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1. Introduction

The work of the Civil Engineering, Mining Industry and Building Sectors of the Construction Industry requires a wide range of plant machinery with a number of basic uses. In order that the plant should have additional flexibility, a variety of attachments have been developed over the years so that machines can be quickly, and easily converted to perform different functions or to extend their original functions. The following chapters give brief descriptions of a wide range of the Earthmoving and Construction Industry Plant under the headings of:

a. Earthmoving
b. Cranes
c. Road Surfacing
d. Compaction
e. Access Equipment
f. Materials Handling

1.1 Earthmoving Plant

The main plant machines in the earthmoving group are:

- Digger-loaders
- Crawler dozers
- Wheeled dozers
- Crawler loaders
- Wheeled loaders
- Graders
- Dump trucks
- Scrapers
- Wheeled Hydraulic excavators
- Tracked Hydraulic excavators
- Crawler Rope excavators
- Trenchers
- Mini excavators
- Mini loader
1.1.1 Excaloader
(Digger-loader)

The digger-loader is probably the most utilised item of plant and is based on an agricultural tractor. A loading shovel is mounted on the front, and a backhoe (excavator) mounted on the rear. The digger loader is one of the most versatile machines used on site and can be fitted with a vast range of attachments to extend its basic functions. Digger loaders are used for loading materials and earth into dumpers etc and general excavations.

1.1.2 Bulldozer
(Crawler dozer)

The crawler dozer is a crawler tractor with a dozer blade fitted to the front. It is a tracklaying machine used for bulk earthmoving, excavating, clearing scrub, spreading and levelling etc. It can also act as a prime mover for towed equipment. Various blades can be fitted to suit a particular application.

1.1.3 Wheel Dozer
(Wheeled dozer)

The wheeled dozer as the name implies is a dozer on wheels as opposed to the tracks. The base machine is basically the same as the wheeled loader.

The wheeled dozer is used for bulk earthmoving, clearing scrub, spreading and levelling etc. It is faster than the crawler dozer but has not the same traction in wet and muddy conditions.
1.1.4 Traxcavator
(Crawler loader)

Based on the crawler tractor the crawler loader is fitted with a loading shovel at the front. It is used to excavate and load in a relatively small area.

1.1.5 Wheel loader
(Wheeled loader)

The wheeled loader is used to excavate (mainly from a stock pile) and load vehicles or hoppers. Most modern wheeled loaders use articulated steering. Earlier types where rigid chassis with rear wheel steering.

1.1.6 Grader
(Motorised Grader)

The motorised grader is used to finish surfaces, grade to fine limits, ditch cleaning and cutting, dirt road maintenance and various other tasks. The grader has a long narrow chassis with four or six wheels.

A blade (or mould board) is fitted to an “A” frame located at the front of the chassis and suspended at the mid point by hydraulic cylinders.

The blade can be moved through a vast number of positions to suit any task; up, down, left, right, rotated 360°, even at 90° to the horizontal. Various other attachments can be fitted to improve its versatility.
1.1.7 Dump Truck

The dump truck is used to haul and dump excavated materials. There are two main types:
- Articulated
- Rigid chassis

1.1.8 Articulated Dump Truck

The articulated dump truck is more manoeuvrable and can be twin or triple axle design. They can be used over rough terrain and on haul roads.

1.1.9 Rigid Chassis Dump Truck

Rigid chassis dump trucks are normally two axle design and are used on well maintained haul roads.

They have limited rough terrain capability.
1.1.10 Scraper

Scrapers are used to excavate, haul and spread earth on large projects where a large amount of material has to be moved.

There are two main types of scrapers:

- Towed scrapers
- Motorised scrapers

1.1.11 Towed Scraper

The towed scraper is towed behind a crawler tractor. It has a large load carrying bowl with a cutting edge on the front. The front wall of the bowl, called the apron, can be raised or lowered allowing the cutting edge to penetrate the ground. The forward motion allows the excavated earth to flow into the bowl until full. The apron is then lowered and the bowl raised so that the material can be transported to the required place. To unload the scraper the apron is raised and the rear of the bowl (tailgate) is pushed or tilted to eject the material in an even layer.

The scraper is operated via a crawler tractor mounted winch assembly (called a cable control unit) which operates the scraper functions via steel wire rope and pulleys. Some towed scrapers are hydraulic powered from the crawler tractor hydraulic system.
1.1.12 Motor Scraper

The motorized scraper does the same job as the towed scraper, but much faster. It consists of a wheeled tractor unit at the front (usually single axle) coupled via a kingpin or vertical hinge to the scraper unit. The scraper unit has the same basic components as the towed scraper with the various movements being powered hydraulically. The motorized scraper is faster than the towed scraper but on some materials it has to be loaded with the assistance of a crawler or wheeled dozer pushing at the rear (push-loading). Some scrapers are single engine type with only one prime mover, other scrapers are twin engine, with a power unit at the rear to drive the rear wheels.

1.1.13 Wheeled hydraulic Excavator

The wheeled hydraulic excavator is used in many excavating operations and materials handling. As it can be driven along the public highway it does not require heavy transport to move it from site to site. It is not as stable as the tracked excavator and is usually fitted with stabilizing legs. It is generally fitted out as a backhoe and the upper works rotates through 360°. It can have various buckets and attachments fitted to improve its versatility.

1.1.14 Tracked hydraulic Excavator

The upper part of this machine is basically the same as the wheeled hydraulic excavator and is mounted on a tracked chassis. It is used extensively for general excavation work.

It has a slow travelling speed and requires heavy transport to move it from site to site. Wheeled and Tracked hydraulic excavators use identical buckets and attachments.
1.1.15 Crawler Rope Excavator
(Dragline)

Crawler rope excavators have been used for many years and were once the back bone of many large excavation projects.

The machine is mounted on crawler tracks and the upper superstructure can rotate through 360°. The drive for the various excavating parts is mechanical via winding drums (winches), clutches and brakes and is transmitted to the front end equipment via steel wire ropes. There are two main types of front end equipment;

- Dragline
- Face shovel

The Face Shovel excavates at a vertical face to load dump trucks.

The Dragline is generally used for large excavations.

1.1.16 Trenchers

Trenchers are used to dig trenches over long distances to enable pipes, telephone cables, drainage and other services to be laid. The trencher can be tracked or wheeled and consists of a power unit, a continuous bucket or chain mounted on a boom. The boom is raised or lowered hydraulically. The buckets and chain are rotated either by mechanical or hydraulic drive. All excavated soil is dumped at either side of the trench via a conveyor or auger.

The drive to the tracks or wheels may be mechanical or hydraulic.
1.1.17 Mini-excavators

Mini excavators have recently made their mark on the Plant scene and bridge the gap between the larger digger loader and the operation with the hand shovel.

The mini excavator is simply a miniature hydraulic excavator mounted on wheels or tracks. They are versatile machines which can work in confined spaces, various attachments may be fitted to compliment the backhoe fitted as standard.

1.1.18 Mini loaders

Mini-loaders, commonly called “skid steer loaders” have been in use for a number of years. They are very popular where there is limited space to manoeuvre. The mini-loader may be tracked or wheeled, (the majority are wheeled). Most of the mini loaders are hydrostatically driven with the ability to have the wheels/tracks contra-rotated to achieve a turn within the machines own length. Some of the larger ‘mini’-loaders are articulated steer.
1.2 Cranes

The crane is important in the civil engineering and building sectors. As projects become larger and more complex more and larger items have to be lifted.

Cranes fall into four main categories:

- Tower cranes
- Truck mounted cranes
- Crawler mounted cranes
- Rough terrain cranes

1.2.1 Tower cranes

The tower crane enables materials to be lifted to great heights and distances.

There are three main types:

1 Mobile, (truck, trailer or crawler mounted).
2 Rail mounted.
3 Static (climbing).

The mobile tower crane maybe self erecting or be built in sections. These are used for smaller projects with standard heights of 27m under the hook.

Rail mounted tower cranes are used where the project is to last over a long period.

The static type is used semi permanently, ie bridge building etc and usually have a standard free standing under hook height of 35-40 metres. Greater height can be obtained by “tying“ the mast to the structure.
1.2.2 Truck mounted cranes

The truck mounted crane is capable of travelling under its own power from site to site. Over the years the truck mounted crane has developed into a versatile heavy lifting machine with lifting capacities in the hundreds of tonnes. The crane carrier lower chassis can be from two to ten axles depending on the design and lift capacity. They can have two, three or four steering axles and a road travel speed up to 70km/h.

A lattice or telescopic jib is usually used. Illustration shows a four axle truck mounted crane with telescopic jib.

1.2.3 Crawler cranes

Crawler cranes are basically a crawler excavator rigged specifically for crane duties. Most crawler cranes have a lattice (framework of crossed strips) type jib. The larger crawler cranes can lift over 100 tonnes. Crawler cranes must be transported on special heavy transport, the largest models being transported in sections.

The rough terrain crane is used on sites where a truck mounted crane or other type of crane would find it difficult to manoeuvre or gain access. The chassis is of a special design and transmission components, ie axles, gearbox etc are usually similar to wheeled loaders. Lift capacities of round 40 tonne are common.
1.3 Road Surfacing Equipment

The major item of plant used on road surfacing work is the paving machine. There are two main types of paver:
- Wheeled and Tracked

Asphalt Plant

1.3.1 Tracked Paving Machine

The pavers’ primary role, is to lay asphalt or Macadam, though they are on occasions used for laying dry lean concrete, crusher run stone or more modern materials. They are normally used for roads and air field runways but small machines may be used to lay paths etc. The paver consists of a hopper with a chain conveyor feed to an auger (spiral spreader tool) running across the back of the machine. The auger spreads the material out, which is then compacted by tampers and smoothed off by a heated screed. Most modern pavers have automatic levelling systems. The width of the screed can be extended to suit the width of the carriageway. The wheeled paver uses pneumatic tires and is easily moved under its own power form site to site. The tracked paver uses crawler tracks and requires transporting. Track drive is usually used on the larger pavers and wheel drive on the small-medium size pavers. The drive from the power unit to the various services ie auger, tamper, feed, hopper, steering an travel maybe mechanical or hydraulic.
1.4 Compaction Equipment

The major items of plant that fall into the category of compaction equipment are:

- Dead weight rollers
- Vibrating rollers
- Pneumatic rollers
- Wheeled soil compactors

1.4.1 Dead weight rollers

Dead weight rollers are usually three and two wheel, towed or self propelled. They rely on their mass to compact materials.

1.4.2 Vibrating rollers

The larger vibrating rollers can be tandem-self propelled or towed.

Tandem rollers have two large steel roller drums with a vibration mechanism in each drum.

The vibrator drive and roller drum drive are usually hydrostatically driven with articulated steering.

Towed rollers are usually towed by wheeled or crawler tractors. They have a power unit to drive the vibrating mechanism. The roller drum can be smooth, sheeps foot or grid design.
1.4.3 Pneumatic rollers

These rollers have pneumatic tyres and are of the towed and self-propelled types.

The body can be ballasted to add weight. On modern self-propelled types the tyres can be inflated or deflated by the operator when in use. Most are hydrostatic drive and can be left or right hand drive.

1.4.4 Wheeled Soil Compactors

These compactors are based on the articulated wheeled loader fitted with special steel roller wheels of sheeps foot, rock foot or tamping foot design. They are used to compact soil and rock on major projects. They are fast and give good compaction.

1.5 Materials handling - Fork lifts

Handling building and construction materials on site by fork lifts is generally done by two types of machine:

- Rough Terrain Fork Lift
- Telescopic Handler

1.5.1 Rough Terrain Fork Lift

These machines are a common machine on site and are normally four wheel drive, rear wheel steer machines. They have a lifting capacity ranging from one to about ten tonnes and are powered by a CI engine with a mechanical, powershift or hydrostatic drive. A wide range of attachments are available to improve the handling capabilities.
1.5.2 Telescopic handlers

These machines are fitted with a telescoping boom which gives both forward reach and high lift. They are powered by a CI engine with powershift, mechanical or hydrostatic transmission. They may be two or four wheel drive, rear wheel or articulated steer. A wide range of attachments are available for different handling tasks.

2. Attachments

There are a vast number of attachments available which can be fitted to the wide range of Construction plant, to quickly and easily convert them to perform different functions or to extend their original functions. The following pages will deal with the more common attachments.
2.1 Loading Shovels

The loading shovel is fitted to the front of a variety of machines, these are:

- Digger loader
- Wheeled loader
- Crawler loader
- Mini loader
- Telescopic handler

There are different types of loading shovels depending on the material to be loaded.
The main ones are:

- General purpose
- Multi purpose (four in one) - Rock
- Side tip or side dump
- Bulk handling

The general purpose or standard loading shovel is a fabricated steel structure for loading sand, gravel, soil and clay.

Cutting edges, of hardened steel, are either welded or bolted to the front edge of the shovel to give long life and wear resistance.

The bolt on type maybe reversed when the leading edge is worn.

Special corner pieces maybe welded or bolted in place to give extra strength and wear.

2.1.1 Digging Teeth

For materials which require high penetration and breakout force digging teeth maybe bolted or welded to the cutting edge.
2.1.2 Multi-purpose Loading Shovel

The multi-purpose or four-in-one shovel, is used for various jobs on site. It can be used for loading, scraping, bottom dumping, grabbing, bulldozing, digging, clam and back filling.

The front part of the shovel is pivoted at the top and actuated by two hydraulic cylinders mounted on the rear of the shovel.

The Rock shovel is used to load ballasted rubble, hard gravel and blasted rock. To aid penetration into the material the shovel has low cut sides and a grill is fixed to the back of the shovel to prevent rocks pilling over the top.

2.1.3 Side Tip Loading Shovel

The side tip or side dump bucket is used for loading in confined spaces where there is insufficient space to load a vehicle at right angles. The shovel is pivoted at one side with an extra hydraulic cylinder to dump the load.

2.1.4 Bulk Handling Loading Shovel

Bulk handling loading shovels are used to load light materials of low density such as wood chips, snow, coke.

The basic design may be the same as that of the general purpose bucket or maybe in the form of an open side box depending on the materials.
2.2 Dozer blades

Dozer blades maybe fitted to the following machines:

- Crawler dozer
- Wheeled dozer
- Grader
- Mini loader
- Hydraulic excavator
- Mini excavator
- Earth compactor
- Telescopic handler
- Wheeled loaders

There are many types of blades manufactured to suit the material to be moved or the task required of the machine.

The main general types are:

- Universal blade (“U”)
- Angle blade (“A”)
- Straight blade (“S”)
- Cushion blade (“C”)

The universal or “U” blade is used to move large volume loads over a long distance. It has large wings on the bald to make it more efficient. It is used in land reclamation, stock pile work, etc. It can be fitted with a tilt cylinder to tilt the blade at an angle to the horizontal.

The Angle blade or “A” blade can be positioned straight or at an angle of 25 degrees to either side. It is designed to be used for side-cutting, pioneering roads, back filling, cutting ditches and similar work.
The Straight or “S” blade is the most versatile and is basically a modified “U” blade. It is physically smaller than the “U” blade, easier to manoeuvre and can handle a wider range of materials.

The cushion or “C” blade is used for on-the-go push loading of scrapers.

Large rubber cushions or steel springs allow the blade to absorb the impact of contacting a scraper push block. It can also be used for cut maintenance and general dozing. It is narrower that the “A”, “S” or “U” blades.

2.2.1 Common types of Dozer Blade

Special blades are used for specific jobs such as the Sanitary land fill blade designed to handle refuse and covering materials.

The “V” tree cutter is used for land clearing, shearing trees, stumps and scrub.

On some smaller crawler and wheeled dozers the Power tilt and Angle blade (P.A.T.) is used.

The tilt and angle is controlled by hydraulic cylinders and can be used for grading, back filling and landscaping etc.

2.2.2 Special Blades

The blade cutting edges, similar to the loading shovel, are bolted to the front edge of the blade and can be reversed when worn. (Surface welding is excellent method to extent duration of front edge and cutting edges). They can be in one, two or three sections.

The corners of the blade are called end bits and will have a different shape depending on the application and material.

The end bits are bolted to the blade.
2.3 Excavating buckets

Excavating buckets are digging tools and can be fitted to the following machines:

- Backhoe of digger loader
  - Wheeled hydraulic excavator
  - Tracked hydraulic excavator
  - Crawler rope excavator
  - Mini excavator

The shape and design of excavating buckets varies with the application and material and there are many different types.

2.3.1 Digger-loader backhoe buckets

These buckets, fitted to the backhoe of the digger loader, are fabricated steel. They fall into three categories, trenching buckets, ditching buckets and grab buckets.

**The main Trenching buckets are:**

- Standard, for most excavating work
- Square hole, for excavating accurate square side holes
- Clay, for use when excavating in clay
- Ejector, for narrow trenches in sticky materials.

**Ditching buckets are:**

- Trapezoidal, for excavating pre-formed shallow ditches
- Ditch cleaning, for cleaning and reshaping ditches

**Grab or Clam shell buckets are:**

- Trenching, for square hole and trench excavations
- Re-handling, for loading loose material
- Round, for round hole excavations
2.3.2 Wheeled and tracked hydraulic excavators buckets

The main configurations of the wheeled hydraulic excavator is the backhoe. The tracked hydraulic excavator maybe a backhoe or a face shovel (front shovel). The buckets for the backhoe machines, tracked or wheeled, are the same and do the same tasks as those for the digger-loader backhoe, but are of larger capacity.

2.3.3 Face Shovel Buckets

The buckets for the face shovel configuration maybe either front dump or bottom dump type. Front dump buckets are used for bulk excavating and loading.

The bottom dump is used where increased dump height and accurate placing of the load is required when working at a face. Illustration shows typical front and bottom dump face shovel buckets for a hydraulic excavator.

2.3.4 Excavating Bucket teeth Tips and Side Cutters

The back-hoe excavating buckets have various types of teeth and side cutters fitted to suit the material to be excavated and the type of excavation. The teeth adaptors are welded to the bucket and the tips pinned to the adapter, some teeth maybe bolted on. The side cutters are bolted to the buckets. Illustration shows the typical teeth tips and side cutters for back-hoe buckets.

The face shovel buckets have the teeth adaptors welded to the bucket and three types of tips maybe fitted.
2.4 Hooks and Shackles

There are a variety of hooks available for lifting purpose and it is impractical to cover them all in this section.

British Standard, B.S. 2903, gives specifications for higher tensile hooks for chains, blocks and general engineering purposes which will be covered in this section.

There are two main categories of hook:
- **Point Hook**
- **C - Hook**

These two categories are broken down into the following types

### 2.4.1 Point hook with shank

Hooks are drop forged to British Standards and are made of Higher tensile steel than heat treated.

Hooks are proof loaded and then marked permanently and legibly by stamping on a non vital part.
Manufacturers must provide a certificate with each hook giving the following information:

- Distinguishing mark (to enable hook to be identified)
- Type of hook
- Proof load applied
- Safe Working Load (S.W.L.)

The certificate must also state the type of material of which the hook is made that it complies with British Standards.

The most highly stressed part of the hook is usually at the horizontal section on the inside called the intrados. The material at this point is under tension and the material at the back (called the extrados) is in compression.

2.4.2 Point hook with eye
(for use with chain)

The shape is Trapezoidal and is chosen as the most economic practical shape. The opening or gap of the hook should be wide enough to admit the largest rope, ring, link or shackle which has to be placed on it. In most cases the hook must, by statute, be provided with a safety catch to prevent the rope or sling etc being displaced. The part called the shank may be attached to the lifting gear or equipment in a number of ways. An eye is used for attachment to slings, a boss to suit shackles and machined and screw threaded to take a nut for swivel attachment.
2.4.3 “C” hook with shank

All hooks should be inspected frequently and any defective hook should be destroyed.

2.4.4 “C” hook with eye
(link fitted for use with chain)
2.5 Shackles

Shackles are used to connect slings, ropes etc. to loads. These are two groups of shackles used for lifting purposes, higher tensile steel shackles and alloy steel shackles covered by B.S. 3551 respectively.

There are five types of shackles which conform to B.S. 3032 these are:

- Small Dee, suitable for hook eyes, eye bolts, wire rope, thimbles etc.
- Large Dee, for general engineering purposes.
- Small Bow, for eyes of hooks eyebolts
- Large Bow, for general engineering purposes.

Grab - Dee shackle with countersunk, square socketed pin for use with grabs.
2.5.1 Sling angles

The rated capacity of any sling depends on its size, configuration, material and the angles formed by the legs of the sling.

If two separate legs are used to lift a load of 450 kg a load of 225 kg will be in each leg if the load is lifted with each leg vertical.

**Angle of 90°**

If a two leg sling is used, with an angle of 90 degrees between each leg, the load on each leg of the sling will be 320 kg.

**Angle of 60°**

If the leg angle is 60° the load in each leg will be 260 kg.
2.5.2 Use of slings

Care must be taken when attaching a sling to a load to ensure that the method of attachment does not result in damage to the slings.

Slings must be kept on suitable racks or pegs when not in use.

The upper ends of the multi-leg slings must be connected by means of a shackle, ring or link.

Angle of 120°

With the legs of an angle of 120°, the load in each leg will be 450 kg each.

Always keep the sling leg angle at 90° or less.
The S.W.L. of a sling must never be exceeded as a result of the angle between the legs.

Back hooking onto the sling leg itself must not be used.

The load must not rest on the sling when lowering, suitable packing must be used under the load so the sling is not damaged by crushing. (It also enables the sling to be removed easily).
2.6 Lifting Beams

Lifting beams, (sometimes called spreaders) take many forms. They are used to lift items of unusual length or shape, ie engine/transmission assembly removal from an item of plant.

They are designed for particular application and made of steel to B.S. 4360: 1979 Weldable Structural Steels.
NON-TELESCOPIC BOOM CRANE
With JIB

- Jib Strut
- Jib Insert
- Jib Lines
- Jib Hoist Line
- Boom Spreader Assembly
- Boom Hoist Line
- Compression Member
- Tension Member
- Base Section
- Main Boom Hoist Sheaves
- Weight Hook
- Point Section
- Boom Insert
Fork Lifts and Lift Trucks

- Control Panel
- Platform
- Scissor Arms
- Lift Cylinders
- Manual Outriggers
- Hydraulic Driven Wheels
- Fixed Scissor Arm
- Movable Scissor Arm
- Fixed Scissor Arm

Diagram showing components of fork lifts and lift trucks.
Side loading can be dangerous and damage or even topple your crane.

- Do Not Drag a Load
- Do Not Allow a Suspended Load to Be Pushed
- Do Not Travel Across a Slope With a Suspended Load
Change of Radius on Lifting Load

Rope stretch and flexing of the Jib or boom when a load is lifted.

Diagram showing the change in radius during lifting.
Safety First!

Critical Clearance Points

Overall Clearance Height

Rear Projection

6m

Inapunguza Makelele

Hutunza Kichwa

Hutunza Mikono

Right
WHEEL LOADER

- Loader Linkage Damage Or Crack
- Damage Or Crack
- Worn Edge & Tooth
- Oil Leak
- Level
- Damaged
- Hose Oil Leak
- Transmission Oil
- Level
- Damaged
- Hose Oil Leak
- Hydraulic System Oil Level Damaged
- Hose Oil Leak
- Engine Oil Level
- Fuel Leak Oil
- Dirt
- Oil Level
- Damaged
- Hose Oil Leak
- Transmission Oil
- Damage Or Crack
- Indicators & Controls Malfunctioned Gauge
- Poor Control
- Tyre Cut Or Damage Inflaction Pressure Loose Wheel Bolt
- Loose Mounting
- Lamps Loose Terminal Burnt Bulb Loose Mounting
- Cooling System Coolant Level Caked Dirt Or Dust
- Coolant Leak
- Brake Oil Level
- Oil Leak
- Frame Crack Loose Mounting
3. Practical Exercise

1) Walk Around Inspection

i) OFF HIGHWAY HAUL TRUCKS (Rigid & Articulated)

SAFETY RULES AND REGULATIONS

PRESTART CHECKS

Ensure that the truck is parked on level ground and no overhead power lines in the vicinity which may constitute a hazard

FRONT

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>COMPETENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check ROPS for damage</td>
<td></td>
</tr>
<tr>
<td>Check the steps for loose bolts, cracks, dirt, grease and condition of handrails</td>
<td></td>
</tr>
<tr>
<td>Mount the truck to ensure the gear lever is in neutral, parking brake is applied and the dump lever is in the float position</td>
<td></td>
</tr>
<tr>
<td>Collect check list, tyre gauge and cloth from cab</td>
<td></td>
</tr>
<tr>
<td>Check the following and complete the checklist as you proceed;</td>
<td></td>
</tr>
<tr>
<td>- Check rock guard damage, cracks</td>
<td></td>
</tr>
<tr>
<td>- Windscreen cracks, dirt and windscreen rubber for tear</td>
<td></td>
</tr>
<tr>
<td>- Wipers loose bolts, worn blades</td>
<td></td>
</tr>
<tr>
<td>- Head lights for cracks and damage</td>
<td></td>
</tr>
<tr>
<td>- Grill for damage, loose bolts, and machine number</td>
<td></td>
</tr>
<tr>
<td>- Pre-air cleaners for damage (dust accumulator)</td>
<td></td>
</tr>
<tr>
<td>- Bottom headlights for cracks and damage</td>
<td></td>
</tr>
<tr>
<td>- Bumper for damage</td>
<td></td>
</tr>
<tr>
<td>- Wheel chocks, fire suppression activator level and lock pin</td>
<td></td>
</tr>
<tr>
<td>- Main switch for “On” and “Off”</td>
<td></td>
</tr>
<tr>
<td>- Engine compartment light switch “On” and “Off”</td>
<td></td>
</tr>
<tr>
<td>- Fault light</td>
<td></td>
</tr>
<tr>
<td>- Roll over Protection System (ROPS)</td>
<td></td>
</tr>
</tbody>
</table>

ANTICLOCK WISE FROM LEFT

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiator fins for blockage, damage</td>
</tr>
<tr>
<td>Fan blade for damage, wear, tear</td>
</tr>
<tr>
<td>Fan cooler for damage, loose bolts</td>
</tr>
<tr>
<td>Fan belts for wear, proper tension and free from grease or oils</td>
</tr>
<tr>
<td>Radiator pipes for leaks and loose fittings</td>
</tr>
<tr>
<td>Air compressor for oil leaks</td>
</tr>
<tr>
<td>Component/Check Item</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Air con motor for vee-belts tension, secure connection</td>
</tr>
<tr>
<td>Fuel filter for diesel leaks</td>
</tr>
<tr>
<td>Check engine oil filters for leaks</td>
</tr>
<tr>
<td>Engine oil level (dipstick)</td>
</tr>
<tr>
<td>Engine breather for damage</td>
</tr>
<tr>
<td>Engine sump and sump guard for damage</td>
</tr>
<tr>
<td>Check engine sump drain plug for oil leaks</td>
</tr>
<tr>
<td>Check steering hose for oil leaks</td>
</tr>
<tr>
<td>Check air dryer or loose, hoses and fittings</td>
</tr>
<tr>
<td>Check front suspension for loose bolts, if greased</td>
</tr>
<tr>
<td>Inner front hub for loose bolts, oil leaks</td>
</tr>
<tr>
<td>Check tyre damage, air pressure</td>
</tr>
<tr>
<td>Check wheel hub filler plug for leaks and drain plug if tight</td>
</tr>
<tr>
<td>Check wheel nuts if tight</td>
</tr>
<tr>
<td>Suspension bolts for loose nuts</td>
</tr>
<tr>
<td>Brake oil hoses for oil</td>
</tr>
<tr>
<td>Steering cylinders and rods for grease, damage and oil leaks</td>
</tr>
<tr>
<td>Air dryer for damage</td>
</tr>
<tr>
<td>Steering oil filter for oil leaks</td>
</tr>
<tr>
<td>Check starter for loose terminals and bolts</td>
</tr>
<tr>
<td>Torque converter for oil leaks</td>
</tr>
<tr>
<td>Torque converter for oil pump for leaks</td>
</tr>
<tr>
<td>Transmission oil pump for oil leaks</td>
</tr>
<tr>
<td>Hydraulic oil pump for oil leaks</td>
</tr>
<tr>
<td>Brake oil pump for oil leaks</td>
</tr>
<tr>
<td>Steering oil pump for oil leaks</td>
</tr>
<tr>
<td>Propeller shaft universal joints if greased</td>
</tr>
<tr>
<td>Vee stabilizer bar for loose bolts</td>
</tr>
<tr>
<td>Transmission oil filter for oil leaks</td>
</tr>
<tr>
<td>Torque converter filter for oil leaks</td>
</tr>
<tr>
<td>Fuel tank for damage, fuel level, fuel filling nozzle, fuel tank breather</td>
</tr>
<tr>
<td>Check bowl for damage</td>
</tr>
<tr>
<td>Rubber mudguard for loose bolts, damage</td>
</tr>
<tr>
<td>Hoist cylinder for oil leaks, if greased, fittings secure</td>
</tr>
<tr>
<td>Rubber mudguard for damage and tear</td>
</tr>
<tr>
<td>Universal joint (transmission) if greased</td>
</tr>
<tr>
<td>Transmission for oil leaks</td>
</tr>
<tr>
<td>Brake oil pipes for oil leaks, air leaks</td>
</tr>
<tr>
<td>Inner final drive bolts for loose oil leaks</td>
</tr>
<tr>
<td>Tyre damage, inflation, cuts, wear</td>
</tr>
<tr>
<td>Final drive bolts for loose bolts, oil leaks</td>
</tr>
<tr>
<td>Oil drain and fill plug for oil leaks</td>
</tr>
</tbody>
</table>
## REAR
- Rock ejector for position pin and damage
- Rear suspension is greased, pin position in place
- Differential oil filter for oil leaks
- Speed sensor for loose connection/terminals
- Reverse lights for loose terminals, damage
- Indicators for damage
- Brake/park lights for damage
- Reverse hooter for damage
- Tow pin if in position
- Safety sling if in position
- Stabilizer bar if greased
- Differential oil level and fill plugs for oil leaks
  (grease) auto tub pipes
- Suspension if greased, pins in position
- Rock ejector for pin position, damage

## RIGHT
- Tyre damage, inflation, final drive for loose bolts
- Wheel nuts if tight
- Filter plug/drain plug for oil leaks
- Rubber mudguard for damage and tear
- Inner tyre damage for inflation, final drive bolts secure
- Brake oil pipes for oil leaks
- Hoist cylinders for oil leaks
- Hydraulic oil tank for oil leaks, oil level, damage
- Transmission oil tank for oil leaks, oil level, damage
- Hydraulic oil tank breather for damage
- Steering cylinder and rod if greased, oil leaks
- Brake oil hose for oil leaks
- Suspension bolts for loose nuts
- Steering accumulator for oil leaks
- Tyre inflation damage, tear, wear
- Oil plug/drain and filler
- Wheel nuts for loose
- Engine oil cooler for water leaks
- Hydraulic oil cooler for water and oil leaks
- Transmission oil cooler for water and oil leaks
- Brake oil cooler for water and oil leaks
- Water pump
- Alternator
- Radiator hose for leaks
- Fan cover for damage
- Fan blade for damage
- Mount with right hand steps
<table>
<thead>
<tr>
<th><strong>TOP</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Batteries dirt, loose terminals, level</td>
<td></td>
</tr>
<tr>
<td>Fire extinguisher level, pin, number</td>
<td></td>
</tr>
<tr>
<td>Air reservoir/tank release moisture, air leaks</td>
<td></td>
</tr>
<tr>
<td>Dust indicators normal range</td>
<td></td>
</tr>
<tr>
<td>Steering oil tank damage, oil level, oil leaks</td>
<td></td>
</tr>
<tr>
<td>Exhaust pipe, silencer</td>
<td></td>
</tr>
<tr>
<td>Rear view mirror/grease tank and auto pump</td>
<td></td>
</tr>
<tr>
<td>Radiator cap, water level</td>
<td></td>
</tr>
<tr>
<td>Pressure release valves</td>
<td></td>
</tr>
<tr>
<td>Engine compartment cover - open</td>
<td></td>
</tr>
<tr>
<td>Turbo charger clamps, oil leaks</td>
<td></td>
</tr>
<tr>
<td>Fuel pump and fuel injector pump for oil leaks</td>
<td></td>
</tr>
<tr>
<td>Injector pipes for fuel leaks</td>
<td></td>
</tr>
<tr>
<td>Close engine compartment</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>INSIDE CAB</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean floor</td>
<td></td>
</tr>
<tr>
<td>Adjust operator seat to suite yourself</td>
<td></td>
</tr>
<tr>
<td>Check all gauges and visual Inspection Management System for damage</td>
<td></td>
</tr>
<tr>
<td>Set rear view mirrors</td>
<td></td>
</tr>
<tr>
<td>Fire suppression activator gauge, pin tag</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>PRE - OPERATION CHECKS</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Before starting the engine ensure that all control levers are in the neutral position</td>
<td></td>
</tr>
<tr>
<td>Turn the key to accessories</td>
<td></td>
</tr>
<tr>
<td>Look around to ensure there is nobody in the vicinity who may get injured</td>
<td></td>
</tr>
<tr>
<td>Sound the hooter</td>
<td></td>
</tr>
<tr>
<td>Panel test “On/Off”</td>
<td></td>
</tr>
<tr>
<td>Start the engine (the engine cannot start unless the gear shift lever is in the neutral position)</td>
<td></td>
</tr>
<tr>
<td>Idle the machine for minimum of 5 minutes to build up the air and oil pressure</td>
<td></td>
</tr>
<tr>
<td>Ensure that all gauges and warning devices are functioning correctly and that all gauge readings are within the prescribed range</td>
<td></td>
</tr>
<tr>
<td>Dismount the machine re-check engine oil level must be on “full” mark engine running</td>
<td></td>
</tr>
<tr>
<td>Re check transmission oil level, oil level must be on the lower mark to the transmission filler collar - sight glass</td>
<td></td>
</tr>
<tr>
<td>Check for oil and water leaks</td>
<td></td>
</tr>
<tr>
<td>Ensure all lights are functioning</td>
<td></td>
</tr>
<tr>
<td>Mount the machine</td>
<td></td>
</tr>
<tr>
<td>Put on seat belt</td>
<td></td>
</tr>
<tr>
<td>Sound the hooter</td>
<td></td>
</tr>
<tr>
<td>Check steering (turn fully both sides)</td>
<td></td>
</tr>
<tr>
<td><strong>TRANSMISSIONS AND DRIVETRAIN</strong></td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>EARTH MOVING EQUIPMENT</strong></td>
<td></td>
</tr>
<tr>
<td><strong>BASIC LEVEL MECHANICS 6</strong></td>
<td></td>
</tr>
</tbody>
</table>

- Check parking brake
- Engage the gear lever on F1 (accelerate to 1200 rpm)
- Check bowl (raise hoist lever and lower the bowl)
- Accelerate to 1500 rpm (if loaded do not test)
- Check reverse hooter and light (engage reverse gear)

### TRAVELLING / OPERATING

- Never rev the machine over 2500 rpm
- Obey traffic signs and always keep left
- Before entering curves on the road, slow down to avoid spillage
- Never down shift the transmission whilst driving at high speed, use the retarder brake to slow the speed of the truck
- Never move the gear shift to neutral or to reverse while travelling
- Overtaking on haul ramp or road is not allowed with exception of track dozers, wheel dozers, drill rigs graders rock breakers and other slow moving machine
- Ensure the road ahead of the unit you are about to over take is safe and clear of traffic
- Dim the lights when approaching other vehicles
- Leave a distance of 50 m between your truck and the one in front of you
- On wet condition leave a distance of 100 m between your truck and the one you are following:

#### Wet Driving

- Engage F2
- Engage automatic retarder
- Drive at 10 km/h
- Maintain the following distance of 100 meters
  - Do not drive into a pool of water
- Give way to emergency vehicles (police, ambulance, explosive truck and fire tender)
  - Empty trucks must give way to loaded
  - Never drive over spillage (call wheel dozer operator)
- When approaching loading site stop a distance of 30 m from the loading site

### AT LOADING SITE

- At the loading area if another truck is being loaded, park 30 m from the loading site and facing the loader
- As soon as the first truck drives off, drive towards the loader and wait for the loader shovel operator to load his bucket and raise it
- Reverse parallel to the front axle or tracks of the loader/shovel
- Remain in the cab whilst your truck is been loaded
- Check shovel/loader bucket teeth, inform foreman of any deviations
- Check both mirrors for falling rocks
| Move off when the hooter sounds (shop 30 m and check load, tires and shocks |
| If there is any deviation please report to your foreman |
| Proceed safely to the tipping point |

**AT THE TIPPING POINT (SIGNAL CONTROL)**

| When tipping at the stockpile and dumps stop at the stop sign |
| Check for cracks and spillage |
| If condition of ramp and stockpile is not in good condition, contact your foreman |
| Never drive off with the bowl up, lower it first before you engage gear |
| When tipping the rear wheels must rest against the protective berm safety |
| At the reception bin stop at the sign and ensure all is clear proceed into a tipping position |
| Do not reverse into tipping position if the rock breaker is breaking rocks in the bin |
| Tipping will only occur when the control |

**SHUT DOWN PROCEDURE**

| Never idle the machine for over 5 minutes |
| Refuel your truck according to the laid down schedule |
| Park you track on a safe level demarcated area |
| Put all the levers in the neutral position |
| Apply the park brake, never park your track with the retarder brake |
| Dismount the machine |
| Walk around the truck to check for any damage or leaks before leaving your machine |
| Dismount and switch off the machine |
| Report to the incoming operator about the condition of the machine |
| Report hour meter to pit control room |
| Grease the machine |
ii) WHEEL LOADERS (Front-end Loaders)

SAFETY RULES AND REGULATIONS

Candidates should observe and check the following:-

1. Pre - start checklist
2. Fire extinguisher
3. Brakes
4. Steering
5. Certified and valid license (H)

PRE START CHECKS

☐ Ensure that the loader is parked on level ground and that there are no overhead power lines in the vicinity, which may constitute a hazard. Ensure that the bucket is on the ground and then carry out the following.

<table>
<thead>
<tr>
<th>LEFT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the steps for loose bolts, cracks, dirt, grease and the condition of the hand rails</td>
<td></td>
</tr>
<tr>
<td>Mount the loader to ensure the gear lever is in neutral, parking brake is applied</td>
<td></td>
</tr>
<tr>
<td>Collect check-list from cab.</td>
<td></td>
</tr>
<tr>
<td>FRONT</td>
<td></td>
</tr>
<tr>
<td>Check ROPS for damage</td>
<td></td>
</tr>
<tr>
<td>Bucket for wear and condition of bucket tips</td>
<td></td>
</tr>
<tr>
<td>Rock guard for damages</td>
<td></td>
</tr>
<tr>
<td>Windscreen for damage</td>
<td></td>
</tr>
<tr>
<td>Lights for damage</td>
<td></td>
</tr>
<tr>
<td>Differential for oil leaks and damage</td>
<td></td>
</tr>
<tr>
<td>Raise and tilt cylinders for hydraulic oil leaks and that all points are greased</td>
<td>“H” frame for damage</td>
</tr>
<tr>
<td>LEFT</td>
<td></td>
</tr>
<tr>
<td>Front tyre for cuts and correct inflation</td>
<td></td>
</tr>
<tr>
<td>Pivot pin top/bottom if secured and greased</td>
<td></td>
</tr>
<tr>
<td>Steering cylinder for oil leaks and if joints are greased</td>
<td></td>
</tr>
<tr>
<td>Propeller shaft if greased</td>
<td></td>
</tr>
<tr>
<td>Hydraulic pipes for oil leaks and loose fitting</td>
<td></td>
</tr>
<tr>
<td>Steps for damage, dirt and condition of hand rails</td>
<td></td>
</tr>
<tr>
<td>Diesel fuel tank for damage and leaks</td>
<td></td>
</tr>
<tr>
<td>Rear tyre for cuts and correct inflation</td>
<td></td>
</tr>
<tr>
<td>Structural damage</td>
<td></td>
</tr>
<tr>
<td>REAR</td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Bumper for damage and loose bolts</td>
<td></td>
</tr>
<tr>
<td>Rear differential for oil leaks and damage</td>
<td></td>
</tr>
<tr>
<td>Radiator fins is not blocked by dirt or dented</td>
<td></td>
</tr>
<tr>
<td>Condition of radiator grill</td>
<td></td>
</tr>
<tr>
<td>Rear lights for damage</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>RIGHT</td>
<td></td>
</tr>
<tr>
<td>Rear tyre for cuts and correct inflation</td>
<td></td>
</tr>
<tr>
<td>Structural damage</td>
<td></td>
</tr>
<tr>
<td>Steps for damage, dirt and condition of hand rails</td>
<td></td>
</tr>
<tr>
<td>Hydraulic oil level - (sight glass) and for leaks</td>
<td></td>
</tr>
<tr>
<td>Steering cylinders for oil leaks and if joints are greased</td>
<td></td>
</tr>
<tr>
<td>Hydraulic pipes for oil leaks and if joints are greased</td>
<td></td>
</tr>
<tr>
<td>Front tyre for cuts and correct inflation</td>
<td></td>
</tr>
<tr>
<td>Condition of hand rails</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>RIGHT TOP DECK</td>
<td></td>
</tr>
<tr>
<td>Transmission oil level (dip stick)</td>
<td></td>
</tr>
<tr>
<td>Exhaust for loose brackets and for fume leaks</td>
<td></td>
</tr>
<tr>
<td>Engine oil level - dip stick)</td>
<td></td>
</tr>
<tr>
<td>Alternator for loose electrical wiring</td>
<td></td>
</tr>
<tr>
<td>Electrical circuit board for any defects</td>
<td></td>
</tr>
<tr>
<td>Turbo-charger for oil and fume leaks</td>
<td></td>
</tr>
<tr>
<td>Sentinel for leaks</td>
<td></td>
</tr>
<tr>
<td>Engine compartment for oil leaks</td>
<td></td>
</tr>
<tr>
<td>Starter for any defects</td>
<td></td>
</tr>
<tr>
<td>Air cleaners for loose nuts</td>
<td></td>
</tr>
<tr>
<td>Batteries for loose terminals, cleanliness and condition of hold down bolts</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>LEFT TOP DECK</td>
<td></td>
</tr>
<tr>
<td>Engine oils filters for oil leaks</td>
<td></td>
</tr>
<tr>
<td>Air cleaner for loose nuts</td>
<td></td>
</tr>
<tr>
<td>“V” belts for wear and correct</td>
<td></td>
</tr>
<tr>
<td>Fan guard and fan blade</td>
<td></td>
</tr>
<tr>
<td>Waste pump for water leaks</td>
<td></td>
</tr>
<tr>
<td>Radiator hoses for leaks</td>
<td></td>
</tr>
<tr>
<td>Oil/corrosion filters for leaks</td>
<td></td>
</tr>
<tr>
<td>Oil cooler for oil leaks</td>
<td></td>
</tr>
<tr>
<td>Pre cleaners for any damage</td>
<td></td>
</tr>
<tr>
<td>Coolant level (only on cold engine or by gauge if hot)</td>
<td></td>
</tr>
<tr>
<td>Cab rear lights for damage</td>
<td></td>
</tr>
<tr>
<td>Rear windscreen for damage</td>
<td></td>
</tr>
<tr>
<td>Rear view mirror for damage</td>
<td></td>
</tr>
</tbody>
</table>
## INSIDE THE CAB
- Clean operator's compartment and ensure that no loose material are left lying underneath the pedals
- Adjust operator's seat to suit yourself
- Set rear view mirrors
- Ensure gauges are not damaged

## STARTING PROCEDURE
- Ensure that all control levers are in neutral position and that the park brake is applied
- Sound the hooter and start the engine to idle at low reverse for 5 minutes
- Switch lights "On" and dismount to check:
  - Lights in working condition
  - Oil/coolant leaks
  - Re check engine and transmission oil levels
  - Mount back into the operator's cab
  - Ensure that all gauges and warning devices are functioning and that gauge readings are within the prescribed range
  - Sound the hooter and check that all brakes are in good working order
  - Ensure that the lifting and tilting mechanism are working
  - Reverse alarm/light in working order
  - Ensure that the machine is in good working order before proceeding to the work place

## TRAVELLING/OPERATING
- Travel with bucket raised 0.6 m off the ground tipped back
- Avoid driving over rocks or any pools of water
- In case of emergency braking, place the bucket on loading position and exert it to the ground
- Do not use the neutralizer brake for normal braking
- Give right of way to the hauling trucks
- Observe all established traffic rules
- Never move the gear shift lever to neutral or to reverse while travelling
- Overtaking on haul ramp or road is not allowed, with the exception of slow moving machine

## LOADING PROCEDURE
- Check for misfires, hang-ups, pipe, electrical cables and grade sets
- Maintain a level and obstacle free surface in the working areas at all times
- Do not load material with your machine in an articulated position
- Never ram the muck pile
- Do not use excessive down pressure on the bucket when loading, use hydraulics
- Always dump material in the center of the truck
- When dumping into the truck, tip slowly with the bucket at right angle to the bowl of the truck
- Do not hit the truck with the loader bucket when dumping into it
<table>
<thead>
<tr>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not overload or under load trucks</td>
</tr>
<tr>
<td>Stop the trucks in such position that they do not reverse into the muck pile</td>
</tr>
<tr>
<td>Engage the variable capacity torque converter whenever the material is difficult to handle</td>
</tr>
<tr>
<td>When you find a misfire, report to your foreman and move further down the muck pile for about 10 m start loading</td>
</tr>
</tbody>
</table>

**SHUTDOWN PROCEDURE**

- Never idle your machine for more than 5 minutes
- Refuel your machine at laid down times
- Park your machine on a safe and level ground
- Ensure all levers are in neutral position
- Apply the park brake
- Switch on lights and dismount
- Walk around your machine to check for any damage and leakage
- Report any defects to your supervisor and hour meter
- Report to the incoming operator about the condition of the machine
- Grease the machine.
iii) HYDRAULIC FACE SHOVEL (excavator)

SAFETY RULES AND REGULATIONS

Candidates should observe and check the following:

1. Pre - start checklist
2. Fire extinguisher
3. Steering
4. Brakes
5. Certified and valid operating license (H)

<table>
<thead>
<tr>
<th>PRE START CHECKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always use the checklist when performing pre-start checks</td>
</tr>
<tr>
<td>Ensure that the machine is parked on level ground, shovel is not tilted and bucket on the ground</td>
</tr>
<tr>
<td>Check for any overhead power lines, which may constitute a danger</td>
</tr>
<tr>
<td>Check the stepladder is free from grease, cracks, loose bolts and the condition of handrails</td>
</tr>
<tr>
<td>Mound the machine and check if the gear lever is on neutral position and if the parking brake and swing brake are engaged</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FRONT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check bucket for cracks, wear and tear</td>
</tr>
<tr>
<td>Check bucket teeth for wear, tear and if all available</td>
</tr>
<tr>
<td>Check boom, tri power geometry, stick boom cylinder, stick cylinder, tip cylinder, bottom dump cylinder for oil leaks, dirt and ensure joints are greased</td>
</tr>
<tr>
<td>Check hydraulic hoses for leaks</td>
</tr>
<tr>
<td>Check windscreen, wipers and windscreen rubber for damages and dirt</td>
</tr>
<tr>
<td>Check lights for damages</td>
</tr>
<tr>
<td>Check swing circle for grease and loose bolts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LEFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check track shoes for loose and missing bolts and cracks</td>
</tr>
<tr>
<td>Check hooter for any damage</td>
</tr>
<tr>
<td>Check idler for damage and wear</td>
</tr>
<tr>
<td>Check carrier rollers for wear, loose and missing bolts and damage</td>
</tr>
<tr>
<td>Check grouser plates if not missing, wear and loose bolts</td>
</tr>
<tr>
<td>Check track rollers for wear and report any accumulated mud</td>
</tr>
<tr>
<td>Check track for tension and track frame for damage</td>
</tr>
<tr>
<td>Check sprocket for loose and missing bolts and wear</td>
</tr>
<tr>
<td>Check final drive for oil leaks and damage</td>
</tr>
<tr>
<td>Check sprocket drive motor for oil leaks and damage</td>
</tr>
<tr>
<td>Check structural body damage</td>
</tr>
</tbody>
</table>
### REAR
- Check fuel tank and hydraulic oil tank for leaks.
- Check emergency stop cable for damages.
- Check emergency bell cable for damages.
- Check oil, fuel and water filling points and gauges for damages.
- Check filling points extension cylinder and hydraulic hoses for leaks.
- Check reverse hooter.
- Check counter weight for loose bolts and damage.
- Check grill for damages.

### RIGHT
- Check sprocket drive motor for oil leaks and damage.
- Check final drive for oil leaks and damage.
- Check sprocket for loose and missing bolts and wear.
- Check track for tension and track frame for damage.
- Check track rollers for wear and report any accumulated mud.
- Check grouser plates wear, loose and missing bolts.
- Check carrier rollers for wear, loose and missing bolts and damage.
- Check idler for damage and wear.
- Check track shoes for cracks, loose and missing bolts.
- Check hydraulic oil coolers for leaks, blockages and grill for damage.
- Check structural body damage.

### (MOUNT THE MACHINE)

### ENGINE NO.1 (LEFT)
- Check alternator “V” belts for correct tension and wear.
- Check water pump for leaks.
- Check turbo charger for oil leaks and exhaust fume leaks.
- Check engine oil level; the oil must be on “full” mark on the dipstick.
- Check motor starters for loose wires.
- Check accelerator solenoid for loose cables, engine oil leaks and oil filters for leaks.
- Check air compressor for air leaks
- Check fire extinguisher level, safety pin and hose.
- Check door condition and light inside engine compartment.
- Check radiator hose for wear and loose clamps.
- Check radiator “V” belts for correct tension, check fan blades – broken.
- Check fan cover for damages.
- Check adjustment spring for damages.
- Check corrosion filter for leaks.
- Check alternator “V” belts for correct tension and wear.
- Check water pump leaks.
- Check turbo-charger for oil and exhaust fume leaks.
| Check engine oil level, the oil must be on “full” mark of the dipstick. |
| Check motor starters for loose wires. |
| Check accelerator solenoid for loose cable, engine oil leaks and oil filters for leaks. |
| Check fire extinguisher level, safety pin and hose. |
| Check splitter gearbox oil level, the oil must be on “full” mark of the dipstick. |
| Check hydraulic hoses for leaks, hydraulic valve banks for oil leaks. |
| Check hydraulic oil filters for oil leaks and if tight. |
| Check slew motor mounting bolts if not loose or missing. |
| Check hydraulic transfer valves for leaks. |

**ENGINE NO.2 (RIGHT)**

| Check fire extinguisher level, safety pin and hose. |
| Check door condition and light inside engine compartment. |
| Check radiator hose for wear and loose clamps. |
| Check radiator “V” belts for correct tension, check fan blades – broken. |
| Check fan cover for damages. |
| Check adjustment spring for damages. |
| Check corrosion filter for leaks. |
| Check alternator “V” belts for correct tension and wear. |
| Check water pump leaks. |
| Check turbo-charger for oil and exhaust fume leaks. |
| Check engine oil level, the oil must be on “full” mark of the dipstick. |
| Check motor starters for loose wires. |
| Check accelerator solenoid for loose cable, engine oil leaks and oil filters for leaks. |

**TOP (LEFT AND RIGHT)**

| Check engine oil reticulation tanks, filters for oil leaks and oil level gauge. |
| Check pre air cleaners for blockages. |
| Check air filter caps if properly closed. |
| Check exhaust hoses and clamps for damages. |
| Check exhaust silencers. |
| Check water filling tanks for leaks. |
| Check hydraulic oil filter for blockages. |
| Check auto lubricating tank for damage. |
| Check swing ring motor oil cooler for leaks. |
| Check grease air pressure gauge for damage. |
| Check transfer valves. |
| Check portable fire extinguisher level, safety pin and hose. |
| Check outside cabin lights for damages. |
| Check cabin rear wiper. |
| Check hand rails for breakages and cracks. |
| Check the cabin door condition. |
### BETWEEN ENGINES
- Check air conditioner motor for damage and "V" belts.
- Check fire extinguisher bottle for damage.
- Check air compressor for leaks.
- Check fuel pump for leaks.
- Check fuel filter for leaks.
- Check engine oil filter for leaks.
- Check after cooler for leaks.
- Check hydraulic oil level.
- Check batteries.
- Check emergency switch board.

### CABIN INTERIOR
- Check for general cleanliness, clean if required.
- Check gauges for damage and glass breakage.
- Check emergency switch – to be on “off” position.
- Check fire extinguisher knob, pin and gauge.
- Check inside cabin lights for damages.
- Check air conditioner for dirt.
- Check seat condition, adjustment and safety belt condition.

### STARTING PROCEDURE
- Before starting engine, ensure that the control levers are in the neutral position.
- Look around to ensure that there is nobody in the vicinity who may get injured.
- Sound the hooter.
- Start the engine and allow it to idle for 5 minutes (Number 1 engine first and then number 2).
- Wait for engine oil pressure warning light to switch off (5 to 10 seconds)
- Switch on the lights.
- Ensure that all gauges and warning devices are functioning and that all gauge readings are within the prescribed range.
- Dismount machine with a piece of cloth.
- Go to the front and check if lights are in good condition.
- Check for oil, water and air pressure leaks.
- Go around the machine to check the rear lights.
- Re-check engine oil level.
- Get into the cab and belt up.
- Sound the hooter.
- Accelerate the machine.
- Raise the bucket up, down, outwards and backwards.
- Tilt the bucket, open and close.
- Tram forward and backwards
- Swing the machine leftwards and rightwards.
## TRAMMING
- Keep to the left of the haul road and obey all traffic signs.
- Avoid sharp turns on haul roads, make turns with the largest possible radius.
- Never ride over pools of water, rocks, electrical cables (dead or live), demarcation cones or any foreign objects.
- Tram for 15 minutes and stop for 15 minutes to allow cooling of tracks.
- Do not stand on the machine whilst in motion, sit on the operators seat provided.

## AT LOADING AREA
- Park the machine 30m away from the working area.
- Dismount the machine and inspect working area for misfires, electrical cables, hang-ups and pipes.
- Load using the parallel to the shovel’s tracks.
- Do not load big boulders onto the trucks.
- Give a signal (hoot) to the truck operator when the truck is fully loaded.
- Never undercut the muck pile, load from the top to the bottom.
- Always use floor control measures provided for correct floor elevation.

## SHUTDOWN PROCEDURE
- Refuel the machine after every shift
- Park the machine on safe level ground and lower all attachments
- Ensure that all control levers are in neutral position.
- Apply parking brake, swing brake and switch on lights.
- Put the machine on the automatic switch off position.
- Walk around the machine to check for any damage, water, oil and air pressure leaks.
- Climb the machine again and switch off the lights.
- Use the step ladder provided when getting off the machine (use the three points contact)
- Report any defects to your supervisor.
- Report to the incoming operator about the condition of the machine.

## OPERATING TECHNIQUES
- Travelling on slopes
- Precautions when travelling
- Precautions when operating
- Method of using brakes
- Working on loose ground
- Loading on trucks
- Loading on faces
This curriculum has been developed as part of the Learning and Knowledge Development (LKD) Facility, initiated by the Swedish International Development Agency (Sida) and the United Nations Industrial Development Organization (UNIDO). The LKD Facility is a platform to promote industrial skills development among young people in emerging economies. Working with the private sector through Public Private Development Partnerships, the LKD Facility supports the establishment and upgrading of local industrial training academies to help meet the labour market’s increasing demand for skilled employees, ultimately contributing to inclusive and sustainable industrial development.

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