

National Construction College

Telescopic Handler

Study Notes

PL 013



National Construction College
The training division of ConstructionSkills

TELESCOPIC HANDLER

Regulations Applicable

- ⇒ Health and Safety at Work Act 1974
- ⇒ The Management of Health and Safety at Work Act 1992
- ⇒ The Electricity at Work Regulations 1989
- ⇒ The Control of Substances Hazardous to Health Regulations 1989
- ⇒ Provision and Use of Work Equipment Regulations 1998
- ⇒ Lifting Operations and Lifting Equipment Regulations 1998
- ⇒ Supply of Machinery (safety) Regulations 1992
- ⇒ The Noise at Work Regulations 1989
- ⇒ Road Traffic Act (UK)

& Guidance notes

- ⇒ Control of Noise Order 1984
- ⇒ Electricity on Construction Sites GS 24
- ⇒ Avoiding Danger from Buried Cables GS 23
- ⇒ Safe Use of Cranes BS 7121 Parts 1&2
- ⇒ Safe use of Lifting Equipment
- ⇒ Rider Operated Lift Trucks – Operator Training CoP 26
- ⇒ Working Platforms on Lift Trucks PM 28
- ⇒ Diesel Engined Lift Trucks in Hazardous Areas PM 58
- ⇒ Avoidance of Danger from Overhead Electric Lines GS 6
- ⇒ Safety in Working with Lift Trucks HS(G) 6
- ⇒ Lift Trucks in Hazardous Areas HS(G) 113

Further guidance on these regulations is given in the plant operator Safety Awareness training manual CSN 074, which accompanies this manual

Category of plant

Telescopic Handler
2-wheel and 4-wheel steer

MODULE ONE – INTRODUCTION

Although the telescopic handler carries out duties similar to the rough terrain forklift truck the design concept is totally different.

The rigid mast of the forklift truck is replaced by a telescopic boom which allows the telescopic handler to handle loads at far greater reach and height. Depending on the make and model the telescopic boom may be two or three stage.

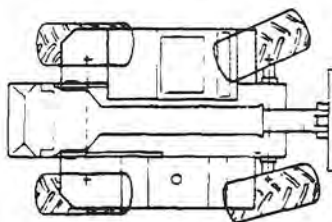
Some modern telescopic handlers have 360° slew capability, but these course notes deal only with rigid 2- and 4-wheel steer machines.

MODULE TWO – TYPES OF MACHINE

Steering Methods

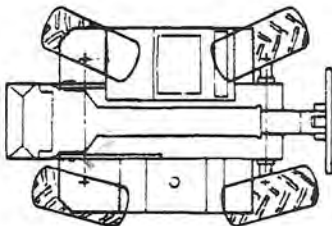
2-wheel steer

The front wheels steer with the rear wheels locked in the 'straight' position. This is the mode for road use. On some models rear wheel steer is used.



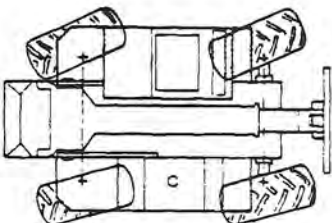
4-wheel steer

Both pairs of wheels steer so that the front and rear wheels run on the same turning circle. This mode is for use on rough terrain or soft ground, and for minimum turning circles.



'Crab' steer

Both pairs of wheels steer in the same direction so that the machine 'crabs' either to the left or right. This mode can be used to assist when manoeuvring.



Two- or Four-wheel Drive

Telescopic handlers may have two-wheel drive only or may be fitted with a selectable two- or four-wheel drive. Where four-wheel drive is fitted it should always be selected for site work where the conditions vary from hard to soft and muddy with ruts and uneven ground.

Two-wheel drive should be selected for use on hard surfaces and when the machine is travelled on a public highway.

Independent Braking

Some machines are fitted with independent brakes which allow one wheel to be braked independently of the other wheel on the same axle. Two brakes pedals are fitted side by side in the cab. Independent brakes are used to help manoeuvre the machine, especially in tight spaces.

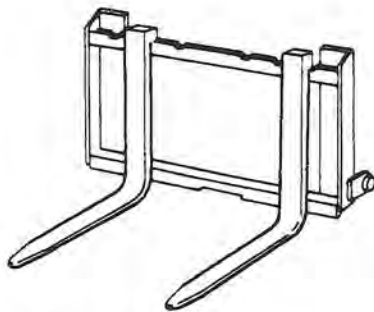
NOTE: Whenever the machine is to be travelled on a public highway the two brake pedals must be latched together. Independent braking should not be used (the brake pedals are fitted with a latch or locking device for this purpose).

Attachments

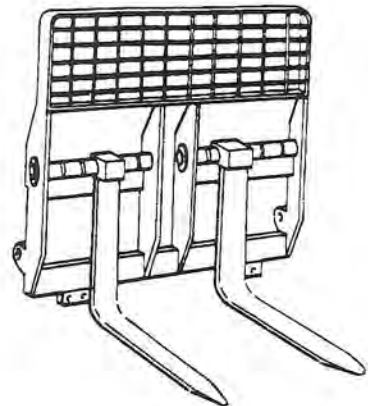
A wide variety of attachments are available which can be fitted to the telescopic handler to increase its versatility.

Some of the common attachments are:

FORKS – standard or floating. These are used for general handling duties.



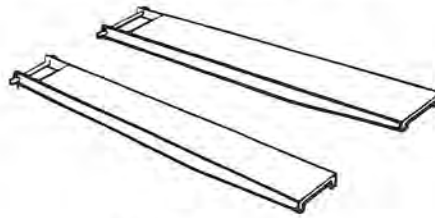
Standard forks



Floating forks

FORK EXTENDERS

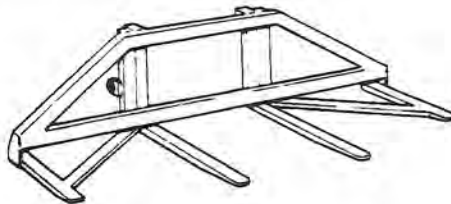
Attached to the forks to increase the fork length to allow handling longer loads.



Fork extenders

LOAD STABILISERS

Used to increase load stability when handling wide loads.

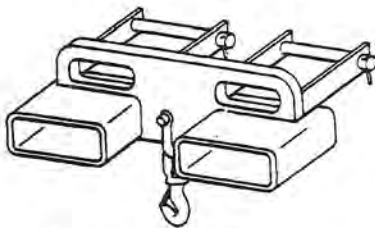


Load stabilisers

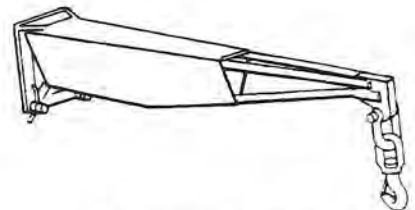
CRANE ATTACHMENTS

Used to lift suspended loads, there are two main attachments:

- a a clamp on hook which is fitted over the forks
- b an extension jib crane which is fitted in place of the forks.



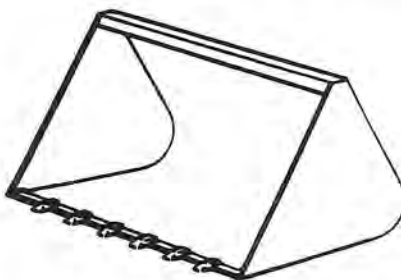
Clamp on hook



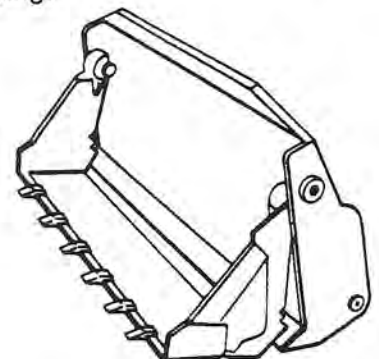
Extension jib crane

LOADING BUCKETS

To convert the machine to a wheeled loader, a standard or four-in-one bucket can be fitted and used for material loading and carrying.



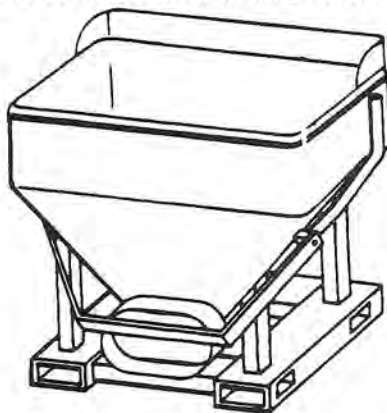
Standard bucket



Four in one bucket

CONCRETE SKIPS

These are used to transport concrete and to lift and discharge at heights.

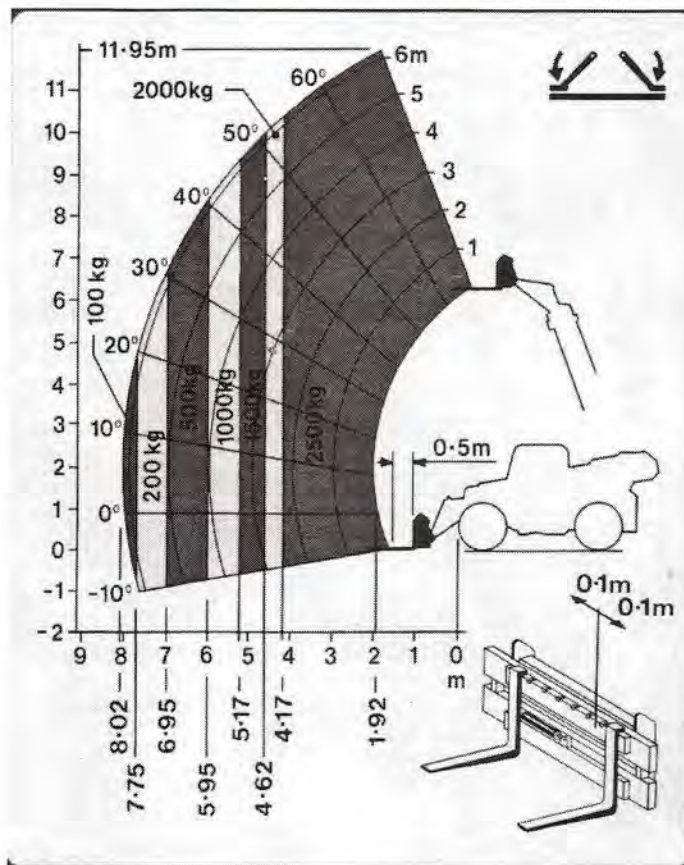
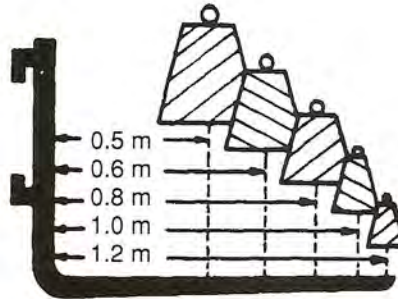


NOTE: There are many other attachments which can be fitted for specific purposes.

Whenever attachments are fitted the rated duty of the machine as shown on the duties plate may be altered by the fitting. Extreme care must be taken to ensure that these duties are not exceeded and that any regulations that apply are adhered to.

Load Centres

All machines have their lifting capabilities shown on a duties plate attached to the machine. These show the load in kilogrammes (or pounds) which can be lifted with the centre of gravity of the load situated at a given distance (the load centre) from the 'heel' of the forks. If the load centre is lengthened the load carrying capacity is reduced. Shortening the load centre does not however allow an increase in the maximum rated safe working load which must never be exceeded as it could lead to structural failure of the machine or cause the machine to overturn.



Telescopic handlers have a lifting envelope showing the safe working loads at differing radii and height.

MODULE THREE – POWER UNIT SYSTEMS

The Power Unit

How does a diesel engine work?

The fuel used in modern high speed diesel engines, usually gas oil, is a liquid which does not vaporise at ordinary temperatures. It is injected into the cylinders of the engine in a very fine spray.

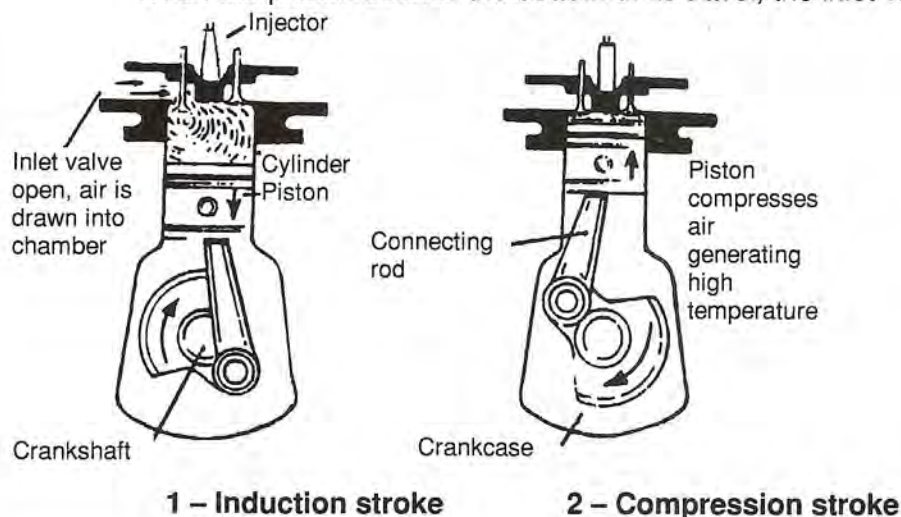
The air necessary for combustion is drawn into the combustion chamber and then compressed by the piston to a high pressure. The compression heats the air sufficiently to ignite the fuel spray spontaneously when the injection takes place.

This process is the characteristic feature of the diesel engine, or as it is otherwise called, the compression ignition engine.

Four-stroke cycle

It is quite simple mechanically. If we consider only the four-stroke engine (a complete movement of the piston, up OR down, is known as a stroke) the working cycle is as follows:

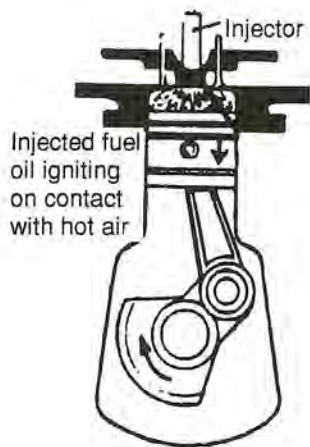
- 1 The piston moves down in the cylinder as the inlet valve opens, and a charge of clean air is drawn in. This is known as the **Induction stroke**. When the piston reaches the bottom of its travel, the inlet valve closes.



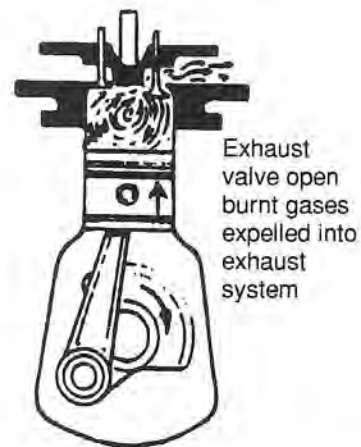
- 2 In the **Compression stroke**, both valves remain closed whilst the piston moves upwards; the charge of air is compressed and its temperature rises steeply. Just before the piston reaches the top of the compression stroke, fuel is injected into the top of the cylinder (combustion chamber) in a very fine spray.
- 3 The fuel is ignited instantly by the heat of the compressed air, and the piston is driven downwards by the rapid expansion of the burning fuel gases. This is known as the **Power stroke**.
- 4 Following the power stroke, the exhaust valve opens as the piston moves upwards, and the waste gases are expelled. This is known as the **Exhaust stroke**.

When the piston reaches the top of its stroke the exhaust valve closes, and this completes one cycle (four strokes).

The cycle repeats itself as long as the engine is supplied with air and fuel.



3 – Power stroke



4 – Exhaust stroke

Air Induction System

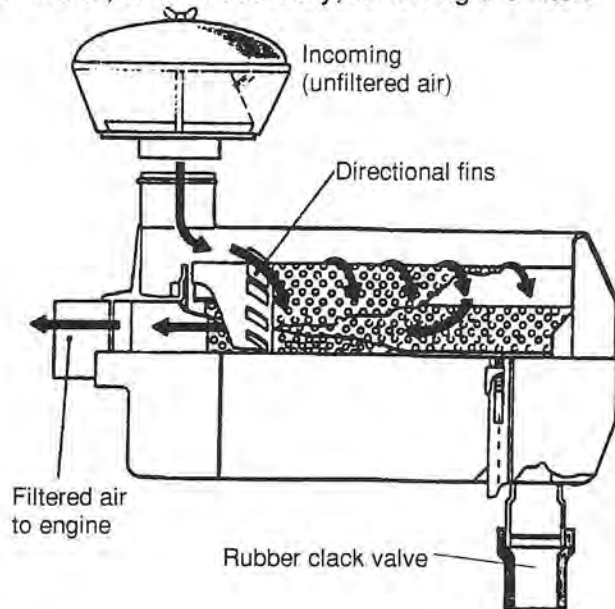
An air cleaner filters the air before it enters the combustion chamber, protecting the engine from dust, water and other foreign matter.

There are two types of air cleaner in general use, the *dry filter* type and *oilbath* type. Both types are usually fitted with a *pre-cleaner*. The pre-cleaner comprises either a cap or bowl shaped so as to create a swirling action which causes the heavier particles of dirt to fly outwards and be deposited either within the casing of the pre-cleaner, or ejected through vents to the atmosphere.

Dry type air filter

This type uses a paper filter element. Air is drawn through the pre-cleaner into the filter housing, then passes through the paper filter and into the engine. Foreign particles are retained by the filter, or else ejected through a rubber clack valve.

Servicing usually consists of gently blowing away the accumulated dust with a LOW pressure air line or, when necessary, renewing the filter.



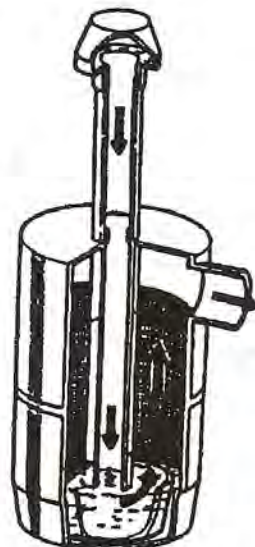
Dry type air filter

Oilbath type air filter

Air is drawn through the pre-cleaner down the inlet tube; then passes through the oil bath, and via a series of wire mesh screens into the engine.

Foreign particles are retained by the oil in the oilbath or collect on the oil-soaked wire mesh screen.

- 1 Both types of filter should be serviced at intervals recommended by the manufacturer. **UNLESS THE CONDITIONS OF WORK ARE IN RAIN OR DUST!** In these bad conditions the filters require more frequent servicing.
- 2 Some dry type filters incorporate a visual indicator which shows when the element requires cleaning or changing.



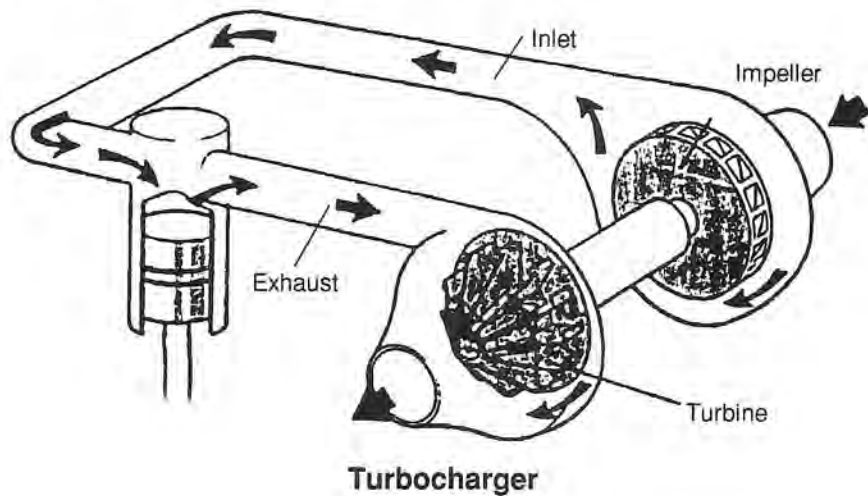
Oilbath type air filter

Turbocharger

Some engines have a turbocharger fitted. Exhaust gases from the engine drive a turbine at very high speed. The turbine is connected to an impeller which forces air under pressure into the induction manifold. The pressurised air increases the efficiency of the engine.

The engine should be run at a high idle speed for one minute before stopping. If this procedure is not complied with, the turbocharger can continue to run for a considerable time after the engine has stopped. As the turbocharger is lubricated from the engine lubrication system, it may then suffer loss of lubrication and seize up.

Note: Turbocharger speeds of 65,000 rpm are common. Special precautions must be taken when stopping a turbocharged engine.



Fuel system

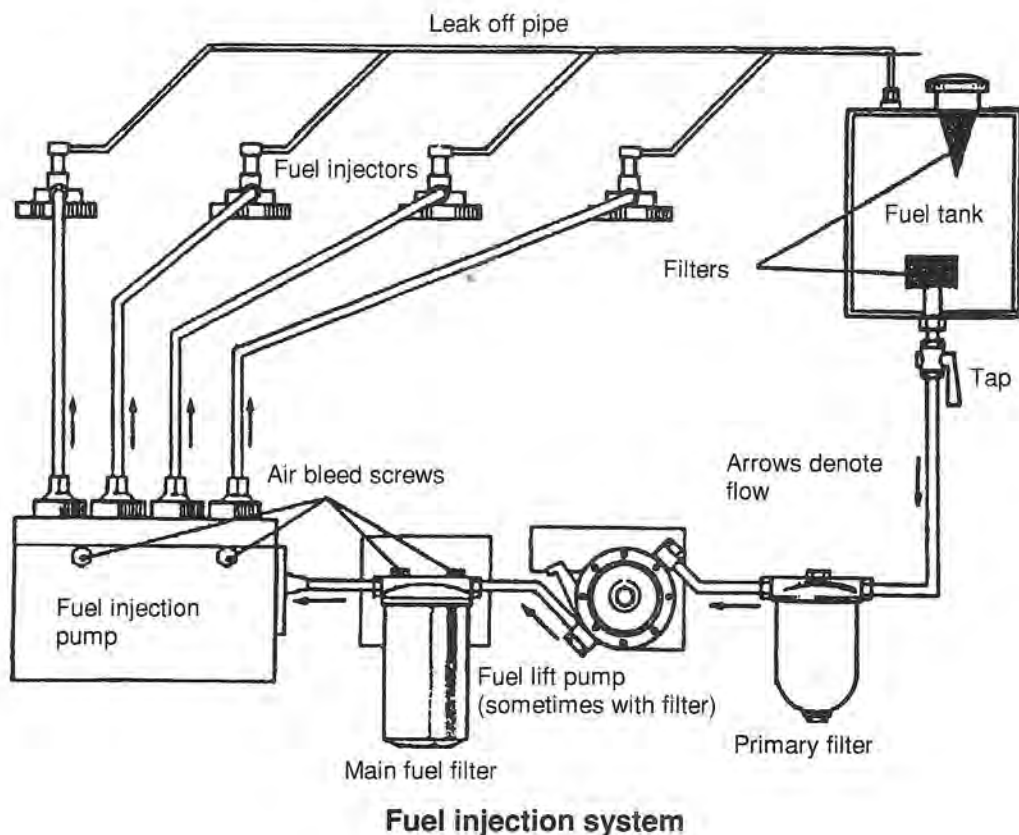
Fuel systems are designed and adapted by manufacturers to suit their particular requirements. Basically, they consist of standard components.

A supply of fuel is contained in the fuel tank. From there it is delivered via the *primary fuel filter*, which filters out coarse grit and foreign matter, and through the *fuel lift pump* to the *main fuel filter* which removes the finer particles. Next it goes to the *injection pump* which measures, pressurises and delivers the fuel to the engine's injectors by way of high pressure pipes, at the correct time. *Excess fuel* is delivered back to the fuel tank.

Diesel fuel is injected either into the cylinders by *direct injection*, or by injection into a *pre-combustion chamber*.

Direct injection takes place through several small atomising orifices, directly into the cylinder, where it is ignited. Multiple orifices, particularly of small size, increase the risk of clogging.

Pre-combustion designs inject through one large orifice into a pre-chamber where the fuel is atomised, and burning begins. The mixture then passes into the cylinder where complete combustion occurs.



Bleeding the fuel system

If air has entered the system, through lack of fuel, loose connections, fractured pipe etc. the engine will either stop or badly misfire. After the cause of the entry of air has been rectified, the system must be 'bled' as follows:

Note: This procedure should be carried out by a trained and competent person.

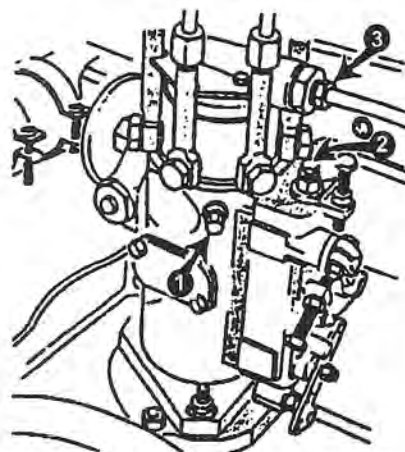
In-line fuel pump

- 1 Check adequate supply of fuel in the tank.
- 2 Check that the fuel cap air vent is clear.
- 3 Open the air bleed screws on the filters and prime by operating the lift pump until fuel flows free of air. Continue pumping whilst tightening the vent screws.
- 4 Carry out procedure (3) at the injection pump and restart the engine.

DPA fuel injection pump

On DPA pumps open the air bleed screws on the main filters, pump body and governor housing. Operate the priming lever and close the bleed screws in the following order: fuel filters, pump body and then governor housing. Also slacken and bleed at pump inlet union.

Note: If the engine still misfires, reopen, bleed and close each screw in turn working from the fuel tank towards engine.



- 1 Hydraulic head locking screw
- 2 Mechanical governor vent screw
- 3 Fuel pump inlet union nut

Set throttle in RUN position and bleed two of the injectors using the engine starter motor. Start engine and check for misfire. If misfire persists repeat process with remaining injectors.

Always take care to observe regulations concerning avoidance of fuel spillage onto site surface causing pollution.

Fuel tank

Only *clean fuel* must enter the tank, through a filter in the filler. Fuel tanks may 'sweat' inside during the night due to condensation and, to prevent this, they should be filled at the end of each day.

Avoid topping up with fuel from the bottom of a storage drum that may be contaminated with dirt or water.

Filters

These must be cleaned at intervals recommended and, where replaceable types are employed, new elements and gaskets fitted. If the presence of dirt or water is suspected then the whole system should be cleaned.

Fuel lift pump filter

This, with the sediment bowl, if fitted, must be cleaned regularly. Care must be taken in refitting so as not to damage the filter and gasket(s).

Fuel injection pump governor

Normally lubricated from its own sump, it must be checked regularly for correct oil level. Drain and refill in accordance with the maker's instructions.

No attempt should be made to tamper with or adjust the governor.

Starting Aids

Ignition of fuel in diesel engines depends upon high temperature of the inducted and compressed air. It is sometimes necessary during cold weather to assist the ignition of the fuel. Two types of device are in general use, an *excess fuel device* and a *glow plug device*.

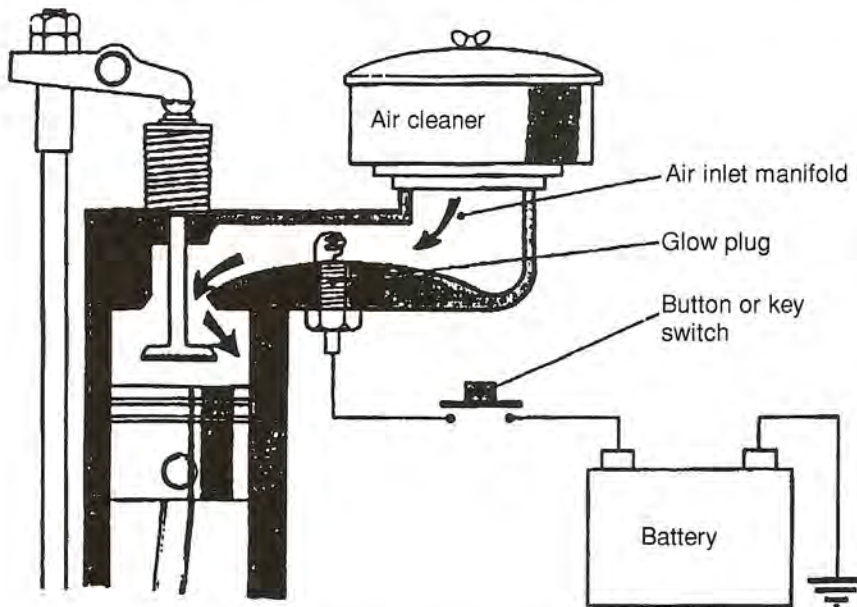
Excess fuel device

This allows delivery of an excess amount of fuel to the combustion chambers. It is normally operated by a control button on the fuel injector pump housing. The throttle must be open *before* setting the button. The device disengages automatically when the engine starts.

Glow plug device

An electric element fitted in the induction manifold (or in some cases, in each pre-combustion chamber) is operated by a control switch. When the starter is engaged, the inducted air flows over the element and is warmed to assist ignition.

Note: A variation, known as the THERMOSTART, injects fuel into the induction manifold where it is ignited by the glow plug to produce a flame to assist ignition.



Glow plug device

Lubricating system

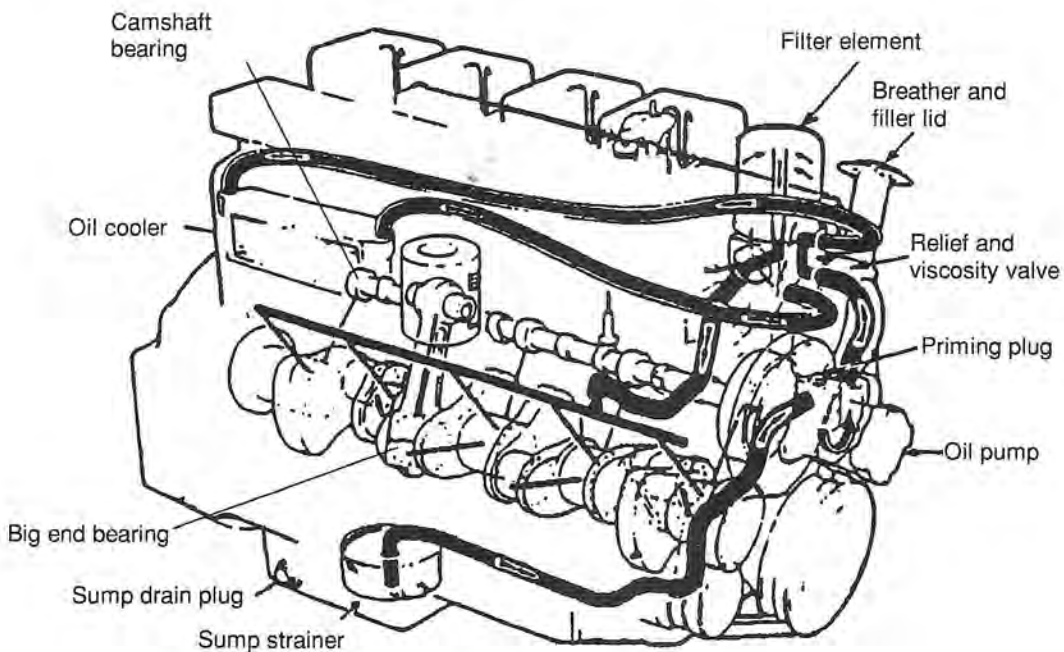
Without oil between the moving parts, wear through friction would be excessive and power would be lost. The heat generated would cause expansion and seizure of the parts.

Oil reaches the main and big-end bearings, camshaft bearings and rocker shaft under pressure. It bleeds out of the rocker shaft bearings and returns to the sump by gravity. The oil is heated by its contact with the moving parts, so this heat is removed by either an oil cooler fitted in the system, or by the movement of air past the surface of the sump. Foreign matter washed from the moving parts and passageways of the engine by the oil, either falls to the sump or is held in suspension by detergent oil and then removed by the filter.

The oil level in the sump should be checked before starting the engine. Remove the engine oil level dipstick, wipe clean and replace in the engine. Remove dipstick again and check the oil level against marks. If the level is low add clean oil until the correct level is obtained. **Do not overfill.**

Immediately after the engine is started, the oil pressure gauge should be checked for the correct pressure reading. A warning light is usually fitted to warn of low oil pressure. This warning light or gauge should be checked occasionally throughout the day for correct reading.

Any excessive oil consumption, unusual noises or vibrations should be noted and reported.

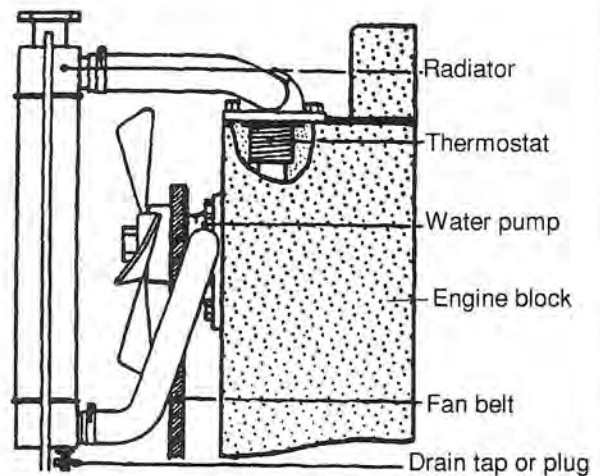


Typical lubricating system

Cooling System

Liquid cooling

The cooling system is designed to dissipate excessive heat. The engine cylinder block and head contain passages to allow circulation of the coolant (water). The system includes a *radiator* which provides a large cooling area and acts as a reservoir, a *fan* to increase the cooling air flow and a *thermostat* to restrict the flow of water to the radiator until correct working temperature is reached.



Radiator and fan

The coolant is circulated by a water pump and by the fact that heated water rises to the top of the radiator through convection.

Most liquid cooling systems are pressurised, using a special *radiator cap*, to allow higher working temperatures. Exercise **extreme caution** to avoid being scalded when removing the pressure cap from a **hot radiator**.

Air cooling

Another method of cooling is to provide each cylinder with finning over which cooling air is blown by a fan (blower). Ducting around the cylinders contains and guides the air down one side of the engine, around the cylinders, and then exhausts to atmosphere.

Maintenance of Cooling System

The system should be checked daily for:

- ⇒ sufficient and correct type of coolant
- ⇒ correct fan belt tension and condition
- ⇒ cleanliness of air passages

During cold weather always be aware of the operating temperature of the engine of the machine. A temperature gauge or warning light is generally fitted for this purpose.

Electrical System

To start the engine, the crankshaft must be revolved. Diesel engines employ an electric starter motor powered from the battery to perform this function. The motor is mounted on the engine and, when the starter switch or button is engaged, the motor turns a small sliding pinion which meshes with a gear ring around the flywheel. The starter motor pinion gear disengages automatically when the engine starts.

The starter motor mounting bolts and connections require occasional checking for security.

The battery, (or more than one battery) is maintained in a charged condition by a *dynamo* or an *alternator*. The batteries also supply electrical current for the lights, horn, windscreen wipers etc.

Batteries

Electrolyte (the acid liquid in batteries) should be checked regularly to ensure that it covers the plates. *Distilled water only* should be used to top it up.

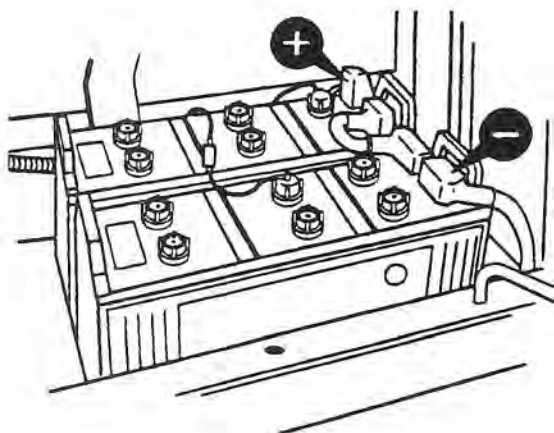
In addition to checking the level of the electrolyte the following regular checks should be made.

- ⇒ Battery posts clean and free from corrosion.
- ⇒ Terminals secure and clean.
- ⇒ Batteries secure in their mountings.
- ⇒ Filler caps in position with the air vents kept clear.

Note: Due to the presence of flammable gas given off in use, naked lights must not be allowed near batteries.

Ammeter

This is a gauge mounted on the instrument panel. It indicates the amount of charge current the batteries are receiving from the dynamo/alternator, or if a discharge (negative) situation applies. Whilst the engine is running the ammeter will normally indicate a positive charge.



Dynamo or Alternator

The purpose of the dynamo or alternator is to keep the batteries fully charged to enable all electrical circuits, including lights, and to keep them fully operational.

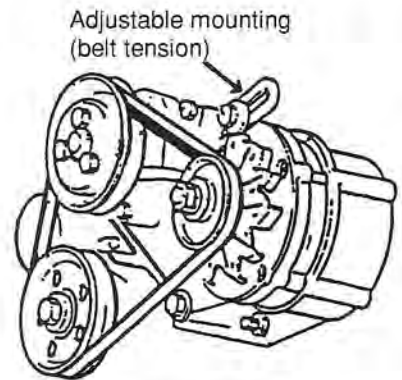
The mountings should be checked at regular intervals for security and, in addition, the end bearings lubricated in accordance with manufacturer's recommendations.

No engine should be run with the batteries disconnected as this may damage the dynamo/alternator internal components.

Note: When a power unit is fitted with an alternator:

It is essential that the alternator is disconnected, to avoid damage to internal components, before any electric arc welding is carried out on either the machine or its attachments.

The ignition switch **must** be in the ON position when the engine is running, and OFF when the engine is **stopped**, or the batteries disconnected.



Alternator

Belt drives

Cooling fan, dynamo, alternator, exhauster, water pump and compressor are generally driven from the engine crankshaft pulley by means of one or more belt drives.

These belts require regular attention to ensure serviceability and correct drive tension. Usually adjustment is made by moving one pulley closer to, or further away from, another pulley; or by employing a spring-loaded jockey wheel riding on the belt to limit the amount of slack.

Always refer to the maker's handbook for the correct belt adjustment.

Multi-belts must always be replaced as a *complete set*. If more than one belt runs on the same set of pulleys, all must be replaced if any fail.

MODULE FOUR – TRANSMISSION SYSTEMS

Transmission systems vary according to make and type but can generally be categorised as:-

Direct drive
Power Shaft

1 Direct Drive

Power from the engine is transmitted by a friction clutch through a sliding gear or constant mesh gearbox. From the gearbox the power is transferred by a propeller shaft to the crown wheel and differential and through drive shafts direct to the road wheels or through final drive reduction hubs.

2 Power Shift

Power from the engine is transmitted through a torque converter to either a countershaft or planetary gearbox. From the gearbox it is transferred the same way as in a direct drive system. Some power shift systems change gears automatically but others require the operator to select the gears required by means of a hydraulic control.

All transmission systems should have the oil level checked daily.

NOTE: Power shift transmissions have reduced engine braking effect and extra care should be taken when working on gradients to avoid over-run.

Hydraulic System

Provides fluid power to operate all the hydraulic functions of the machine.

The hydraulic oil is stored in a reservoir from which it is drawn by a pump which circulates the oil through pipelines to the control valves. From the control valves oil either returns to the reservoir or is directed, by opening the appropriate control valve, to a required service before returning to the reservoir.

The system runs at a pre-set pressure and if excessive pressure occurs a main relief in the control block will open to relieve this excessive pressure.

All hydraulic systems can easily be damaged by dirt, other foreign bodies or by contaminated hydraulic oil. Use clean oil, clean containers and always clean around reservoir filler cap before removing the cap.

Dynamo or Alternator

The purpose of the dynamo or alternator is to keep the batteries fully charged to enable all electrical circuits, including lights, and to keep them fully operational.

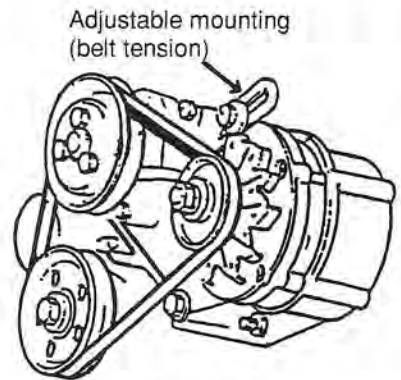
The mountings should be checked at regular intervals for security and, in addition, the end bearings lubricated in accordance with manufacturer's recommendations.

No engine should be run with the batteries disconnected as this may damage the dynamo/alternator internal components.

Note: When a power unit is fitted with an alternator:

It is essential that the alternator is disconnected, to avoid damage to internal components, before any electric arc welding is carried out on either the machine or its attachments.

The ignition switch **must** be in the ON position when the engine is running, and OFF when the engine is **stopped**, or the batteries disconnected.



Alternator

Belt drives

Cooling fan, dynamo, alternator, exhauster, water pump and compressor are generally driven from the engine crankshaft pulley by means of one or more belt drives.

These belts require regular attention to ensure serviceability and correct drive tension. Usually adjustment is made by moving one pulley closer to, or further away from, another pulley; or by employing a spring-loaded jockey wheel riding on the belt to limit the amount of slack.

Always refer to the maker's handbook for the correct belt adjustment.

Multi-belts must always be replaced as a *complete set*. If more than one belt runs on the same set of pulleys, all must be replaced if any fail.

MODULE FOUR – TRANSMISSION SYSTEMS

Transmission systems vary according to make and type but can generally be categorised as:-

Direct drive
Power Shaft

1 Direct Drive

Power from the engine is transmitted by a friction clutch through a sliding gear or constant mesh gearbox. From the gearbox the power is transferred by a propeller shaft to the crown wheel and differential and through drive shafts direct to the road wheels or through final drive reduction hubs.

2 Power Shift

Power from the engine is transmitted through a torque converter to either a countershaft or planetary gearbox. From the gearbox it is transferred the same way as in a direct drive system. Some power shift systems change gears automatically but others require the operator to select the gears required by means of a hydraulic control.

All transmission systems should have the oil level checked daily.

NOTE: Power shift transmissions have reduced engine braking effect and extra care should be taken when working on gradients to avoid over-run.

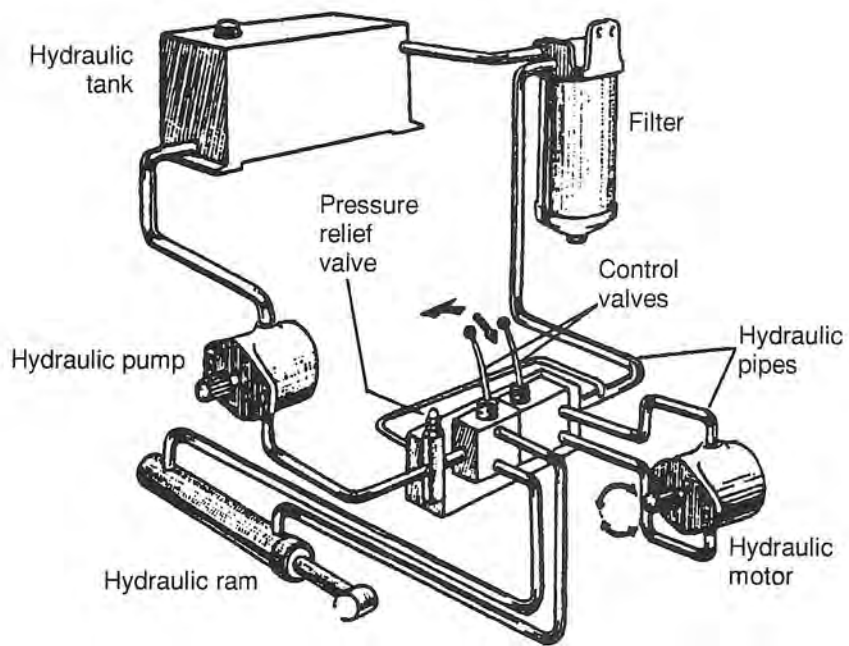
Hydraulic System

Provides fluid power to operate all the hydraulic functions of the machine.

The hydraulic oil is stored in a reservoir from which it is drawn by a pump which circulates the oil through pipelines to the control valves. From the control valves oil either returns to the reservoir or is directed, by opening the appropriate control valve, to a required service before returning to the reservoir.

The system runs at a pre-set pressure and if excessive pressure occurs a main relief in the control block will open to relieve this excessive pressure.

All hydraulic systems can easily be damaged by dirt, other foreign bodies or by contaminated hydraulic oil. Use clean oil, clean containers and always clean around reservoir filler cap before removing the cap.



Hydraulic system

MODULE FIVE – STARTING UP

Checks Before Starting the Engine

Check level of:

- 1 engine oil
- 2 hydraulic oil
- 3 coolant
- 4 fuel

Check the general condition of:

- 1 running gear and tyres
- 2 hoses
- 3 all attachments

Starting Procedure

- ⇒ All controls must be in the neutral position and all safety locks applied
- ⇒ Open throttle and if necessary use cold starting aids
- ⇒ Engage starter and release when engine fires
- ⇒ When engine is running smoothly, throttle back to fast idle
- ⇒ Check all gauges and warning lights

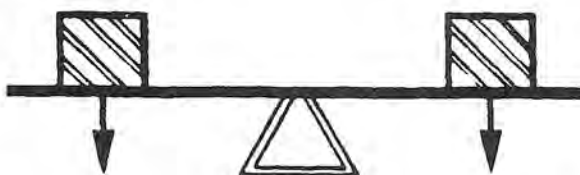
MODULE SIX – STABILITY

A truck and its load follow the same principle as the see-saw. Three vital factors can affect stability:

Weight – Force – Distance

The three figures below show how **distance** is just as important as weight.

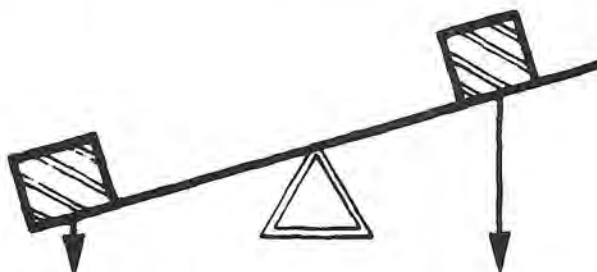
If two equal weights are placed at an equal distance from the pivot point the see-saw remains in balance



If the weight of the load on one side is increased the see-saw will tip.



If one of the equal sized weights is moved further from the pivot point the see-saw will tip.



This principle applies equally to the telescopic handler – with the centre of the front wheels acting as the fulcrum or pivot point. The weight of the machine is balanced by the load carried on the end of the telescopic arm. If the rated load is exceeded or the load extended too far then the machine will become unbalanced and could tip forward.

A rated load indicator (commonly referred to as a safe load indicator) is fitted to warn the operator approaching overload conditions and also to warn when an overload has occurred. These warnings are given visually by flashing lights on

the indicator panels and in the case of an overload by an additional audible warning by an alarm bell or klaxon.

Induced Forces

These are forces which act upon a machine, or its load, due to sudden changes in speed or direction, such as stopping, turning and starting. The greater the travelling speed of the machine when such incidents occur, the greater will be the effect of the induced forces. Induced forces could cause a machine to overturn sideways or to tip forwards. Travelling with a load raised will greatly increase the effect of induced forces.

Lateral and Longitudinal Stability

Anything which causes the telescopic handler to move away from a level condition will affect the stability of the machine.

1 Some causes of lateral instability.

- a Driving or working along a slope
- b Turning at speed, (instability increases as the radius of the turn decreases)
- c Centre of gravity of the load not over the centre of the wheel base
- d Uneven tyre pressures
- e Carrying a load too high
- f Travelling too fast

2 Some causes of longitudinal instability

- a Overloading the machine
- b Placing a rated load too far forward on the forks
- c Violent braking and starting
- d Erratic forward movement
- e Uneven tyre pressures
- f Operating hoist controls violently
- g Driving or working up and down a slope
- h Travelling too fast

MODULE SEVEN – SITE CONDITIONS

Regardless of the fact that telescopic handlers have rough terrain capability, the best possible running conditions should be provided. Machine stability is then maintained to the maximum extent possible. Sites should be tidied up and levelled off to create the desirable conditions for materials movement and placing in the working area. Routes should be planned to utilise site roads as far as possible, and running on irregular ground restricted to the absolute minimum.

Where a site is hilly, or has local steep gradients, routes should be designed to minimise the effect of such gradients. If steep slopes are unavoidable, the telescopic handler driver must be fully briefed as to the correct method of travelling with a load in such circumstances.

Always keep the weight uphill, i.e.

- 1 drive down/reverse up – empty
- 2 drive up/reverse down – loaded

At all times, routes should be kept in the best possible condition, and local pot holes etc. filled as soon as they occur.

Indiscriminate digging of trenches, pits and other excavations, at the wrong time could create serious hazards to materials handling operations.

Obstructions from odd items left lying about the site, can be avoided by systematic and planned stacking of material. Equally dangerous obstructions on or just above the ground may arise as part of the permanent work, travel routes should be arranged to avoid them.

Tyres

Telescopic handler tyres must cope with uneven ground, arduous and uncertain conditions, and the tyres' ability to withstand them is vital.

It is essential that tyre pressures are maintained as recommended by the manufacturers, and checked daily before commencing work. Failure to maintain the correct pressures will result in a short life, overheating and, most important, in the machine being out of level, which, in turn, will affect the load and machine stability.

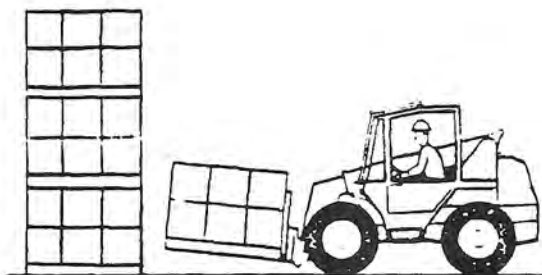
Some machines use water ballast in their tyres as an aid to stability, where this is so, the ballast must always be maintained in accordance with the manufacturer's instructions. Air pressure in this type of tyre should always be checked with the valve at the **topmost** position.

Note: Water ballasted tyres accentuate the effect of 'surge' during travel.

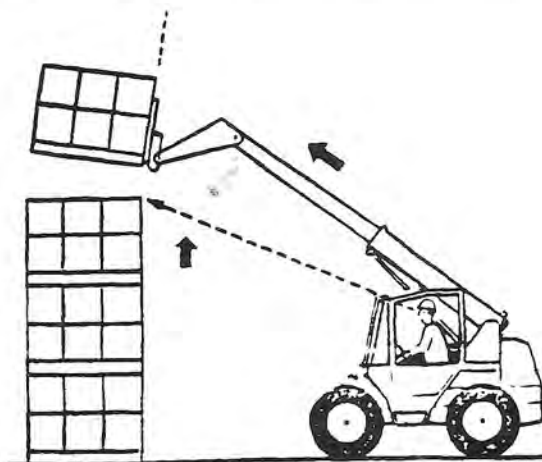
MODULE EIGHT – OPERATING TECHNIQUES

Stacking

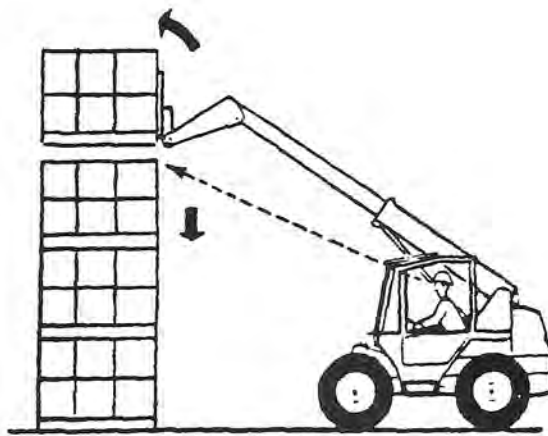
Always approach the stack squarely with the load in the correct carry position. Manoeuvre the truck so it is in the straight ahead position and stop at the face of the stack.



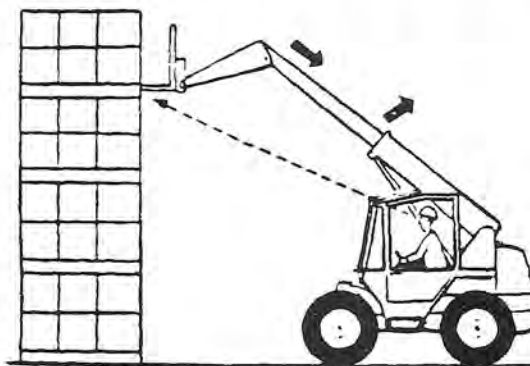
Lower stabilising jacks where fitted, making sure they are on firm ground, and check the machine is level by using the inclinometer. Raise and extend the boom to take the load directly over the stack.



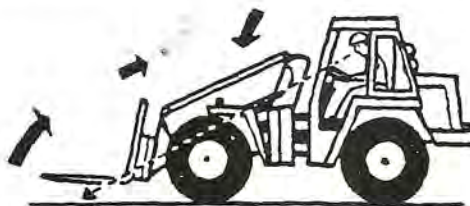
Remove backward tilt and adjust the boom angle to allow you to lower load onto the stack. If necessary, retract the boom slightly to help position the load.



Once the load is safely landed, withdraw the forks by alternate use of the boom retracting and angle controls. On firm level ground and if stabilisers are not used you can remove the forks by reversing away from the load slowly.



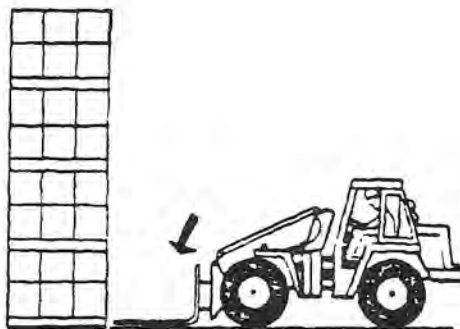
When clear of the stack tilt the fork carriage backwards, retract boom fully and lower to return the equipment to the travel position before moving off.



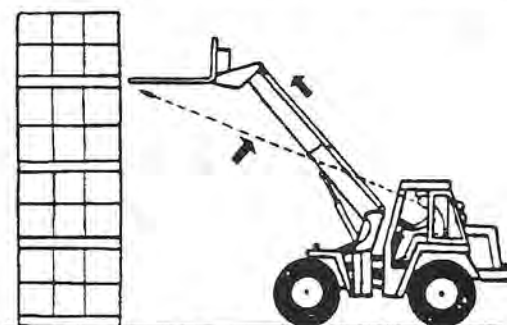
Destacking

Ensure the weight of the load is within the capacity of the truck.

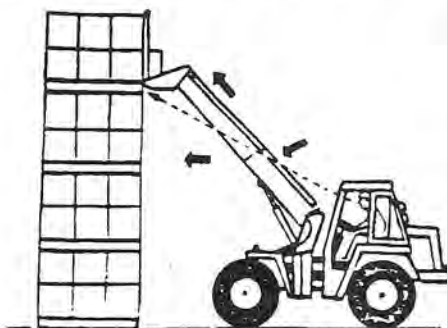
To destack a load: halt at the face of the stack, apply brakes, lower stabilisers if fitted and adjust fork spread to suit the width of the load.



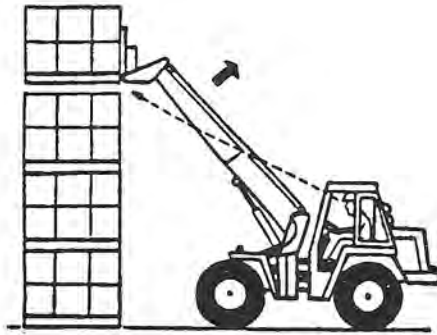
Raise and extend the boom to a position where with a combination of boom and tilt movements the forks can enter the pallet or dunnage strips.



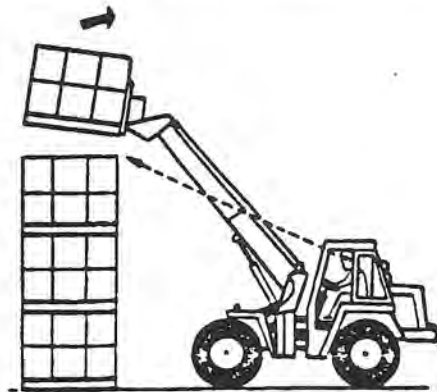
On level ground if stabilising jacks are not used and the weight of the load permits, drive slowly to insert the forks into the pallet or dunnage strips.



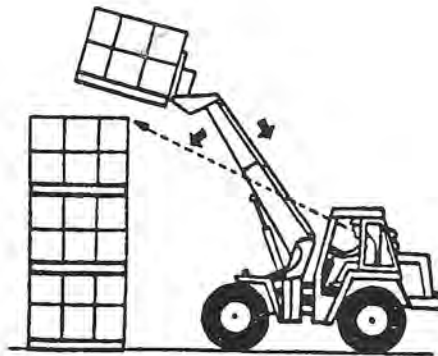
Check boom angle and extension are compatible with the expected weight of load. Take the weight of load, re-check with Safe Load Indicator that load is within the capacity of truck.



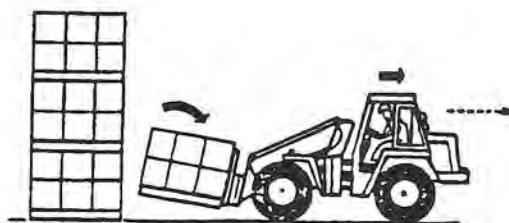
Lift the load clear of the stack, tilt slightly rearwards to stabilise the load



First retract then lower the boom carefully and smoothly to the correct travelling position.



Tilt further backwards, raise stabiliser jacks if fitted and used. Make sure way is clear and then move off.

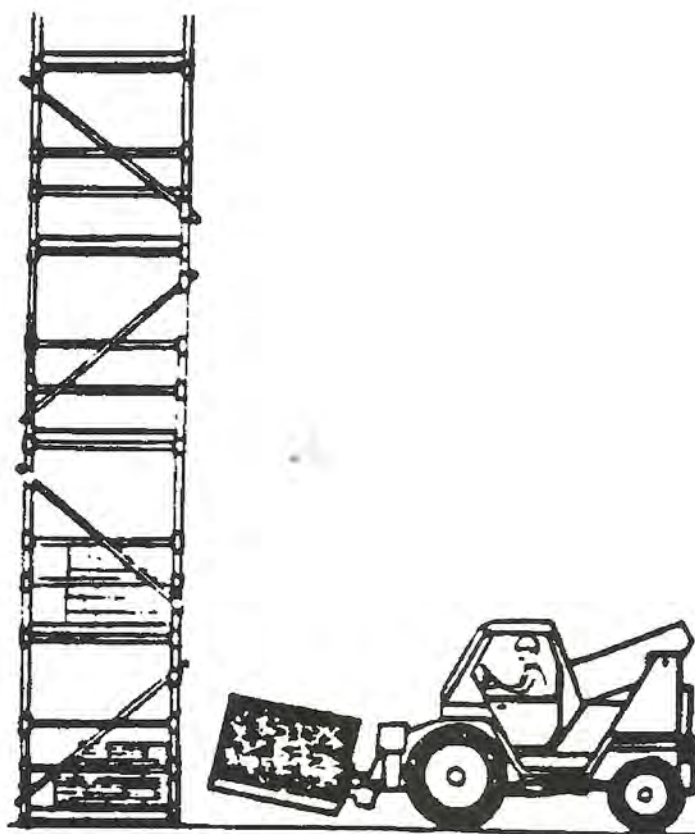


Stacking at Very High Levels

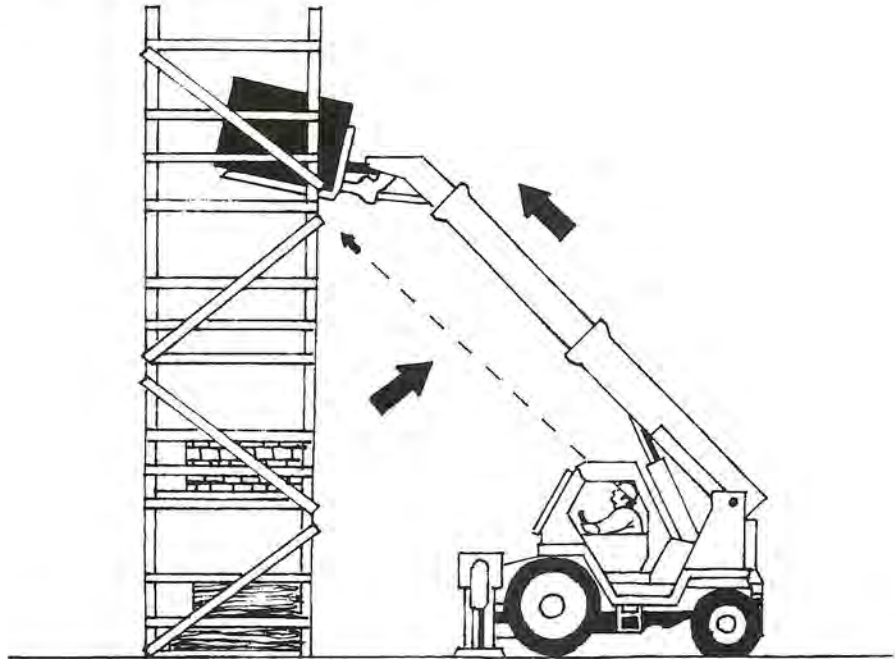
Approach the stack squarely with the load low.



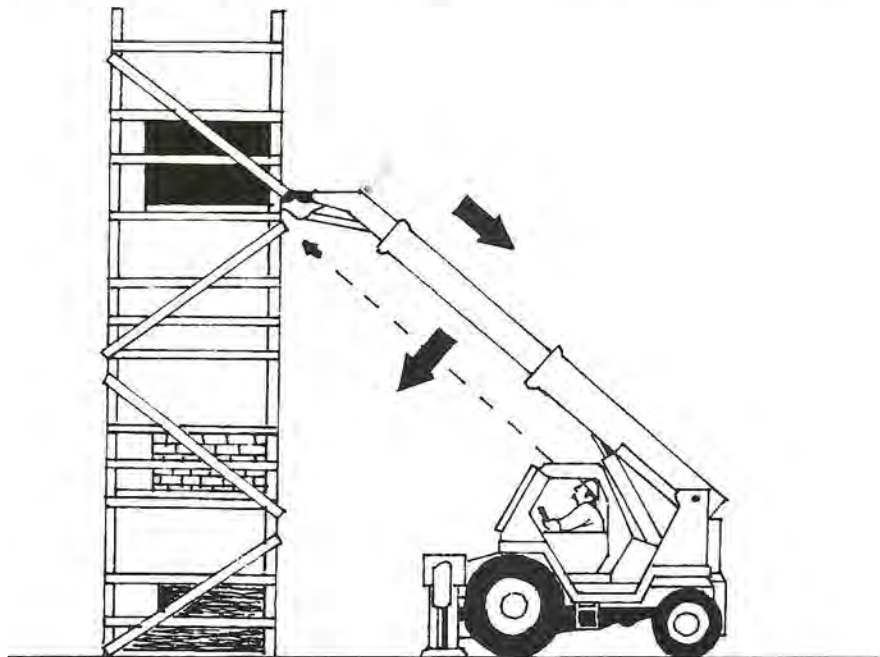
Stop at the face of the stack, apply brakes and lower stabiliser jacks if fitted ensuring they are on firm ground.



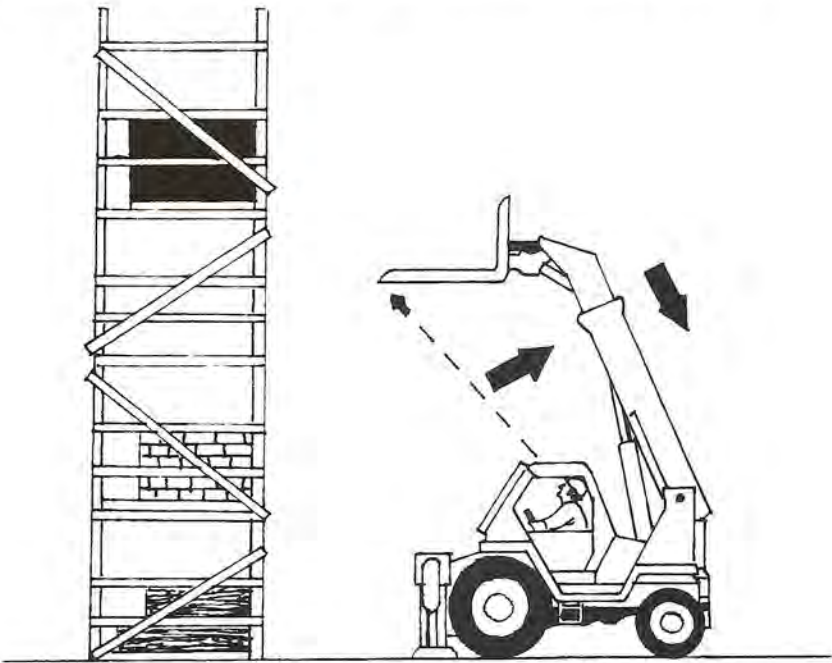
Raise and extend the boom until the load is over the loading area. Monitor the boom angle and extension and/or the Safe Load Indicator. If the maximum safe levels are approached cancel the operation firstly by retracting the boom and then lowering it.



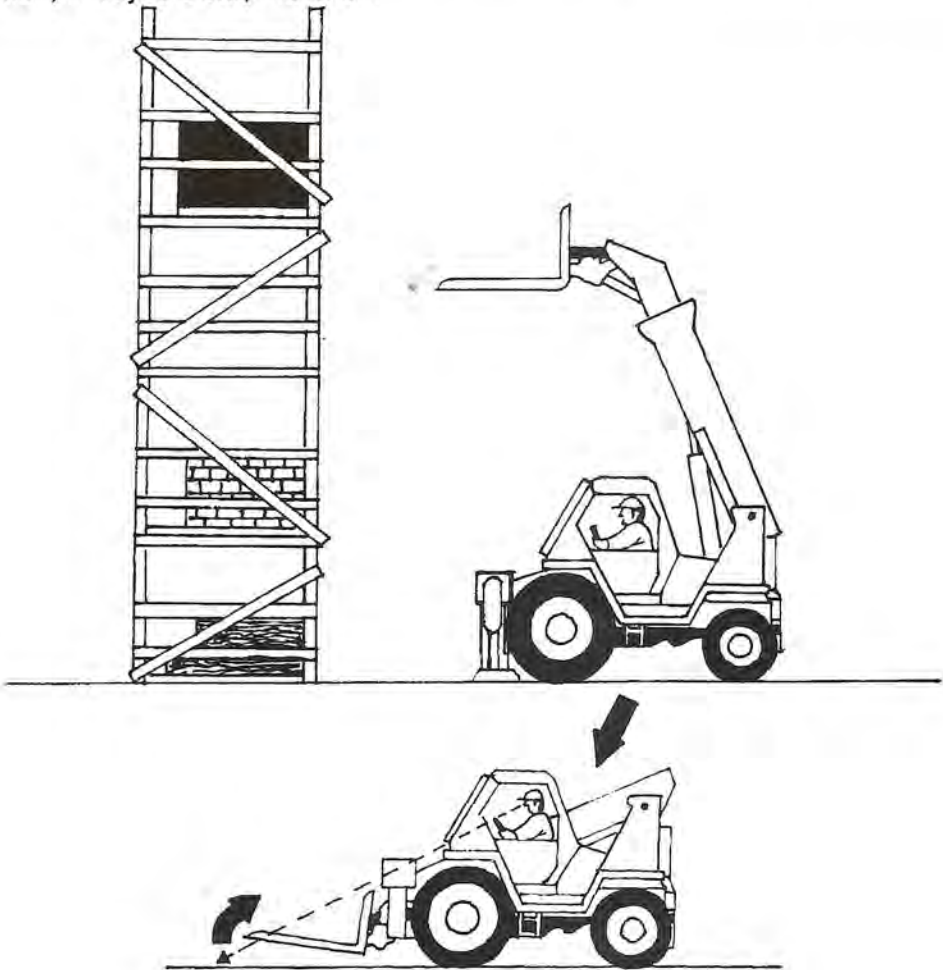
If load levels are safe, remove backward tilt and lower the load into position by retracting and lowering the boom slightly.



Free and withdraw the forks by using alternate movements of the boom retract and angle controls. Once clear of the stack retract the boom fully.

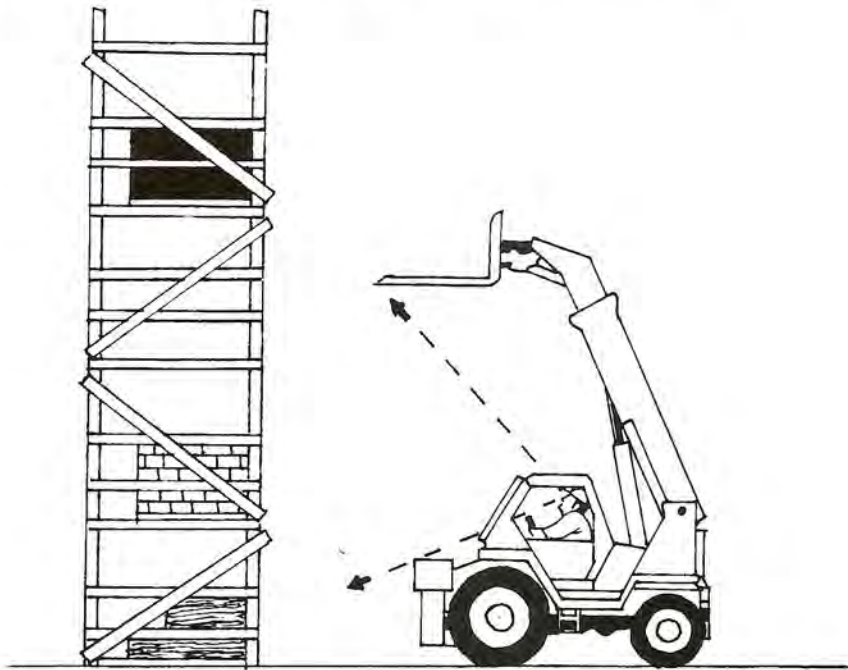


Lower boom and raise stabiliser jack if used. Return all equipment to the travel position, if way is clear, move off.

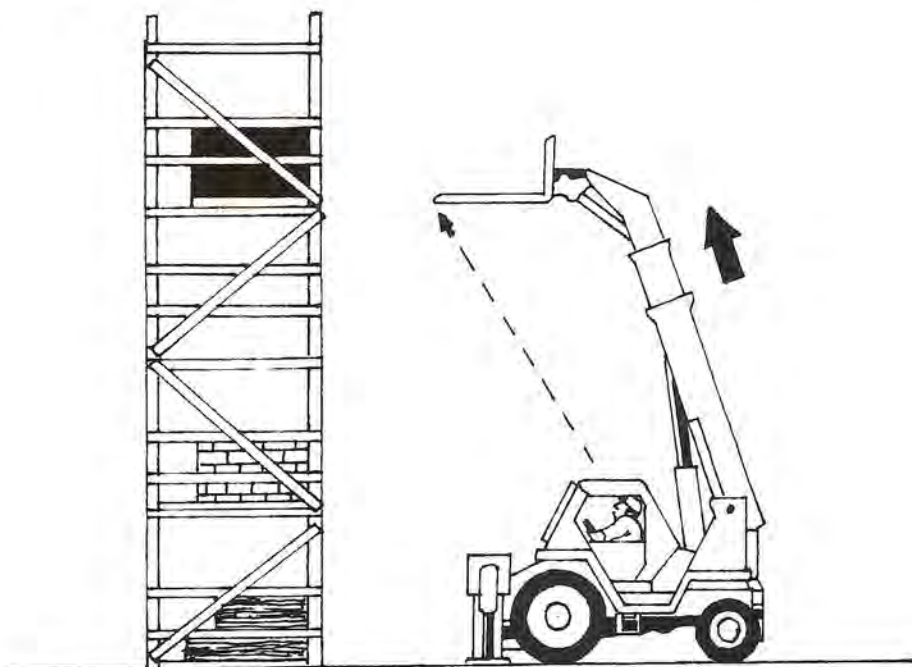


To Destack a Load From High Levels

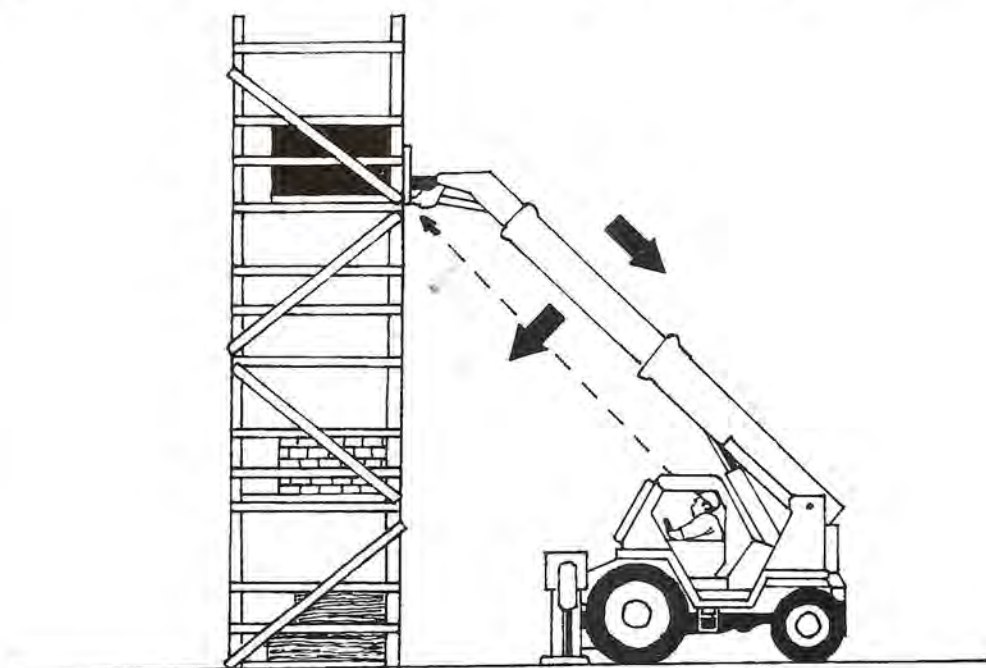
To destack a load from a high level, firstly drive close (allowing room to lower load if stabilisers are used) and squarely to the stack. Apply the brakes and select neutral. Lower the stabiliser jacks, if fitted, ensuring they are hard down on firm ground.



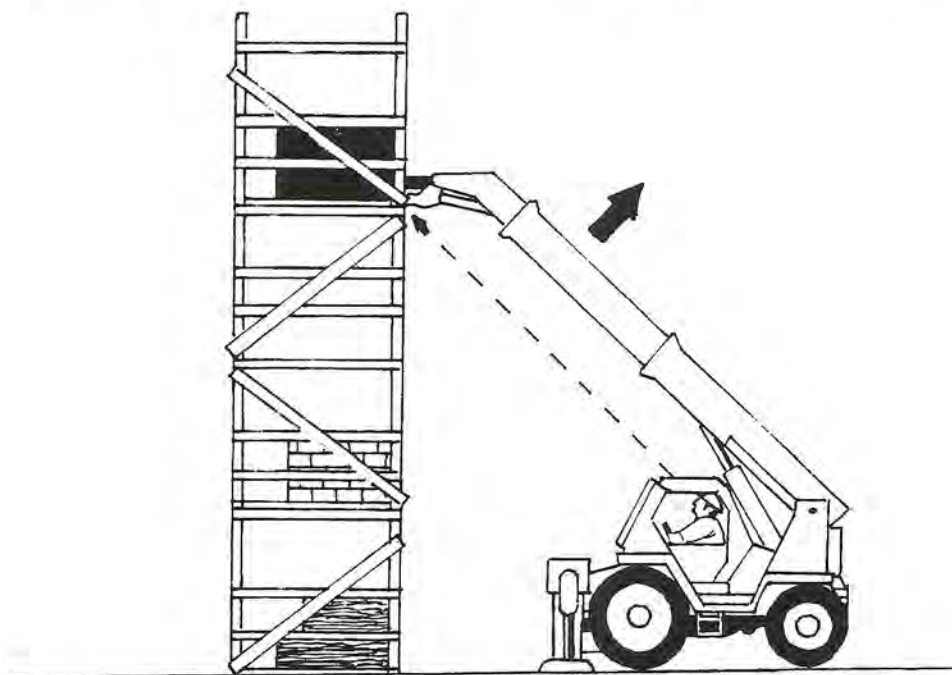
Raise and extend boom until the forks are in a position to enter the pallet or dunnage strips cleanly.



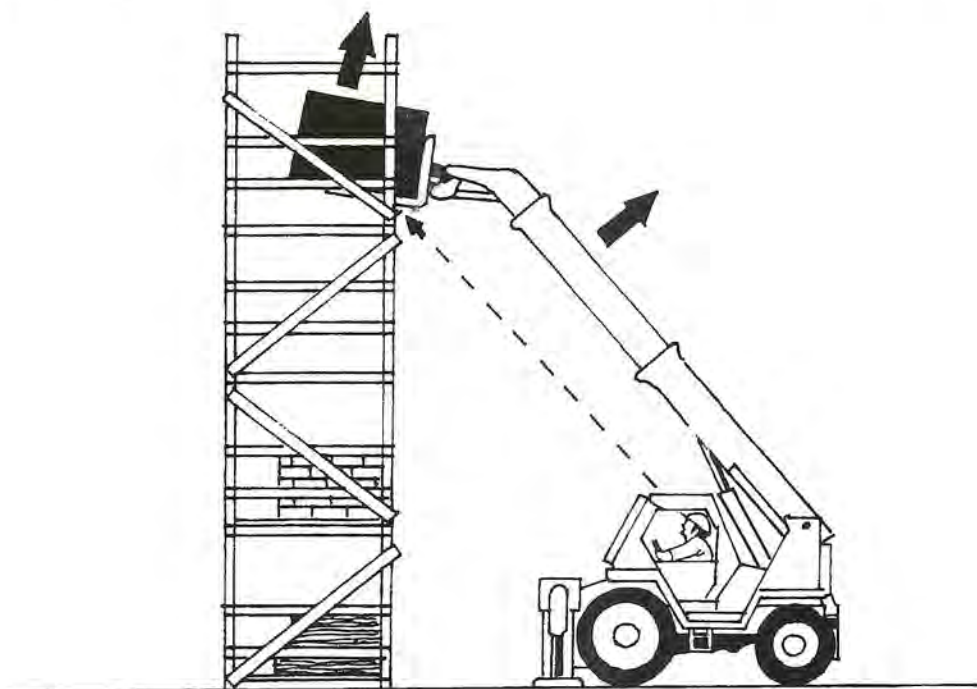
Fully insert forks by alternative use of boom angle and extending controls



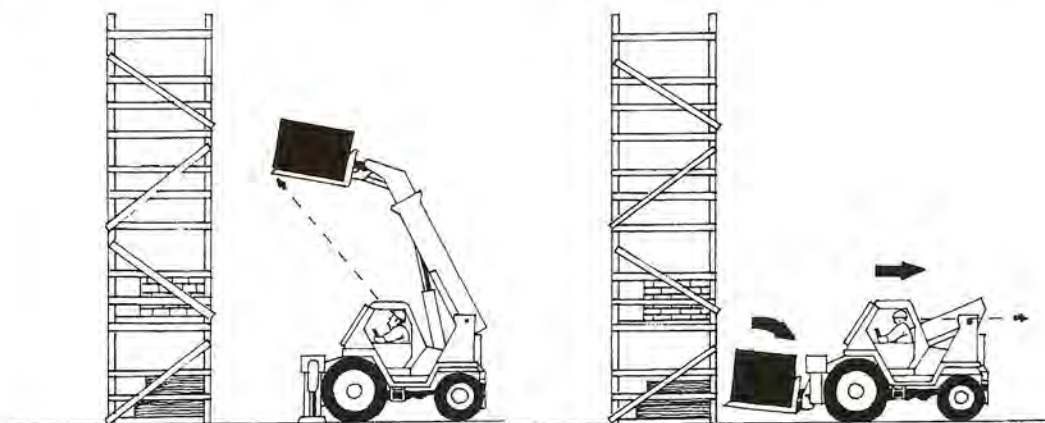
Check that the boom angle and extension are compatible with the weight of the load to be lifted. Slowly raise the load and check by using the safe load indicator that the weight of the load is within the capacity of the truck



Lift the load just clear of the stack and tilt the forks backwards just sufficient to stabilise the load.



Raise the boom slightly and retract the load as far as possible, then lower the load, raise the stabiliser jacks, adjust the load to the travel position. If the way is clear, move off.



MODULE NINE – OFFLOADING AND LOADING VEHICLES

Any vehicle being unloaded/loaded should be on a prepared area or an adjacent road. If possible it should be unloaded and loaded in such a manner that the platform remains level.

The following points should be observed:

- a Check that the unit loads are within the machine's capacity
- b Ensure that the forks do not project beyond the far side of the load and interfere with adjacent loads
- c The vehicle driver should be out of his cab acting as banksman
- d Unload from the rear first and load from the front first
- e Raise load just clear of the platform, ensure it is within safe working capacity and check the stability before travelling

Manoeuvring

Manoeuvring on site entails similar care and attention to that used with a mobile crane. Such care involves not only the machine, but also the conditions in which it operates.

The following should be observed:

- a Recently backfilled excavations should be consolidated so that they will support the machine **and** its load safely
- b Access ways should be wide enough to accommodate two vehicles
- c Unless the driver has an unrestricted view he should be guided, when travelling forwards or backwards, by a banksman
- d With all wheel steer machines a lift should not be made unless the front and back wheels are in a straight line
- e Travelling on gradients demands special care
- f Travel speed should be kept down to minimise load surge when braking (see also water ballasted tyres)
- g Where overhead electric lines exist the appropriate legislation must be complied with

Travelling with Loads

- a Before moving with a load, the forks need to be raised clear of the ground. To maintain maximum stability this should not be more than approximately 150mm (6 inches)
- b The forks should be leading when travelling loaded up an incline and trailing when travelling loaded down an incline. (The reverse applies when the machine has no load, i.e. The counterweight facing **up** the slope.)
- c It may be necessary on occasions to travel with the load elevated because of the nature of the load, or that it might foul obstructions. In such circumstances, the load should be well heeled and secured to the forks, and the travel speed as slow as possible.
- d The driver, should **always** be facing the direction of travel and, if the load, or obstructions, impair his view, be under guidance from a banksman.

Stacking

When forming a stack with unit load elements adequate precautions are necessary to ensure the stability of the whole. Such stability depends on:

- a the quality of the stacking area, and its ability to support the loads
- b ability of the unit loads to support the loads above them
- c height/base ratio of the stack (it is recommended that the height should not exceed three times the minimum base dimension of the package)
- d box or post pallets – for the containerisation of loose materials, should never be stacked unless of the interlocking type
- e unit loads which do not require pallets, e.g. timber and plasterboard, require separators one above the other
- f when stacking prestressed elements, ensure that the separators are placed in the **specified positions**

Loading Towers

Loading towers are coming into increasing use due, primarily, to brick and block manufacturers producing unit loads in excess of those acceptable on normal scaffolds. Such towers have many safety advantages:

- a They are independent of the main scaffold so that excess loading of the scaffold cannot take place
- b Shock loading is not transmitted to the building
- c They are designed with a known load capacity
- d Resulting from (c) they provide a safe reservoir of materials

At the platform level of loading towers guard-rails and toe-boards are necessary to comply with statutory regulations. These must be replaced immediately after material is stacked onto the towers.

MODULE TEN – PALLETS

Flat Pallet

This type has a deck or decks but no superstructure. When the decks are composed of a number of spaced slats it is referred to as construction of a flat pallet.

Top deck – the upper deck on which the load rests

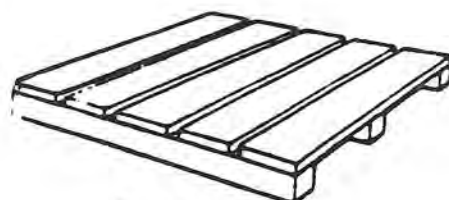
Bottom deck – the lower deck of a double decked pallet, acting as a base

Bearers – members under the top deck or separating the top and bottom decks which provide space for the entry of forks

Stringer – a horizontal member connecting the bearers and supporting the deck; used in four-way and eight-way entry pallets

Single-deck Pallet

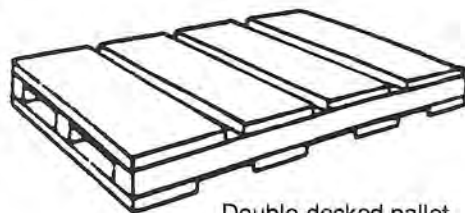
A pallet with only a top deck. This is the simplest kind of flat pallet, suitable for items which can withstand the concentrated loads imposed by the bearers during stacking, e.g. wooden boxes and drums. It is also used for storing unit loads in racks when the bearers are supported on the rack framework.



Single-deck pallet

Double-decked Pallet

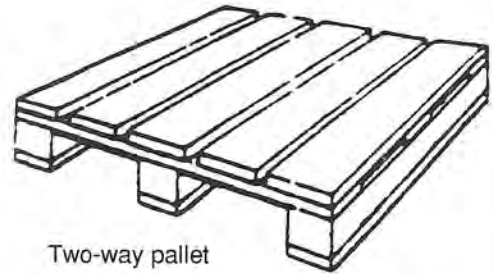
A pallet with top and bottom decks. The bottom deck adds to the strength of the pallet and makes it more suitable for stacking since the bottom slats provide a larger surface area and, therefore, a less concentrated load distribution. If used in conjunction with pallet trucks, the spacings between the bottom slats must allow the passage of the truck load wheels.



Double-decked pallet

Two-way Pallet

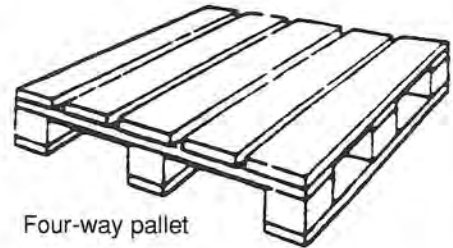
This figure illustrates this type of pallet. Here the bearers permit the entry of forks or fingers from two opposite directions only. The sides through which the forks enter are called the 'entry sides'.



Two-way pallet

Four-way Pallet

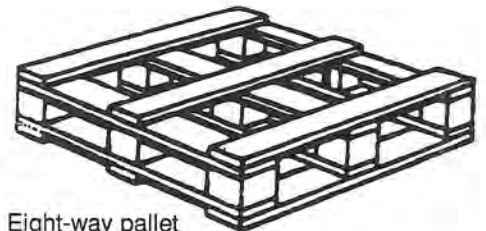
A pallet having bearers which permit the entry of forks or fingers at each end and at each side. The sides through which the finer wheels of a pallet truck can pass without leaving the ground are known as 'free entry sides'. The facility for pick-up in two directions at right angles can be of advantage in block stacking operations. The over-all height of the pallet is increased by the inclusion of the stringers.



Four-way pallet

Eight-way Pallet

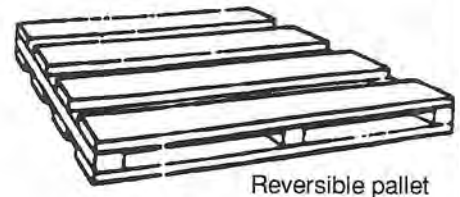
This construction permits entry for the forks on all four sides and diagonally on all four corners. This type of pallet is not in common use since, though it gives greater flexibility, it is more expensive and the additional bottom stringers increase further the height of the pallet.



Eight-way pallet

Reversible Pallet

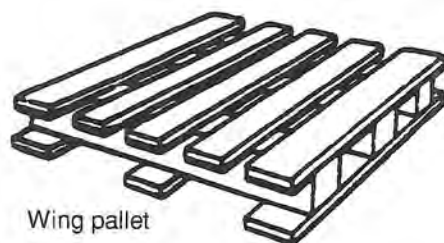
A double decked flat pallet with identical top and bottom decks. The one shown has a good bearing surface but is not suitable for use with pallet trucks.



Reversible pallet

Wing Pallet

The foregoing flat pallet illustrations depict 'flush' pallets, i.e. the top deck or both decks do not extend beyond the bearers. The wing pallet is made with the top and often the bottom deck extending beyond the bearers for lifting purposes, e.g. for handling by overhead crane or mobile crane with spreader bar slings.



Wing pallet

Skeleton Pallet

The term given to a pallet constructed with the minimum of decking.



Skeleton pallet

Maritime or Stevedore's Pallet

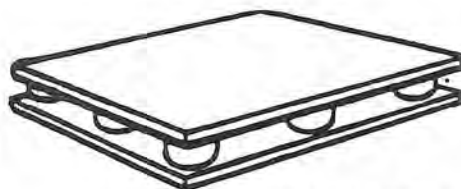
A large, strongly constructed pallet with, in some cases, steel channel outer bearers. Lifting eyes are fitted on some types for slinging by crane; other types have retaining lugs housed within the wings of the pallet for use with bar slings. Sizes range between 4' x 5'4" and 4'6" x 6', and carrying capacities from two to three tons. Maritime pallets are used for the movement and stacking of goods in ports and for transport by sea.



Stevedore's pallet

Expendable Pallet

One used for movement of product between supplier and customer, which can be regarded as non-returnable. Materials used for manufacture are usually wood, plywood or fibreboard and the unit load is often strapped to the pallet. The expendable pallet represents a commonly used type made up of two sheets of reinforced paper fibreboard with cylindrical fibreboard spacers.



Expendable pallet

MODULE ELEVEN – MAINTENANCE

Maintenance Programme

All machines are expensive. If users are to obtain a profitable return on plant investment, it is essential that the machine is maintained fully and economically.

An efficient maintenance programme makes use of all available resources. These include the operator, the site mechanic, depot mechanic and various workshop facilities.

The object will be to:

- ⇒ maintain maximum output from the machines
- ⇒ obtain maximum working life between overhauls
- ⇒ as far as possible prevent breakdowns on site

Generally, maintenance can be divided into two categories:

- ⇒ planned
- ⇒ preventative

An effective maintenance programme should be a combination of the two.

Planned maintenance

This is an overall plan designed to ensure that the machines are fully maintained with the minimum number of staff. Aim for an even work load on the maintenance department.

The plan should take into consideration:

- ⇒ company policy
- ⇒ length of time the machine will be retained
- ⇒ type of machine
- ⇒ type of work for which it will be used
- ⇒ expected hours the machine will work by day, week, month, etc.

Previous experience, and knowledge obtained from records or other sources or different machine characteristics, can assist greatly in the formulation of such a plan. Regular technical inspections are necessary to allow amendments to the plan as needs arise, also to ensure that operator maintenance is being carried out efficiently. The reports from these should indicate:

- ⇒ the location of the plant
- ⇒ the lubrication and cleanliness state of the machine
- ⇒ the mechanical state of the machine. Show repairs that require immediate action; repairs that should be effected in the very near future; and those that can safely be carried forward to a more convenient date
- ⇒ the total machine hours

Records of field servicing, adjustments and running repairs will assist in amending and updating the overall maintenance plan. The plan must be sufficiently flexible to allow for unforeseen circumstances, such as machine damaged in transit, etc.

Preventative maintenance

This is a series of checks and inspections performed at regular intervals. They are designed to extend the working life of the machine, and prevent premature and unexpected failure of components.

The inspection will be of the whole machine to assess general wear and condition of parts, and allow ordering of any replacements. It will also allow the arrangement of machine time so that repairs or replacements can be effected with the least interruption to the work schedule.

The operator's contribution to preventative maintenance is of prime importance. It is essential that adequate time and facilities are given. Supplies of materials (oils, greases, etc.) should be always to hand, with suitable provision for storing them.

All maintenance should be carried out in accordance with the machine manufacturer's schedule or as dictated by company policy.

MODULE TWELVE – TRANSPORTATION

Transporters will normally be in one of the following categories:

- ⇒ Articulated low-loader
- ⇒ Semi low-loader
- ⇒ Towed trailer

But whichever type is used, it must be adequately capable of carrying the weight of the machine.

All loading and unloading operations must be carried out on firm, level ground.

Rear End Loading

- 1 The transporter must be in a straight line with the brakes applied, and with a low-loader it will be necessary to remove the rear wheels or drop the trailer at the swan neck.
- 2 On a semi low-loader, place packing underneath the rear.
- 3 Fix the ramps in position, making sure that they are firm and secure.
- 4 Line up the machine with the ramps and drive up slowly.
- 5 Travel the machine on to the transporter, and position it according to the driver's instructions.
- 6 Lower all attachments, place the gears in neutral, lock on the brakes and stop the engine.

NOTE: In some cases the assistance of a winch will be safer and even necessary, as when loading an unserviceable machine.

Unloading

Particular care should be taken to drive squarely down the ramps.

Signals

The driver will normally guide the operator on or off the transporter, and he should stand in a prominent position and use signals that are clearly understood.

MODULE THIRTEEN – SAFETY

Before Operation

- ⇒ Always ensure machine is serviceable and safe to use
- ⇒ Carry out the daily checks
- ⇒ Always face the machine and use the hand and foot holds provided when climbing on or off. **Never jump**
- ⇒ Check the location of underground services and overhead lines
- ⇒ Clean all windows, mirrors, lights
- ⇒ Check the function of brakes, steering and all controls
- ⇒ Lock cab doors open or keep them shut. Never let them swing loose

During Operation

- ⇒ Always wear a seat belt if fitted
- ⇒ Periodically check the instruments and gauges
- ⇒ Never carry passengers
- ⇒ Be aware of persons entering the working area of the machine
- ⇒ Keep cab clean and free of loose items
- ⇒ Lower all attachments to the ground whenever you leave the machine
- ⇒ Use all safety devices fitted
- ⇒ Travel at speeds consistent with site conditions
- ⇒ Never remove guards with engine running
- ⇒ Always look to the rear before reversing

After Operation

- ⇒ Always park on firm, level ground in a safe location
- ⇒ Lower all equipment to the ground and (when engine has stopped) release pressures
- ⇒ Apply handbrake and all safety locks
- ⇒ Stop the engine, remove key and lock the doors