

Participant Handbook

Sector
Infrastructure Equipment

Sub-Sector
Equipment Operations

Occupation
Operator

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NSQF Level 4



Excavator Operator

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Shri Narendra Modi
Prime Minister of India

“ Skilling is building a better India.
If we have to move India towards
development then Skill Development
should be our mission. ”

Acknowledgements

This Facilitator Guide has been developed with the efforts of all the stakeholders in the industry; equipment manufacturers, customers/end users as well as training organisations who are proactively involved in this pioneering project to transform the skill landscape in the infrastructure equipment sector.

We wish to acknowledge with gratitude the following organisations who whole heartedly supported us with their technical inputs as well as valuable feedback at different stages in our endeavour to bring out this Guide. We are confident this will go a long way in enabling our Trainers to deliver time bound quality skill training to our operators and mechanics.



About this book

With the renewed focus on infrastructure projects, the demand for construction equipment is bound to get better. The excavator market will see an increased demand which in turn will lead to a larger number of skilled operators being needed to operate these machines.

To address the future sector demand, this Participant Handbook is designed to enable training for the specific Qualification Pack (QP). Each National Occupational (NOS) is covered across Unit(s).

Key Learning Objectives for the specific NOS mark the beginning of the Unit(s) for that NOS. The symbols used in this book are described below.

Symbols used



Key Learning
Outcomes



Steps



Time



Tips



Notes



Unit
Objectives

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Employability & Entrepreneurship Skills







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1. Introduction

Unit 1.1 - About the Programme
Unit 1.2 - About the Product



Key Learning Outcomes




At the end of this module, you will be able to:

-  Develop acquaintance with one another.
-  Outline the program expectations.
-  Define the role of Excavator Operator.
-  Identify different parts of the excavator along with their uses.
-  List the primary controls of the excavator and its uses.

UNIT 1.1: About the Programme

Unit Objectives

At the end of this unit, you will be able to:

-  Discover the design and structure of this training curriculum.
-  Develop acquaintance with each other.
-  List all the expectations from this training.

1.1.1 Overview of the Book

This participant handbook empowers participants to approach the job role of excavator operator with confidence and execute the tasks assigned at worksite effectively. The training curriculum will help you:

- 1. Carry out pre-operation checks** - General introduction to excavator machine, basic working of engine, hydraulic and electrical systems, operational controls and instrument panel, preparing machine for operations.
- 2. Operate an excavator** - Starting of excavator, moving to worksite and carrying out earth digging, load lifting and dumping; parking and shutting down the machine; post-operative checks.
- 3. Carry out maintenance and troubleshooting** - General maintenance procedures and periodic service schedule of a excavator; common faults and their diagnosis; reports and documents.
- 4. Comply with worksite health and safety guidelines** - Health, safety and environment policies; personal protective equipment, fire-fighting equipment, basic first aid for common injuries at worksite.

Activity 

Knowing Each Other

1. List out two names of fellow participants whom you have met and interacted with.

2. List out two names of those from the same place/district/state.

3. List out two names among the participants whose hobbies are the same as yours.





Expectation Mapping

1. My expectations from the training programme are:

UNIT 1.2: About the Product

Unit Objectives

At the end of this unit, you will be able to:

-  Outline the history of excavators.
-  Identify the basic features and uses of excavators.
-  Identify various parts of excavators and their uses.
-  Discover the safety features of excavators.

1.2.1 Brief History of Excavators

Most construction projects, especially large-scale undertakings, begin with land excavation. During this initial phase of construction, excavation contractors use heavy equipment to carve away or fill in the existing land to make way for new buildings, roadways, and sewers. Before the rise of motorised construction machinery, earthmoving was a truly backbreaking process. With help from hydraulic excavators, it is now much easier to shape the land according to the needs of the project.

Driven by a skilled equipment operator, a hydraulic excavator aids the site supervisor in meeting construction deadlines. While their specific capabilities vary depending on size and available attachments, all excavators work in a similar fashion. Though they are most commonly seen working on large construction projects, models in the mini class are designed to handle smaller jobs.

1.2.2 Brief Specs, Features and Performance

Excavators are heavy construction equipment consisting of a boom, dipper (or stick), bucket and cab on a rotating platform known as the "Cabin". The house sits atop an undercarriage with tracks or wheels. They are a natural progression from the steam shovels and often mistakenly called power shovels.

All movement and functions of a hydraulic excavator are accomplished through the use of hydraulic fluid, with hydraulic cylinders and hydraulic motors. Due to the linear actuation of hydraulic cylinders, their mode of operation is fundamentally different from cable-operated excavators which uses winches and steel ropes to accomplish the movements.

1.2.2.1 General Excavator Specifications

Dimensions and specifications	Value
Operating weight	2,390 Kg
Bucket mass	900 Kg
Name of the engine	SAA6D1071-diesel engine
Engine horsepower	KW (HP)/rpm 110 (148)/2,000
Overall length	9,475 mm
Overall height	3,000 mm
Overall width	2,800 mm
Track width	600 mm
Height of cab	3,305 mm
Radius of the upper structure	2,800 mm
Length of track	4,080 mm
Tumbler centre distance	3,270 mm
Min. ground clearance	440 mm

Performance specifications	Value
Travel speed (Lo/Mi/Hi)	3.0/4.1/5.5 Km/h
Swing speed	12.4 rpm
Max. digging reach	9,875 mm
Max. digging depth	6,620 mm
Max. digging height	10,000 mm
Max. vertical wall depth	5,980 mm
Max. dumping height	7,110 mm
Min. dumping height	2,645 mm
Max. reach ground level	9,700 mm

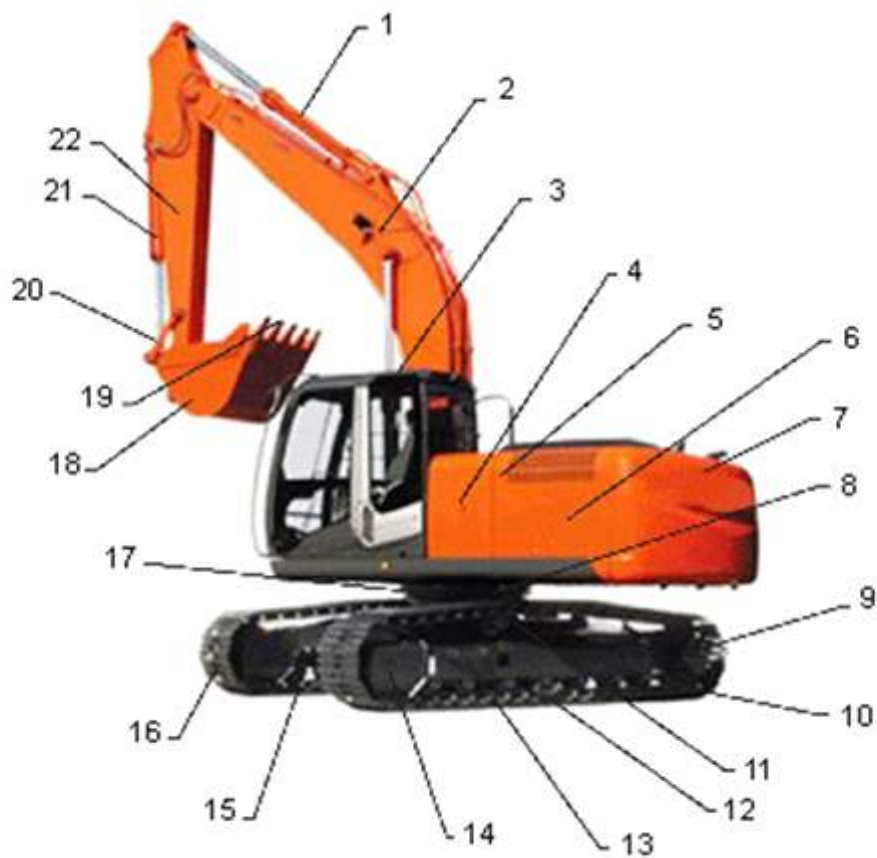
Exercise

Answer the following questions:

1. Name any four performance specifications of Excavator.

2. Write the specifications for the following dimensions:

3. Identify and label the parts of Excavator in the figure given below:



Notes



Lined writing area containing 20 horizontal lines for notes.

2. Carry Out Pre-Operation Checks on an Excavator









- Unit 2.1 - Excavator Parts and Control Panels
- Unit 2.2 - Pre-Operation Checks of Machine and its Attachments
- Unit 2.3 - Cabin Interiors



Key Learning Outcomes



At the end of this module, you will be able to:

-  Identify excavator parts and control panel.
-  Take part in pre-operational checks on an excavator.
-  Examine the excavator for the checks to be done before starting the operation.
-  Test for visual inspection and take part in basic maintenance.
-  Test for basic hydraulic and electronic unit functioning.
-  List different adjustments to be done inside the machine and cabin.

UNIT 2.1: Excavator Parts and Control Panels

Unit Objectives

At the end of this unit, you will be able to:

-  Label parts of excavator on excavator model diagram.
-  Summarise functions of each control panel buttons and switches.

2.1.1 Excavator Parts

An excavator diagram with labelled number enables participants to understand the external visible parts of the machine. Following are the main parts of excavator machine:

- (1) Bucket
- (2) Bucket cylinder
- (3) Arm
- (4) Arm cylinder
- (5) Boom
- (6) Boom cylinder
- (7) Sprocket
- (8) Track frame
- (9) Track shoe
- (10) Idler

2.1.1 Excavator Parts

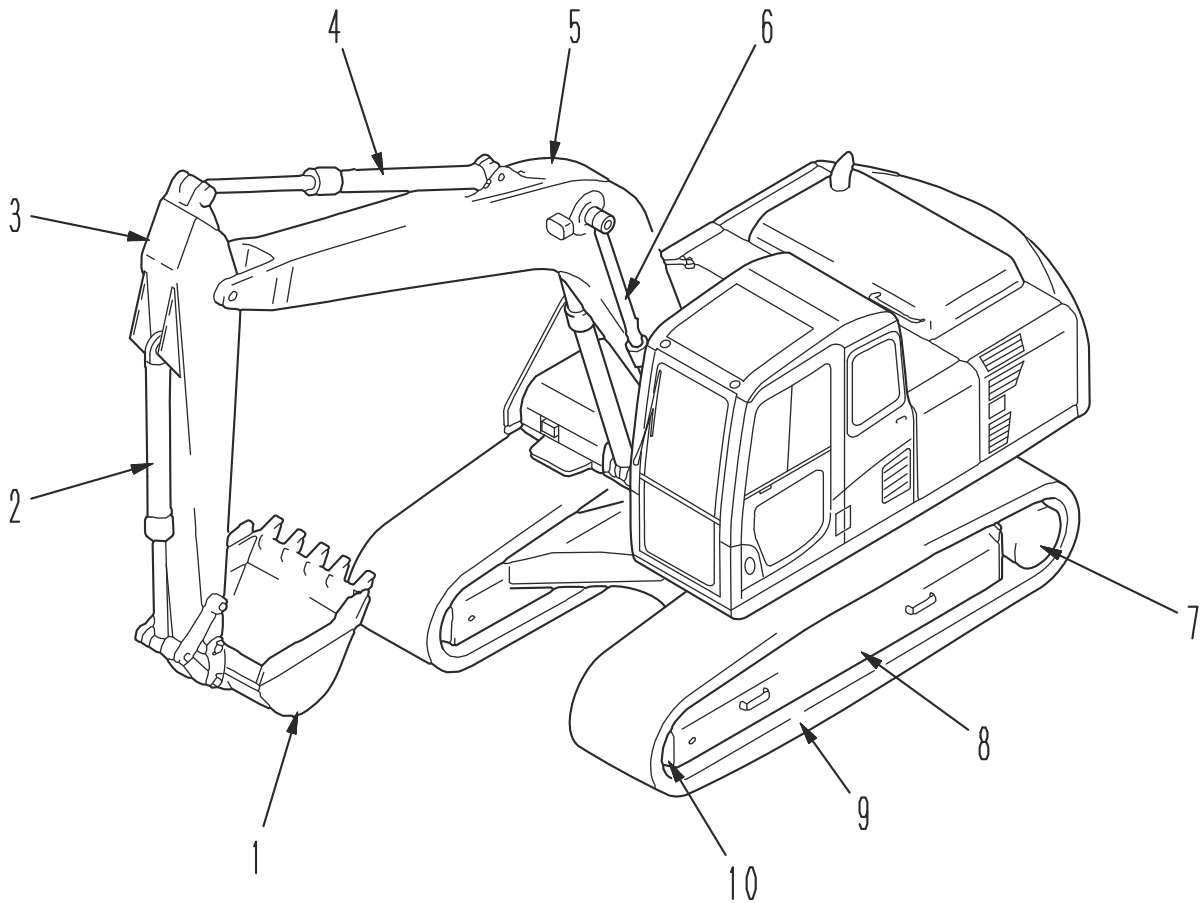


Fig 2.1.1 Main Parts of Excavator Machine

2.1.2 Control Panel

A control panel is an area where user's control and monitoring instruments are set that user can access to operate the excavator. Different parts of control panel are as below:

- | | |
|---|--|
| (1) Radio | (13) Starting switch |
| (2) Lock lever | (14) Fuel control dial |
| (3) Left work equipment control lever | (15) Lamp switch |
| (4) Knob switch (2 x spare switches) | (16) Swing lock switch |
| (5) Travel pedals | (17) Revolving warning lamp switch (if equipped) |
| (6) Travel levers | (18) Attachment control pedal (if equipped) |
| (7) Horn switch (2 x spare switches) | (19) Attachment control pedal (if equipped) |
| (8) Machine monitor | (20) Swing brake cancel switch |
| (9) Air conditioner control switches | (21) Emergency pump drive switch |
| (10) Cigarette Lighter monitor | (22) Hydraulic oil temperature monitor |
| (11) Right work equipment control lever | (23) Hydraulic oil temperature gauge |
| (12) Blade control lever (if equipped) | (24) Maintenance interval monitor |

2.1.2 Control Panel

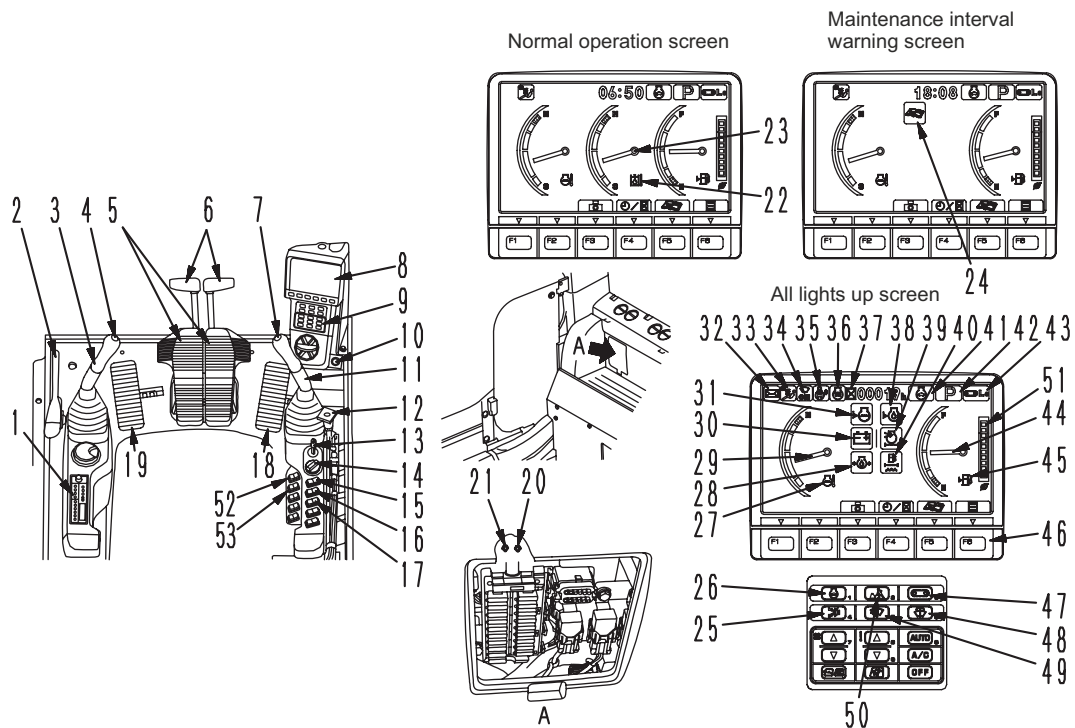





Fig 2.1.2 Control Panel

- | | |
|--|-----------------------------------|
| (25) Buzzer cancel switch | (40) Water separator monitor |
| (26) Auto-deceleration switch | (41) Auto-deceleration monitor |
| (27) Engine coolant temperature monitor | (42) Working mode monitor |
| (28) Engine oil pressure monitor | (43) Travel speed monitor |
| (29) Engine coolant temperature gauge | (44) Fuel gauge |
| (30) Charge level monitor | (45) Fuel level monitor |
| (31) Radiator coolant level monitor | (46) Function switches (F1 to F6) |
| (32) KOMTRAX message monitor | (47) Travel speed selector switch |
| (33) Air conditioner monitor | (48) Window washer switch |
| (34) Wiper monitor | (49) Wiper switch |
| (35) Swing lock monitor | (50) Working mode selector switch |
| (36) Engine pre-heating monitor or One-touch power max | (51) ECO gauge |
| (37) Service meter, Clock | (52) Lower wiper (if equipped) |
| (38) Engine oil pressure monitor | (53) Heated seat |
| (39) Air cleaner clogging monitor | |

UNIT 2.2: Pre-Operation Checks of Machine and its Attachments

Unit Objectives

At the end of this unit, you will be able to:

-  Take part in outside the overall machine checks before starting the engine.
-  Utilise refuelling pump to add fuel at worksite.
-  Determine the need to tighten bolts and refill the excavator with oil, water, fuel, coolant, etc.

2.2.1: Before Starting Machine

Steps

Walk-around Checks

Before starting the engine, look around and under the machine to check for loose nuts and bolts, or leakage of oil, fuel, or coolant, and check the condition of the work equipment and hydraulic system. Also check for loose wiring, play, and accumulation of dust at places with high temperatures. Perform the following inspections and cleaning every day before starting engine for the day's work:

Step-1: Check for damage, wear, play in work equipment, cylinders, linkage, hoses. Check for cracks, excessive wear, play in work equipment, cylinders, linkage, and hoses. If any problem is found, repair it.

Step-2: Remove dirt and debris from around the engine, battery, and radiator. Check for dirt accumulated around the engine and radiator. Also check for flammable material (dry leaves, twigs, etc.) around the battery, engine muffler, turbocharger, or other high-temperature engine parts. If any dirt or flammable materials are found, remove them.

Step-3: Check for coolant and oil leakage around the engine. Check for oil leakage from the engine and coolant leaks from the cooling system. If any problem is found, repair it.

Step-4: Check for oil leakage from hydraulic equipment, hydraulic tank, hoses, and joints. Check for oil leakage. If any problem is found, repair the area where oil is leaking.

Step-5: Check the undercarriage (track, sprocket, idler, guard) for damage, wear, loose bolts, or leakage of oil from rollers. If any problem is found, repair it.

Step-6: Check for problems in handrails, steps, loose bolts. If any problem is found, repair it. Tighten any loose bolts.

Step-7: Check for the problem in gauges, monitor. Check that there is no problem in the gauges and monitor in the operator's cab. If any problem is found, replace the parts. Clean off any dirt on the surface.

Step-8: Clean, check rear-view mirror. Check for damage to the rear-view mirror. If damaged, replace it with a new mirror. Clean surface of the mirror and adjust angle so area at the rear can be seen from the operator's seat.

Steps

Step-9: Seat belt and mounting clamps Check for damage or wear to the seat belt and mounting clamps. If there is any damage, replace with new parts.

Step-10: Check bucket with hook (if equipped) for damage. Check for damage to the hook, guide, and hook mount. If any problem is found, contact your distributor for repairs.

2.2.2: Refuelling Pump

Steps

When the machine is operated on sites with no fuel container and pump, the machine may be refuelled using the refuelling pump (if fitted) from fuel barrels.

Step-1: The refuelling pump is located next to batteries at the front right-hand side of the machine.

Step-2: Place the fuel hose (2), which is stored in tray (3) into the fuel barrel placed next to the machine.

Step-3: Switch on refuelling pump using switch (1) on the pump assembly when adding fuel, never let the fuel overflow. This may cause fires.

Notice

This pump is protected by an in line blade fuse. If pump fails to function check fuse.

Ensure strainer on hose end is clean.

WARNING

Do not bring fire or sparks near the fuel.

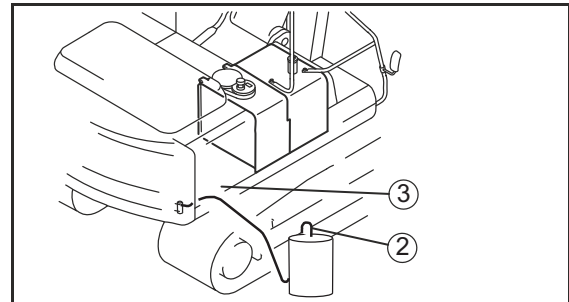


Fig 2.2.2 (a) Pump Location



Fig 2.2.2 (b) Fuel Pump

2.2.3: Checks Before Starting

Steps

Check Coolant Level, Add Coolant

Coolant helps to avoid engine overheating and keep engine heat at recommended levels for your vehicle's optimum operation. Make sure the system is cool before removing the radiator cap to add coolant.

Step-1: Open the door at the rear left of the machine, and check if the coolant in sub-tank (1) (shown in the diagram on the right) is between the FULL and LOW marks. If the coolant level is low, add coolant to the FULL level through the filler port of sub-tank (1).

Step-2: After adding coolant, tighten the cap securely.

Step-3: If the sub-tank (1) is empty, there is probably leakage of coolant. After inspecting, repair any problem immediately. If there is no problem, check the coolant level in the radiator. If the coolant level is low, add coolant to the radiator, then fill the sub-tank (1).

Step-4: If the inside of sub-tank (1) is dirty and the water level cannot be seen, use the procedure in "Clean inside of cooling system".

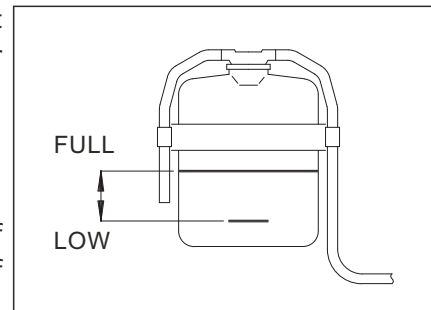
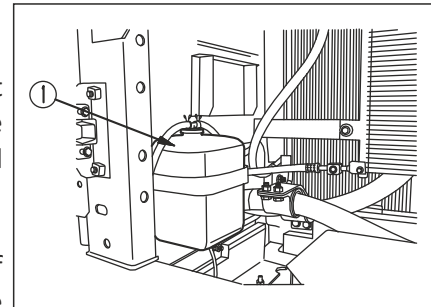


Fig 2.2.3 (a) Checking for the Coolant

Check Oil Level in Engine Oil Pan, Add Oil

Oil lubricates the engine and prevents friction thus controls the heat inside the engine. Friction causes wear which will eventually destroy the engine. Friction and heat degrade oil over time. This is the reason the engine oil and oil level need to be checked and refilled regularly.

Step-1: Open the engine hood on the machine.

Step-2: Remove dipstick (G), and wipe the oil off with a cloth.

Step-3: Fully insert dipstick (G) into filler pipe (F), then remove it.

Step-4: The oil level should be between the H and L marks on dipstick (G). If the oil level is below the L mark, add oil through oil filler (F).

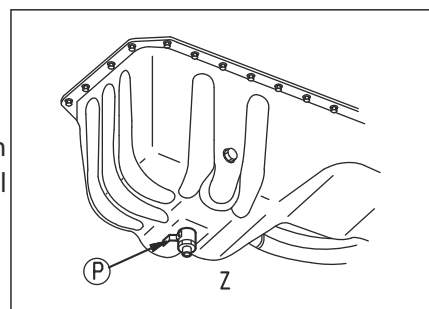
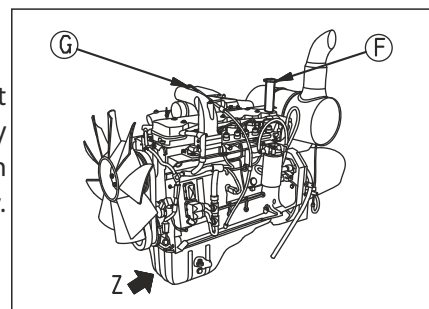


Fig 2.2.3 (b) Checking for Oil Level in engine

Steps

Step-5: If the oil is above the H line, open drain valve (P) at the bottom of the engine oil pan, drain the excess engine oil, then check the oil level again.

Step-6: If oil level is correct, securely tighten the oil filler cap and close the engine hood.

Remark

When checking the oil level after the engine has been operated, wait for at least 15 minutes after stopping the engine before checking. If the machine is at an angle, make it to a horizontal position before checking.

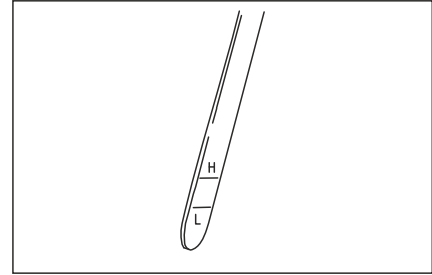


Fig 2.2.3 (c) Checking for Oil Level in engine

Check Fuel Level, Add Fuel

Fuel level is to be checked on daily basis by estimating the working hours. Refill fuel up to the required level. No spark or flammable substance must be near while filling a fuel tank.

Step-1: Open fuel filler cap (F) of the fuel tank.

Step-2: If fuel filler cap (F) is opened, float gauge (G) rises to the fuel level. Check that the fuel tank is full. Check the fuel level visually and with float gauge (G).

Step-3: If the fuel tank is not full, add fuel through the fuel filler until float gauge (G) rises to the maximum position.

Q Fuel tank capacity: 400 liters

Position of tip (a) of float gauge (G) when fuel tank is full:
50 mm

Step-4: After adding fuel, push float gauge (G) straight down with fuel filler cap (F). Be careful not to get float gauge (G) caught in the tab of fuel filler cap (F), and tighten fuel filler cap (F) securely.

Remark

If breather hole (1) in the cap is clogged, the pressure inside the tank will go down and no fuel will be supplied, so clean the breather hole periodically. The diagram on the right shows the rear surface of the cap.

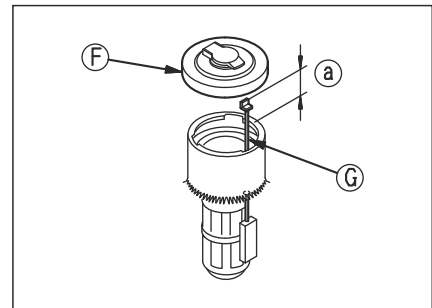
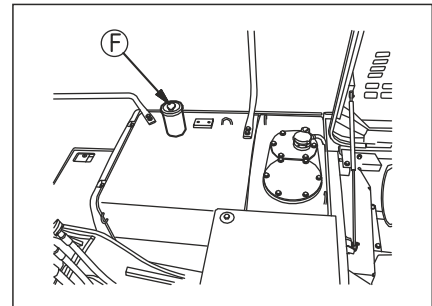


Fig 2.2.3 (d) Checking for the Fuel Level

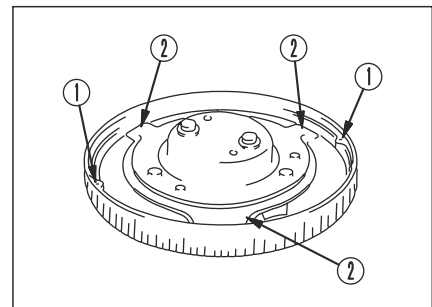


Fig 2.2.3 (e) Rear Surface of the Cap

Steps

Drain Water And Sediment from Fuel Tank

The fuel-air mixture which helps in spark-ignition in the combustion engine carries moisture. Overtime moisture condenses and forms water which rusts the inside of the fuel tank. This rust forms debris. The fuel tank needs to be water drained and sediment to be removed for optimum performance of the engine.

Step-1: Open the pump room door on the right side of the machine.

Step-2: Set a container under drain hose (1) to catch the drained fuel.

Step-3: Open drain valve (2) at the rear of the fuel tank and drain the water and sediment accumulated at the bottom of the tank together with the fuel.

Step-4: When only clean fuel comes out, close drain valve (2).

Step-5: Close the pump room door on the right side of the machine.

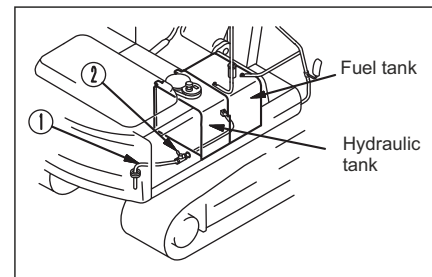


Fig 2.2.3 (f) Drain Water and Sediment from Fuel Tank

Check for Water and Sediment in Water Separator, Drain Water

The water separator makes sure clean fuel is delivered to the engine. A water separator provides effective protection for engines against water and solid contaminants from the fuel before it reaches the fuel pump. However, over time it becomes not as effective so the regular check is a necessity.

Step-1: Open the pump room door on the right side of the machine. The water separator forms one unit with fuel pre-filter (1) and consists of bottom parts (2) - (4).

Step-2: Water and sediment on the bottom can be checked through transparent cap (2). If there is water or sediment, prepare a container to receive it under drain hose (4).

Step-3: Loosen drain valve (3) to drain the water.

Step-4: If fuel starts flowing out from the drain hose (4), close valve (3) immediately.

Step-5: On this machine, a sensor is installed to detect if water is accumulated at the bottom of fuel pre-filter (1). When the water separator monitor shown in the illustration on the right lights up red on the machine monitor at the front right of the operator's seat, it indicates that water is accumulated in fuel pre-filter (1). In this case also, use the above Steps 1 - 4 to drain the water.

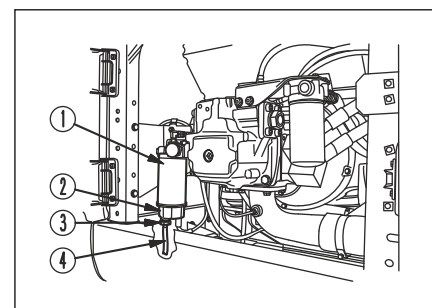
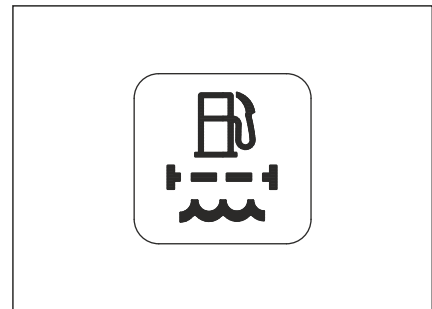


Fig 2.2.3 (g) Check for Water and sediment in Water Separator

Steps

Step-6: Close valve (6) at the bottom of the fuel tank to shut off the fuel supply.

Step-7: Set a fuel container under drain hose (4).

Step-8: Loosen drain valve (3), then drain all the sediment together with the fuel from drain hose (4).

Step-9: Check that nothing comes out from drain hose (4), then remove drain valve (3).


Step-10: Coat O-ring portion (5) with a suitable amount of grease. When doing this, be careful not to let the grease get on the drain valve water drain port (a) or the drain valve thread.


Step-11: Screw-in drain valve (3) by hand until it contacts the bottom.

Step-12: Remove the fuel container.

Step-13: Open valve (6) at the bottom of the fuel tank.

Remarks:

 If transparent cap (2) is dirty and the contents cannot be easily seen, clean transparent cap (2) when replacing the filter.

 When washing, if drain valve (3) is removed, coat the O-ring with grease, then tighten by hand until it contacts the bottom.

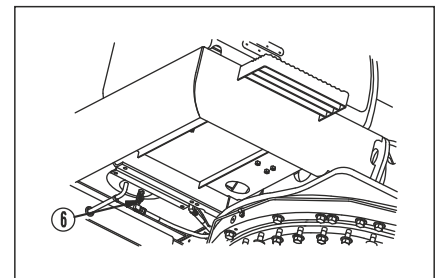
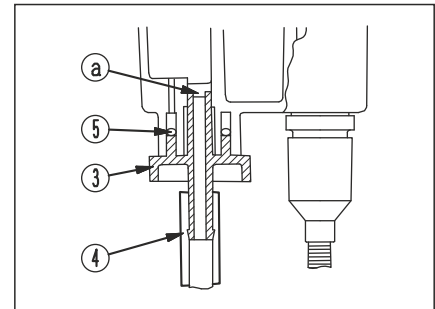


Fig 2.2.3 (h) Check for Water and sediment in Water Separator

Check Oil Level in Hydraulic Tank, Add Oil

The main function of a hydraulic fluid is to transfer power to hydraulic machinery. The other important function of hydraulic fluid is protection of the hydraulic machine components. For this reason optimal level of oil level in hydraulic tank is critical.

Step-1: If the work equipment is not in the condition shown in the diagram on the right, start the engine, run the engine at low speed, retract the arm and bucket cylinder rods fully, then lower the boom, set the bucket teeth in contact with the ground, and stop the engine.

Step-2: Check sight gauge (G) from the right window installed to the operator's compartment. The oil level should be between the H and L lines.

Step-3: If the oil level is below the L line, add oil through oil filler (F) at the top of the hydraulic tank.

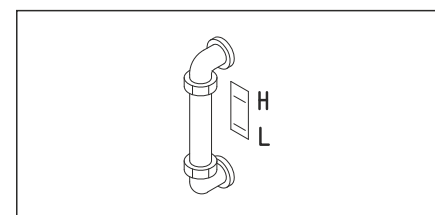
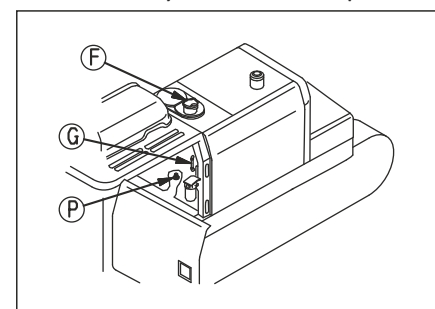


Fig 2.2.3 (i) Check for Oil Level in Hydraulic Tank

Steps

NOTICE:

Do not add oil above the H line. This will damage the hydraulic equipment and may cause oil to spurt out. If oil is added above the H line, stop the engine, wait for the oil temperature to cool down, put a container to catch the oil under drain plug (P) at the bottom of the hydraulic tank, then drain the excess oil from the drain plug.

Check Working Lamp Switch

Turn the lamp switch ON (night mode (a), and day mode (b)) and check that the working lamp lights up.

If it does not light up, there is probably a blown bulb or a disconnection, so contact your distributor to have repairs carried out.

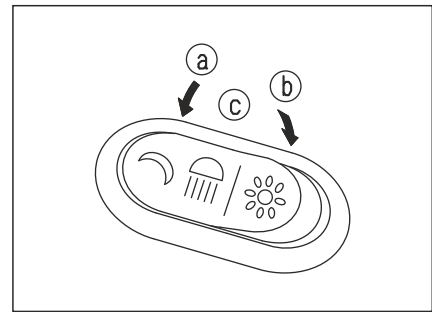


Fig 2.2.3 (j) Check Working Lamp Switch

Check Electric Wiring

Before dealing with electric wiring ensure personal safety by switching OFF all electrical current from the source. Test if the current is cut-off with a circuit tester. Wear thick rubber soled shoes to be insulated from ground.

Step-1: Check that there is no damage to the fuses; that fuses of the specified capacity are used; that there is no disconnection or trace of short-circuiting in the electric wiring and no damage to the covering. Check also that there are no loosened terminals. If any, tighten them.

Step-2: Moreover, pay particular attention to the electric wiring when checking the battery, engine starting motor and alternator.

Step-3: Be sure to check that there is no inflammable material accumulated around the battery. If any is found, remove immediately.

Check Function of Horn

The horn is used to alert others or to draw attention to certain hazards regarding the approach or presence of the vehicle. Thereby ensure horn proper functioning for safety concerns.

Step-1: Turn the starting switch to the ON position.

Step-2: Confirm that the horn sounds immediately when the horn button is pressed. If the horn does not sound, contact your distributor for repair.

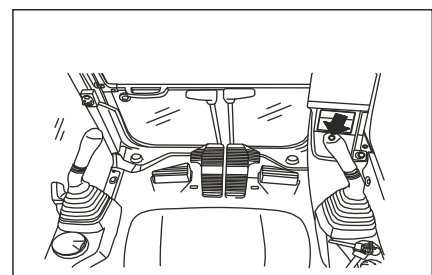





Fig 2.2.3 (k) Check Function of Horn

UNIT 2.3: Cabin Interiors

Unit Objectives

At the end of this unit, you will be able to:

-  Change the seat adjustments inside the cabin.
-  Modify the position of safety mirrors for optimum view.
-  Take part in checks to be performed before starting the machine operation.

2.3.1 Adjustments

Seat Adjustment

Always adjust the operator's seat before starting each operation or when the operators change shift. Adjust the operator's seat so control levers and switches can be operated freely and easily with the operator's back against the backrest.

(A) Fore-and-aft adjustment

Pull lever (1) up, set the seat to the desired position, then release the lever. Fore-and-aft adjustment: 160 mm (16 stages)

(B) Adjusting reclining

Pull up lever (2) and set the backrest to a position that is comfortable for operation, then release the lever. Sit with your back against the seat backrest when adjusting. If your back is not against the backrest, the backrest may suddenly move forward.

(C) Adjusting seat tilt

Forward tilt. Push lever (3) down to adjust angle of the front of seat (4 stages).

To raise the angle at front of the seat, keep the lever pushed down and apply your weight to the rear of seat.

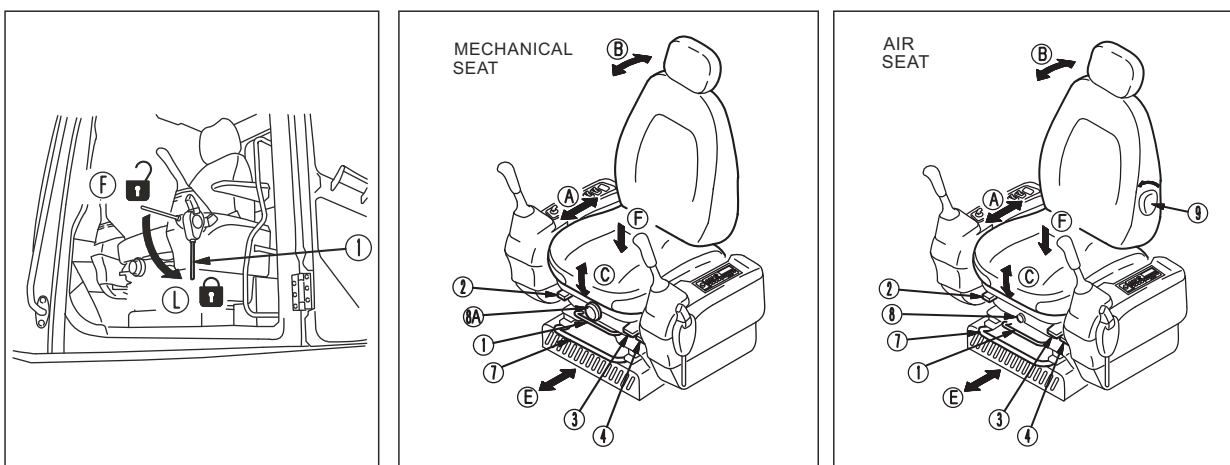


Fig 2.3.1 (a) Seat Adjustment

2.3.1 Adjustments

To lower the angle at front of the seat, keep the lever pushed down and apply your weight to the front of seat.

Rear tilt Pull lever (4) up to adjust angle of the rear of seat. (4 stages) To raise the angle at rear of the seat, keep lever (3) pulled up, and stand up slightly to remove your weight from the seat.

To lower the angle at rear of the seat, keep lever (3) pulled up, and apply your weight to the seat.

Amount of tilt: Up 13°, down 13°

Adjusting seat height It is possible to move the seat up or down by combining adjustments forward tilt and rear tilt. After setting the forward tilt or rear tilt to the desired height, operate the opposite part to set the seat horizontal then secure in position Height adjustment: 60 mm

(D) Adjusting armrest height

The height of armrest (5) can be adjusted up or down by changing the position of adjustment bolt (6) at the rear of the armrest. Armrest height adjustment: 16.5 mm

(E) Overall fore-and-aft adjustment of seat

Raise lever (7) and slide to the desired position, then release the lever. In this case, the operator's seat, left and right control levers, and lock lever all slide together. Fore-and-aft adjustment: 180 mm

In order to function correctly, the seat suspension must be adjusted to suit the drivers weight and is done so by pressing or pulling control knob (8) The seat should be adjusted so that there is equal travel in both upward and downward directions. (weight range 60~ 150 Kg)

(F) Adjusting suspension - Air seat

In order to function correctly, the seat suspension must be adjusted to suit the drivers weight and is done so by pressing or pulling control knob (8) The seat should be adjusted so that there is equal travel in both upward and downward directions. (weight range 60~ 150 Kg)

(G) Adjusting suspension - mechanical seat (if equipPed)

Turn knob (8A) to the right to make the suspension harder, or to the left to make the suspension softer. Adjust the reading of the dial to match the operator's weight and select the optimum suspension.

(H) Lumbar Adjustment

Rotate knob (9) in direction shown to increase the amount of lumbar support (five positions). Further rotation in the same direction causes the lumbar support to return to the original position.

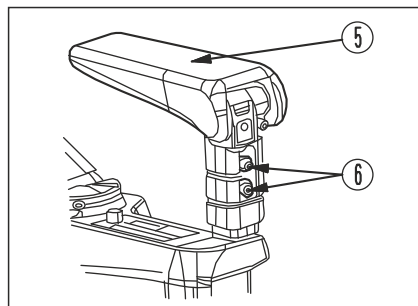


Fig 2.3.1 (b) Adjusting Arm Height

Steps

Rearview Mirrors








Adjust the mirror to a position which gives the best view from the operator's seat to avoid blind spots.

Step-1: Mirrors A, B - Loosen bolt (1) or (2) of the mirror, then adjust the mirror at the left and right sides at the rear of the machine. When installing the mirror, adjust so that it is possible to see any person (or any object of a height of 1 m and diameter of 30 cm) at the rear left or right of the machine.

Step-2: Mirrors C, D - Adjust so that it is possible to see the ground around the machine at a range of 1 m from the operator's seat. If the movement of the mirror is stiff when adjusting it, loosen screw (3) of the mirror.

Remarks:

Install the mirrors at the position and dimensions shown in the diagram. The values below are reference values for the range of visibility.

-  Mounting height: 120 mm (mirror A), 100 mm (mirror B)
-  Range of view (left): 1830 mm
-  Range of view (right): 1500 mm
-  Mirror A: Must be possible to see hatched portion (A)
-  Mirror B: Must be possible to see hatched portion (B)
-  Mirror C: Must be possible to see hatched portion (C)
-  Mirror D: Must be possible to see hatched portion (D)

Seat Belt

This seat belt has a wind-in device for fastening and removing, so it is not necessary to adjust the length.

Step-1: Fastening Seat Belt Hold grip (2) and pull the belt out from wind-in device (1), check that the belt is not twisted, then insert tongue (3) into buckle (4) securely.

Step-2: When doing this, pull the belt lightly to check that it is properly locked.

Step-3: Removing Belt-Press button (5) in buckle (4), and remove tongue (3) from buckle (4). The belt is automatically wound in, hold grip (2) and return the belt slowly to wind-in device (1).

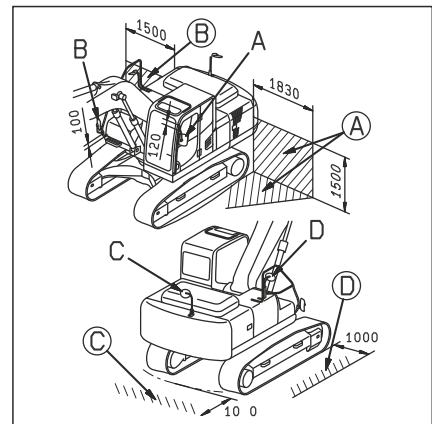
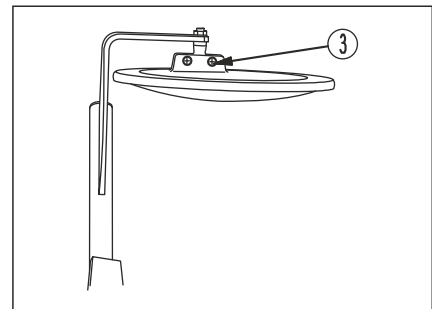
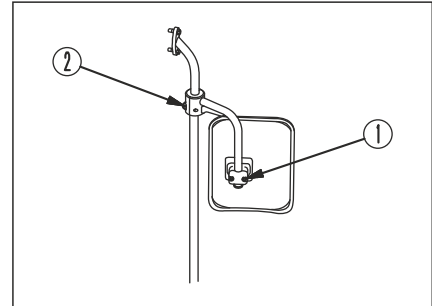


Fig 2.3.1 (c) Mirror Adjustment

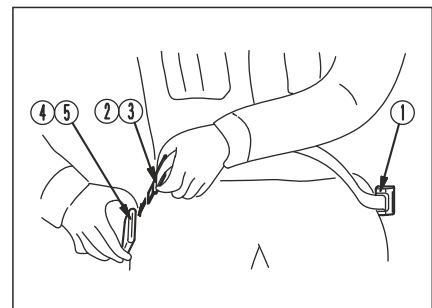


Fig 2.3.1 (d) Seat Belt Adjustment

Steps

Checking before starting the machine operation:

Inspection of excavator before starting every use decreases the possibility of the equipment being utilized in an unsafe condition. This makes it preventive maintenance issues early before it turns to breakdown maintenance affecting the economy of company, machine damage or costly repairs.

Step-1: Inspection before starting the day's work be sure to carry out a pre-work inspection and walk-around check before starting the engine for the day's work, following the instructions in the Operation and Maintenance Manual.



If any abnormality is found during inspection, immediately take corrective action in accordance with instructions in the operation and maintenance manual. Operating the machine without proper corrective action can cause serious damage to the machine.

Step-2: Warm-up run before starting the machine, thoroughly warm up the engine, in accordance with the instructions in the operation and maintenance manual. Operating the machine before the engine is thoroughly warmed up can shorten the service life of the engine and hydraulic equipment. If the machine is started while the hydraulic oil is still cold, it can cause a larger time lag in the work equipment and travel, which could result in serious accidents.

Step-3: Do not remove the strainer when refueling

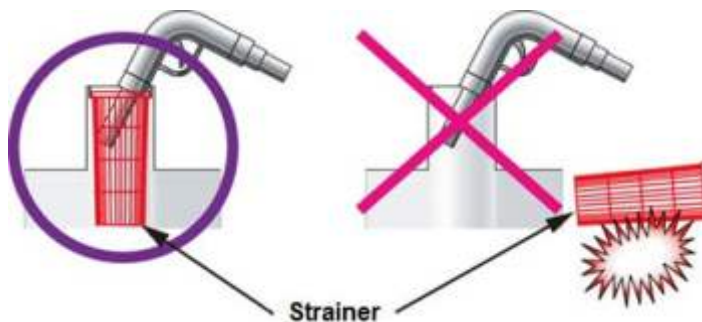


Fig 2.3.1 (e) Strainer removal



The strainer protects the fuel tank against large pieces of dust. Even if the fuel is clean, large pieces of dust can get in through the fuel port during refilling, causing the fuel system to get clogged. Therefore, do not remove the strainer when refilling with fuel.

Step-4: Greasing of Attachments / Precautions:

Be sure to grease at the intervals specified in the operation and maintenance manual. When greasing the pins, keep feeding until the old grease is pushed out and the new grease begins coming out of the pin end. Wipe off the old squeezed out grease.



Failure to grease as instructed can cause squeaking pins or scuffed bushing. If the condition becomes worse, parts may need to be replaced, resulting in considerable cost.

Steps



The old grease contains a high proportion of metallic dust generated as the pins and bushings wear out. Therefore, if the old grease is not removed, it can cause the pins and bushings to wear out prematurely.

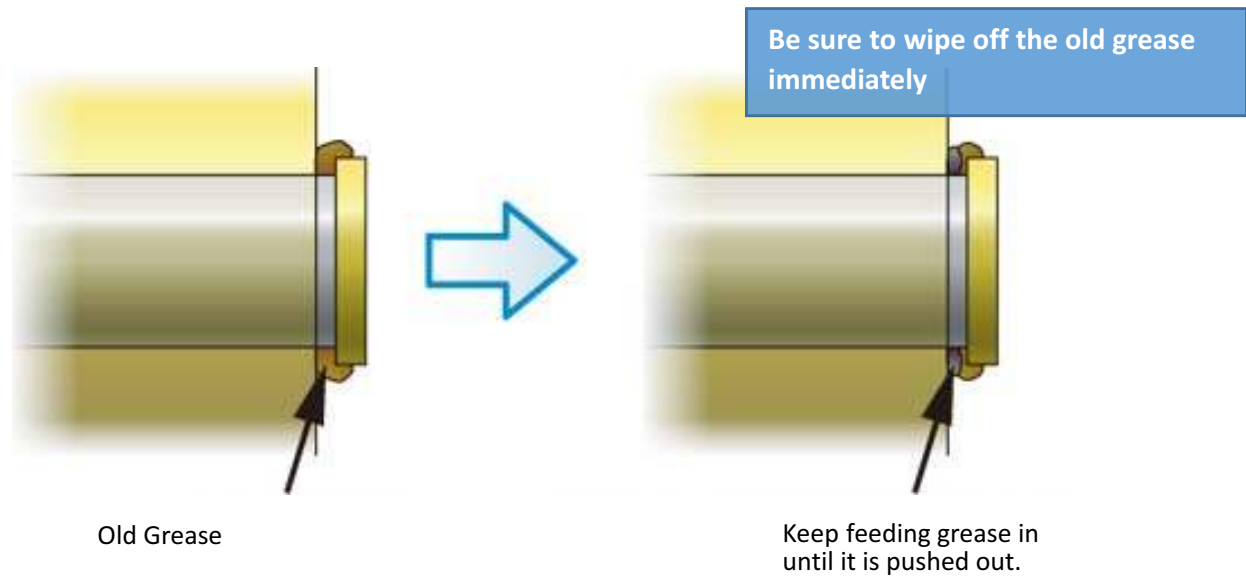


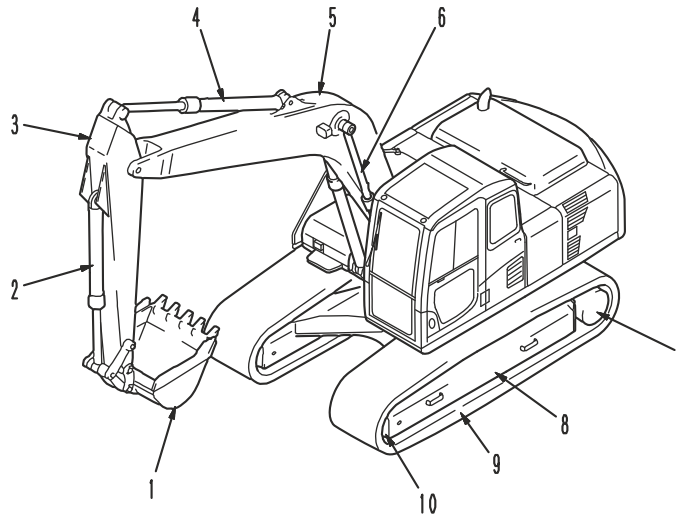
Fig 2.3.1 (f) Greasing of attachments

Exercise



Briefly answer the following questions:

1. Identify and label the parts of Excavator in the figure given below:



2. What are the first five-seat adjustments that are to be done before operating an Excavator?

3. What are the steps to be followed while greasing the attachments in an Excavator?





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3. Operate an Excavator

- Unit 3.1 - Inspection of worksite and safety
- Unit 3.2 - Standard operations
- Unit 3.3 - Transportation
- Unit 3.4 - Reporting & documentation













IES/N0108

Key Learning Outcomes





At the end of this module, you will be able to:

-  Utilise manufacturer's instructions for safe operations.
-  Recall the symbols and signs for operating an excavator.
-  Examine the worksite for safe operations.
-  Apply skills to confidently operate the excavator and loader.
-  Develop safe working practices and avoid danger to self and to others.
-  Mark-in logbooks and record all the activities related to general checking and maintenance.
-  List all the problems that are beyond the scope of an operator and inform the supervisor.
-  Develop in-depth understanding on importance of documentation and reporting.
-  Utilise pre-use checklists related to the excavator.
-  Utilise the excavator worksite inspection checklists.

UNIT 3.1: Inspection of Worksite & Safety

Unit Objectives

At the end of this unit, you will be able to:

-  Examine the worksite for safe operations.
-  Recall the communication symbols used for site safety and operating an excavator.

3.1.1: Inspection of Worksite

Steps

Following are the main points to be noted for worksite inspection:

There could be dangerous materials such as asbestos, poisonous chemicals or other harmful substances buried on the site. If you see any signs of toxic waste, advise the excavator operator immediately.

Step-1: Help the excavator operator check with your local public water and gas supplier if there are buried pipes and/or drains on the site. If there are, obtain a map of their locations and follow the advice given by the suppliers.

Step-2: Hand dig trial holes to obtain precise pipe locations. Any cast iron pipes found should be assumed to be gas pipes until contrary evidence is obtained.

Step-3: If a gas leak is suspected, assist the operator to contact the local gas company immediately and warn all personnel on the site.

Step-4: Safety Items fire extinguisher, PPE, eye wash, first-aid kit, etc.



Fig 3.1.1 Inspection of the worksite

3.1.2 Sample Site Safety Notice

The significance of displaying Safety Signs at the site is to prevent injury and safeguard employees and visitors. Make sure everyone is well aware of the likelihood of further dangers and hazards while in particular situations/environments or while performing certain activities.



Fig 3.1.2 Site Safety Notice

3.1.3 Signals to Guide a Excavator Operator

The signaller should stand in a secure position where he/she can see the load and can be seen clearly by the driver and should face the driver if possible. Each signal should be distinct and clear.

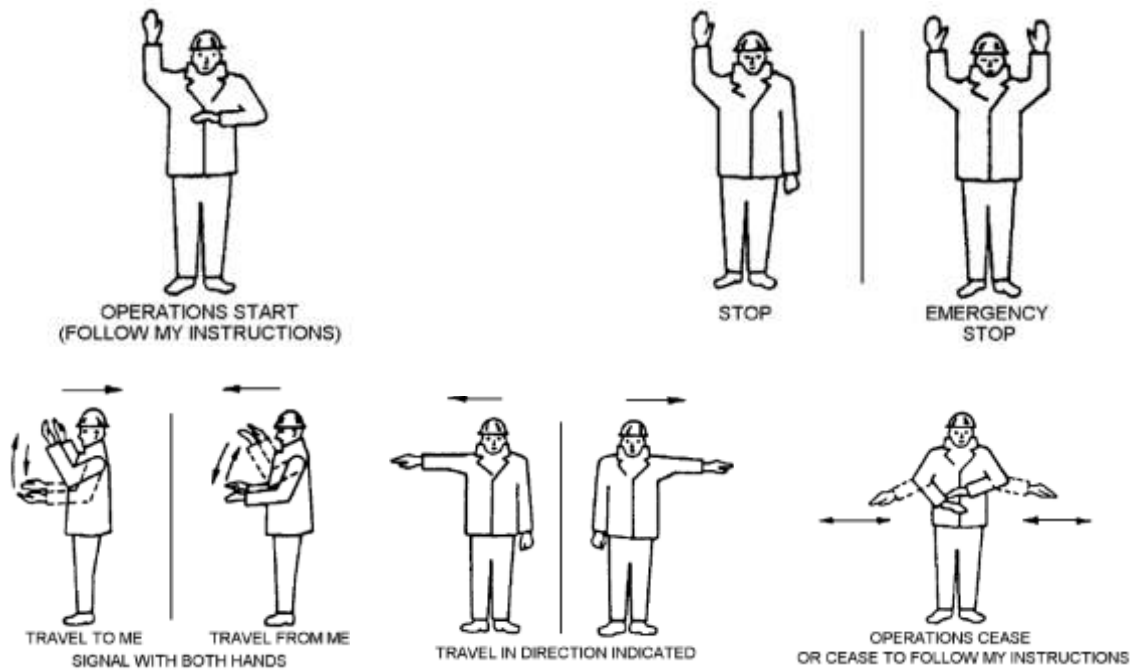






Fig 3.1.3 Signals to Guide a Excavator Operator

3.2: Standard Operations

Unit Objectives

At the end of this unit, you will be able to:

-  Interpret the stability of machine during operation.
-  Estimate the angles of arms for safe digging.
-  Decide the methods of digging using the weight of the machine.
-  Choose the posture of arms during travelling on horizontal, uphill and downhill surfaces.

3.2.1 Digging Operation

Stability of Machine:

Stability of the machine during operation increases production and extends the life of machine and provides safety. When sprocket is at the rear, the stability is better than when it is at the front. This posture also helps in protecting the final drive.



Fig 3.2.1 (a) Excavator Machine



Fig 3.2.1 (b) Excavator working over side

Length of track on ground A is always longer than track gauge B. Hence, working over the front will always provide better stability

3.2.1 Digging Operation



Fig 3.2.1 (c) Effective Digging Angles

When digging with the arm, keep the arm angle within the 45° to the front and 30° to the rear. Within this range, if the boom and bucket are used, the operating efficiency can be improved

When the bucket cylinder and link, and arm cylinder and arm are both at 90° to each other, the forces of each cylinder is at its maximum. If digging operation are carried out with skill full use of this angle, the operating efficiency is increased



Fig 3.2.1 (d) Digging Point Distance

If the digging point is far from the machine, the centre of gravity shifts to the front and causes instability.

Keeping the digging point close to the machine improves stability and increases the digging force.

3.2.1 Digging Operation

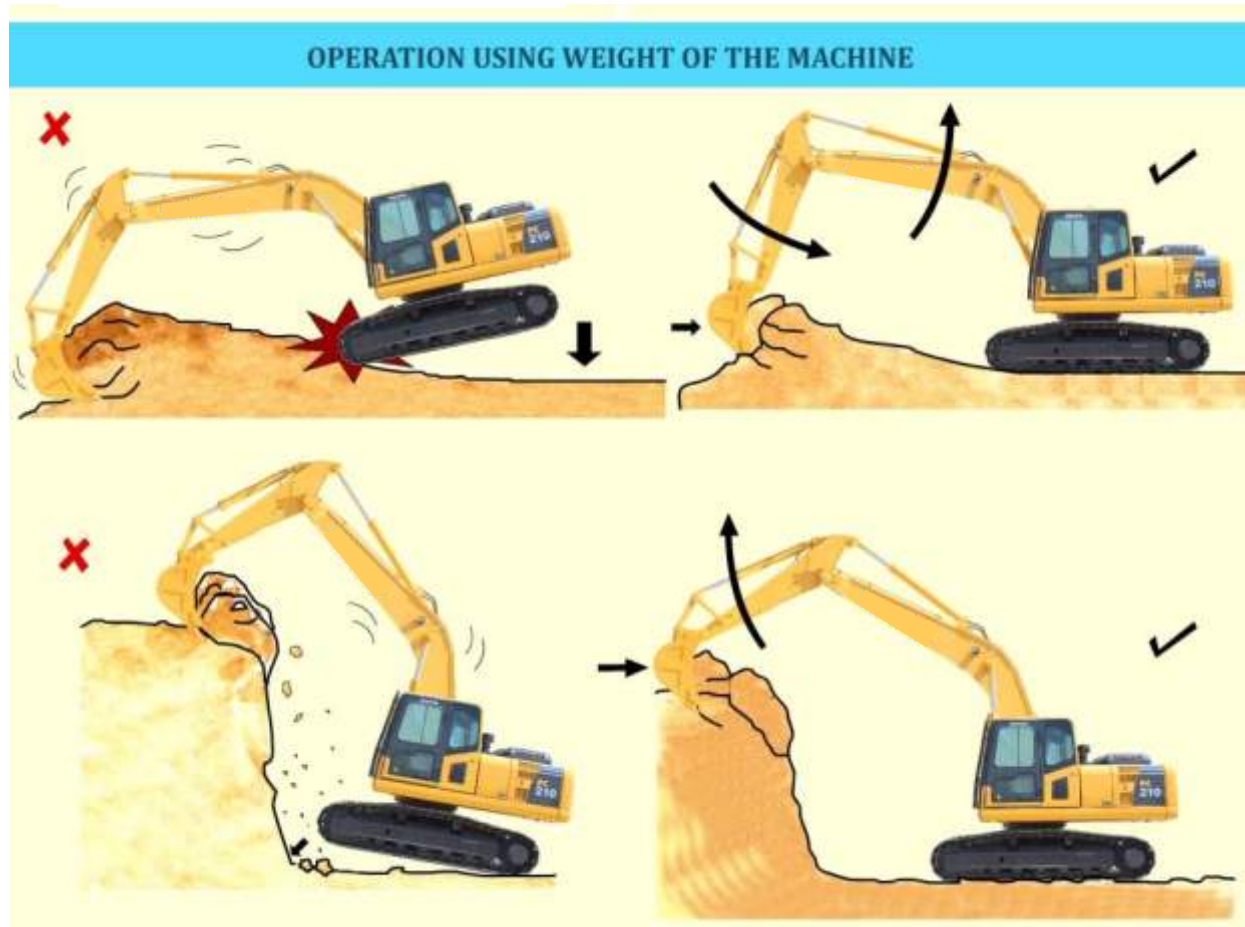


Fig 3.2.1 (e) Utilising Weight for Operation

Using the weight of the machine as a method of digging brings an excessive load to bear on the structures and attachments. Carry out digging work by using hydraulic force to operate the work equipment.

Using impact force to carry out operations will cause damage and breakage to the bucket and work equipment; it will also generate pressure spikes inside the cylinder which can cause failure of seal kit and also swelling of the cylinder.



Fig 3.2.1 (f) Utilising Impact Force

3.2.1 Digging Operation



Fig 3.2.1 (g) Loading Dump truck

When loading large rocks/boulders, load it close to the bottom of the dump body. If the rock is dropped from a high position, it will cause damage to the dump truck body. Loading soil into the body before loading rocks is a method which will reduce shock/impact. When carrying out loading operations, stop the dump truck in a position where it can be seen easily by the operator.

When travelling, keep the attachment as close to the centre of the machine, this provides stability to the machine. To protect the final drive, it is recommended to travel with the sprockets at the rear.



Fig 3.2.1 (h) Travel Posture

This should be the posture while travelling up a slope. If the sprocket is kept in front while travelling up a slope, the surface of the track in contact with the ground will become loose and cause loss of drive force or traction.



Fig 3.2.1 (i) Uphill Posture

3.2.1 Digging Operation

This posture should ideally be used while traveling down the slope. When traveling downhill, if the sprocket is at the rear, then the track at the top will become loose. During stopping, when the travel lever is placed at neutral, there is possibility of machine traveling forward to the amount of loose track, causing loss of control.



Fig 3.2.1 (j) Downhill Posture






Fig 3.2.1 (k) Travelling and operating simultaneously

The travel force is used to move the machine. Using travel force to excavate is prohibited. Such operation can cause severe load on undercarriage components and final drive. Hence while excavating, digging force of work equipment should only be used.

UNIT 3.3: Transportation

Unit Objectives

At the end of this unit, you will be able to:

-  Develop understanding for the ways of loading and unloading the excavator from trailer.
-  Discover methods of securing the machine during transport.
-  Develop understanding for the lifting procedure of an excavator.

3.3.1 Loading and Unloading with Trailer

Always obey the following when loading or unloading the machine from a trailer. Select firm, level ground when loading or unloading the machine.

Maintain a safe distance from the edge of the road. Always turn the auto-deceleration switch OFF (cancel). If the auto-deceleration switch is left ON, the machine may suddenly start moving. Always set the travel speed switch to low speed (Lo), run the engine at low idling, and operate the machine slowly when loading or unloading.

In cold areas, carry out the warming-up operation thoroughly and make sure that the engine speed is stable before carrying out the loading or unloading operation. Never correct your steering on the ramps. There is danger that the machine may tip over. If necessary, drive off the ramps or back on to the trailer and correct the direction.

It is dangerous to use the work equipment for loading and unloading operations. Always use ramps. When on the ramps, do not operate any lever except the travel lever.

The center of gravity of the machine will change suddenly at the joint between the ramps and the trailer, and there is danger of the machine losing its balance. Travel slowly over this point.

If it is necessary to swing the work equipment on the trailer platform, the footing is unstable, so be extremely careful that the machine does not tip over.

If the work equipment is installed to the machine, pull the work equipment in, and operate slowly to prevent the machine from losing its balance. Position a flagman to give guidance to prevent the machine from coming off the ramps and to ensure safety in the operation.

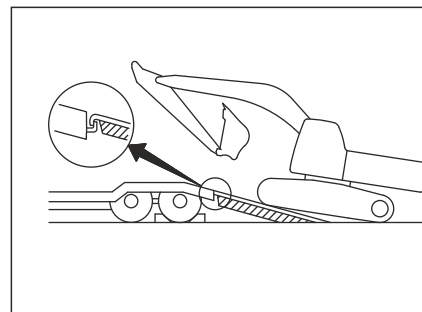
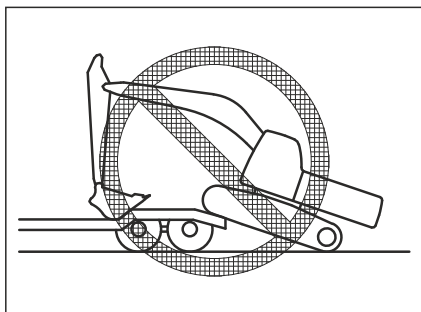


Fig 3.3.1 (a) Loading and Unloading with Trailer

Steps

Always observe the following regarding the ramps and trailer platform. Use ramps with ample width, length, thickness, and strength and install them at a maximum slope of 15°. When using piled soil, compact the piled soil fully to prevent the slope face from collapsing. Clean the machine tracks and ramps before starting in order to prevent the machine from slipping on the ramps. There is danger of the machine slipping if there is water, snow, grease, oil, or ice on the ramp surface.

Loading and unloading an excavator for transportation from one job site to another involves several challenges. To minimise obstruction in productivity, utilise recommended size trailer, ramp, and proper loading, positioning, and securing equipment.

Step-1: Load and unload on firm level ground only. Maintain a safe distance from the edge of a road.

Step-2: Apply the trailer brakes securely, then put blocks (1) under the tires to prevent the trailer from moving. Set left and right ramps (2) parallel to each other and equally spaced to the left and right of center (3) of the trailer. Make angle of installation (4) a maximum of 15°. If the ramps bend a large amount under the weight of the machine, put blocks under the ramps to prevent them from bending.

Step-3: Turn the travel speed selector switch to low-speed travel (Lo lamp lights up). Press travel speed selector switch (5) to switch the travel speed. The travel speed (Lo, Mi, Hi) is displayed on pilot monitor display portion (6).

Step-4: Turn auto-deceleration switch (7) OFF and set the fuel control dial to run the engine at low speed. Each time auto-deceleration switch (7) is pressed, it switches OFF -> ON -> OFF. When auto-deceleration switch (7) is turned OFF, pilot monitor display (8) goes out.

Step-5: Turn the swing lock switch ON to apply the swing lock. When the swing lock switch is turned to the ON position, pilot monitor display (9) lights up. (a): ON position (b): OFF position

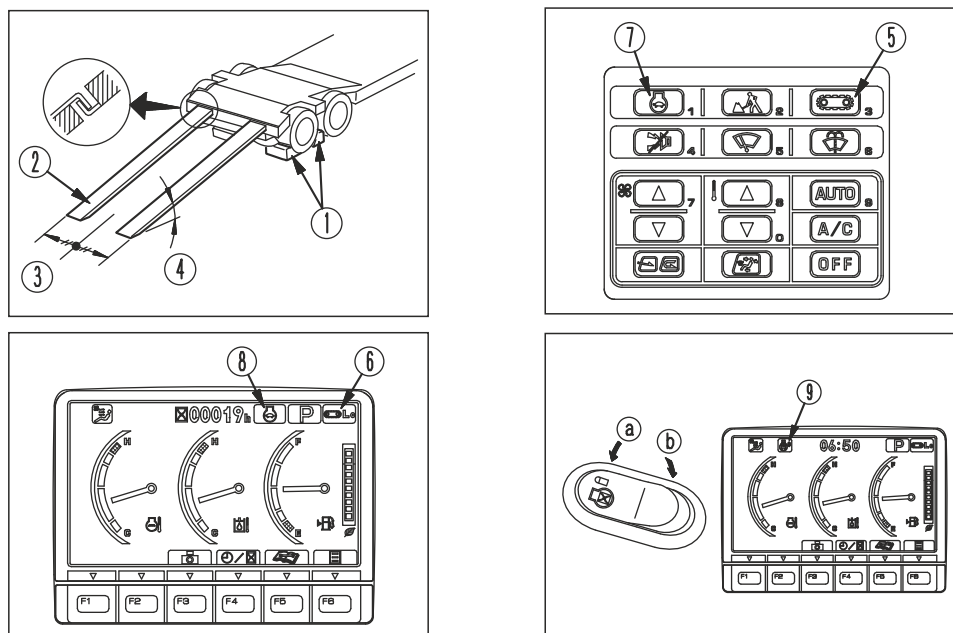


Fig 3.3.1 (b) Loading Controls

Steps

Step-6: If the machine is equipped with work equipment, set the work equipment at the front, and travel forward to load it; if it has no working equipment, travel in reverse to load it. Follow instructions and signals of a conductor particularly when travelling in reverse.

Step-7: Before moving onto the ramps, make sure that the machine is positioned in a straight line with the ramps and that the centerline of the machine matches that of the trailer. Align the direction of travel with the ramps and travel slowly. Lower the work equipment as far as possible without causing interference. When on the ramps, operate only the travel lever. Do not operate any other lever.

Step-8: When loading or unloading a machine with the work equipment installed, at the point where the tracks are on both the ramps and the ground surface, turn the swing lock switch OFF, then swing the upper structure slowly 180°. After doing that, drive slowly in reverse and load the machine onto the trailer.

Step-9: Turn the swing lock switch ON to lock the swing lock. When the swing lock switch is turned to the ON position, pilot monitor display (9) lights up.

(a): ON position

(b): OFF position

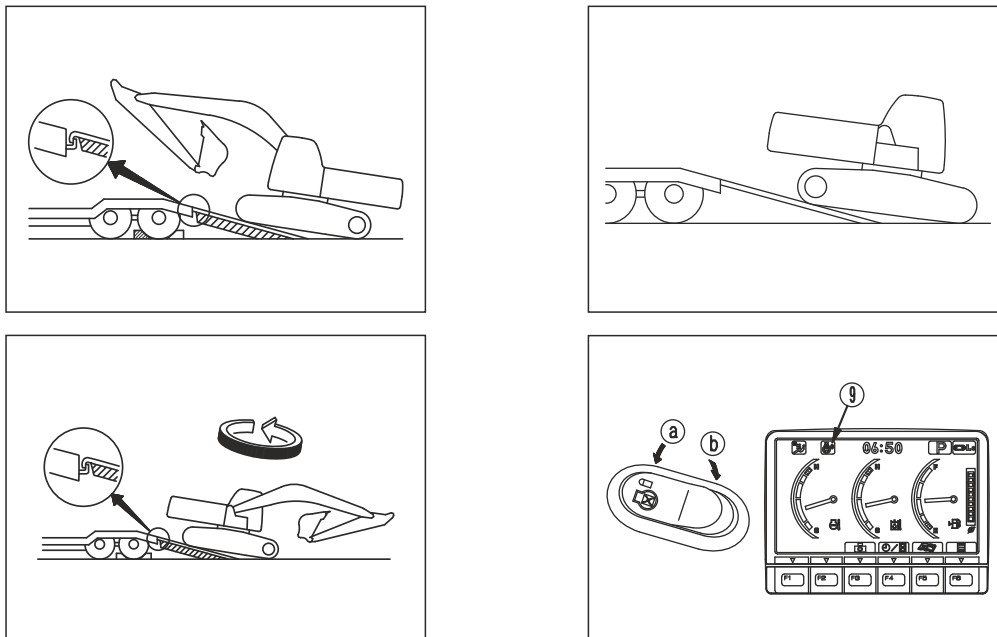


Fig 3.3.1 (c) Loading into Trailer

Steps

Step-10: When the machine travels over the rear wheels of the trailer, it becomes unstable, drive slowly and carefully. (Never operate the steering.)

Step-11: At the moment the machine passes the rear wheels, it tilts forward, be careful not to let the work equipment hit the trailer body. Drive the machine forward to the specified position, then stop the machine.

Step-12: Lower the work equipment on top of wooden blocks.

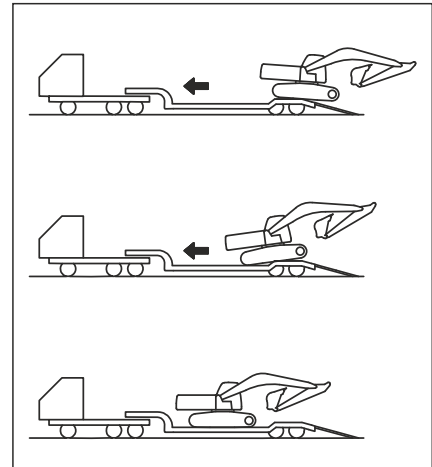


Fig 3.3.1 (d) Travel into Trailer

3.3.2: Securing Machine

Steps

Load the machine onto a trailer as follows:

Loading excavator onto the trailer requires stability and uniformity, do ensure the main actions are not skipped.

Step-1: Extend the bucket and arm cylinders fully, then lower the boom slowly.

Step-2: Set the lock lever securely to the LOCK position (L).

Step-3: Stop the engine, then remove the key from the starting switch.

Step-4: Close all doors, windows, and covers. Lock the covers, caps, and doors fitted with locks.

Step 5: Before loading the machine, clean the excavator's undercarriage from mud, sand and any other debris that were collected on undercarriage while working on job site.

Step 6: Travel the excavator up the ramp with the heaviest end up (i.e. front of excavator because it is connected to an attachment), when you are loading the excavator onto the trailer.

Step-7: Place blocks under both ends of the tracks to prevent the machine from moving during transportation, and secure the machine with chains or wire rope of suitable strength. Be particularly careful to secure the machine in position so it does not slip to the side.

Steps

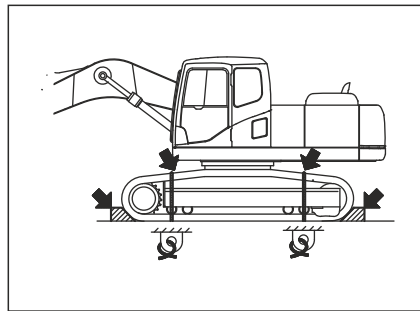
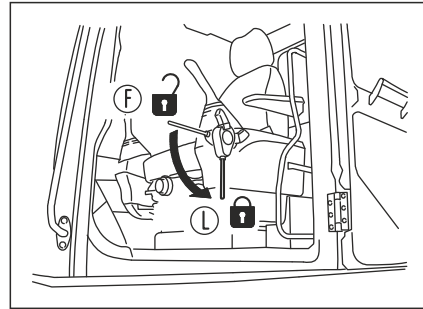
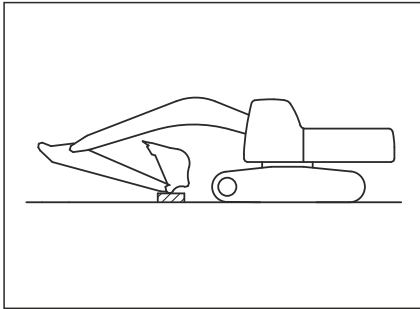


Fig 3.3.2 (a) Load the Machine on to the Trailer

Stowing Radio Antenna

Antennas have different stowing position, to prevent the radio antenna from getting stuck to other objects while transportation, antennas need to be stowed in downward position.

Step-1: Loosen bolt (2) of radio antenna (1) at the rear of the cab, lower the antenna, then tighten bolt (2) again to secure radio antenna (1) in position.

Step-2: When unloading the machine from the trailer and operating it, follow the opposite procedure from stowing to set radio antenna (1) vertical, then secure it in position with bolt (2).

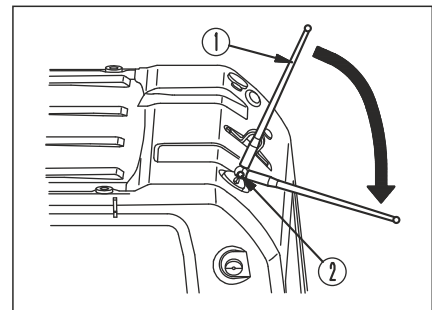


Fig 3.3.2 (b) Stowing Radio Antenna

Steps

Rearview Mirrors

The mirrors are at the positions shown in the diagram on the right. If they are damaged or are to be removed for shipment, or are to be installed again, use the following procedure.

Removal:

Mirrors A, B

Step-1: Loosen mounting bolt (2), then remove mirror (1) from support (3).

Step-2: Loosen bolt (4) and remove support (3) and clamp (5) from the handrail.

Mirrors C, D

Step-3: Loosen locknut (2), then remove mirror (1) from support (3).

Step-4: Remove bolt (4), then remove support (3) from the machine.

Installation:

Mirrors A, B

Step-1: Install support (3) and clamp (5) to the handrail, then tighten with bolt (4).

Step-2: Install mirror (1) to support (3), then tighten lock bolt (2).

Mirrors C, D

Step-3: Install support (3) to the machine with bolt (4).

Step-4: Install mirror (1) to support (3), then tighten locknut (2)

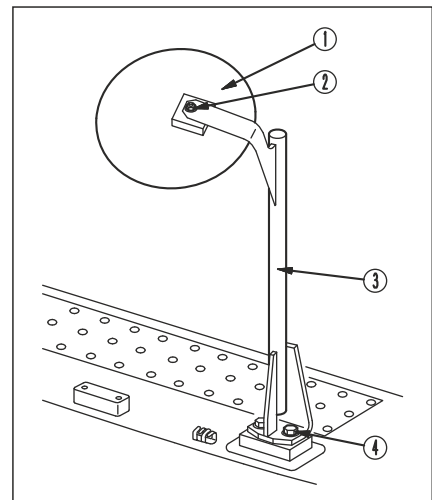
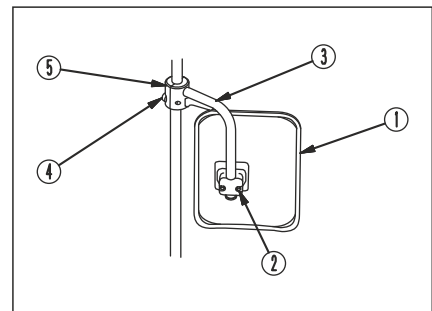
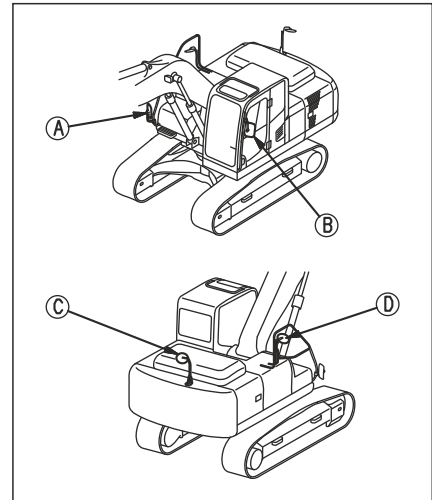


Fig 3.3.2 (c) Rear View Mirror

3.3.3: Unloading

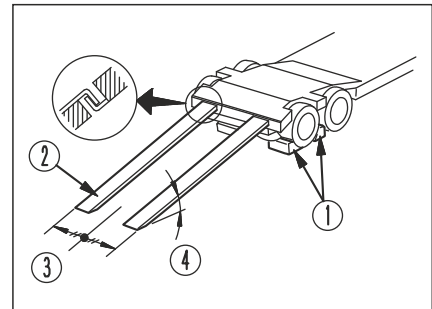
Steps

Ensure not to unload below overhead wires, near structures, facilities or obstacles. Never presume you have permission to unload. Form visual and verbal contact with the site operator is necessary.

Step-1: Load and unload on firm level ground only. Maintain a safe distance from the edge of a road.

Step-2: Apply the trailer brakes securely, then put blocks (1) under the tires to prevent the trailer from moving.

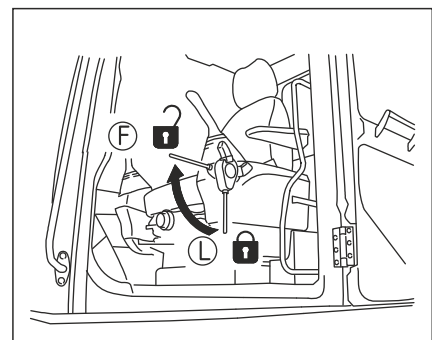
Set left and right ramps (2) parallel to each other and equally spaced to the left and right of center (3) of the trailer. Make angle of installation (4) a maximum of 15°. If the ramps bend a large amount under the weight of the machine, put blocks under the ramps to prevent them from bending.



Step-3: Remove the chains and wire ropes fastening the machine.

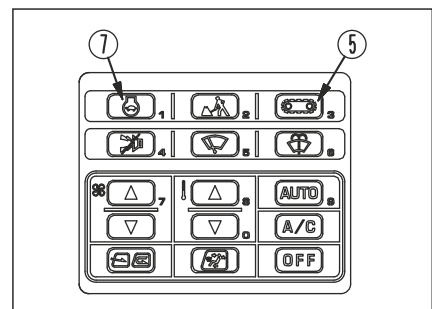
Step-4: Start the engine. Warm the engine up fully.

Step-5: Set the lock lever to FREE position (F).



Step-6: Turn the travel speed selector switch to low-speed travel (Lo lamp lights up).

Press travel speed selector switch (5) to switch the travel speed. The travel speed (Lo, Mi, Hi) is displayed on pilot monitor display portion (6).



Step-7: Turn auto-deceleration switch (7) OFF and operate the fuel control dial to set the engine speed to low idling. Each time auto-deceleration switch (7) is pressed, it switches OFF ON OFF in turn.

When auto-deceleration switch (7) is turned OFF, pilot monitor display (8) goes out.

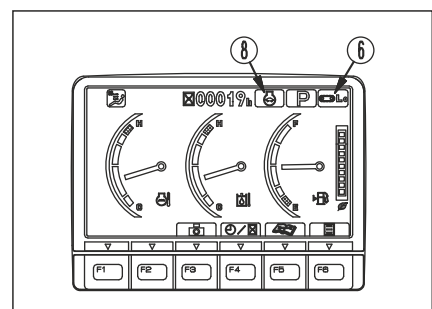


Fig 3.3.3 (a) Unloading

Steps

Step-8: Raise the work equipment, pull in the arm under the boom, then move the machine slowly.

Step-9: When the machine is horizontal on top of the rear wheels of the trailer, stop the machine.

NOTICE

When unloading the machine, always keep the arm and boom at an angle of 90° - 110° .

If the machine is unloaded with the arm pulled in, it will cause damage to the machine.

When moving onto the ramps, do not thrust the bucket into the ground. This will cause damage to the hydraulic cylinders.

Step-10: When moving from the rear of the trailer on to the ramps, set the angle of the arm and boom to 90° to 110° , lower the bucket to the ground, then move the machine slowly.

Step-11: When moving down the ramps, operate the boom and arm slowly to lower the machine carefully until it is completely off the ramps.

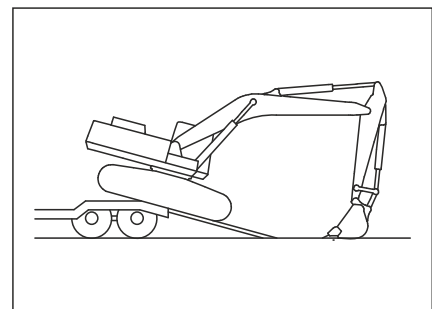
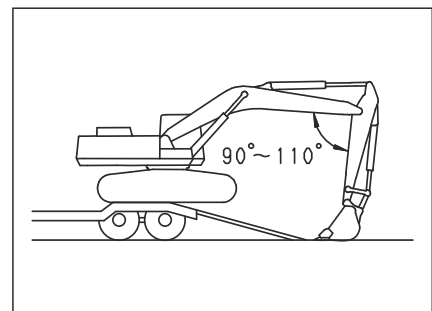
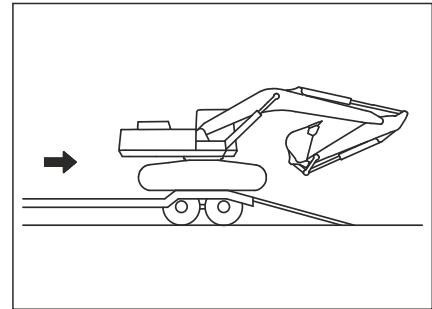


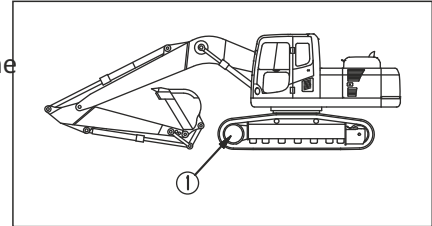
Fig 3.3.3 (b) Unloading

3.3.4: Lifting Machine

Steps

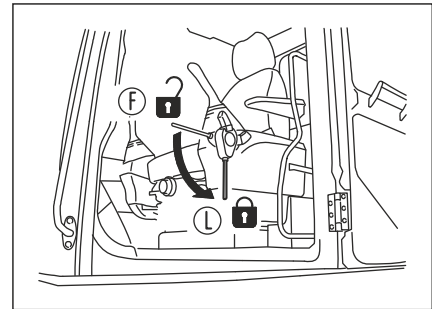
The lifting procedure applies to machines with standard specifications. The method of lifting differs according to attachments and options actually installed on the machine. When lifting the machine, carry out the operation on flat ground as follows:

Step-1: Start the engine, then swing the upper structure so that the work equipment will be on the side of sprocket (1).



Step-2: Extend the bucket cylinder and arm cylinder fully, then lower the work equipment to the ground as shown in the diagram on the right using the boom cylinder.

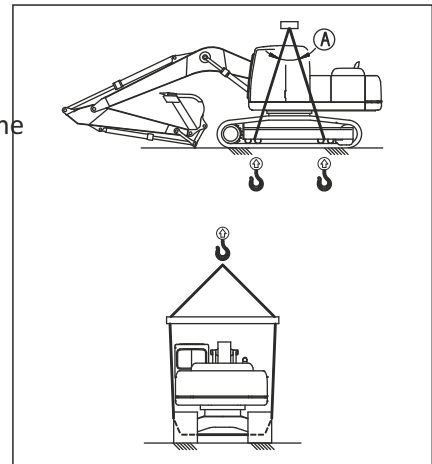
Step-3: Set the lock lever securely to the Lock position (L).



Step-4: Stop the engine, check that there is nothing around the operator's compartment, then get off the machine. Close the cab door and front glass securely.

Step-5: Pass wire ropes between the 1st and 2nd track rollers from the front and between the 1st and 2nd track rollers from the rear. However, for machines equipped with a full roller guard for the track roller, pass the wire rope under the track.

Step-6: Set the lifting angle (A) of the wire rope to 30° to 40°, then lift the machine slowly.



Step-7: After the machine comes off the ground, check the hook condition and the lifting posture, and then lift slowly.

Warning



The operator carrying out the lifting operation using a crane must be a properly qualified crane operator. Never raise the machine with any worker on it. Always make sure that the wire rope is of ample strength for the weight of this machine. When lifting, keep the machine horizontal. When carrying out lifting operations, set the lock lever to the LOCK position to prevent the machine from moving unexpectedly. Never enter the area under or around a raised machine. Never try to lift the machine in any posture other than the posture given in the procedure below or using lifting equipment other than in the procedure below. There is a hazard that the machine may lose its balance.

Fig 3.3.4 Lifting the Machine

3.4: Reporting and documentation

Unit Objectives

At the end of this unit, you will be able to:

-  Utilise pre-use checklists related to the excavator.
-  Utilise the excavator worksite inspection checklists.

3.4.1 Worksite Inspection Checklist

	Acceptable		Immediate action taken	Further action required*	Date signed off	Date to be completed
	Y	N				
Thoroughfares (access and egress)						
Pathways/walkways/stairs/ramps and access areas clear of rubbish and obstructions						
Pathways/walkways are slip-free. Surfaces are even, free of holes, cracks, fraying or uplifted edges						
Slip-resistant materials or absorbent mats used in wet areas						
Steps/stairs/ramps/handrails are secure and in good repair						
Electrical cables/cords kept clear of walkways or secured						
Exit and egress points clearly identified and accessible						
Other:						
Office environment (workstations and surrounding areas)						
Ergonomic furniture is appropriately adjusted e.g. keyboards, chairs						
Furniture is well maintained and in good/safe condition						
Desks and benches stable and suitable for the work						
Materials are stored appropriately e.g. not on floor around work areas						
Staff use good housekeeping practices around their work areas						
Sufficient space is provided around workstations so staff can move and work safely						
Walkways and aisles are clear of obstructions						
Floor mats do not present trip hazards						
Lifting aids are available where required						
Electrical equipment is in good working order						
Electrical leads are secured to prevent trip hazards						
Adequate ventilation in all areas						
Other:						
Storage						
Storerooms and storage areas are tidy and free from obstruction						
Stored materials are secured appropriately to prevent them from falling						
Heavy equipment is stored at waist level						
Storage areas are accessible and free from trip hazards						
Shelving is stable and well maintained						
Other:						

3.4.1 Worksite Inspection Checklist

Company: Your Company Name	Date:	Start Time:	am/pm		
Operator:	Evaluator:				
Location:	Excavator Type:				
	Status:		Status:		
1. Pre Start-up Walk around Status	OK	NO	NA	2. Start-up Status	OK NO NA
Safe Area / Equipment Secured				Seat belt Inspected and Fastened	
Undercarriage				Engine Sounds Normal	
Track Shoes / Wheels & Tires				Instrument Panel Warnings Indicators	
Rollers				Oil Pressure	
Sprockets				Coolant Temperature	
Idler Wheels				Hour meter	
Track Links				3. Powered Systems	OK NO NA
Turntable / Stewing Assembly				Lights	
Turret				Horn	
Cab				Wipers	
Glass				Fan / Heater / Air Conditioner	
Doors				Radio /Accessories	
Emergency Exit				Hydraulic Controls	
Entry / Exit Steps				Drive	
ROPS / FOPS /TOPS				Steer	
Counterweight Bolts				Turret Rotate	
Lights				Boom	
Mirrors				Dipper I Stick	
Engine / Engine Compartment				Work Attachment	
Fluid Levels				Accessories	
Leaks				4. General	OK NO NA
Pelts / Hoses				Housekeeping	
Radiators I Coolers				Fire Extinguisher	
Fire Suppression System				Manufacturers Manual	
Digging Assembly				Log Book	
Boom				Decals /Warnings / Placards	
Dipper I Stick				Certification / Capacity Labels	
Work Attachment				Level Indicator	
Articulated Joints				5. Other	OK NO NA
Hydraulics					
Fluid Level					
Leaks					
Cylinders				Report ANY problems to your	
Pins / Locks				supervisor	
Fittings					
Hoses				Always tag out unsafe equipment	

Exercise



Briefly answer the following questions.

1. What are the items to be inspected at the worksite?

2. How to install rear-view mirrors of an Excavator?

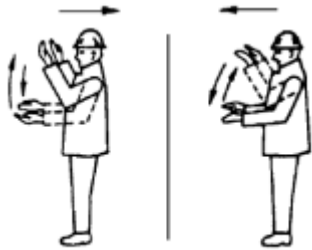
Exercise

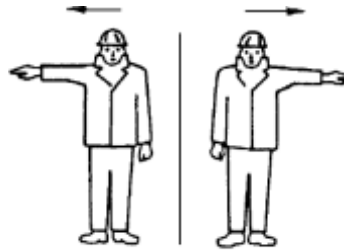
3. Write the meaning of symbols against the box provided in Participant Handbook.

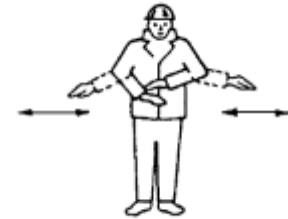












Tips

Following are recommended tips:

If a fibre optic cable is cut during operations, do not look into the end of it as your eyes could be permanently damaged.





4. Perform Routine Maintenance an Troubleshooting of an Excavator






Unit 4.1 – Basic Maintenance and Schedules
Unit 4.2 – Simple Trouble Shooting
Unit 4.3 – Reporting & Documentation



Key Learning Outcomes



At the end of this module, you will be able to:

-  Summarise basic maintenance activities and the schedules.
-  Choose correct troubleshooting procedures of the excavator engine and indicator lamps.
-  Determine the importance of machine logs and reporting.

UNIT 4.1: Basic Maintenance and Schedules

Unit Objectives

At the end of this unit, you will be able to:

-  Develop clear understanding of machine maintenance and take part in maintenance activities.
-  Identify the maintenance schedule and its importance.

4.1.1 Cleaning the Machine

Observe the following points while cleaning the excavator:

Heavy, earth-moving equipment usually moves in under-construction location and gets dirty. Excavator needs to be loaded into the trailer and transported once the job at the end of the day. So, the machine is to be kept clean of any debris and dirt. After repeated dirt and debris collection into the undercarriage, dirt can get into any sensitive areas which can lead to malfunctioning and break downs. Store the excavator in a clean and dry area to prevent environmental damage.

1. Always dilute detergents as per the manufacturer's recommendations, otherwise, damage to the paint finish may occur.
2. When using a steam cleaner, wear safety glasses or a face shield as well as protective clothing. Steam can cause serious personal injury.
3. Ensure that the engine air intake, alternator, starter motor and any other electrical components are shielded and not directly cleaned by the high-pressure cleaning system. Do not aim the water-jet directly at bearings, oil seals, the engine air intake or electrical and electronic components such as the engine electronic control unit (ECU), alternator or fuel injectors.
4. Never use water or steam to clean inside the cab. The use of water or steam could damage the on-board computer and render the machine inoperable. Remove dirt using a brush or damp cloth.
5. Safely disposal of debris created from machine cleaning.
6. When cleaning is complete move the machine away from the wash area, or alternatively, clean away the material washed from the machine.

4.1.2 Maintenance Information

Do not perform any inspection and maintenance operation that is not found in this manual.

Service Meter Reading

Check the service meter reading every day to see if the time has come for any necessary maintenance to be performed.

Genuine Replacement Parts

Use genuine parts specified in the Parts Book as replacement parts.

Genuine Lubricants

Use genuine oils and grease. Choose oils and grease with proper viscosities specified for ambient temperature.

Windshield Washer Fluid

Use automobile window washer fluid, and be careful not to let any dirt get into it.

Fresh and Clean Lubricants

Use clean oil and grease. Also, keep the containers of the oil and grease clean. Keep foreign materials away from oil and grease.




Check Drained Oil and Used Filter

After oil is changed or filters are replaced, check the old oil and filters for metal particles and foreign materials. If large quantity of metal particles or foreign materials are found, always report to the person in charge, and carry out suitable action.

Fuel Strainer

If your machine is equipped with a fuel strainer, do not remove it while fueling.

Do not Drop Things Inside Machine

-  When opening inspection windows or the oil filler port of the tank to carry out inspection, be careful not to drop nuts, bolts, or tools inside the machine.
-  If such things are dropped inside the machine, it may cause damage and/or malfunction of the machine and will lead to failure. If you drop anything inside the machine, always remove it immediately.
-  Do not put unnecessary things in your pockets. Carry only things which are necessary for

4.1.3: Maintenance Information

Steps

The most adequate solution for owners and operators to increase the serviceable life of the machine to keep excavator operational to its potential is consistency in following the manufacturer's maintenance schedule.

When working at dusty worksites, do as follows:

Step-1: Clean the radiator core, oil cooler core, aftercooler core, fuel cooler core, and condenser core frequently to avoid clogging.

Step-2: Replace the fuel filter more frequently.

Step-3: Clean electrical components, especially the starting motor and alternator, to avoid accumulation of dust.

Step-4: When checking and replacing the oil or filters, move the machine to a place where there is no dust and take care to prevent dust from entering the system.

Step-5: Avoid Mixing Lubricants - If a different brand or grade of oil has to be added, drain the old oil and replace all the oil with the new brand or grade of oil. Never mix different brand or grade of oil.

Step-6: Locking the Inspection Covers - Lock inspection cover securely into position with the lock bar. If inspection or maintenance is performed with inspection cover not locked in position, there is a danger that it may be suddenly blow shut by the wind and cause injury to the worker.

Step-7: Hydraulic System - Air Bleeding - When hydraulic equipment has been repaired or replaced, or the hydraulic piping has been removed and installed again, the air must be bled from the circuit. For details, see "bleeding air from hydraulic system".




Step-8: Hydraulic Hose Installation - When removing parts at locations where there are O-rings or gasket seals, clean the mounting surface, and replace with new parts.

Note: When doing reassembly, be careful not to forget to assemble the O-rings and gaskets.


When installing the hoses, do not twist them or bend them sharply. If they are installed so, their service life will be shortened extremely and they may be damaged.


Step-1: Checks After Inspection and Maintenance Works

If you forget to perform the checks after inspection and maintenance, unexpected problems may occur, and this may lead to serious injury or property damage. Always do the following:


-  Checks after operation (with engine stopped)
-  Have any inspection and maintenance points been forgotten?
-  Have all inspection and maintenance items been performed correctly?


Steps


 Have any tools or parts been dropped inside the machine? It is particularly dangerous if parts are dropped inside the machine and get caught in the lever linkage mechanism.

 Is there any leakage of coolant or oil? Have all nuts and bolts been tightened?

Step-2: Checks when operating engine

 For details of the checks when operating the engine, see “two workers for maintenance when engine is running” and pay careful attention to safety.


 Are the inspection and maintenance items working properly?


 Is there any leakage of fuel or oil when the engine speed is raised?

4.1.4 Greasing the Machine

With construction machines like excavator, it's mandatory to grease promptly and deliberately since there is dust, soil, aggregates and moisture at worksite environment.

Observe the following points while greasing the excavator:

 The machine must always be greased after pressure washing or steam cleaning.

 Greasing should be done with a grease gun. Normally, two strokes of the gun should be sufficient.

 Stop greasing when fresh grease appears at the joint.

 Use only the recommended type of grease.

 Do not mix different types of grease, keep them separate.

4.1.5 Example of Lubrication Chart

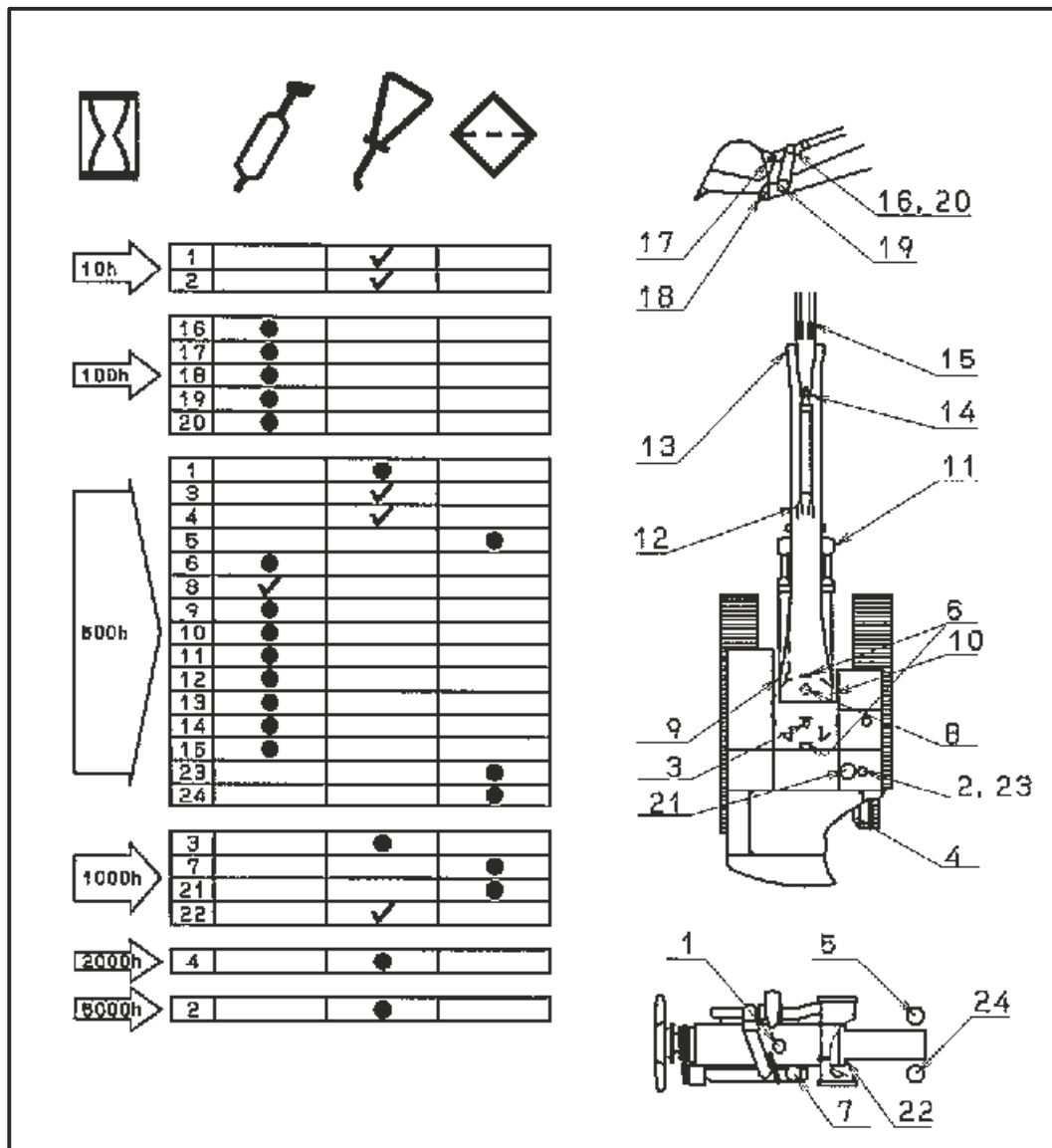


Fig 4.1.5 Lubrication chart



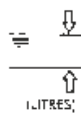
Interval of service



Change filter



Lubrication by greasing (G)



Amount of oil required at change (liters)



Check oil level/change (EO)

4.1.5 Example of Lubrication Chart

Item	Part	Action
1	Engine oil	Check level change oil
2	Hydraulic oil	Check level change oil
3	Swing machinery oil	Check level change oil
4	Final drive oil	Check level change oil
5	Engine oil filter	Change filter
6	Swing circle	Lubricate
7	Fuel main filter	Change filter
8	Swing pinion	Lubricate
9	Boom cylinder foot pin	Grease
10	Boom foot pin	Grease
11	Boom cylinder rod end pin	Grease
12	Arm cylinder foot pin	Grease
13	Boom arm coupling pin	Grease
14	Arm cylinder rod end	Grease
15	Bucket cylinder foot pin	Grease
16	Bucket cylinder rod end	Grease
17	Bucket-link coupling pin	Grease
18	Arm-bucket coupling pin	Grease
19	Arm link coupling pin	Grease
20	Link coupling pin	Grease
21	Hydraulic filter element	Change filter
22	Damper case	Check level
23	Hydraulic tank filter	Change filter
24	Fuel pre-filter and water separator	Change filter

UNIT 4.2: Simple Troubleshooting

Unit Objectives

At the end of this unit, you will be able to:

Take part in elementary troubleshooting activities of Electrical system, chassis and engine.

4.2.1 Electrical System

Always contact your distributor when dealing with these items.

In cases of problems or causes which are not listed below, contact your distributor for repairs.

Problem	Main causes	Remedy
Lamp does not glow brightly even when the engine runs at high speed.	<ul style="list-style-type: none"> •Defective wiring, deterioration of battery •Loose fan belt 	<ul style="list-style-type: none"> •Check, repair loose terminals, disconnections, replace battery
Lamp flickers while engine is running.		<ul style="list-style-type: none"> •Replace fan belt, Check tension
Charge level monitor does not go out even when engine is running.	<ul style="list-style-type: none"> •Defective alternator •Defective wiring 	<ul style="list-style-type: none"> •Replace •Check, repair
Abnormal noise is generated from alternator.	<ul style="list-style-type: none"> •Defective alternator 	<ul style="list-style-type: none"> •Replace
Starting motor does not turn when starting switch is turned to ON.	<ul style="list-style-type: none"> •Defective wiring •Defective starting motor •Insufficient battery charge 	<ul style="list-style-type: none"> •Check, repair •Replace •Charge
Pinion of starting motor keeps going and out.	<ul style="list-style-type: none"> •Insufficient battery charge •Defective safety relay 	<ul style="list-style-type: none"> •Charge •Replace
Starting motor turns engine sluggishly.	<ul style="list-style-type: none"> •Insufficient battery charge •Defective starting motor 	<ul style="list-style-type: none"> •Charge •Replace
Starting motor disengages before engine starts.	<ul style="list-style-type: none"> •Defective wiring, defective ring gear pinion •Insufficient battery charge 	<ul style="list-style-type: none"> •Check, repair •Charge
Engine pre-heating monitor does not light.	<ul style="list-style-type: none"> •Defective wiring •Defective heater relay •Defective monitor 	<ul style="list-style-type: none"> •Check, repair •Replace •Replace
Oil pressure monitor does not light up when engine is stopped. (starting switch at ON position)	<ul style="list-style-type: none"> •Defective monitor •Defective caution lamp switch 	<ul style="list-style-type: none"> •Replace •Replace
Outside of electrical heater is not warm when touched by hand.	<ul style="list-style-type: none"> •Defective wiring •Disconnection in electric heater •Defective operation of heater 	<ul style="list-style-type: none"> •Check, repair •Replace •Replace

4.2.2 Chassis

Always contact your distributor when dealing with these items.

In cases of problems or causes which are not listed below, contact your distributor for repairs.

Problem	Main causes	Remedy
Speed of travel, swing, boom, arm, bucket is slow	<ul style="list-style-type: none"> •Lack of hydraulic oil 	<ul style="list-style-type: none"> •Add oil to specified level, see check before starting
Pump generates abnormal noise (sucking in air)	<ul style="list-style-type: none"> •Clogged element in hydraulic tank strainer, lack of oil 	<ul style="list-style-type: none"> •Clean, see every 2000 hours service
Excessive rise in hydraulic oil temperature	<ul style="list-style-type: none"> •Loose fan belt •Dirty oil cooler •Lack of hydraulic oil 	<ul style="list-style-type: none"> •Check fan belt tension, replace •Clean, see every 500 hours service •Add oil to specified level, see check before starting
Track comes off	<ul style="list-style-type: none"> •Track too loose 	<ul style="list-style-type: none"> •Adjust track tension, see when required
Abnormal wear of sprocket		
Boom rises slowly, does not rise	<ul style="list-style-type: none"> •Lack of hydraulic oil 	<ul style="list-style-type: none"> •Add oil to specified level, check before starting
Does not swing	<ul style="list-style-type: none"> •Swing lock switch still applied 	<ul style="list-style-type: none"> •Turn swing lock switch OFF

4.2.3 Engine



Always contact your distributor when dealing with these items. In cases of problems or causes which are not listed below, contact your distributor for repairs.

Problem	Main causes	Remedy
Engine oil pressure monitor lights up	<ul style="list-style-type: none"> • Engine oil pan oil level is low (sucking in air) • Clogged oil filter cartridge • Defective tightening of oil pipe, pipe joint, oil leakage from damaged point • Defective engine oil pressure sensor • Defective monitor 	<ul style="list-style-type: none"> • Add oil to specified level, see check before starting • Replace cartridge, see every 500 hours service • Check, repair • Replace sensor • Replace monitor
Steam spurts out from top of radiator (pressure valve)	<ul style="list-style-type: none"> • Coolant level low, leakage of water • Loose fan belt • Dirt or scale accumulated in cooling system 	<ul style="list-style-type: none"> • Check, add coolant, repair, see check before starting • Check fan belt tension, replace • Change coolant, flush inside of cooling system, see when required
Radiator coolant level monitor lights up	<ul style="list-style-type: none"> • Clogged radiator fins or damaged fins • Defective thermostat • Loose radiator filler cap (high-altitude operations) • Defective coolant level sensor • Defective monitor 	<ul style="list-style-type: none"> • Clean or repair, see every 500 hours service • Replace thermostat • Tighten cap or replace packing • Replace sensor • Replace monitor
Engine does not start when starting motor is turned	<ul style="list-style-type: none"> • Lack of fuel • Air in fuel system • Defective fuel injection pump or defective nozzle • Starting motor cranks engine sluggishly • Engine pre-heating monitor does not light up • Defective compression (Defective valve clearance) 	<ul style="list-style-type: none"> • Add fuel, see check before starting • Repair place where air is sucked in, see every 500 hours service • Replace pump or nozzle • See electrical system • See electrical system • Adjust valve clearance
Exhaust gas is white or blue	<ul style="list-style-type: none"> • Too much oil in oil pan • Improper fuel 	<ul style="list-style-type: none"> • Set oil to specified level, see check before starting • Change to specified fuel
Exhaust gas occasionally turns black	<ul style="list-style-type: none"> • Clogged air cleaner element • Defective nozzle • Defective compression • Defective turbocharger 	<ul style="list-style-type: none"> • Clean or replace, see when required • Replace nozzle • See defective compression above • Clean or replace turbocharger
Combustion noise occasionally make breathing sound	<ul style="list-style-type: none"> • Defective nozzle 	<ul style="list-style-type: none"> • Replace nozzle
Abnormal noise generated (combustion or mechanical)	<ul style="list-style-type: none"> • Low-grade fuel being used • Overheating • Damage inside muffler • Excessive valve clearance 	<ul style="list-style-type: none"> • Change to specified fuel • Refer to "Radiator coolant level monitor lights up" as above • Replace muffler • Adjust valve clearance

UNIT 4.3: Reporting and Documentation

Unit Objectives

At the end of this unit, you will be able to:

-  Mark in logbook and record all the activities.
-  List all the problems that are beyond the scope of an operator and inform the supervisor.

4.3.1 Maintaining Machine Logs

Machine log maintains the history of the entire machine. It acts as a guide in times of emergency when the excavator goes out of order. The log helps the technician ascertain the condition of the machine, what parts consumables, etc., have been changed.

Date	Hours	Service Procedures
13/07/2014	1:00	Changing the Air Filter
19/03/2014	1:15	Replacing Engine Oil
04/06/2015	1:30	Engine Coolant change
05/08/2015	00:30	Battery Fluid Level maintenance
15/12/2016	1:00	Monitoring the Hydraulic Oil Level
26/04/2016	3:00	Verify Rotation System
21/03/2017	2:00	Validate the Controls and Switches
14/11/2017	1:30	Test the Wiring Harnesses
04/07/2017	1:10	Examine Hydraulic Leaks

4.3.2: Maintenance Procedure

Steps

Maintenance schedule chart

Maintenance schedule chart is a list of predetermined maintenance actions executed at regular time intervals or distance covered to prevent the machine from breakdowns. Maintenance schedule chart comprises checks, adjustments, regular service and foreseen shutdowns. Scheduled maintenance check

Steps

helps to increase the serviceable life of an excavator and mitigate the necessity for part replacement or repair.

Initial 250 hours maintenance (only after the first 250 hours).

Replace fuel pre-filter cartridge.

Initial 500 hours maintenance (only after the first 500 hours).

Replace fuel main filter cartridge.

When required:

Steps-1: Check, clean and replace air cleaner element.

Steps-2: Clean inside of cooling system.

Steps-3: Check and tighten track shoe bolts.

Steps-4: Check and adjust track tension.

Steps-5: Replace bucket teeth (vertical pin type).

Steps-6: Replace bucket teeth (horizontal pin type).

Steps-7: Adjust bucket clearance .

Steps-8: Check window washer fluid level, add fluid.

Steps-9: Check and adjust air conditioner.

Steps-10: Washing washable floor.

Steps-11: Bleeding air from hydraulic system.

Checks before starting:

Every 100 hours maintenance.

Lubricating.

Every 250 hours maintenance.

Steps-1: Check level of battery electrolyte.

Steps-2: Check air conditioner compressor belt tension, adjust.

Every 500 hours maintenance.

Steps-1: Lubricating.

Steps-2: Lubricate swing circle.

Steps-3: Change oil in engine oil pan, replace engine oil filter cartridge.

Steps-4: Replace fuel pre-filter cartridge.

Steps-5: Check swing pinion grease level, add grease.

Steps-6: Clean and inspect radiator fins, oil cooler fins, aftercooler fins, fuel cooler fins, and condenser fins.

Steps

Steps-7: Clean air conditioner fresh/recirc filters.

Steps-8: Replace breather element in hydraulic tank

Steps-9: Check oil level in swing machinery case, add oil

Steps-10: Check oil level in final drive case, add oil

Every 1000 hours maintenance

Steps-1: Replace hydraulic oil filter element

Steps-2: Change oil in swing machinery case

Steps-3: Check oil level in damper case, add oil

Steps-4: Replace fuel main filter cartridge

Steps-5: Check all tightening points of engine exhaust pipe clamps

Steps-6: Replace corrosion resistor cartridge (if equipped)

Steps-7: Check fan belt tension and replace fan belt

Steps-8: Check nitrogen gas charge pressure in accumulator (for breaker)

Every 2000 hours maintenance

Steps-1: Change oil in final drive case

Steps-2: Clean hydraulic tank strainer

Steps-3: Checking charge pressure of nitrogen gas in accumulator (for control circuit)

Steps-4: Check alternator, starting motor

Steps-5: Check engine valve clearance, adjust

Every 4000 hours maintenance

Steps-1: Check water pump

Steps-2: Check vibration damper

Steps-3: Replace accumulator (for control circuit)

Steps-4: Check for looseness of high-pressure piping clamp, hardening of rubber

Steps-5: Check for missing fuel spray prevention cap, hardening of rubber

Steps-6: Check operating condition of compressor

Steps-7: Every 5000 hours maintenance

Steps-8: Change oil in hydraulic tank





Every 8000 hours maintenance

Replace high-pressure piping clamp, fuel spray prevention cap

4.3.3 Informing Supervisor if Problem is Unresolved

It is important to inform the supervisor if you are unable to resolve a problem that has occurred with the excavator. The supervisor is adequately trained and well informed to tackle the situation. In case he is unable to do so he will co-ordinate with the dealer for a solution or whatever he deems fit in such a situation.

Inform the supervisor in the following cases:

-  The machine is not functioning properly and the operator unable to ascertain the problem
-  Even after diagnosing the operator is unable to rectify the faults
-  The required spares and or consumables are not available
-  The operator is not trained to do a specific task

Exercise

Briefly answer the following questions.

1. How do you rectify engine overheating?



2. What are the possible causes of engine/coolant leak?

3. What is the importance of maintaining machine logs?

4. Why should the operator inform the supervisor if he / she is unable to resolve issues with an Excavator?

Tips

Following are recommended tips:

-  Visit a construction site and have a detailed look at the excavator in the presence of the operator.
-  Always follow recommended safety guidelines and warning signs by the manufacturer.





5. Comply with Worksite Health and Safety








- Unit 5.1 – ESH Policies and Guidelines
- Unit 5.2 – Types and Uses of PPE
- Unit 5.3 – Common Hazards and Preventive Measures
- Unit 5.4 – Segregation and Disposal of Waste
- Unit 5.5 – Basic Fire-Fighting Equipment and Use
- Unit 5.6 – Common Injuries and Appropriate First-Aid



Key Learning Outcomes



At the end of this module, you will be able to:

-  Make use of the safety guidelines and precautions that an excavator operator has to follow.
-  Utilise the Personal Protective Equipment (PPE) in an effective and efficient manner.
-  Utilise the safety measures that can avoid worksite accidents.
-  Criteria to handle waste safely at the work place.
-  Utilise first aid effectively for common injuries at the worksite.

UNIT 5.1: ESH Policies and Guidelines

Unit Objectives

At the end of this unit, you will be able to:

-  Develop clear understanding for the safety precautions that an operator must follow at work.
-  Classify with various Do's and Don'ts while working with the machine.

5.1.1 Safety Precautions to be Taken





It is of vital importance for every employer and employee involved in machine operations and maintenance to safeguard themselves, learn safety procedures and encourage safe practices within their workplace. This prevents many accidents from taking place due to carelessness and ignorance.

The **Excavator Operator** has a duty to:






1. Be responsible and as safe and careful as possible in his work, so as not to put his own health and safety or others at risk, including members of the public
2. Co-operate with and assist the excavator operator or any other person, as far as necessary, to enable them to carry out their legal duties in health and safety
3. Not interfere with or misuse any safety device or equipment
4. Not intentionally or recklessly interfere with anything provided in the interest of health, safety and welfare
5. Follow excavator operator's procedures and the manufacturer's instructions which apply to the care and safe operation of the machine they are responsible for
6. Inform the supervisor, without unreasonable delay, of any work situation that they are aware of which presents a risk to the health and safety to them or others
7. Immediately report any defects in plant and equipment which might endanger safety.

5.1.2 Do's and Don'ts During Operation

Do's

-  Comply fully with instructions given by the supervisor.
-  Follow the manufacturer's instructions (operator manuals) for the specific excavator you are assisting on.
-  Take safety precautions when assisting on the machine prior to, during and after work.
-  Inspect the worksite, equipment and machine before starting the operation.



Don'ts

-  Don't operate the machine unless you have received appropriate training and are authorised to do so.
-  Ignore hazards and put yourself at risk, in case you do not feel safe without delay tell about the situation to your immediate supervisor.
-  Misuse, tamper or interfere with your machine and any associated safety equipment provided.
-  Access or enter under any conditions any structures or machinery whose structural integrity or safety has been or is in compromised and is in question.
-  Endanger your own health and safety, or that of anyone else, by being negligent.

UNIT 5.2: Types and Uses of PPE








Unit Objectives

At the end of this unit, you will be able to:



-  Discover the importance of different types of PPE.
-  Utilise the PPE in a proper manner.

5.2.1 Personal Protective Equipment

Personal Protective Equipment (PPE) includes protective clothing and equipment with a good fit to be worn in order to protect oneself against injury from chemical exposure, contact with hot or molten metal, fire hazards, environmental conditions, and other dangers. As per the decals and instructions, all employees, visitors and site owners must utilize PPE at a worksite. However, certain activities can decrease PPE effectiveness which is elaborated below:

-  Individual must store and protect PPE in the recommended way.
-  Individual needs to report any impairment, loss, mistake or unsuitability of protective clothing/equipment to their immediate supervisor.
-  Do not keep safety helmet under direct sunlight, including near the window of office or car, because sunlight and intense heat can Damage protective headgear.
-  Make use of soap and warm water to keep PPE clean if dirty. Do not use abrasives or solvents to clean it. Store it in a clean and dry place away from sunlight.
-  Do not expose synthetic gloves to alkalis and solvents as they can only withstand some diluted acids. Gloves of different materials provide protection against heat, cold, cut and abrasive.
-  Do not use marker, glue or paint to mark on PPE, utilize decals or stickers to mark it.
-  Every 2-5 years replace PPE, if suggested before by the manufacturer of the product or if there is any kind for major repercussion. Change the faulty parts with parts produced by the same manufacturer for that machinery. Do not carry out makeshift repairs. In case it cannot be fixed, replace it.

Remarks:

-  Do not wear PPE outside of worksite areas to avoid distribution of dirt to other areas.
-  It's crucial for PPE to fit each individual fit properly it must be close-fitting, not tight or loose, and it should not hinder motion or communication. Choose the right PPE for performing an activity. Do not use PPE that can cause potential injuries, e.g., loose-fitting gloves that could be caught in moving

5.2.1 Personal Protective Equipment

Safety Helmets (Don'ts)

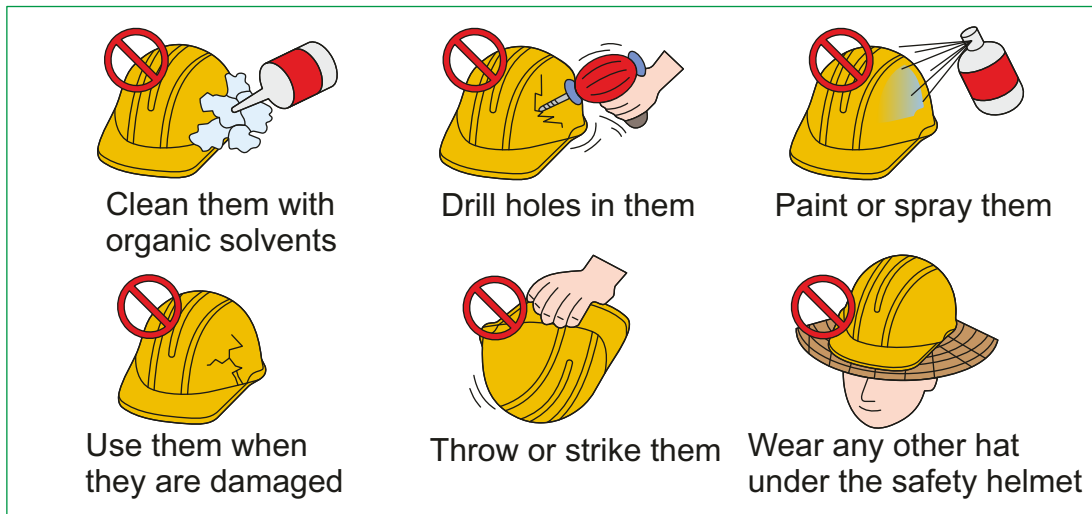


Fig 5.1.2 (a) Don'ts for Safety Helmet

PPE IS INCREDIBLY IMPORTANT, BECAUSE IT PROVIDES A LAST LINE OF DEFENCE AGAINST INJURY AND IT CAN SAVE YOUR LIFE



Fig 5.1.2 (b) Need for PPE

Use of different PPE at worksite:

Safety Helmet - Safety helmets with reflective bands are to be used at worksite based on hazard assessment in work place area. An excavator operator is exposed to hazard of objects falling in the work area. If excavator works below other working with tools or loose objects where objects can dislodge or fall need for safety helmet increases. Reflective bands on hard hats add to the safety feature and also ensure night working safety.

Respirator filter mask - At construction site excavator has to wear due to dust, cement, chemical additives, fumes and pollution to protect them.

Eye Protection - At worksite due to dust, dry soil, chemical fuses and other pollutants in atmosphere of construction protecting once eye from these pollutants is required.

Ear Protection - Wear ear protection based on assessment of a worksite, to reduce noise exposure levels at construction site due to use of tools and heavy machinery .

5.2.1 Personal Protective Equipment

PPE implies any resource or device deliberately designed for safety against one or more health and safety risks, to be carried or worn by a person. Examples of PPE include such items as gloves, foot, and eye protection, protective hearing devices (earplugs, muffs) hard hats, respirators, and full bodysuits.



Fig 5.2.1 (c) Personal Protective Equipment for Worksite

5.2.1 Personal Protective Equipment

Ear Protection - Wear ear protection based on assessment of a worksite, to reduce noise exposure levels at construction site due to use of tools and heavy machinery .

Protective Overalls - It is recommended to wear industrial jumpsuit or full sleeve shirt/t-shirt to protect self from injuries and cuts.

High Visibility Clothing - At worksite neon colour jackets with reflective bands is compulsory for high visibility at the workplace and night site work. Certain professionals require camouflage attires but as an excavator operator doing site work visibility ensures safety of individual.



Protective Gloves - Construction gloves are mandatory to be worn by an excavator operator in order to operate the machine with ease. Gloves also protect hands from dirt, chemical substances and prevent hand injury.

Safety Footwear - It's recommended to wear 8" CSA steel toe boots at construction site to protects the foot from falling objects and compression. Thes shoes even have mid sole plate as protection against puncture. from below.

UNIT 5.3: Common Hazards and Preventive Measures

Unit Objectives











At the end of this unit, you will be able to:

-  Develop clear understanding for different types of common hazards at the work place.
-  Classify with the Do's and Don'ts to avoid accidents.






5.3.1 Do's and Don'ts of Accident Prevention and Control

Common accidents with excavator are overturned, falls, runovers and contact with other people and other objects. By following some basic Do's and Don'ts many of such accidents can be prevented:

Do's

-  Wear all protective clothing and personal safety equipment issued to you or required by your working conditions.
-  Understand and follow safety procedures when working on-site and using plant and work equipment.
-  Ensure you are fully aware of the job requirements and how they need to be carried out.
-  Know where to get help. Know the first aid and emergency procedures.
-  Study the manufacturer's operator's manual for using your plant and equipment. If the manual is not provided, ask your supervisor or the suppliers of the plant / equipment to supply one.
-  Report faulty/unsafe plant or equipment and any dangerous incidents.
-  Use the plant equipment safely so as not to affect its stability.
-  Ensure you watch out for others who are affected by your actions.
-  Ensure all personal injuries, no matter how slight, are reported and entered in the accident book (or equivalent).
-  Attend all training courses being organised by your employer. It is possible to learn new techniques and safety practices at any age.



Don'ts

-  Use plant or work equipment that you have not been trained to use.
-  Throw or drop objects from plant or work equipment.
-  Attempt to carry out work on moving parts of plant or work equipment with the safety guards removed.
-  Indulge in horseplay on plant or work equipment.
-  Attempt to operate any type of plant or work equipment under the influence of drugs, alcohol or any other substance, which affects your health or judgment.

UNIT 5.4: Segregation and Disposal of Waste

Unit Objectives

At the end of this unit, you will be able to:

-  Categorize different types of waste and their segregation methods.
-  Evaluate the most suitable way to dispose the waste.

5.4.1 Waste Management

Waste if not dealt properly has devastating effect on environment, health of everyone within it and against regulation set out by law. A excavator operator needs to remember some basic waste management rules:





-  Use only authorised waste disposal sites.
-  Never store lubricants in open or unlabelled containers.
-  Never pour used oil, chemicals or paints into sewers, drains or on the ground comprises of several chemicals, solvents, and even trace metals which without correct treatment and disposal, they will potentially harm the environment and our health.
-  Look out for the proper bin (black in case of general rubbish) in case of non-industrial waste at your worksite. Most bins clearly mention the waste that can go in it.





Fig 5.4.1 Waste management

UNIT 5.5: Basic Fire-Fighting Equipment and Use

Unit Objectives

At the end of this unit, you will be able to:

-  Identify different types of fire-fighting equipment and use them effectively.
-  Utilise the equipment in a correct manner.

5.5.1 Fire Extinguisher

Make sure to use the right fire-extinguisher according to the table given below. Identify the source of fire, as using the wrong fire-extinguisher may prove ineffective or worsen the situation.

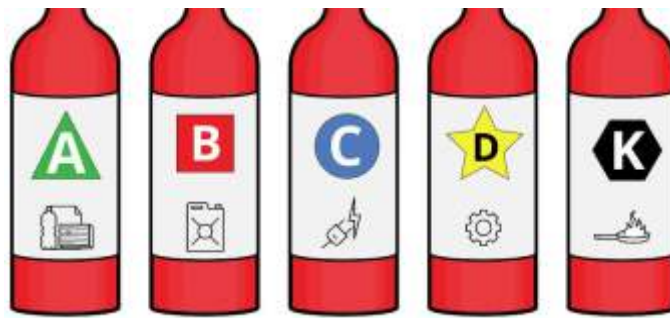


Fig 5.5.1 (a) Types of Fire Extinguisher

Sr. No	Class Type	Suitability	Ingredients
1	A	Cloth, wood, rubber, paper, various plastics, and regular combustible fires.	Water or foam.
2	B	Gasoline, grease, and oil fires.	Dry chemical or carbon dioxide.
3	C	Energized electrical fires.	Dry chemical or carbon dioxide.
4	D	Combustible metals.	Dry powdered chemical.
5	K	Oil, grease and fat.	Wet or dry chemical.
6	ABC	Multi purpose for class A, B, and C fires.	Dry chemical.

Steps

Identifying the process to operate fire extinguisher effectively can save your life provided fire can be controlled by the fire extinguisher.

Procedure:

Step-1: Make sure everyone is out of danger zone first and at safe assembly point.

Step-2: Tell someone to call fire station helpline or call them yourself.

Step-3: Identify the height of flame. If the fire is shorter than you use fire-extinguisher, as they are made for short and initial non-growing fire.

Step-4: Decide to evacuate immediately, if the fire has grown large and cannot be stopped by the fire extinguisher.

Step-5: Pull the extinguisher pin, maintain a distance of 6-8 feet away from fire.

Step-6: Aim the nozzle at the base of the fire, squeeze the lever and sweep the hose from side to side in left to right manner covering the entire fire base.

Step-7: Decide to evacuate immediately, if the fire doesn't stop after fire extinguisher is finished.

To operate an extinguisher:

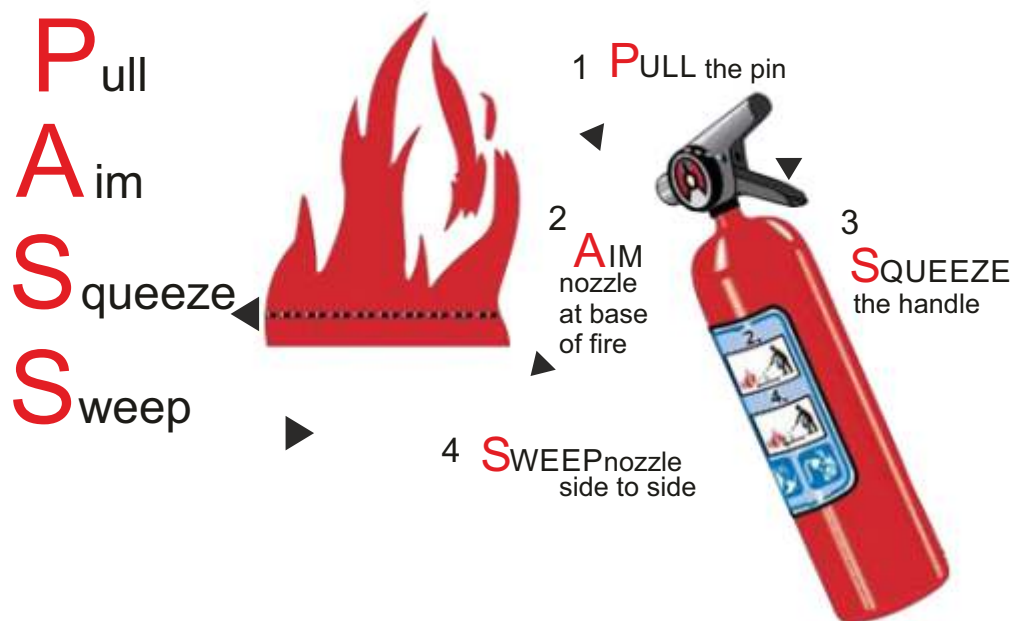


Fig 5.5.1 (b) Fire Extinguisher

5.5.2: Sand Bucket

Steps

Sometimes fire extinguishers are not available, another way of putting out the fire is using the sand bucket. Dry or wet sand is filled inside a steel bucket filled with fire stenciled on both the side so this sand is not used for other purposes. Though a primitive method of fighting a fire, generally it's quite useful. Decide to evacuate immediately, if fire cannot be controlled by the sand bucket.

Step-1: Distribute the sand over the fire, try to cover the flames completely. The oxygen supply from the fire will be choked when sand is poured over the fire.

Step-2: After the fire is extinguished, move the sand and watch for hot spots.

Step-3: Until the fire is completely extinguished, do not leave the fire unwatched.





Fig 5.5.2 Sand Bucket

UNIT 5.6: Common Injuries and Appropriate First-aid

Unit Objectives

At the end of this unit, you will be able to:

-  Develop knowledge of various items in a first-aid kit.
-  Make use of first-aid kit effectively for common injuries at the worksite.

5.6.1 Basic First-aid Kit

A junior excavator operator must have basic knowledge of emergency medicines that can be used as primary medical service for cuts, wounds, headache, burn gel, bandages, antiseptic liquid, ointments, pair of scissors, fever, etc.

Excavator machine must have a first-aid kit inside it with big red plus sign and placed at a position of average eye level that everyone can see.

Basic first aid is the preliminary medical treatment to be used to assist someone injured to become safe. As opposed to panicking, the knowledge of basic first aid instruction empowers to help in the correct manner. These allow you to quickly understand a person's physical condition and the correct method of treatment. Regardless of an injury or sickness, knowing or having access to basic first aid can make a difference even in life and death situation.



Fig 5.6.1 Basic First-aid Kit

5.6.2: Administer Aid

Steps

Mouth-to-Mouth Resuscitation:

Mouth-to-mouth resuscitation, a form of artificial ventilation, is the act of assisting or stimulating respiration, where a rescuer presses his or her mouth against that of the victim and blows air into the person's lungs.



Fig 5.6.2 (a) Step 1

Step-1: Make sure the person is lying on a hard, flat surface. Look into the mouth and throat to ensure that the airway is clear. If an object is present, try to sweep it out with the fingers (wear disposable surgical gloves if they are available). If vomiting occurs, turn the person on his or her side and sweep out the mouth with two fingers. Do not place the finger in the mouth if the person is rigid or is having a seizure.

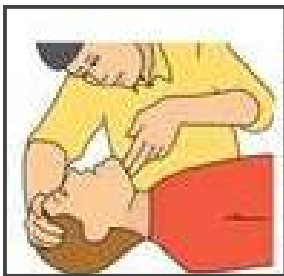


Fig 5.6.2 (b) Step 2

Step-2: Tilt the head back slightly to open the airway. Put upward pressure on the jaw to pull it forward.



Fig 5.6.2 (c) Step 3

Step-3: Pinch the nostrils closed with thumb and index finger. Place the mouth tightly over the person's mouth. Use a mouthpiece if one is available. Blow two quick breaths and watch for the person's chest to rise.



Fig 5.6.2 (d) Step 4

Step-4: Release the nostrils. Look for the person's chest to fall as he or she exhales. Listen for the sounds of breathing. Feel for the person's breath. If the person does not start breathing on his or her own, repeat the procedure.

Steps

Chemical Burns in an Eye:

To assist the person who has experienced chemical burns in eyes, follow these steps:

Step-1: Do not rub your eyes.

Step-2: Immediately rinse the eye or eyes under a water tap or in a gentle shower or with a clean container of water. Position the person's face so that the injured eye is down and to the side. Avoid spraying a high-pressure water stream into the eye or eyes.

Step-3: Flush with lukewarm water for 15 to 30 minutes. The person should keep the eye open as wide as possible. Wash the person's hands thoroughly to make sure no chemical is still on them.

Step-4: Do not rub the eye or place a bandage over the eye.

Step-5: While waiting for medical care, have the person wear sunglasses to decrease light sensitivity.

Foreign Particle in an Eye:

To assist the person who has experienced a foreign particle in an eye, follow these steps:

Step-1: Tell the person not to rub his/her eye – this could cause scratches on the eye surface.

Step-2: Ask the person to sit down and gently, separate his/her eyelids with thumbs or thumb and finger.

Step-3: Ask the person to look right, left, up and down and examine the eye for foreign objects.

Step-4: If something is present in the white of the eye, wash it out by pouring clean water or a sterile eyewash from the inner corner of the eye towards the outer corner.

Step-5: If this is unsuccessful, try lifting the object off with a moist swab or the damp corner of a clean handkerchief. If still the particle is not removed, seek medical help.



Fig 5.6.2 (f) Washing Eyes in Running Water

5.6.2 Administer Aid

Choking:

Choking occurs when a foreign object becomes lodged in the throat or windpipe, blocking the flow of air. Choking cuts off oxygen to the brain, administer first aid as quickly as possible.

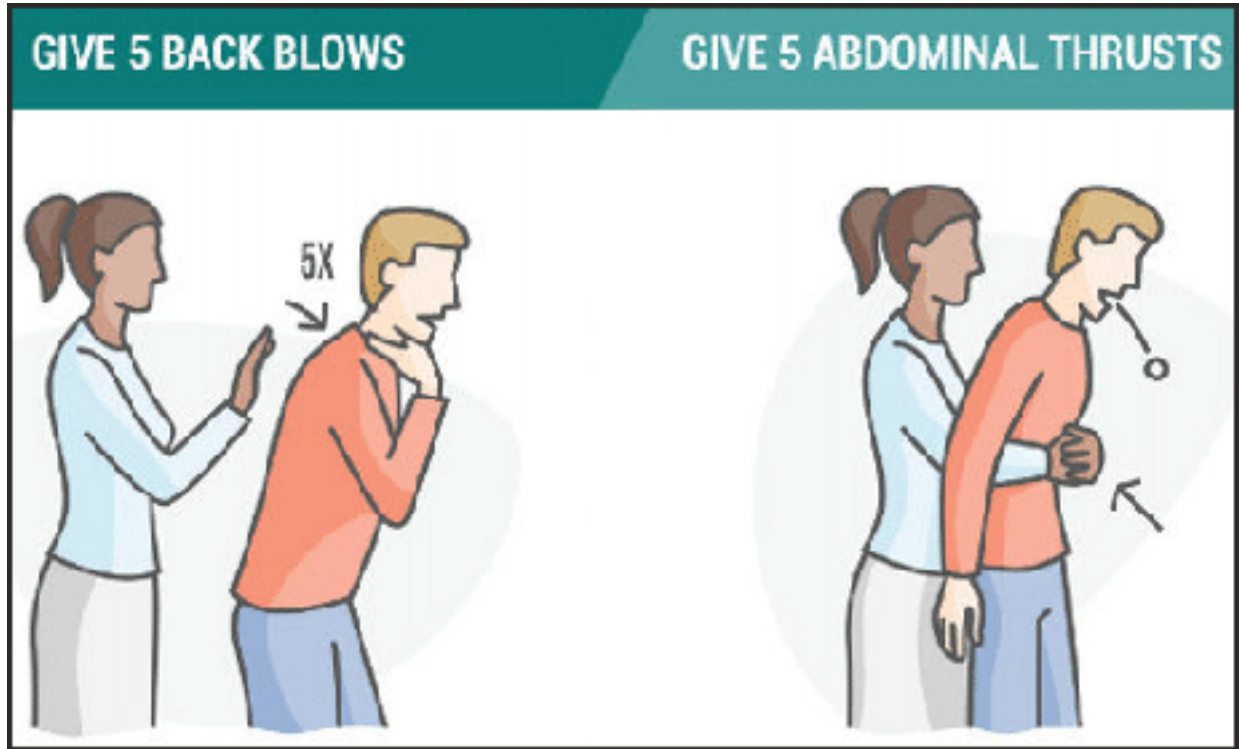





Fig 5.6.2 (e) First-aid for Choking

-  5 back blows: First, deliver five back blows between the person's shoulder blades with the heel of your hand.
-  5 abdominal thrusts: Perform five abdominal thrusts.
-  Give alternate 5 blows and 5 thrusts until the blockage is dislodged.

Steps

Severe Bleeding:

In case of severe bleeding, if bleeding isn't stopped quickly, they may lose plenty of blood, become unconscious or lead to life-threatening shock due to lack of blood flow to cells and organs.

For severe bleeding, take these actions immediately:

Step-1: If there is an object embedded in the wound, control bleeding by pressing firmly on either side of the object, do not remove or press the object, otherwise, apply direct pressure on the wound.



Fig 5.6.2 (g) Controlling the Bleeding

Step-2: Apply a dressing firmly to control bleeding. Ensure that it is not so tight that it restricts circulation.

Step-3: Prevent/treat shock by lying the casualty down with his/her feet raised (if possible).

Step-4: If the casualty has a head injury, lay himself/herself down and slightly raise his/her head and shoulders.



Fig 5.6.2 (h) Controlling the Bleeding

Step-5: If blood comes through the dressing apply another bandage on top.

Step-6: If blood seeps through this too, remove both dressings and re-apply a new sterile dressing using direct pressure to the wound.

Step-7: Support the injured area in a raised position.

Step-8: Seek medical attention if the bleeding does not stop or if the casualty goes into shock.

Step-9: Keep the casualty warm by laying him/her on a blanket or some other item.

Steps

Fracture:

In case of a fracture, provide first aid before taking the injured to professional care. Apply follow the few first-aid treatments until the professional medical treatment is given:

Step-1: If the injured person is bleeding, elevate and apply pressure to the wound using a sterile bandage, a clean cloth or a clean piece of clothing.

Step-2: If the injured person is bleeding, have fracture in his/her neck or back, help him/her stay as still as possible. If the injured person has fracture in one of his/her limbs, immobilise the area using a strap or suspend.

Step-3: Wrap an ice pack or bag of ice cubes in a piece of cloth and apply it to the injured area for up to 10 minutes at a time.

Step-4: Treat the injured for shock. Help the injured to get into a comfortable position, encourage him/her to rest and reassure. Cover him/her with a blanket or clothing to keep himself/herself warm.

Step-5: Help the injured get to the emergency department for medical care.

		
<p style="text-align: center;">R-Rest</p> <p>Do not move the victim unless it is undeniably needed. After the injury, stop the injured person from taking part in any painful activity. Moving the injured part can increase bleeding and swelling and slow down the healing process.</p>	<p style="text-align: center;">I-Ice</p> <p>Use an ice pack to reduce the pain and swelling in the affected area. Apply ice for 15minutes every two hours for 24 hours, then for 15 minutes every four hours for 24 hours.</p>	<p style="text-align: center;">C-Compression</p> <p>Bandage the area firmly (but not too tightly), starting just below the injured area and moving up. Overlap each layer by half. Finish bandaging about one hand's width above the injured area.</p>

Fig 5.6.2 (i) Rest Ice Compression Method

Steps

Electric Shock:

To assist the person who has experienced an electric shock, follow these steps:

Step-1: Look first. Don't touch. The person may still be in contact with the electrical source. Touching the person may pass the current through rescuer.

Step-2: Turn off the source of electricity if possible. If not, move the source away from the affected person, using a non-conducting object made of cardboard, plastic or wood.

Step-3: Check for signs of circulation (breathing, coughing or movement). If absent, begin resuscitation (CPR) immediately.

Step-4: Lay the person down and, if possible, position the head slightly lower than the trunk, with the legs elevated.

Step-5: Figure 5.6.2 (j) shows a man moving the power source away from the affected person using a wooden stick.



Fig 5.6.2 (j) Electric Shock

Shock due to Injury:

To assist the person who has experienced a shock, follow these steps:

Step-1: Lay the person down with their head low and legs raised and supported, to increase the flow of blood to their head. Do not raise an injured leg.

Step-2: Loosen any tight clothing around the neck, chest and waist to make sure it doesn't constrict their blood flow.

Step-3: Fear and pain can make shock worse, by increasing the body's demand for oxygen, so while waiting for help to arrive, it's important to keep them comfortable, warm and calm. Do this by covering them with a coat or blanket and comforting and reassuring them.

Step-4: Keep checking their breathing, pulse and level of response.

Step-5: If they become unresponsive at any point, open their airway, check their breathing and prepare to treat someone who has become unresponsive.

5.6.3 Do's and Dont's

Sl.No	Do's	Don'ts
1	Report suspicious activity.	Do not leave your system unlocked if not in use.
2	Communicate and co-ordinate with respective officials in case of any potential threat.	Never misuse the office resources (Pax manifest, duty mobile, system credential, etc) it may lead to potential threat.
3	Stay alert.	Do not share your login credentials.
4	Closely monitor passenger (pax) activity during check-in and boarding to report any suspicious activity.	Do not only depend on human calculations, but also use calculator to reduce human error.
5	Ensure your safety at all point of time.	Effectively use the time to avoid flight delays.

Exercise



Briefly answer the following questions.

1. List the steps to be taken by an operator to create a safer workplace.

2. List some common PPE.

3. What rules an operator has to follow when dealing with waste?

4. What makes up a basic first aid kit?

Tips

Following are recommended tips:

Wash skin contaminated with oil thoroughly in warm soapy water. Do not use petrol, diesel fuel or paraffin to clean your skin.



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