work site or area the operator must get to know the site.

Attend the site induction program.

Find out the safety rules of the site such as accident reporting procedures and emergency procedures.

Find site facilities such as the First Aid Station and the stores area.

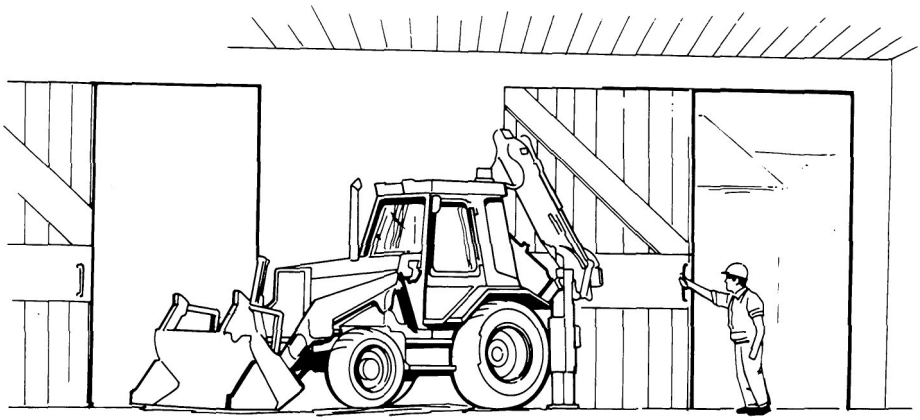
Study the plans, levels and soil types of the site.

Get to know the warning signs and barricades on site.

(The information above refers to organised construction sites only. The information below can also refer to clearing or trenching out in the bush.)

Check the working area for hidden holes, drop-offs, embankments, overhead obstructions, underground services, overhead power and telephone lines or obstacles that could be dangerous.

Make sure the starting up area is adequately ventilated. Exhaust fumes in an enclosed space can kill.



Make sure the area is well ventilatecl before starting up.

If you are working in a confined space, a shaft or a tunnel, then an exhaust emission control unit (scrubber) must be fitted and maintained.

Try to find out about any trenches, excavations and dumps (including of chemicals and asbestos) that were previously on the site.

Check that you have the necessary personal protective equipment (PPE). Your employer must provide the necessary PPE.

You may need to wear:

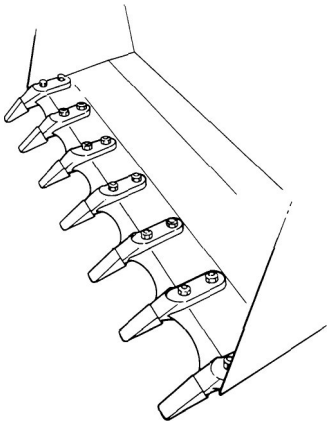
- safety goggles or glasses
- a safety helmet
- hearing protection
- safety boots
- a respirator
- heavy gloves
- reflective clothing
- sun (UV} protection.

Replace any damaged PPE equipment immediately.

All PPE must comply with the appropriate Australian Standard.

Pre-checks

Before mounting walk around your machine and carry out the following checks.



Check the bucket for worn or missing teeth, or worn cutting edges.

Check that there are no mud clumps on the tyres which can be thrown off when travelling.

Check the condition and tension of the tracks. Refer to the maker's manual for the correct adjustment.

Check whether the backhoe boom is fixed or locked into position.

Check that all safety pins are in place.

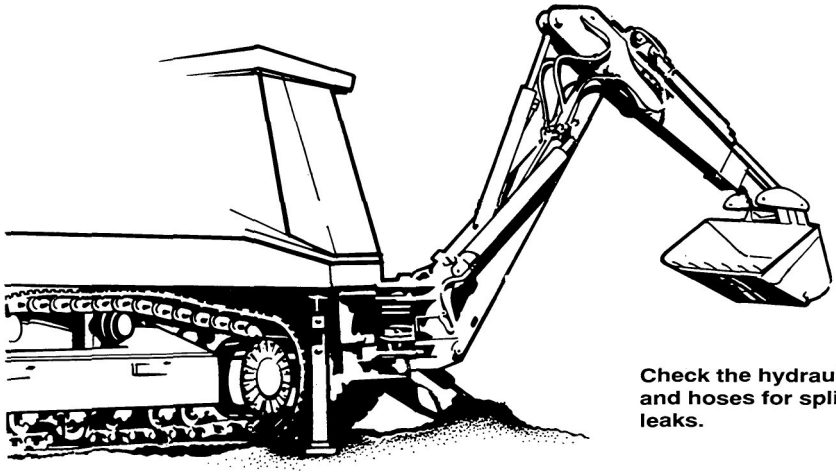
Check the cubic capacity of the bucket to avoid overloading.

Check the type of material to be moved.

Check the bucket for worn or missing teeth or worn cutting edges.

Check the bucket power arms and connections for excessive wear.

Check the hydraulic rams and high pressure hoses for splits, leaks and fractures.



Check the hydraulic rams and hoses for splits or leaks.

Make sure there are no loose bolts or missing keeper plates or pins.

Make sure that all safety guards and devices are secured and in position, including the seat belt and lock down safety bar for skid steer types.

Check the diesel fuel, hydraulic fluid, engine oil, transmission oil, water in radiator and the water in the battery.

Check for loose gear and under the machine for oil or water leaks. If applicable check the position of all fitted attachments such as the backhoe, ripper and stabilisers.

Rubber tyrecl machines. Check the tyre pressure, the condition of the tyres and the wheel nuts. (Water filled tyres as per manufacturer's compliance plate.) If the pressure is uneven it can cause the machine to overturn.

Trackecl machines. Check the condition and tension of the tracks. To check the tension:

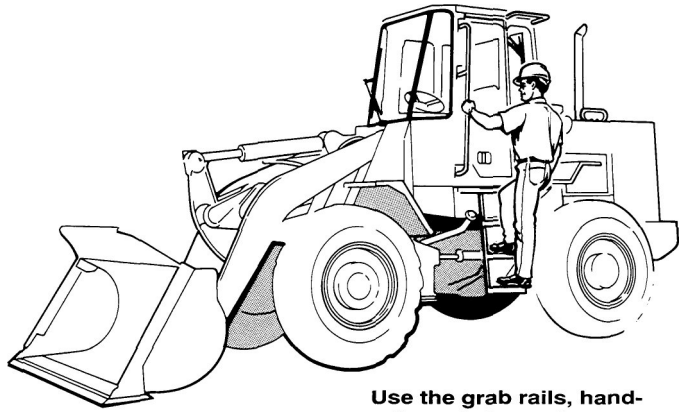
1. Make sure that the track pin is centrecl over the track carrier roller.

2. **Place a straight edge over the track chain** from the roller to the drive wheel.

3. The track sag must not be less than 2.5cm or more than 3.8cm.
   (Refer to the manufacturer's manual for the correct adjustment.)

Mounting and clismounting

Do not use the controls or steering wheel as a handhold to get into the operator's cab. Always face the machine when getting on or off and use the grab handles, handrails and steps.



General purpose bucket

Use the grab rails, hand-rails and steps when mounting a machine.

Before starting up

Clean the windows and mirrors.

Familiarise yourself with the machine (eg controls and safety decal information) if you have not used it before.

Check all controls for operation direction marking.

Make sure all the controls are in neutral or park. Make sure any gear placed in the driver's cabin is not in the way of the controls.

Adjust the seat until it is comfortable and use the seat belt.

Starting up

The operator must be seated and in full control of the machine when starting the engine.

If the machine is fitted with glow plugs for easier starting, refer to the manufacturer's manual for the correct procedure.

Always follow the starting procedure in the manufacturer's manual. Remember, there are differences between engines. For example, the engine might be turbo charged. As a general rule machines require a three to five minute warm up to give time to check the controls and gauges.

Check the operation of all the controls and gauges.

Listen and watch for equipment defects and report trouble immediately.

Before moving off

Make sure that all grounded attachments (ripper or stabilising legs) are fully retracted.

Test that the ratchet footbrake or handbrake is fully applied before raising the stabilising feet and bucket for travelling.

Test the lights, horn and backup alarm (if fitted). Test the steering, limiting devices and all equipment controls.

Test the brakes. If the machine has air assisted brakes, they must reach the correct air pressure before moving off. If the machine has a torque converter, test the brakes against the engine speed after warm up.

Adjust the mirrors for proper vision.

Make sure that everyone is standing clear before moving off and move off slowly.

Before mounting to travel on the roacl in a ruDber tyred machine carry out the following checks:

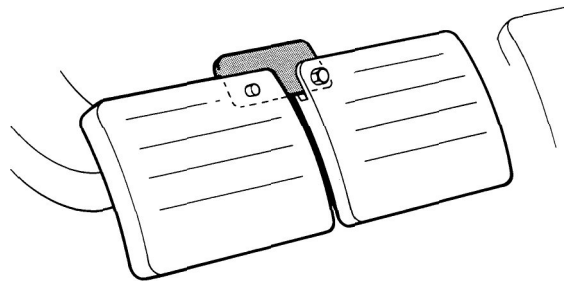
Check that the machine is registered to travel on public roads.

Check the condition of the tyres and wheel nuts.

Make sure that the tyres are clear of mud and rocks.

Lower the air pressure in the front tyres to avoid bounce.

Make sure that the hinged clip between the two brake pedals is locked into position.



Before travelling on the road make sure the hinged clip between the two brake pedals is locked irsto position.

Make sure that the backhoe (if fitted) is housed and locked into position.

Check the lights, indicators and horn.

Raise the bucket to a safe travelling height, but not high enough to obscure your vision.

Driving

General

Do not drive when tired, ill or under the influence of alcohol or drugs, or medication which can cause drowsiness.

Do not carry passengers unless an approved seat is fitted.

Be familiar with the site traffic control system and who will be giving the signals. Watch all signals carefully and obey them.

Keep the machine under control at all times.

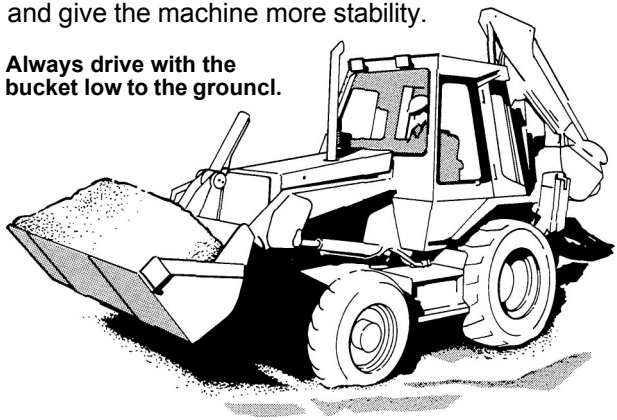
Carry the bucket as close to the ground as possible and racked back to allow greater stability and better vision.

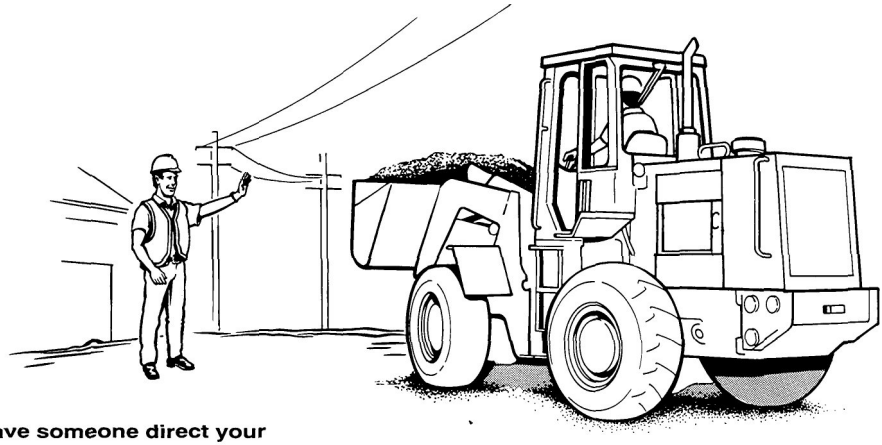
Do not speed. Operate at the correct ground speed for the working conditions and terrain. Keep in control at all times. Drive slowly and carefully if visibility is poor or when operating in dust, smoke or fog.

Large front end loaders with balloon tyres front and back will bounce badly if driven at speed and could overturn. Many operators have been killed because of driving too fast.

Always Carry the bucket low to allow better vision and give the machine more stability.

Always drive with the bucket low to the grouncl.



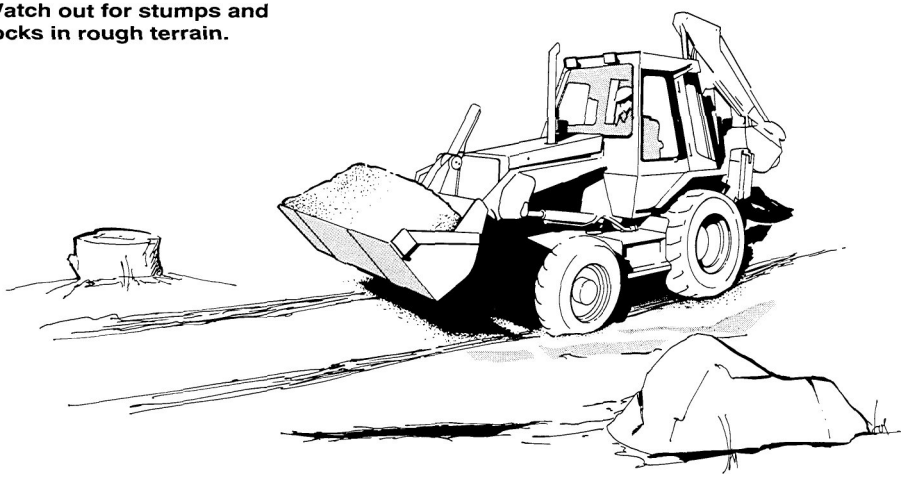


Have someone direct your machine in hazardous areas.

When driving in hazardous areas, be very alert and if possible have someone else direct the machine and watch for dangers.

Always look towards the direction you are travelling, even if only for a short distance.

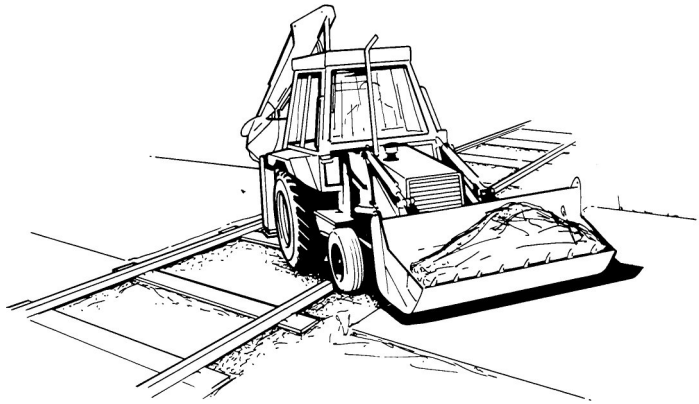
Watch out for stumps and rocks in rough terrain.



When driving in rough terrain, watch out for obstacles such as stumps and large rocks. Where possible back away from them and go around.

Make sure all the gauges, indicators and warning lights are working properly and readings are within the safe operating range.

Cross railway lines at an angle.



Avoicl crossing exposed railroad tracks, ditches, ridges or curbs where possible. If they cannot be avoided, reduce speed and cross at an angle.

Always avoid soft edges and deep holes.

Keep well clear of the edges of excavations.

Give way to pedestrians.

Pass other vehicles with caution.
Do not ‘tailgate’. If braking on loose surfaces control can be lost.

When travelling downhill stay in gear. Do not shift into neutral. Use the same gear range for travelling up or down a grade.

Do not travel across the slope on a steep incline. The machine can roll over sideways.

When filling a trench the machine must approach at a 90° angle to the trench.

Reversing

Before reversing, look behind, sound the horn twice unless there is a reversing alarm on the machine, and look in the direction of travel.

Stopping

The brake pedals must be locked together or equalising gear fitted to the dual braking pedals.

Driving near electrical wires

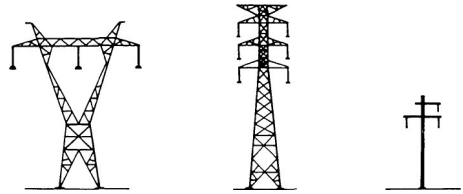
Always maintain a safe distance from electrical wires when travelling with the boom raised.

To prevent electrocution:

“ Keep at least 2 metres clear of distribution lines on poles.
” Keep at least 6 metres clear of transmission lines on towers.

If unsure of the voltage remain 8 metres away.

Types of electric power tower ancl voltages.



If your machine makes contact with electrical wires: ” Stay calm.

” Do not leave your seat.

” Warn others to keep away.

” Try to have the power turnecl off.

” If possible, try to break contact with the wires.

- If possible try to lower the bucket without causing further clamage to the power lines. Make sure that the bucket does not make contact with the ground as this coulcl earth the machine.

- If it is unsafe to stay on the machine because the machine is in danger, such as from fire or if you are alone, jump well clear on to dry ground and move away from the machine.

- Do not Cltmb ¢fown because if you make contact with the machine and the ground at the same time you could be electrocuted

- Stay near to the machine until help arrives.

- Report the inciclent as soon as practicable to your supervisor and the Authority.

Driving at night

Use the appropriate lights when driving at night. Set up reflectors if parking.

Always set up reflectors for night parking.

Vibration while driving

Vibration can, in time, damage the body. It can affect the back and joints, the internal organs and the circulation.

The extent of the damage depends upon the amount of vibration problem. It helps to take frequent breaks from sitting on the machine, rotating to other types of work, keeping physically fit and not working excessively long hours.

Shutting clown and securing the machine

Park on firm, level ground if at all possible.

Park in a non-operating area or a designated parking place, clear of fire hazards, entrances, exits, fire fighting and electrical equipment.

Park away from deep excavations and trenches.

Position the machine up and down the slope when parking on a grade.

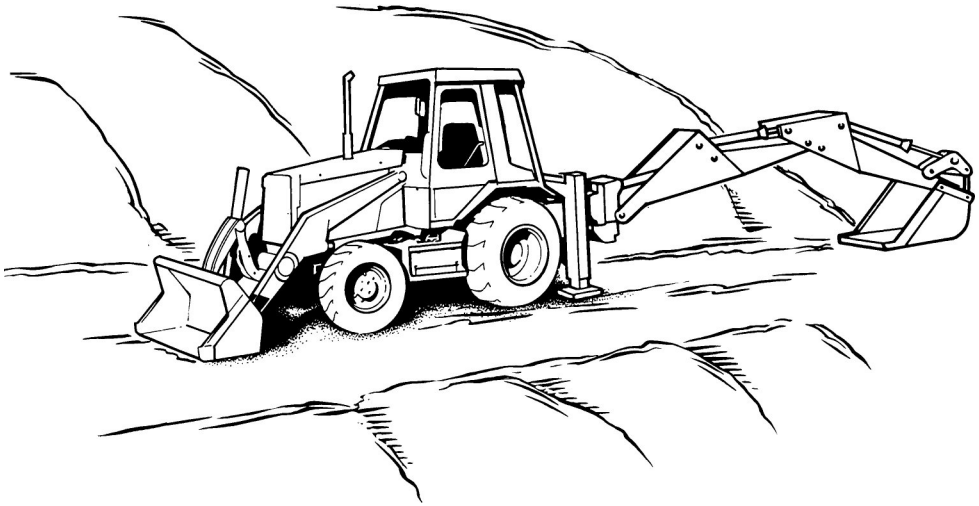
Place the transmission in neutral or park position.

Apply the handbrake if fitted.

Lower the bucket to the ground with the front cutting edge flat on the ground.

Park with the back hoe bucket locked up or with the boom and dipper arm fully extended and the backhoe bucket placed on the ground.

Always park on firm level ground with the buckets on the ground and the cutting edge down.



Lower other attachments such as the ripper to the ground.

Place the stabilising legs on the ground.

Idle the engine for gradual cooling before turning it off. Always follow the directions in the operating manual when doing this.

- Iclle non-turbo chargers for 3 to 5 minutes on low idle before shutting off.

- **Machines** fitted **with turbo-chargers** shoulcl be idlecl on high for 3 to 5 **minutes** to allow the heat to evenly **¢fissipate** and then iclled for 30 seconcls on low idle to slow the impellers **before** shutting off. This is to **prevent the turbines continuing to** spin without being lubricated.

Turn the steering wheel back and forth and cycle the hydraulic controls to dissipate residual pressure in the hydraulic system before leaving the machine.

Engage the safety lock if fitted.

Remove the ignition key and secure the machine as recommended in the operating instructions or as advised by the supervisor.

Excavating

Safe operation

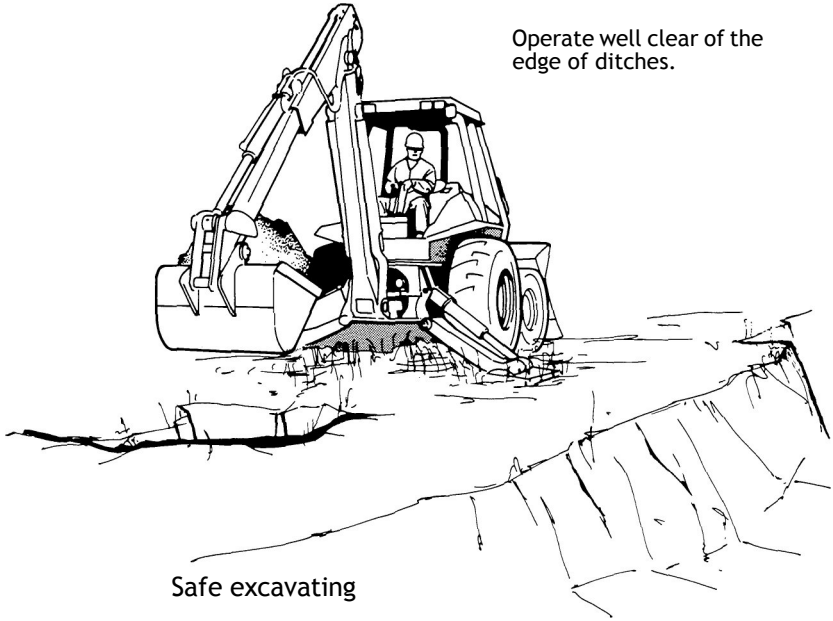
Warm up the engine and hydraulic oil before starting work.

Do not make jerky, sudden movements with the controls. This can damage the machine and will make it work inefficiently.

Carry the bucket close to the ground and racked (tilted) backwards.

Keep the work area as level and smooth as possible. If necessary, prepare a sloping surface by ‘cut and fill’ method.

Do not operate close to an overhang or a deep ditch. The weight could collapse the sides of the trench.



Safe excavating

Before excavating, always check with the appropriate authorities about the location of underground services such as gas, electricity, telephone, sewerage and water.

Read the site plan and check for undergrouncl services before starting

When gas pipes are cut, friction can cause a spark resulting in an explosion. Contact gas authorities if working near gas pipes especially if they are very old. The pipes may need to be blown clear to make them safe.

Warn other vehicles and machines away from the excavation by using suitable barricades or hazard bunting.

When operating the loader make sure the backhoe (where fitted) is in the transport position and that all chains and locks are secured to prevent backhoe swing.

Where stabilisers are fitted they must be in position and packed (if necessary), to prevent unnecessary movement and hold the mass of the machine off the tyres.

Stabilisers parked and in position with wheels off the ground.

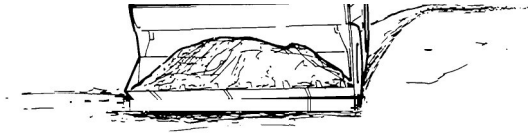
Always operate from a **seated position.**

Always operate from the correct seated position.

Clear everyone from the operating radius of the bucket.

Keep people away from the rear side of large excavators to prevent them being caught by the scissors action between the counterweight and the base.

Always approach embankments or trenches from a 90° angle.



Always approach a trench from a 9O° angle.

Operating a backhoe

Do not move the machine by pushing it back with the backhoe bucket.

Make sure that the brakes are fully applied before raising the stabilisers.

The stabilisers must be in position and packed if necessary. Before operating the backhoe, lower the stabilisers so that the rear wheels are just off the ground and the machine is level.

When lowering the stabilisers the one on the low side of the hill must be grounded first. When raising the stabilisers the one on the high side must be lifted first.

Do not undercut the backhoe stabilisers. Doing so can cause a cave-in.

When digging in unbroken ground, break up the hard surface first before attempting large bites.

Do not use the bucket as a hammer.

Do not try to move the machine with the bucket dug in the ground. This can cause serious damage.

Do not stop the swing of the bucket by hitting it against the wall Df a trench.

Do not sweep sideways with the bucket to push spoil. This can damage the dipper arm and the boom.

Operating a backhoe across a slope

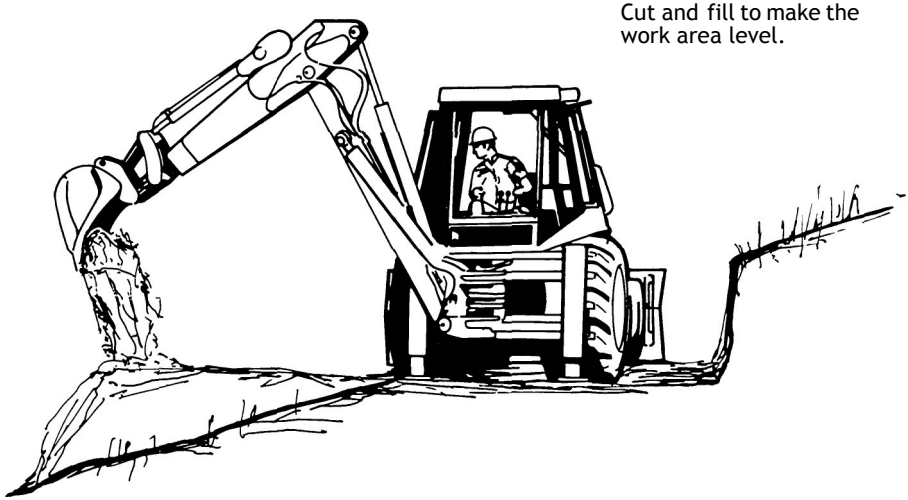
When operating on a slope exercise extreme caution. It is in this situation that many accidents occur.

Make sure the machine is level when digging and not tilted with the slope.

Make sure the machine is level and stationary before digging.

When operating the backhoe on a slope, the area should be levelled by cutting and filling wherever possible.

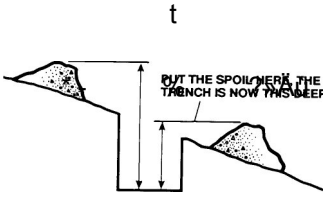
Cut and fill to make the work area level.



Remember, that by using stabilisers the machine is twisted when down pressure is put on the loader bucket. A large part of the cutting edge of the bucket is not in contact with the ground in this situation.

When working on a slope, it is necessary to determine whether or not to dump the spoil to the high side or the low side of the trench.

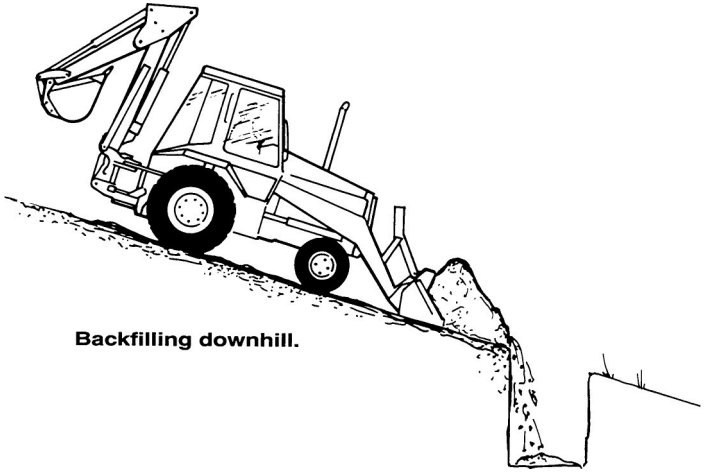
The spoil alters the depth of a **trench.**



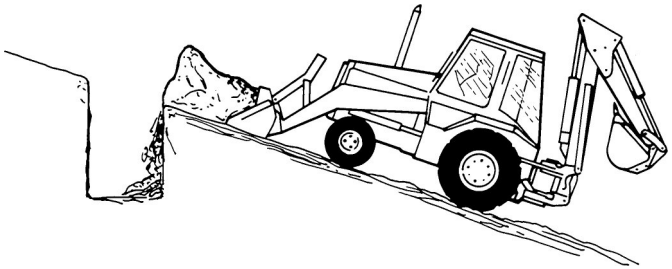
Dangers of ôumping spoil to the high side

If the spoil is dumped to the high side of the trench the trench is màde deeper and the spoil is more likely to fall back in.

Although backfilling from the high side is easier there is an increased danger of the machine falling into the trench.



Backfilling downhill.



Backfilling uphill

Dangers of dumping to the low side

If downhill dumping is necessary, swing only as far as necessary to dump the spoil. If the machine is not level when doing this the action of swinging to the low side could destabilise the machine.

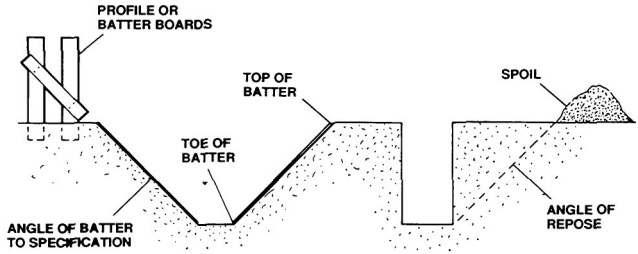
When pushing the spoil uphill into the excavation by a loader fitted with a backhoe, the backhoe bucket can act as a counterweight when the spoil is released and cause the machine to tip backwards down the slope.

Trenching

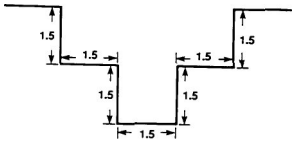
The supervisor and mechanical operator must check the site conditions every day, before the start of work.

Any trench likely to be unsafe even if it is less than 1.5 metres deep, must be shored, battered or benched.

Battering – Angle of repose.



Beeching.

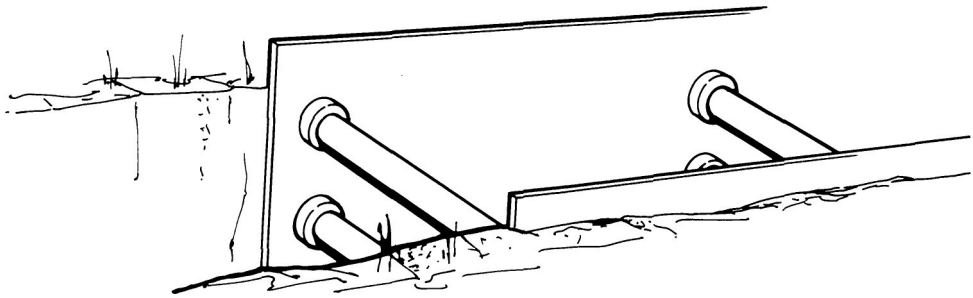


Check the stability of the ground before benching.

Get good advice

If a bank could be unstable, especially in clay soils, get advice from a qualified engineer experienced in soil mechanics and follow their recommendations.

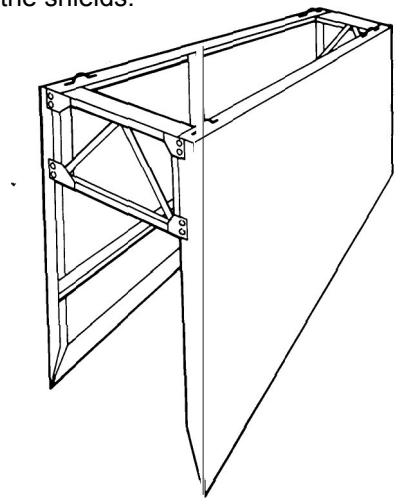
The safe section is the shieldlike section.



Spoil must be placed at least 1 metre away from the excavation to prevent cave-ins and falls, with the toe of the pile no closer than 500 mm.

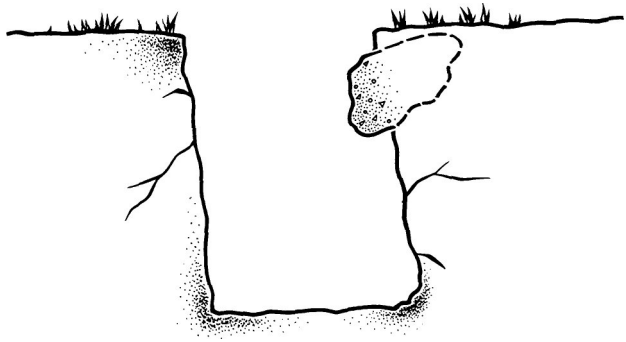
Do not enter an unsupported part of the trench. When using shields, the only safe section is the part supported by the shields.

Trench shield.



If a large rock is uncovered in the trench, work out whether or not it is a ‘floater’. If it is a floater, remove it because it could fall and injure someone or cause damage. It may need to be jack-picked away.

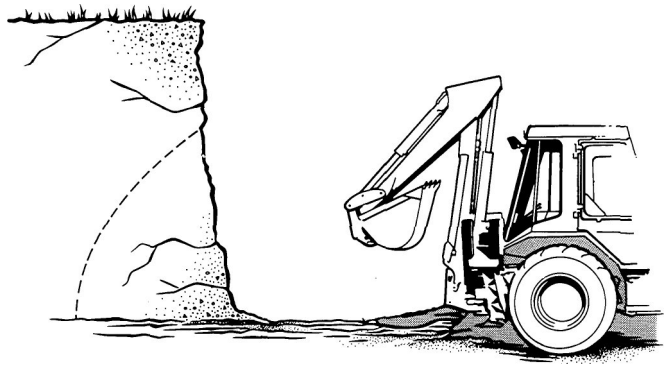
Watch out for ‘floaters.



Undercutting

Do not undercut the side of a trench. Trench walls should be kept straight and perpendicular. Undercutting can cause trench walls to collapse.

Beware of undercutting overhangs.



Safe truck loading

Know the location of the truck driver before loading. If the truck driver is not in the cab when loading make sure they are well clear.

Do not swing the bucket over a truck cab.

Caution: The loacler **bucket** must work down the incline. Extreme care must be taken when **loaning a truck** on an incline using a combination loacfer/backhoe. If the loader bucket is working up an **incline the** backhoe bucket and dipper arm will act as a counterweight and the machine could lose **stability** and turn over backwards when the spoil is releasecl from the loader bucket into the truck.

When loading a truck with large rocks cover the tray with a layer of soil or sand to prevent damage to the tray.

Working in timber

When working in timber with rubber tyred machines be aware that stumps and sharp fallen branches can cause punctures.

When working in the timber industry, the machine must be equipped with overhead guarding.

Beware of dead tree limbs (often termed ‘widow makers’) which may fall on the machine.

Beware of beehives or wasps' nests.

Beware of growing limbs which may pierce the cabin and injure the driver.

Quick hitching

A quick hitch is a latching device for excavators or front end loader excavators bolted to the end of the boom for rapid coupling to buckets or other attachments.

Most quick hitch attachments are coupled by a mechanical catch actuated by a hydraulic cylinder.

There are many varieties of quick hitch. The operator must be familiar with the particular system to be used before commencing work. Check the manufacturer's manual for details.

Failure of a quick hitch can occur:

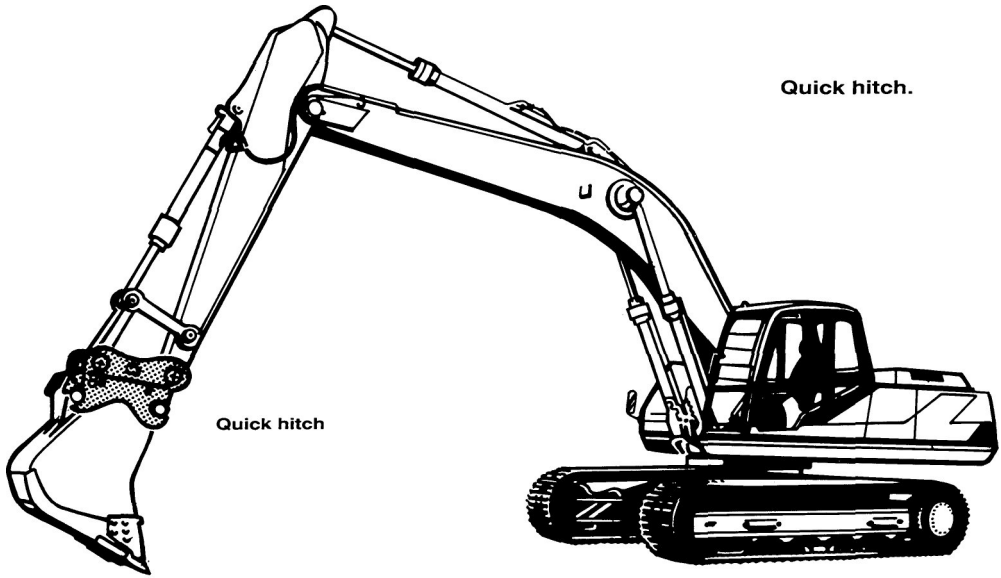
- **where the hydraulic pressure is** captive for an extended **period of time due to possible line failure or** slow fluid leakage.
- due to gravel or dirt causing an **improper** engagement.

Where a quick hitch is fitted with a safety locking pin it must be correctly fitted before the machine is used.

The operator must check:

" the engaging gear for wear.

* that the bucket or attachment is the correct make and size for the quick hitch.



4. Lifting

Safe load lifting

Machines with attachments for lifting materials such as pipes or drums must clearly display the safe working load (SWL).

Lifting attachments should be fitted by the manufacturer or to the manufacturer's standard.

Make sure that the machine is on solid, level ground before lifting any load.

Do not exceed the safe load and work radius limits of the machine.

Check the SWL of the machine and the approved lifting lug. If a lifting bar is used in place of a lifting lug it must be half the width of the bucket plus 500 mm to avoid slipping out.

Make sure the load is correctly slung and balanced.

If there is any sign of instability, lower the load immediately.

When the load is raised keep all people at a safe distance.

Do not swing loads over people's heads.

Do not leave the load suspended in the air, lower it as soon as possible.

Always lower the load to the ground if leaving the machine.

If using the backhoe to lift and place objects such as pipes, do it over the back end of the unit, not the side. If there is too much weight on the side, the machine will tip over.

Lifting using the bucket

Before loading, check the cubic capacity of the bucket and the type of material to be handled.

To calculate the cubic capacity of the bucket the following is a 'rule of thumb':

Cubic capacity of the bucket

= **length** x height x width

Travel with the bucket as close to the ground as possible. Do not lift the bucket into unloading height until reaching the dumping point. A high bucket can be dangerous. It limits vision, is unstable and can hit overhead obstructions.

If you do not know the weight of a load do not lift it.

When travelling on sloping surfaces with a loaded bucket, always keep the bucket low and facing uphill.

Do not reeve or nip slings around buckets. The sling can be cut by the cutting edge or teeth.

Do not place a sling over a tooth or teeth.

Make sure that you know the SWL of the machine you are using. Do not try to lift loads that exceed the SWL. The weights of commonly lifted materials are listed in the table below.

Weights of commonly handled materials in kgs
(per cubic metre)

Shale	**2600**
Dry beach sand	**2OOO**
Wet beach sand	2300
Blue metal	2000
Coal	864
Earth	**1900**
Dry river sand	**1300**
Wet river sand	**15OO**

Excavators as cranes

Although excavators are versatile machines that can be used as cranes they must only be used as cranes for work connected directly with excavation.

To adapt the excavator for use as a crane, securely attach lifting gear to the machine that is designed for that purpose. Never hook slings over the bucket teeth or attach them in any other make-shift way. Use approved types of rope anchorages only.

The SWL must be marked on the machine in raised or etched lettering. Machines must not be loaded beyond their SWL.

There are three basic rules to remember when slinging loads:

1. Use the right sling.
2. Use it correctly.
3. **Use slings that are in a safe condition.**

Rules for load handling with the machine:

1. **Check the weight of the load. If the weight is unknown,** cJo not guess. Ask the **supervisor.**
2. Check the SWL **of the machine.**
3. **Check that the weight of the load is not** more than the SWL **of the machine.**

Lifting attachments should be fitted according to the manufacturer's standard.

Check that the sling and fittings are safe. Never use a chain or synthetic sling that does not have a manufacturer's label with the correct SWL marked on it. If in doubt about the safety of a sling do not use it.

Make sure there are no knots or twists in the sling.
The person who slings and directs the load must have a Dogman's or a Crane Chaser's Certificate.
Make sure that the load is correctly slung.

The sling must be attached to the lug by a shackle.

Do not lift a load by placing a sling on the teeth of a bucket.

Choose the best type of sling for the load, hitch and environment. Check the sling for exposure to chemicals, heat and moisture. If the sling is safe to use:

1. **Choose the** safest slinging method.
2. Choose the assembly type needed for the

3. **Make sure the sling is long enough to do the job and to minimize the sling angle.**
4. Make sure the sling is **protected with** packing against any sharp corners on the load.
5. Make sure the load is balanced and not top heavy.
6. Make sure no *part* of the load can slide or fall out during lifting.

When starting a lift, take up the slack gradually.
Use taglines where necessary to guide and keep the load balanced. Taglines must be no less than 16 mm diameter and made of dry natural fibre rope.
The person controlling the load should stay at a safe distance from the load.

Move the machine slowly so the load does not sway or swing around.

Make sure that slings are regularly inspected. It is expensive to discard a sling before it is necessary, but it is dangerous to continue using one beyond a certain point. Skilled examination is necessary. If uncertain about the condition of a sling ask.

Materials commonly used to sling loads are:

” Flexible steel wire rope (FSWR). ”
Steel chain.
” Synthetic slings.

Slinging and safe working loads

The safe working load (SWL) 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.

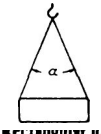
For example:

- A reeved sling around a square load will halve the lifting capacity of a sling. The load factor is o.5.
- A basket hitch around a round lodl doubles the lifting capacity. The load factor is 2.0.

Below are the various methods of slinging with their load factors.

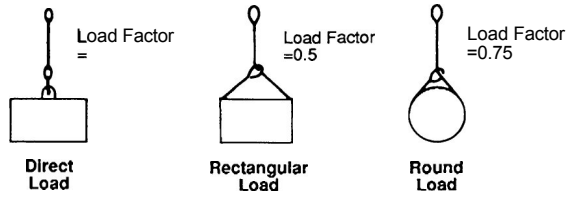
SWL tables are available for all types of slings and rope. Make sure that you consult the correct table before lifting.

A SAFE WORKING LOAD CHART FOR 6 x 24 •1570 GRADE — GALVANISED STEEL WIRE ROPE

	DIRECT LOADED	CHOKE HITCH		BASKET HITCH									
		 Round load	 Rect. load	 Round load					 Rectangular load				
angle t	"	"	"	0°	45°	60°	7U	12U	U	4J°	0U°	7U°	12U°
Loading factor	∞	0.75	OSO	2.00	L85	1.73	1ñ1	∞	I.CXI	0.92	0.87	0.71	OF
tOQ*di .				Safe	rkin$ loa	d — kilo$	ms or ton	nes					
				6 x 24 (I 5/	/1-) — I S		7(GRADF		- GALVANIZED				
8	570	430	260	1.1	1.0	990	8 l0	570	570	530	500	400	280
9	720	540	360	1.4	1.3	1.2	1.0	720	720	670	630	570	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	.3	1.3	1.2	1.1	910	640
13	1.5	1.1	750	3.0	2.8	2.6	2.1	1.S	I.S	1.4	1.3	1.0	750
14	1.7	1.3	880	3.5	3.2	3.0	2.5	1.7	t7	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			56	52	t2	3.0
28	7.0	5.2	3.5	14.0	13.0	12.1	9.9			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/ t	8.4	7.9	6.4	4.5

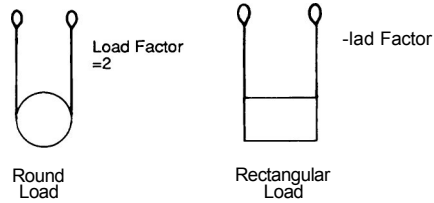
You must know the loan factors for each method of slinging shown below.

SINGLE SLING

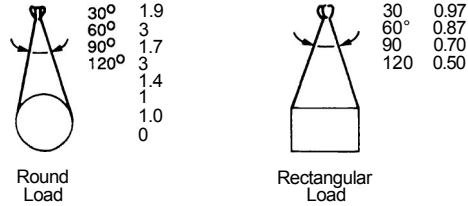


BASKET HITCH

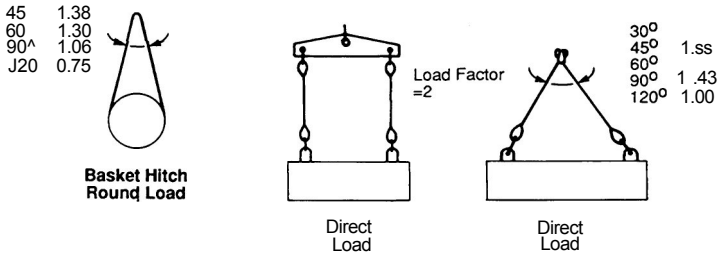
Single Sling
Vertical
Legs



Include Angle between tha legs



ENDLESS SLING OR GROMMET

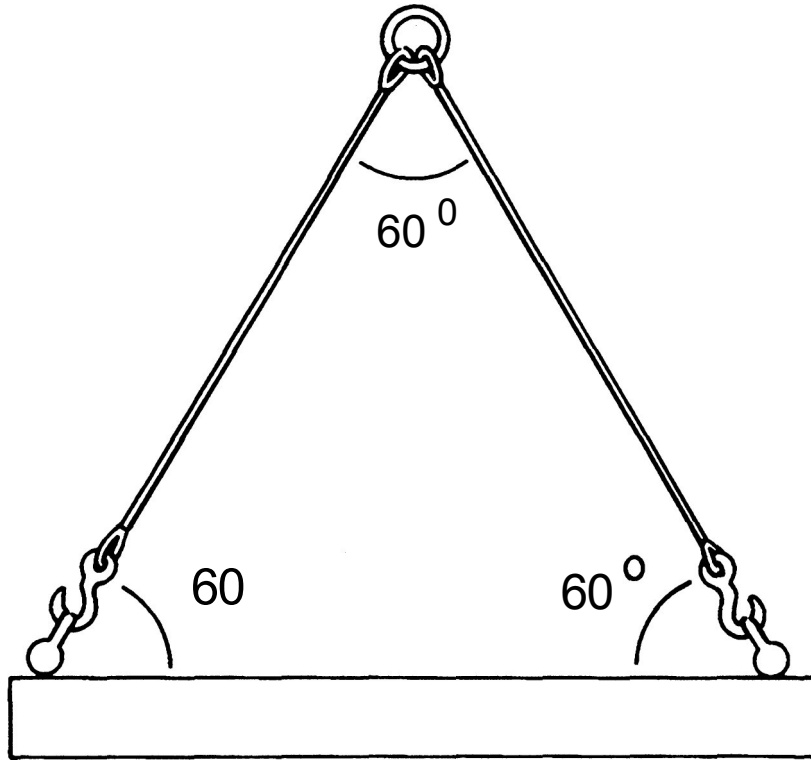


Comparing methods of slinging ance load factors.

A simple rule of thumb for slinging is:

" The horizontal distance between the points of attachment of the load shouted not exceecl the length of the slings.

* This will ensure that the angle between the two legs of thesling cloes not exceed 6o .



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 (kgs) = D*(mm) x B

For example:

Rope diameter (D) = 12mm

SWL (kgs) = D“(mm) x 8
= D (mm) x D (mm) x 8

=JJ52kgs
SVVL(t) =d.d5tonnes

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) **=**

For example:

Loacl = 15OO kg
D(mm)

=Y]8W5

Therefore an FSWR sling of at least 14mm diameter is required to lift a 1500 kg load.

Chain

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

Do not use a chain sling 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 re-tagging.

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

Formula: SWL (kgs) = D*(mm) x G x O.3

For example:

Chain diameter, 10 mm. Chain grade (T}
{ie grade BO)

SWL = O' (mm) x G x 0.3
= O (mm) x O (mm) x G x 0.3
= 40 x 40 x 80 x 0.3
= 2AOO Age
OWL. (I) = 2.4 tonnes

Fibre rope

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

Formula: SWL (kgs) = D*(mm)

For example:

Diameter = 25 mm
SWL. (kgs)= O (mm)
SwcAgs) =O (mm) xD (mm)
=25x25
=625 kgs
SWL (t) = O.625tonnes.

Flat webbing and rouncl synthetic slings

Flat webbing and round synthetic slings are labelled with the SWL. If the label is missing do not lift and return to the manufacturer for testing and relabelling. Synthetic slings are colour coded. (See table below.)

ndlcetor stripes - eech stripe represents 1 tonne W.LL. - sefety factor 8:1.

COLOUR NO STRIPES	TONNE	VERTICAL	CHOKE	BASKET	30°	60°	90°	120°
1	1	1	0.8	2	1.9	1.7	1.4	1.00
GREEN	2	2	1.6	4	3.8	3.4	2.8.	2.00
YELLOW	3	3	2.4	6	5.7	5.1	4.2	3.00
*	"4	4	3.2	8	7,6	6.8	5.6	4.00
RE05	5	5	4.0	1O	9.5	8.5	76	5.00
BROWN	6	6	4.8	12	11.4	10.2	8.4	6.00
BLUE	8	8	6.4	16	15.2	13.6	11.2	8.00
OMVE 10	10“	10	8.0	20	19.0	17.0	14:0	10.00
GREY	12	12	9.6	24	2Ž	20.4	1'6.8	12.00

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 SWL of the sling(s) by the angle factor 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 multi-legged sling is one tonne, the angle between the two sling legs is 60^0 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.

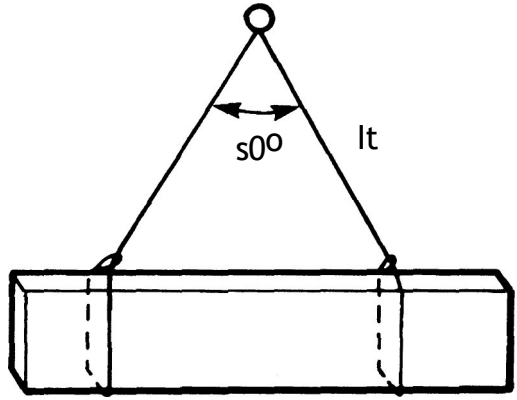
Sling SWL	1 tonne
Angle factor	1.73
Reeve factor	0.5

Therefore:

Max load = 1 x 1.73 x 0.5

= 0.865 tonnes

Therefore 865 kilograms is the maximum **weight.**



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

Formula for a calculator:

SWL = weight + load factor Formula can

be written:

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

For example: The weight of the load to be lifted is 2 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.

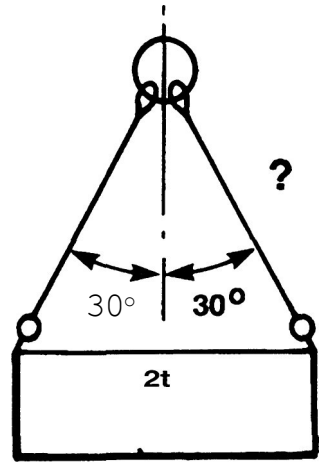
Weight	2 tonnes
Loact factor	1.73

Therefore:

SWL = 2 + 1.73

= 1.156 tonnes

Therefore use a sling with a lifting capacity greater than 1.156 tonnes.



3.
To calculate the SWL of a sling needed to lift a one tonne 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:

SWl = weight ___ 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.

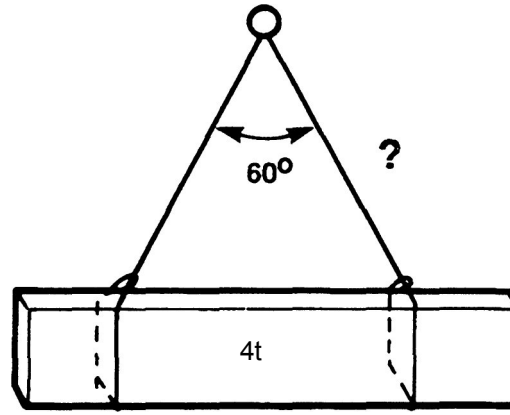
Weight	4 tonnes
Angle factor	1.73
Reeve factor	O.5

Therefore:

SWL = 4 + 1.73 + O.5

= 4.62 tonnes Therefore

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



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

Formula:

SWL = weight + angle factor + reeve factor Formula can **be**

written:

SWL = weight ___ angle factor x reeve factor

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

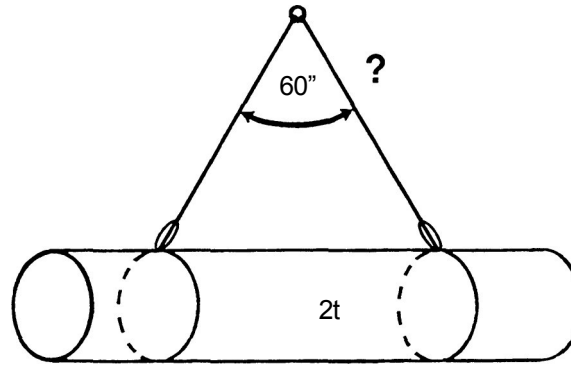
Weight 2 tonnes
Angle factor 1.73
Reeve factor O.75

Therefore:

SWL = 2 + 1.73 + O.75

= 1.54 tonnes

Use a sling with a lifting capacity greater than 1.54 tonnes.



To calculate the diameter (D) in millimetres (mm) of FSWR needed to lift a load of 0.5 tonnes as a straight lift, convert tonnes into kilograms, divide by 8 and then find the square root of the answer.

Formula: D (mm) = at

Formula can be written:

D (mm) = ad

Therefore:

D (mm) = 65OO + 8

An 8mm diameter FSWR is needed for the lift.

Weight of the load

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 —
Do not lift.

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 and 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.

Hanclling

To lengthen the life of the sling and prevent damage make sure that there is suitable lagging or packing at all sharp edges.

Make sure that packing and lagging is secure so that it will not fall out during a lift.

Timber, split piping or old rubber tyres make excellent packing.

Ali loads of lengths of pipe, metal or timber must be securely strapped.

Keep hands clear of the load. Use a dry natural fibre rope tag line of no less than 16 mm diameter to guide the load.

Secure lengths of pipe with double wrapped slings to prevent individual pipes from falling out.

Before lifting a load make sure that it is stable and not caught or trapped in some way.

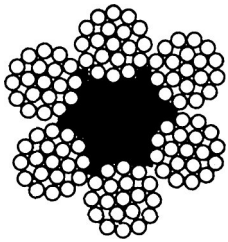
Machinery, plant and fuel containers must all have lifting lugs with the SWL clearly stamped.

Slings

Flexible steel wire **rope**

FSWR 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.



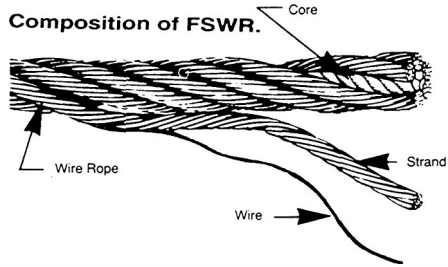
6 x 19

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.

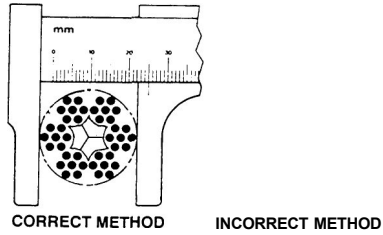
A 6/19 (6 strands of 19 wires each) is the minimum FSWR construction that can be used for slings.



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.

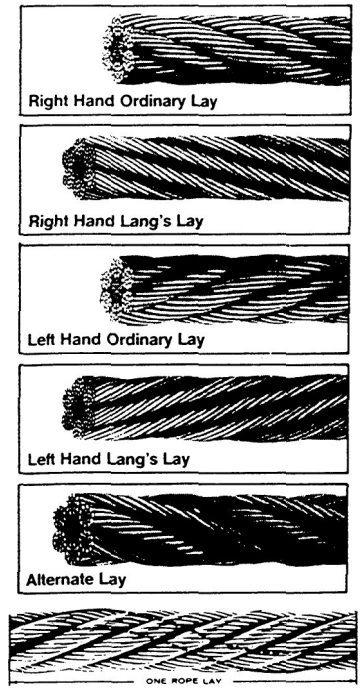
Lang's Lay is where the wires are laid in the same direction as the strands. There is therefore:

“ 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 can be fixed such as for lulling. 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 ancl cliscaro

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 must not exceed 1o% of the total wires.

For example:

In a 6 x 24 rope (s strands of 24 wires) the total number of wires is 144. The cliameter of the rope is 12 mm.

Length of rope to inspect = 12 (mm) x 8
= 96 mm

Number of wires = 6 x 24

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 sling if there are signs of the following:

- Abrasion ancl core collapse.
- Wear caused by badly maintained or aligned sheaves.
- Corrosion. Reel oxide powder and loose and springy wires can indicate serious corrosion. Check the valleys between the wires for corrosion beneath the surface.
- Kinks or fractures from benching or reeving. Crushed or jammed strands.
- Birdcaging. This is where the strands loosen from their proper tight lay. It can be caused by rotation of the encl of a rope or a sudden release from high loading. It is often found in Lang's Lay.
- High stranding. This occurs where there has been faulty whipping of the rope encls and a strand has slipped around the lay and projects above the surface.
- Also 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 d sling or be pulled roughly from under or through an object.
- Check the tailed or swaged splices for fatigue, **corrosion** and broken strands where the rope enters a splice. Reject a rope where there is one broken wire immediately below a tailed or swaged splice.

The rope must be replaced.

Watch for broken wires
in this area.

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 ot 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.

Discard criteria for F£2WR.

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 diameter.
- Do not use a rope that should be discarded.
- Do not use Lang's Lay unless the encls 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.

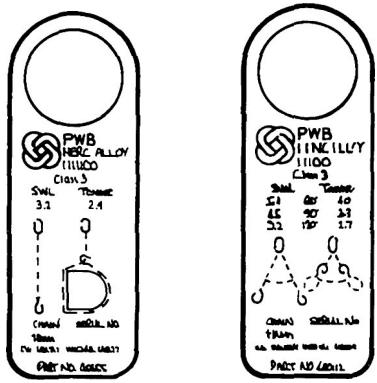
Make sure that wire rope is properly lubricated before storage to minimise the risk of corrosion.

Chain

Although chain is from 5 to 6 times heavier than FSWR of the same lifting capacity it is more durable. It can withstand rough handling and can be stored without deterioration.

Chain used for lifting

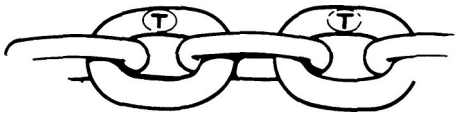
Always check that the grade on the tag matches the grade markings on the chain. Do not use if there is no tag on the chain.



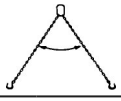
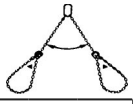
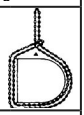
Each chain sling must have a tag stating: manufacturer, grade, SWL of different applications ancf conditions of use.

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 gracle marking.

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	

Safe working loads for slings
“of special alloy chain (marked

Grade (P)

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

Gracle (L)

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

Other chain you may encounter

Gracle (S)

Grade (S) or 60 alloy steel grade is marked (S), 60, or 06.

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

Safe use ancl maintenance

Do not use an approved alloy chain that is 5.5 mm in diameter or less for lifting.

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

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

Do not lift a load heavier than the SWL of the chain.
Do not use a chain in which the links are stretched, locked or do not move freely.
Do not use chain with a nick or cut greater 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 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 C unless heat reduction charts are used.

Inspection anci **cliscarcl**

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.

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.

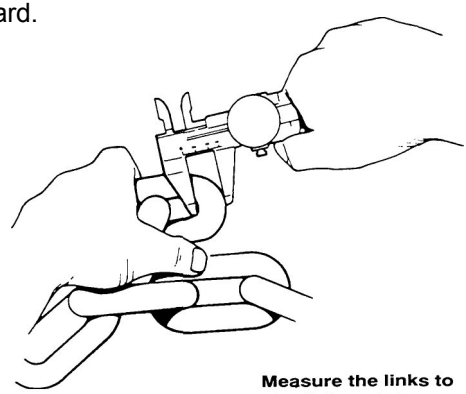
Inspect links and couplings for signs of wear at their load bearing points and for excessive play in the load pin between the body halves.

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.



Measure the links to check for wear.

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.

Inspection

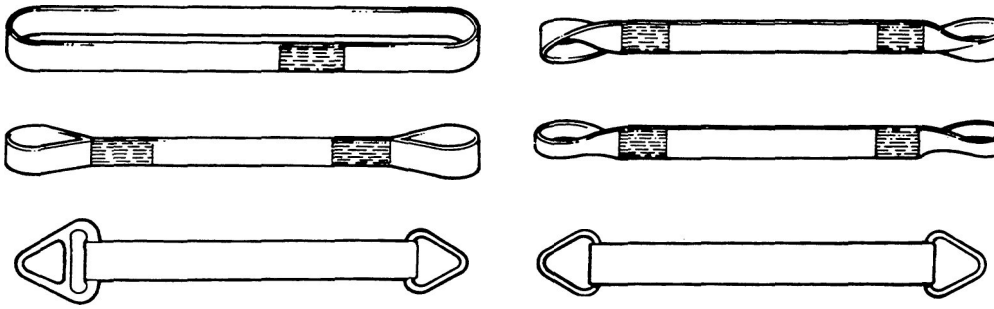
Synthetic slings must be inspected before each use.

They must also be inspected by a competent person at least once every 3 months. If a sling is subject to severe conditions the inspections should be more frequent.

Send slings for a proof load test at least every 12 months.

Look for:

- Any external wear such as abrasion or cuts ancl confusions.
- Internal wear which is often inclicated by a thickening of the sling or the presence of grit and dirt.
- Damage to protective coating of the sling. Damage caused by high temperatures, sunlight or chemicals (indicatecl by cliscolouration).
- Damage to the label or stitching.
- Damage to the eyes or any terminal attachments or encl fittings.
- Where the sling is covered by a sleeve, the sleeve must cover the sling for the full length from eye to eye.



Types of synthetic slings and fittings.

Discard a synthetic sling if:

* It has lost more than 10% 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.

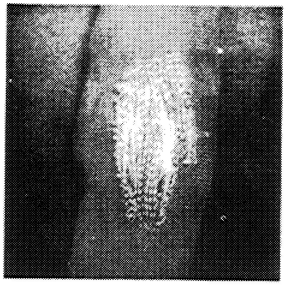
NB. A nylon sling will lose more than 10% of its strength when it is wet.

After 6 months exposure to sunlight send a sling in for testing.

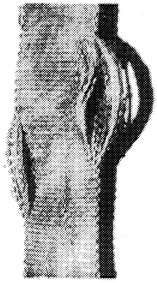
Synthetic slings must be stored:

” In a clean, dry, well-ventilated place.
” Away from the ground or floor.
* Away **from d**irect **sunlight,** ultraviolet 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.

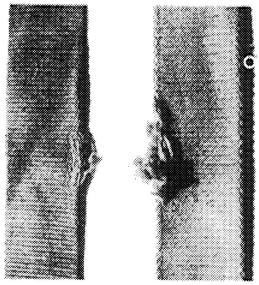


(a) Damaged sleeve

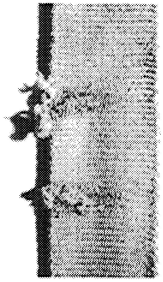


(b) Some damage to load-bearing fibres

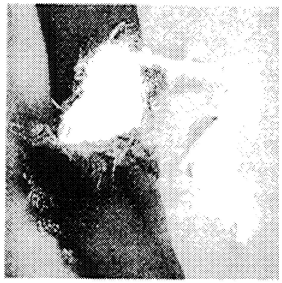
(c) badly damaged sleeve



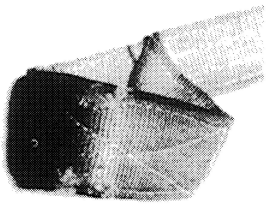
(d) Load-bearing fibres have been cut



(e) Cut load-bearing fibres

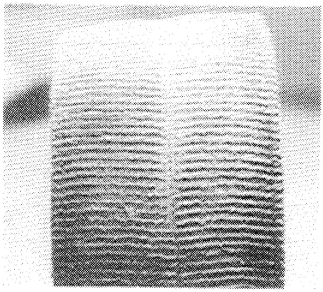


(f) Broken load-bearing yarn



(g) The use of hooks that are too narrow has damaged the eye of the sling

(h) Burn damage to sleeve and load-bearing yarn



(i) Surface wear evident by furry surface

Examples of extreme damage to flat synthetic-webbing slings.

Fibre rope

Fibre rope should not be used for lifting of any kind with excavators. It must only be used as a tagline for guiding a load.

Maintenance

Keep fibre rope neatly coiled when stored and protected from:

* Falling objects.
” Fire and excessive heat.
” 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 discoloration due to excessive heat.

“ A dirty grey colour, loss of weight and brittleness clue to sun rot.

” Signs of mildew by opening the strands and looking and smelling for **mould.**

* Discoloration and powered 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.

5.

Transporting procedures

Preparation of the **machine for transport**

Clean all soil and mud out of buckets, tracks and wheels.

Check the manufacturer's manual for the correct loading procedure. Not all machines are loaded the same way.

Attach the steering frame lock if it is an articulated machine and the slew lock if it is a large slewing machine.

Load and unload on a level area.

Hauling

Hauling is transporting a machine on the tray of a truck or semi-trailer.

If possible, haul a disabled machine to a repair area rather than tow it.

Find out what the arrangements are and whether the machine will be escorted.

Check the travel route for adequate overhead clearance and load restrictions.

Check loading equipment to be sure it will handle the weight of the machine. Chock the transport vehicle's wheels to stop them moving when loading machine.

Use ramps of adequate strength, low angle and proper height.

Tie down and chock the machine securely for transporting.

Make sure the trailer bed is clean of clay, oil and all materials which can become slippery.

If the machine is broken clown

If the machine is broken down, mark it with witches hats during the day and with reflective triangles at night.

If the loader/backhoe/excavator has to be towed, check the manufacturer's manual for the correct towing procedure.

If you are towing another machine make sure that the towing point on your machine is located below the rear axle height.

If using a tow line to tow a disabled machine, keep people well clear. If the wire breaks it can cause fatal injuries.

6. Maintenance procedures

Maintenance work must be carried out by someone who is authorised and competent to do so.

Machinery must be on level ground and the wheels correctly jacked and chocked.

Remember to: ‘jack up and pack up and never have metal against metal’.

The machine attachments must be safely lowered and blocked.

Inspection covers should never be removed while the engine is running.

The ignition keys must be removed to prevent the machine being accidentally started up while someone is underneath.

Hoisting equipment must be used when major assembly removal is necessary.

There must be adequate ventilation in the work area.

The manufacturer's guidelines must be followed.

All guards and safety devices must be replaced.

All filters must be replaced.

All drained fluids must be contained and disposed of properly.

All drained fluids must be replaced.

The machine must be left clean.

Log books must be filled in.

Inspection checklist

Attachments

Make sure attachments are well greased.

Blades, buckets, teeth

Check the bucket for worn teeth or cutting edges, which can lead to overloading and inefficiency. Check all bucket power arms and connections for excessive wear. Keep bucket teeth tight because loose teeth break more easily than tight teeth.

Brakes

When travelling on the road dual braking pedals must be positively fixed together or equalising gear fitted to make sure that both wheels brake evenly at all times. Check brake fluid level and top up if necessary. Use only brake fluid recommended by the manufacturer.

Check the mechanical condition of the brakes, linings and bands for cracks and mechanical linkages.

Cleanliness of the machine

Clean the windshield, mirrors and lights.

Check that the windshield wiper is working properly.

Remove grease, oil and mud from the grab irons, handrails, steps, pedals and floor.

Secure any loose items such as tools, chains and containers. Loose items could jam a control or cause trips.

Remove the radiator grille once a week especially in summer and autumn. Clean both the radiator and oil coolers. Dead grass, straw and leaves can block the radiator and cause overheating.

If you are using an air line to clean the radiator always blow through from the back or engine side of the radiator. This pushes any material out the way it came in.

Battery

Check the electrolyte levels and top up if necessary.

Disconnect the battery before servicing.

Always remove the ground (or earth) terminal first and install last.

Air filters

Check the air filter and clean it if necessary. In dusty conditions it may need cleaning every day.

Fuel level

Check the fuel level and top up if necessary.

When filling an empty tank with diesel fuel an air lock may form. Do not fill the fuel tank when near an open fire, with the engine running or when smoking. Replace the fuel cap securely.

Hydraulics

Always lower hydraulically powered equipment before servicing the hydraulic system. If equipment has to be raised, use cylinder or rod collars, or block securely.

Make sure all hydraulic controls are properly marked for the direction of travel. Check the machine for leaks of hydraulic fluid. Do not check for leaks in pressurised hydraulic lines with bare hands. The pressure could drive the oil through pores and under the skin. Use a piece of cardboard or wood. Fill hydraulic fluids to the proper level. When filling or venting is necessary, loosen the filler cap slowly.

Cooling system

Check fan belt tension and coolant level.

Oil levels

Check the oil levels in the engine, the transmission and the torque converter. Top up if necessary.

Protective devices

Check that all the protective devices are in place, working properly and not damaged. For example, stabilizers, warning horn or back-up alarm, lights, guards and shields, rear-view mirrors, seat belts and canopies.

Check that if the machine is fitted with a fire extinguisher, it is mounted outside the cabin area.

Check that guards effectively stop body parts being caught between fixed and moving parts near the operator's seat.

Tyres/wheels/tracks

Check the air pressure in the tyres daily.

When adding air use a long hose with a self-attaching chuck. Tyres must be inflated or deflated in a suitable cage when they are removed from a machine. Rims can fly off with enough force to cause severe injury.

Make sure others are also out of the way when adding air.

When filling tyres with liquids for ballast, jack up the machine on the side on which you are working. To prevent liquid from leaking out do not fill the tyres above the valve insert.

Check the tyres for cuts, bulges and any irregular or abnormal wear. Be alert to a possible blow out of inflated tyres that are damaged by cuts and sidewall bubbles.

Do not mix rim parts from different manufacturers or of different sizes.

Do not replace rims with anything but the correct part (size, type and quality).

Do not use damaged parts.

When changing a tyre, lower all attachments and block equipment securely before placing the jack in position.

Support the machine securely before working underneath in case the jack slips.

Check for missing valve caps, wheel lugs, nuts and bolts.

Only check tyres when the machine is unloaded.

Always deflate the tyre before removing spikes or other objects from the tyre carcass.

Do not cut or weld on the rim or rim parts.

A permanent warning notice must be fixed to the driving station by screws or rivets if the tyres on a machine are water-filled to make the machine more stable. Where ballast other than water is used, this must be clearly specified on the notice. Refer to the manufacturer's manuals for liquid ballast procedures.

Keep the wheel nuts tight. Once a nut has become loose, the thread at the base of the stud becomes damaged. This stops the nut from seating and tightening down properly. If this happens, a new wheel stud will have to be fitted.

Tracks

When adjusting track tension follow the manufacturer's manual.

Do not place fingers between the track shoes when removing the track.

Do not let hands come in contact with sharp edges. Wear gloves.

7. Further information

Some terms used in this guide
(in alphabetical order)

Angle of repose:
A mound of loose clay or sand assumes a characteristic shape with sloping sides. The angle which a sloping face of loose earth makes with the horizontal is known as the angle of repose.

The minimum safe angle of repose (batter) is 1:1 for all material other than rock.

Batter:
The profile or slope of the sides of cuttings and embankments other than rock. The angle of the batter depends on the angle of repose of the soil.

Bench:
The stepping of the face, sides, walls or bottom of an excavation. Benches are more than 1.5 metres deep and 1.5 metres wide.

Birdcage:
A springing or enlargement of flexible steel wire rope.

Boom:
The projecting arm of a crane.

Condemned:
No longer safe to use and not to be used.

Cut and fill:
An excavation formed by removing earth or rock materials to fill or level an adjacent site.

Diameter:
The length of a straight line drawn from one side to the other through the centre of a circle.

Direct load:
A load attached to a single, perpendicular sling.

Excavation work:
Work involved in the breaking of ground, excavation or filling of trenches, ditches, shafts, drifts, rises, tunnels, pier holes, cuttings, benches, wells or canals or any similar work.

Gracle (of chain):
A measure of the strength of chain.

Hitching:
Attaching.

Load:
The raised bucket or hoe with or without a load attached.

Lulling:
Raising or lowering the crane boom.

Nip or reeve:
The point where the sling passes back through itself. Nipping or reeving reduces the SWL.

Quick hitch:
A latching device with rapid coupling action between the appliance boom termination and gear.

Safety decal:
A warning notice attached to a machine.

Safe Working Load:
The maximum load which may be lifted by a machine, slings or accessories.

Shackle:
Coupling link.

Shoring:
Method of supporting a building, structure, excavation or trench.

Slewing:
Swinging from side to side from a pivot.
For example, the movement of a crane on its base.

Sling:
Lifting gear made from flexible steel wire rope, chain or synthetic material.

Sling angle:
The angle between the legs of slings.

Tagline:
A small rope (a minimum of 16 mm in diameter) used to steady or guide a load.

Undercutting:
Over-excavation at the bottom of a trench side wall.

First aid

Construction work involves high risk. Both serious and minor injuries occur. Serious injuries may require first aid to restore breathing and/or heart beat and to stop bleeding.

Always know the location of the first aid room and the nearest first aid kit and the identity of the first aider. The standard first aid symbol in Australia is a white cross on a green background.

First aid kits on construction sites must 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 all those who work in the construction industry take the time to do an approved first aid certificate.

Sample exam questions

Below are examples of the questions you could be asked in an examination for a front end loader or excavator certificate. The questions are grouped according to the chapters in this guide where the answers can be found.

Chapter 3

1. List 6 things that must be checked on the worksite before checking the machine.

2. List 5 safety checks that must be carried out before mounting the machine.

3 Under what circumstances can a passenger ride on the machine with the driver?

4 Describe how to safely mount an excavator.

5. List 4 things which must be checked before starting up.

s. Where can the correct start-up and shut-down procedures for each machine be found?

7. The motor has started. List 6 checks which must be made before driving off.

8. How high must the loader bucket be kept above the ground when driving forward?

9. If the appliance is fitted with an independent brake for each rear wheel, what precaution must be taken before moving off?

IO. List 8 things that must be done when parking the machine.

11. On a combination backhoe loader, what must be done with each bucket before leaving the machine?

12 How far away from an excavation must material be dumped?

13. How are vehicles/machines stopped from coming too close to an excavation?

14. What clearances must there be from the following overhead electric wires:
up to 132,000 volts? .....
132,000 to 330,000 volts? .....
more than 330,000 volts?

15. What should the driver do if the machine makes contact with electric powerlines.

16. What precautions should be taken when cutting a trench across a footpath to a house?

17. What precautions must be taken if there is an old gas main 'somewhere' across where you have to cut a trench?

1B. How far must people be kept away from the machine when digging?

19. At what depth should a trench be timbered?

20. What is the danger of driving along the high side of a trench cut in sloping ground?

21. When filling a trench with a front end loader, should you approach square or diagonally to the trench?

22. You are going to lay pipes in a trench using a quick hitch attachment. What precautions must be taken?

23. Under what circumstances can a person be in a trench while pipe is being lowered into it?

24. What action should be taken if a large rock is uncovered in the side of trench being dug?

zs. How is the cubic capacity of the bucket calculated?

26. List 6 precautions which must be taken when lifting a load in the bucket.

27. What is the danger of loading uphill into a truck using a combination backhoe loader?

28. List 3 precautions which must be taken when lifting a load in the bucket.

29. Which stabilising foot would you put down first when working across the side of a slope? Explain your answer.

30. List 3 dangers of working in timber.

Chapter 4

31. What is the SWL of a FSWR 16 mm in diameter?

32. List 6 defects that would condemn FSWR.

33. What is the SWL of a 12 mm diameter grade 80 chain?

34. List 6 things that condemn a chain sling.

35. When laying a pipe in a trench under what conditions can you put the sling eye over a tooth on the bucket?

36. When can you reeve a sling around the bucket to lift a load?

37. When a sling is reeved around a square load how is the SWL altered?

Chapter 5

38. What must be checked about a travel route before moving excavator?

Chapter 6

39. List 6 things that must be checked and made safe before carrying out maintenance on an excavator.

40. How do you fill machine tyres with water ballast?

Notes