

Participant Handbook

Sector
Infrastructure Equipment

Sub-Sector
Equipment Maintenance

Occupation
Mechanic

Reference ID: IES/Q1104, Version 2.0
NSQF Level 3



Junior Mechanic Engine



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



About this Book

This program is aimed at training candidates for the job of a “Junior Mechanic Engine”, in the “Infrastructure Equipment” Sector/Industry and aims at building the very key competencies amongst the learner.

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



Tips



Notes



**Unit
Objectives**

Table of Contents

S.No.	Modules and Units	Page No.
1.	Introduction	1
	Unit 1.1 – About the Program	3
	Unit 1.2 – Engine and its Systems	5
2.	Assist in Repairs to Engine of the Infrastructure Equipment (IES/N1102)	17
	Unit 2.1 – Identification of Engine Repair Tools	19
	Unit 2.2 – Repairing Procedure	23
	Unit 2.3 – Maintenance Instructions	25
	Unit 2.4 – Maintenance Schedule	37
	Unit 2.5 – Preservation and Pre-Commissioning of Engine	41
3.	Maintain Workshop Area, Tools & Machinery(IES/N7801)	47
	Unit 3.1 – Work Area Maintenance	49
	Unit 3.2 – Tools & Machinery Maintenance at Work	54
	Unit 3.3 – Reports and Documentation	62
4.	Workshop Health and Safety (IES/N7602)	67
	Unit 4.1 – ESH Policies and Guidelines	69
	Unit 4.2 – Types and Use of PPE	71
	Unit 4.3 – Common Hazards and Preventive Measures	73
	Unit 4.4 – Segregation and Disposal of Waste	74
	Unit 4.5 – Basic Fire-Fighting Equipment and Use	75
	Unit 4.6 – Common Injuries and Appropriate First Aid	77

Employability & Entrepreneurship Skills







1. Introduction

Unit 1.1 – About the Program

Unit 1.2 – About Engine and It's Systems



Key Learning Outcomes

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

1. Know each other and understand workshop norms.
2. Share program expectations.
3. Understand the role and safe use of engine and parts as a junior mechanic.
4. Identify work instructions and specifications and interpret them accurately.
5. Know the lifting and handling procedures.

UNIT 1.1: About the Program

Unit Objectives

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

1. Understand training curriculum design.
2. Know each one and all.
3. List expectations from the training.

1.1.1 Overview of the Book

The training curriculum will help you:

1. **Assist in carrying out repairs and maintenance of equipment's engine.** Basic working of engine & systems, identification and use of hand tools and equipment, techniques for removal of defective components and fitment after rectification.
2. **Maintain the work area, tools and machine to support operations.** Maintenance of work area, tools and equipment, various cleaning agents and their use, safety precautions & measures.
3. **Comply with workshop health and safety guidelines.** Health, safety and environment policies; personal protective equipment, fire-fighting equipment, basic first aid for common injuries at work site.

1.1.2 Knowing Each Other

Let's Know Each Other:

- Your Name
- Your Location
- Your Favourite Hobby

1.1.3 Expectation Mapping

My expectations from the training program are:

UNIT 1.2: Engine and its Systems

Unit Objectives

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

1. Know what an Engine is.
2. Know the history and classification of engine.
3. Know the basics system & components of engine.
4. Know the application of Engine.

1.2.1 What is an Engine?

An Engine is a machine which converts Chemical Energy into Mechanical Energy.

Engine is one of the sources of energy in equipment's as Prime mover where Heat/Chemical Energy is converted into Mechanical Energy. Whereas in Electrical Motor (Electrical Engine) the other source of energy in equipment's Electrical Energy is converted into Mechanical Energy.

Selection of Engine/ Electrical Motor depends upon the application and end users facility.



Engine [*Heat/Chemical* *Mechanical*]

Fig. 1.2.1.1. Engine



Electrical Motor [*Electrical* *Mechanical*]

Fig. 1.2.1.2. Electrical Motor

1.2.2 Classification of Engine

Engines are classified based on

1. Fuel
2. Number of cylinders & their Position
3. Cooling arrangement
4. Strokes
5. Application: Vehicular, Industrial, Machinery, Marine, Generator--etc

1. Based on Fuel:

- a. Diesel Engine
- b. Petrol Engine



Compression Ratio Ranges from 14:1 to 22:1

Fig. 1.2.2.1. Classification of Engine

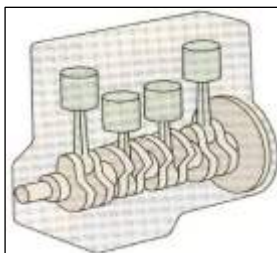


Compression Ratio Ranges from 7:1 to 12:1

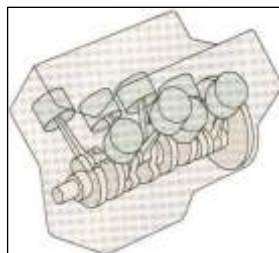
Fig. 1.2.2.2. Classification of Engine

2. Based on Cylinder (Number/Position)

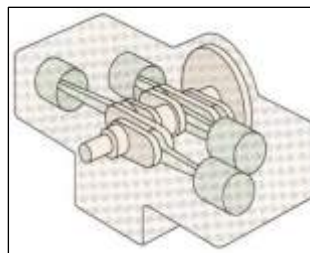
- a. Number: 6, 4 Cylinders etc., Position:



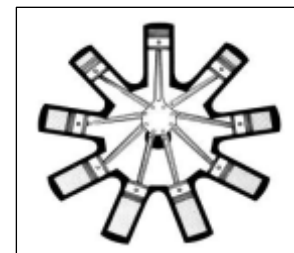
In-Line



V-Type



Opposed



Opposed

Fig. 1.2.2.3. Classification of Engine

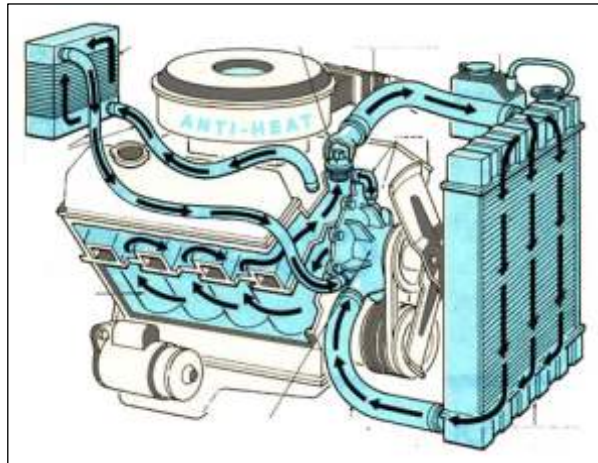
1.2.2 Cont...

1. Based on Cooling



Liquid Cooled Engine

Fig. 1.2.2.4. Classification of Engine



Air Cooled Engine

Fig. 1.2.2.5. Classification of Engine

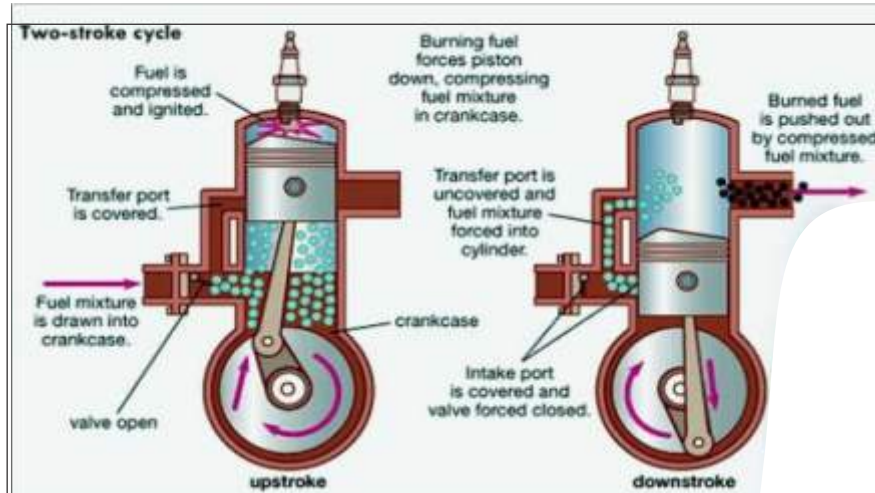
Difference in Engine Cooling Systems:

Items	Air Cooled	Liquid Cooled
Cooling Media	Air	Liquid (Water + Chemical)
Components	Fan, Belt, Fins	Radiator, Pump, Fan, Belt, Hoses, Clamps
Maintenance	Less	More
Cost (Coolant)	Less	More
Problem Frequency	Less	More
Design (Under Severe Load)	Less performance	Better

Table. 1.2.2. Difference in Engine Cooling System

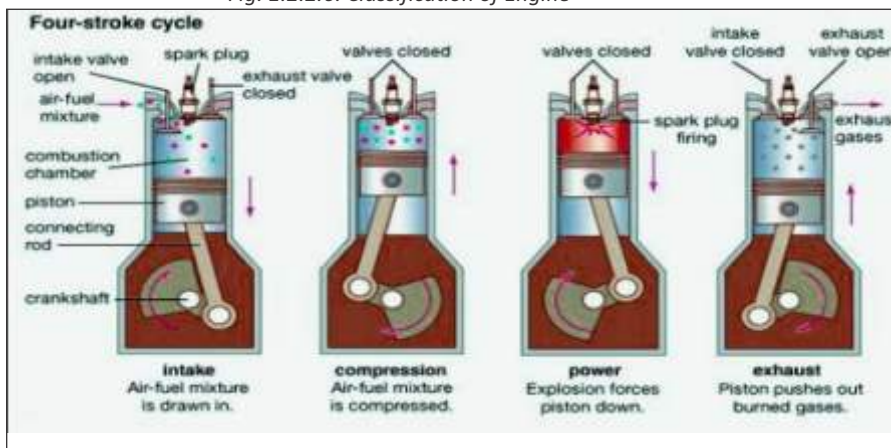
1.2.2 Cont...

3. Based on Strokes



2 Strokes Engine

Fig. 1.2.2.6. Classification of Engine



4 Strokes Engine

Fig. 1.2.2.7. Classification of Engine

Technical Terms of Engine:

1. TDC - Top Dead Center
2. BDC - Bottom dead center
3. HP - Horse Power (*Rate of doing work*)
 - a. IHP - Indicated Horse Power (Gross)
 - b. FHP - Friction Horse Power (Loss)
 - c. BHP - Brake Horse Power (Net)
$$\text{IHP} = \text{FHP} + \text{BHP}$$

HP = Torque X Speed / Constant,

Torque - "Twisting Force"

Torque = Force (Kgf) X Distance (Meter)

CC - Cubic Centimeter (Volume of Cylinder)

RPM - Revolution per Minute

1.2.3 Basic Systems & Components of Engine

1. Air System:

- a. Air Filter
- b. Turbocharger – Compressor side
- c. Intake Manifold
- d. Cylinder Valve Port
- e. Combustion Chamber
- f. Exhaust Manifold
- g. Turbocharger – Turbine side
- h. Exhaust Pipe
- i. Silencer
- j. Tail Pipe

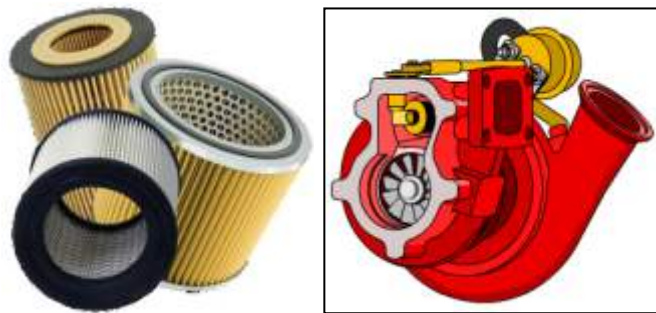


Fig. 1.2.3.1. Basic Components of Engine

2. Lubrication System:

- a. Oil Sump
- b. Strainer
- c. Oil suction pipe
- d. Oil Pump
- e. Oil Filter
- f. Oil Cooler
- g. Main Oil Gallery (MOG)– Crank & Cam Bush
- h. Crankshaft Main Journal – Crank Pin
- i. Cam bush – Cyl Head – Rocker Lever
- j. Cyl valve / Push rod / Tappet – Cam lobe – Sump

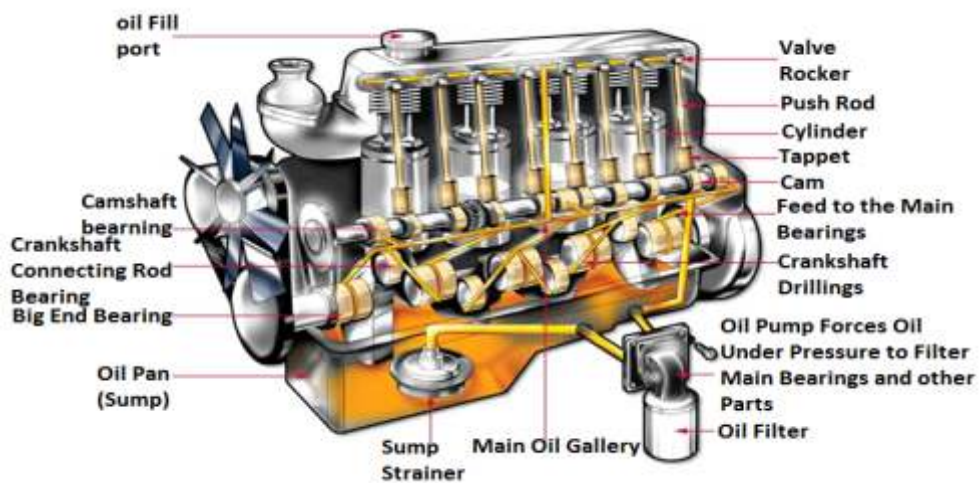


Fig. 1.2.3.2. Basic Components of Engine

1.2.3 Cont....

3. Cooling System

- a. Radiator Top Tank
- b. Radiator Bottom tank
- c. Water suction Pipe
- d. Water Pump
- e. Cylinder block water Jacket
- f. Cylinder Head
- g. Thermostat - Bypass - Outlet
- h. Thermostat Bypass -Water Pump suction
- i. Thermostat Outlet – Radiator Top tank

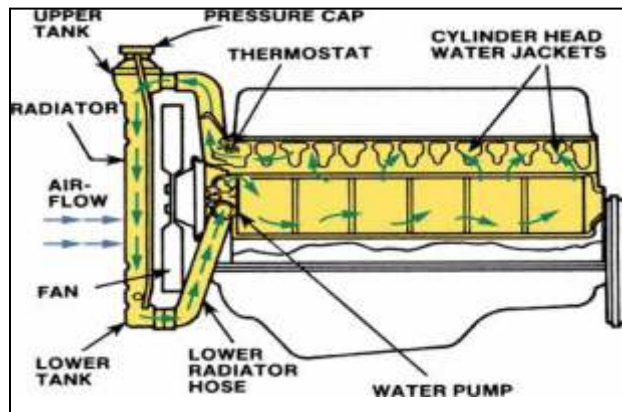


Fig. 1.2.3.3. Basic Components of Engine

4. Electrical System:

- j. Battery
- k. Battery Lead
- l. Starter
- m. Alternator
- n. Ignition Switch
- o. Engine Panel
- p. Charging Alternator

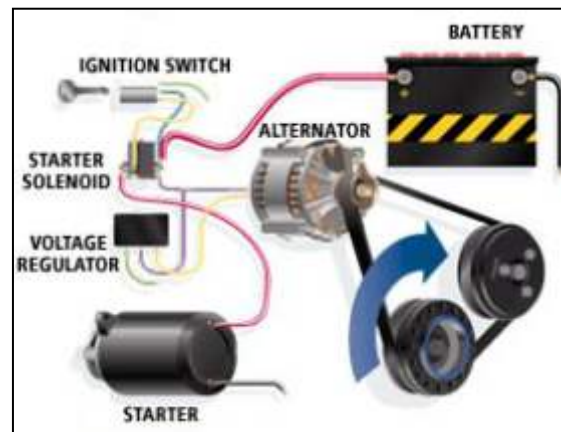


Fig. 1.2.3.4. Basic Components of Engine

5. Fuel System: Included Components

- a. Fuel Tank
- b. Fuel Feed Pump
- c. Fuel Injection Pump
- d. Filter
- e. Leak Off Pipe
- f. High Pressure Fuel line
- g. Injector
- h. Bleed screw
- i. Hand Priming Lever

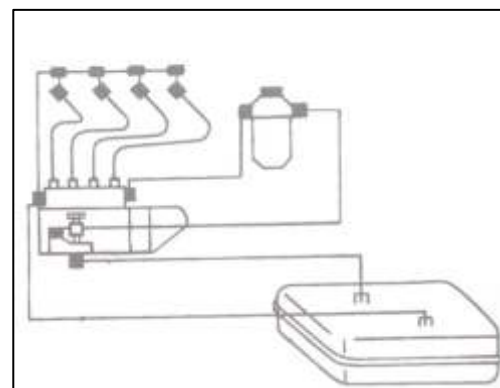


Fig. 1.2.3.5. Basic Components of Engine

1.2.4. Sample Specification of Engine

General Data:

Model	ABC
Type	Diesel, 4 stroke, 4 cylinder in-line, overhead valve, water cooled, Turbo charged Intercooled & EGR
Aspiration	Turbocharged with Intercooled
Max output	56 kW (Gross) @ 2200 rpm
Engine rpm	850 – 2470
Bore & Stroke (mm)	104 x 113
Displacement (ltrs)	3.8
Compression ratio	16.5 : 1
Engine oil capacity - Sump (ltrs)	9
Electrical system	12 V - 65 Amps
Direction of rotation	Anti-clockwise from rear
Firing order	1-3-4-2

Table. 1.2.4. Sample Specification of Engine

1.2.3 Contd...

Components of Engine

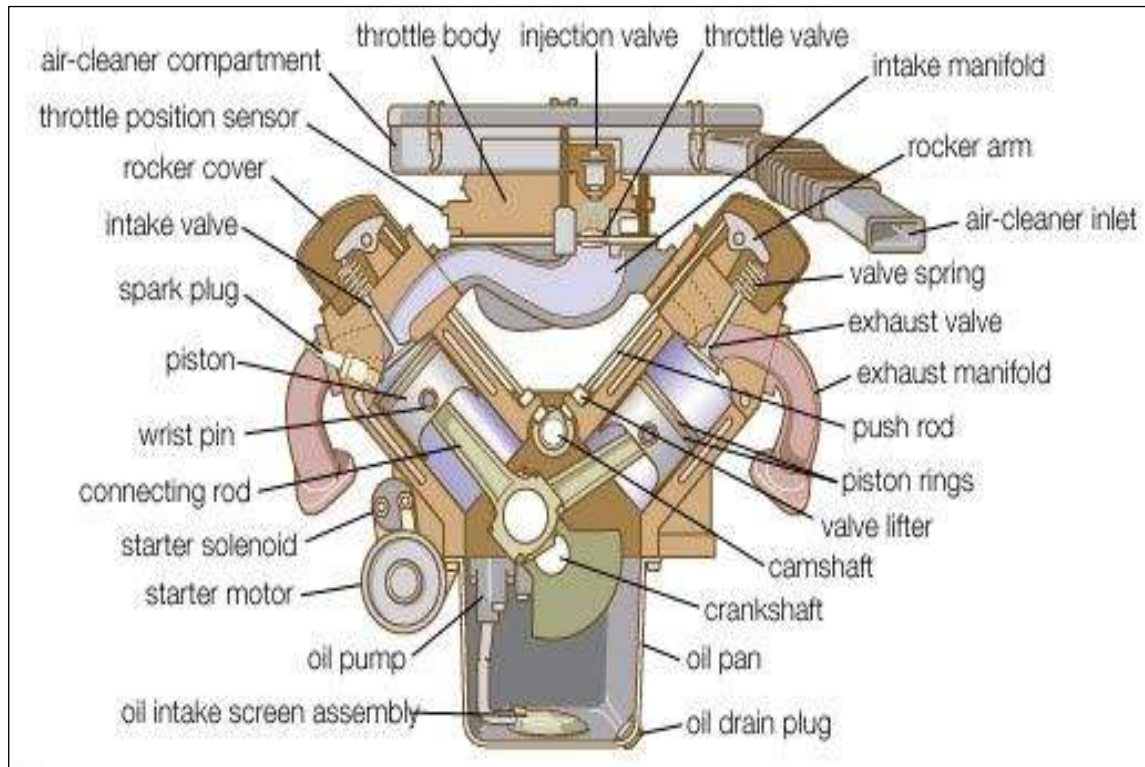


Fig. 1.2.3.6. Basic Components of Engine

Exercise

Briefly answer the following questions.

What is basis of engine classification?

What is the classification based on cylinder?

List out the parts in the lubrication system of engine?

What are the major differences in air cooled and liquid cooled engines?

2. Assist in Repair to Engine of the Infrastructure Equipment



Unit 2.1 – Identification of Repair Tools

Unit 2.2 – Repairing Procedure

Unit 2.3 – Maintenance Instructions

Unit 2.4 – Maintenance Schedule

Unit 2.5 – Preservation and Pre-Commissioning of Engine



Key Learning Outcomes

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

1. Assist in repair and maintenance of equipment under the supervision of the mechanic.
2. Record and document the basic details of repairs and maintenance performed on various aggregates/ components.

UNIT 2.1: Identification of Repair Tools

Unit Objectives

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

1. Get to know, about the various repair tools for engine and its specific uses.
2. Visualize the right repair tools required for engine repair and maintenance.
3. Assist mechanic in engine repair and maintenance within shortest time.

2.1.1 Engine Repair Tools


		
<p>Torque Wrenches</p>	<p>Piston Ring Compressors</p>	<p>Valve Spring Tester</p>
		
<p>Compression Testers</p>	<p>Valve Spring Compressors</p>	<p>Cylinder Hones</p>
		
<p>Engine Hoists</p>		

Fig. 2.1.1.1 Engine Repair Tools

2.1.1 Engine Repair Tools

Working on engines will require some special engine repair tools. Below mentioned are the various repair tools for engine maintenance.

Torque Wrenches

- Beam type
- Click type
- Electronic digital type
- Dial type

Engine Hoists

- Fixed Type of Engine Hoist
- Fold Up Engine Hoist

Piston Ring Compressors

- Wind up type of piston ring compressor
- Pliers type
- Solid type of ring compressor

Compression Testers

Valve Spring Compressors

- Universal Manual "C" Clamp Style
- Air Operated "C" Clamp Style
- Stud Mounted Valve Spring Compressor
- On the car valve spring compressors

Cylinder Hones

- Stone type hone
- The Flex hone

Valve Spring Tester

- Rimac Valve Spring Tester
- Trackside or "on the engine" type

2.1.1 Engine Repair Tools



Fig. 2.1.1.2 Engine Repair Tools

UNIT 2.2: Repairing Procedure

Unit Objectives

The following concepts are discussed in the operating instructions

1. Before Starting the Engine
2. Frost Precautions
3. Do's & Don'ts

2.2.1 Before Starting the Engine

Before starting the engine make sure that;

1. The Radiator is full of coolant.
2. Fuel tank with sufficient fuel.
3. Engine oil level is correct (dipstick).

Topping up the Engine Sump

1. The engine oil level should be maintained between dipstick's high and low marks.
2. While checking the oil level, shut down the engine.
3. Wait for few minutes. Withdraw the dipstick from its holder, clean and refit.
Withdraw again and note the level.
4. Top up as required with the clean correct grade of engine oil.

2.2.2 Frost Precautions

If anti-freeze solution is not in use and the engine has to be left in the open with temperatures close to freezing point, the cooling system must be completely drained by opening the two drain points which are situated as follows

1. Drain Plug fitted at the rear right hand side of the cylinder block
2. Drain tap fitted on the radiator.

Drain tap/plug should be tested at frequent intervals by inserting a length of wire to ensure that they are clear. This should be done as soon as they are opened so that an obstruction freed by the wire may be flushed out by the water. After draining place a notice on the engine to the effect that the cooling system is empty and the drain taps are open.

2.2.3 Do's & Don'ts

For more info on the Operating Procedures of Engines, it's recommended to study the operating manuals of the engines.

1. Engine life to a great extent depends upon clean fuel oil. So it's recommended to always use clean oil. Before filling the diesel to tank filter it with fine cloth.
2. Keep the suction pipe at least 1" from the bottom so that water can settle down and can be drained periodically.
3. Never use kerosene. This will cause permanent wear of FIP components and injectors and ultimately result in major expenditure of engine over haul.
4. Always use correct grade of engine oil and coolant as per AL recommendations.
5. Always use genuine engine oil and fuel filters and replace them as recommended.
6. Never use spurious filter elements especially gauge type filter elements.

UNIT 23: Maintenance Instructions

2.3.1. Maintenance Instructions

Engines are designed to ensure ease of access to mechanical components. This will enable the Mechanic to carry out a number of simple maintenance & repairs.

In order to perform engine components basic maintenance, please go through the instructions provided in the following pages on below systems

1. Fuel System
2. Lubrication System
3. Cooling System
4. Air Intake System
5. Turbocharger



Used Engine Oils

1. Prolonged and repeated contact may cause serious skin disorders, including dermatitis and cancer.
2. Avoid excessive contact, wash thoroughly after contact.
3. Keep out of reach of children.

2.3.2 Maintenance of Fuel System

1. Fuel additives should not be used.
2. Always use good quality diesel.
3. Keep fuel clean and prevent water from entering the fuel system.
4. Care should be taken when filling the fuel tank in the rain or snow not to allow the water in the fuel system. Do not forget to close the fuel tank cap securely.

Fuel Tank:

Remove the fuel tank. Thoroughly clean the inside surface and strainer once in 6 months.



Fig. 2.3.2.1 Maintenance of Fuel System

Maintenance of Fuel Filter:

Fuel filtering system consists of a strainer (Fitted before feed pump) and fuel filter cum water separator (Fitted on pressure side before FIP).

For easy identification, fuel inlet and outlet ports are embossed clearly on the filter-head.

Further, as a fool proof, the fuel inlet port is provided with M14 size and fuel outlet port is provided with M12 size threads.



Fig. 2.3.2.2 Maintenance of Fuel System

2.3.2 Cont...

Under normal operating conditions, fuel filter cum water separator to be replaced at every 500 hours of operation and mud strainer to be replaced at every 1500 hours of operation.

Renewal procedure for Fuel Filter cum Water separator

1. Remove old filter cartridge using appropriate filter wrench and discard.
2. Clean filter head base and ensure that all the unwanted material is completely removed.
3. Check the filter mounting head for tightness.
4. Apply/thread seal on the thread portion in the filter head.
5. Apply a thin coat of clean engine oil to the rubber ring surface of the new filter. Press the rubber ring firmly into the retaining groove in the filter. Do Not Use Grease.
6. Carefully read the installation instructions printed on the peripheral of the filter, before fitment.
7. Pre-fill the new filter with clean fuel.
8. Mark a reference point on the filter and filter head to identify the point. Ensure that the rubber sealing ring first makes contact with the sealing surface of the head.
9. Screw on the filter fully in and rotate 1/ 2 turn further.
10. Start the engine and ensure no fuel leakage around the sealing rubber ring and filter assembly.

2.3.2 Cont...

Procedure for draining water:

Please look into the instruction provided on the component for draining the water from the unit.

1. Rotate the drain cock anti-clockwise (as shown in the instructions printed on the outside of the filter).
2. Drain the water till the fuel starts to flow.
3. Rotate the drain cock clockwise the number of turns as indicated by the installation instructions printed on the side of the filter canister.
4. Start the engine and check for fuel leakage around the sealing gasket and filter assembly.
5. Never use a spanner for rotating the drain cock



1. **Drain Water Daily. Drain cock should be hand tightened fully. Never use any spanner.**
2. **Fuel additives should not be used.**
3. **Since nozzle tip is very sensitive, do not use emery sheet or any hard material to clean the tip of nozzles.**

2.3.2 Cont...

Bleeding Procedure for Fuel System:

1. Ensure that diesel is available in the tank. Arrest leakage if there is any. And ensure there is no blockage in the filter/pipe lines.
2. The suction strainer in fuel tank is clean.
3. Diesel filters and their seals are in good condition.
4. The filter in the banjo bolt on feed pump suction pipe is clean.
5. Pump the plunger on lift pump and ensure that air free diesel flow occurs at the filter bleeding screw.
6. Crank the engine few times by loosening the high pressure injector pipes at the injector end and retighten after clear delivery takes place.
7. Start the engine.
8. Even after priming if diesel does not appear at the outlet, remove the feed pump assembly. Check and rectify the defects.

2.3.3 Maintenance of Lubrication System

Engine Oil level Checking:

1. Withdraw the dipstick located on the LH side of engine. With a clean cloth wipe the dipstick scale and re insert fully.
2. Withdraw the dipstick. If oil level is found to be between Min. and Max. Marking oil level is sufficient for running. If oil level is at Min. mark or below top-up engine oil to the Max. level.

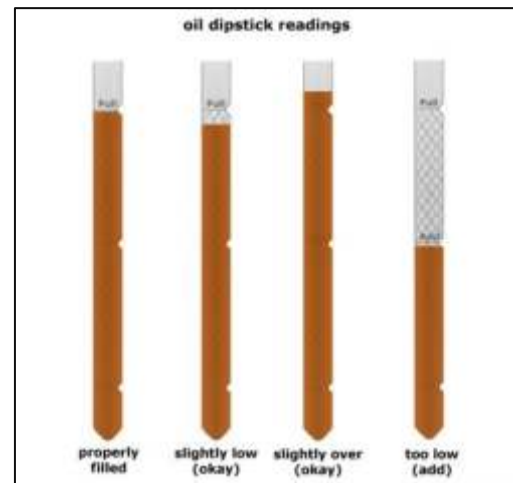


Fig. 2.3.3. Maintenance of Lubrication System

Engine Oil & Filter Change:

1. Ensure that the engine is warm. Draining of oil should be done within 10 minutes, from shutdown.
2. When the oil is completely drained install the drain plug with new washers and tighten securely.
3. Using suitable spanner, loosen center bolt of filter bowl and withdraw the bowl assembly. Discard the used filter element and sealing 'O' rings at center bolt and bowl fitting face. Fit a new oil filter element after placing the spring and the plate washer in position. Fit filter bowl with filter element to the filter head by center bolt. Ensure that oil filter is not fitted in the inverted position.
4. Open oil filler cap.
5. Refill the engine with the correct quantity of the specified grade of engine oil. Check the oil level on the dipstick and run the engine for a short time. Allow 5 - 10 minutes for the oil to settle down. This is essential when the oil filter has been changed and engine oil top.

2.3.4 Maintenance of Cooling System

Charge air cooler and Radiator core cleaning and fin repair:

When mud, debris, etc. are stuck up at the front of the radiator or charge air cooler core, the passage of cooling air is impaired. Hence such matter should be removed completely by washing with water. Deformed fins also can impair cooling and these should be repaired.

Replace cooling system rubber hoses. Check hoses for cracks, swelling or deterioration and replace if necessary.

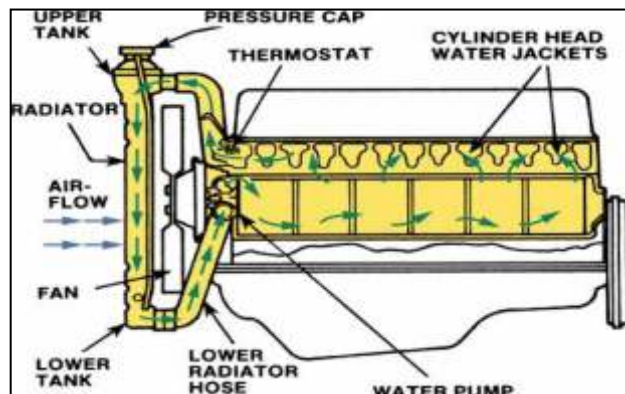


Fig. 2.3.4.1. Maintenance of Cooling System

Changing Coolant in Radiator:

1. Do not loosen the drain plugs while the engine is still hot. If you do so, hot liquid coolant can come out resulting, in personal injury.
2. Stop the engine. Loosen-the radiator drain plug to drain the coolant. Drain will improve if you remove the cap from radiator.
3. Drain the complete system and tighten the radiator drain plug.
4. Slowly feed coolant into the radiator.
5. Through the filler until the radiator is full. When supplying coolant from a pail, pour it slowly to prevent air from mixing with the coolant.
6. When the level of the coolant reaches the filler neck, squeeze the upper radiator hose two or three times. This will cause air inside the hose to be expelled, and the level of the coolant will fall.
7. Properly close the radiator cap.
8. To ensure that the air in the engine and the piping is properly expelled, set the engine speed slightly higher than normal idling speed. Raise the coolant temperature above 82°C, then continue to idle the engine for another 10 minutes.
9. Stop the engine and after the engine, has cooled down sufficiently, check the coolant in the radiator. Add coolant to make up for any drop in the coolant level.

2.3.4 Cont...

Radiator Cap:

The presence of the radiator cap prevents loss of coolant entry of foreign particles and raises boiling point of coolant. The absence can lead to engine overheating and reduction in engine life.

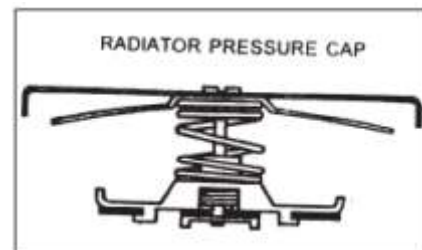


Fig. 2.3.4.2. Maintenance of Cooling System

Water Pump: Adjustment of the driving belt tension of water pump (Poly V belt arrangement)

1. Loosen the necessary fasteners, slacken the pulleys & remove the old belt.
2. Check pulley grooves for wear / damage and replace the pulley if required.
3. Clean the pulley grooves for debris and ensure not to apply oil or grease on the pulley grooves at the time of fitment.
4. Check alignment of the pulleys.
5. Mount the belt over pulleys and ensure that the belt ribs are seated in the respective pulley grooves.
6. Tension the belt and tighten all the Fasteners.
7. Run the engine for 3 to 5 minutes with the applied tension to allow the belt to seat in the respective pulley grooves properly. Reset tension.
8. Apply initial belt tension of 700N by adjusting the alternator position.

Note: Misalignment of pulleys will, produce noise and shorten the belt life.

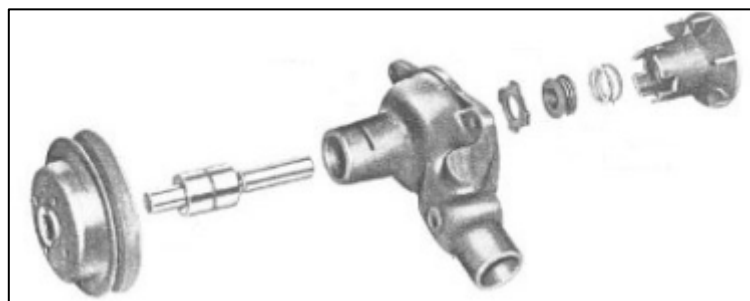


Fig. 2.3.4.3. Maintenance of Cooling System

2.3.4 Cont...

Belt Tension Measurement Procedure:

1. Hold the sensing head steadily across the belt span within 5 -10 mm distance above the top surface of the belt.
2. Tap the belt gently near the mid span using a rod or with similar tool to cause the belt span to vibrate.
3. Check the required tension display on the LCD panel on the tension meter.
4. If a reading is not obtained check that the sensing head and ensure that it is positioned properly.
5. Repeat the same procedure to recheck.

Do's	Don'ts
Check belt tension at regular intervals and adjust as needed	Don't over tension the belt
Check for any abnormal wear and damage in pulleys / Belt	Don't apply oil/grease or paint on pulley grooves
Check for pulley alignment	Don't fix the belt improperly aligned
	Don't use worn out belts
Make belts free of fluffs and dirt	Don't pry the belt using sharp tools

Table. 2.3.4. Belt Tension Measurement Procedure

2.3.5 Maintenance of Air Intake System

Poor air cleaner maintenance will result in:

1. Excess liner wear
2. High engine oil consumption
3. Excess blow by &
4. Poor pick up

The maintenance schedule has been recommended to ensure adequate checks on air induction system, air cleaner element and oil changes for normal service requirements. More frequent servicing may be required in severe dust conditions. Consult our authorized dealer for specific requirements.



Fig. 2.3.5. Maintenance of Air Intake System

Servicing of Dry type Air cleaner:

Maintenance Recommendations to be followed strictly are

1. Remove dust deposit weekly by squeezing the dust evacuator valve.
2. Replace dust evacuator valve immediately if it is torn, cracked, remains open or missing.
3. Never operate the engine, if the restriction indicator is either broken or missing
4. Ensure that the washers are in place before tightening the wingnut.
5. Replace primary filter element every 1000 hrs. or as soon as red band appears fully on the transparent portion of the vacuum indicator and in this position red band will not regain its position when the engine is switched off.
6. Replace the secondary filter element at the time of every third replacement of the primary filter element.



1. **Do not clean the air filter.**
2. **The wing nut should be tightened with hand alone Excessive tightening would damage the air cleaner.**

2.3.6 Maintenance of Turbocharger

Initial Running: Check all air ducts and gaskets for leak. Repair any leaks before proceeding. Inlet of air compressor must be free from dust and contamination.

Turbocharger does not require any maintenance. But please follow the below Do's & Don'ts

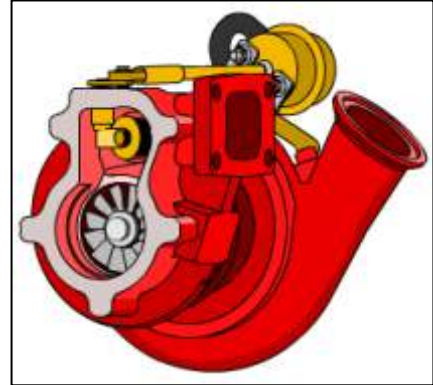


Fig. 2.3.6. Maintenance of Turbocharger

Do's

1. Adhere strictly to recommended maintenance schedule.
2. Use of specified grade of engine oil and oil filter and periodic change as recommended in maintenance schedule.
3. Replace air filter element as recommended.
4. Check for oil pressure at engine idling condition minimum oil pressure should be 1 kg/cm².
5. Allow the engine to run for 2 minutes after starting the engine.
6. Allow the engine to run for 3-5 minutes before switching off the engine.
7. When carrying out maintenance work on the engine, the piping leading from or to the turbocharger must be removed, and the pipe openings on the turbocharger to be closed properly.
8. Regularly check the oil feed and return pipes for leaks, air intake system pipes and hoses for leakage, blockage and exhaust piping connections for leakages, blockage.
9. Prior to fixing turbocharger to the engine, fill the central housing with clean engine oil and ensure that, all pipes are thoroughly cleaned before connecting to the turbocharger.
10. Check the fuel injection system for its proper functioning
11. Close all the turbocharger openings with protective plugs when it is not in use.
12. Contact authorized dealer/authorized centers for turbocharger complaints / service / overhaul.

2.3.7 Contd...

Don'ts

1. Don't run the engine with low oil pressure.
2. Don't run the engine with leaky, restricted oil feed and drain pipes.
3. Don't run the engine with blocked, punctured, aged, deformed hose / pipe connections from the air cleaner to the turbocharger, turbocharger to charge air cooler and charge air cooler to the inlet manifold.
4. Don't run the engine with leaky connections, blocked, and deformed connections to the turbocharger turbine inlet and from turbine outlet.
5. Don't tamper the fuel injection system.
6. Don't dismantle the turbocharger center.

UNIT 24: Maintenance Schedule

2.4.1 Maintenance Schedule

SCOPE AND PROCEDURES OF REGULAR MAINTENANCE

The operations described here as “Regular Maintenance” involve such service operations as inspection, lubrication, adjustment, and replacement which should be carried out at specified intervals. The importance of these regular service operations need not be emphasized further for they have a close bearing on the performance and service life of your engine.

The periods under which the various items are listed are intended to apply to engine engaged on normal operating conditions. More frequent attention will be necessary to engine working under adverse conditions. The regular maintenance periods, therefore, should be altered to suit the local conditions.

2.4.1 Cont...

Checklist	Daily	First 50 hours only	Every 250 hrs	Remarks
1. Check level and top up		<input type="checkbox"/>		
a) Oil in engine	✓	✓		
b) Coolant in radiator	✓	✓		
c) Electrolyte in battery		✓	✓	
2. Check tightness of				
a) Battery terminals & apply petroleum jelly		✓	✓	
b) Fan belt and tighten if necessary		✓	✓	
c) Hose connections in cooling systems		✓	✓	
d) Hose clamp of charge air cooler / turbocharger		✓	✓	
e) Fuel piping connections		✓	✓	
f) Exhaust piping connections		✓	✓	
g) Engine mountings		✓	✓	
h) Engine to drive unit coupling		✓	✓	
i) Electrical connections at instrument panel		✓	✓	
j) Radiator mtg, stay & gap between fan and cowl		✓	✓	
k) Turbocharger mounting		✓	✓	
l) Injection pump mounting		✓	✓	
m) Cylinder head nuts		<input type="checkbox"/>	<input type="checkbox"/>	First 500 Hours and thereafter every 2500 Hours
3. Run the engine, check and record		<input type="checkbox"/>	<input type="checkbox"/>	
a) Oil pressure	✓	✓	<input type="checkbox"/>	
b) Battery charging	✓	✓	<input type="checkbox"/>	
c) Idling RPM	✓	✓	✓	
d) Maximum RPM	✓	✓	✓	
e) Maximum operating temperature	✓	✓	✓	
4. Check leakage from		<input type="checkbox"/>	<input type="checkbox"/>	
a) Fuel piping & injector high pressure lines		✓	✓	
b) Exhaust manifold, flange & connections		✓	✓	
c) Engine oil filter and other areas		✓	✓	
d) Coolant hoses		✓	✓	
5. Lubricate		<input type="checkbox"/>	<input type="checkbox"/>	
a) Throttle linkages		✓	✓	

Table. 2.4.1.1. Maintenance Schedule

2.4.1 Cont...

Checklist	Daily	First 50 hours only	Every 250 hrs	Remarks
6. Clean		<input type="checkbox"/>	<input type="checkbox"/>	
a) Fuel feed pump strainer		✓	✓	
b) Fuel filter bowl, drain till clear fuel appears and then bleed the system		✓	<input type="checkbox"/>	
c) Strainer in fuel tank		<input type="checkbox"/>	✓	
d) Engine breather		<input type="checkbox"/>	<input type="checkbox"/>	Every 1250 Hours
7. Replace/Fill		<input type="checkbox"/>	<input type="checkbox"/>	
a) Replace engine oil and oil filter at scheduled hours		<input type="checkbox"/>	<input type="checkbox"/>	Every 250 hours or 60 days whichever is earlier
b) Fuel filter and seal ring Every 500 Hours		<input type="checkbox"/>	<input type="checkbox"/>	Every 500 Hours
c) Coolant (Refer page 5.07 for recommended coolants)		<input type="checkbox"/>	<input type="checkbox"/>	Every 5000 Hours or 24 months
d) Cooling system hoses and rubber pads for radiator mounting and stay rods		<input type="checkbox"/>	<input type="checkbox"/>	Every 2500 Hours
e) Fuel hoses		<input type="checkbox"/>	<input type="checkbox"/>	Every 3500 Hours
f) Air filter element		<input type="checkbox"/>	<input type="checkbox"/>	Every 1000 Hours or whenever vacuum indicator shows red band even after cleaning/in case of any damage
8. Check & reset		<input type="checkbox"/>	<input type="checkbox"/>	
a) Injection pump timing		✓	<input type="checkbox"/>	
b) Adjust valve clearance		<input type="checkbox"/>	<input type="checkbox"/>	During every oil change
c) Injector opening pressure		<input type="checkbox"/>	<input type="checkbox"/>	Every 2000 hours.
d) Recalibrate Fuel Injection Pump		<input type="checkbox"/>	<input type="checkbox"/>	Every 3500 Hours.
9. Check charge air cooler		<input type="checkbox"/>	<input type="checkbox"/>	
a) For any blockage of fins and clean the cooler if necessary		✓	✓	
b) Hoses for any damage		✓	✓	

Table. 2.4.1.2. Maintenance Schedule

2.4.1 Cont...

OIL CHANGE INTERVALS - INDUSTRIAL AND MARINE ENGINES		
Type of Service	Gulf Oil India/ Indian Oil Corporation - CF4 15W-40	
	Hrs.	Days
1st Free Service	50	30
2nd Free Service	250	60
Paid Service -1	500	120
3rd Free Service	750	180
Paid Service -2	1000	240
Paid Service - 3	1250	300
4th Free Service	1500	360
Paid Service - 4	1750	420
Paid Service - 5	2000	480
5th Free Service	2250	520
Paid Service - 6	2500	600

Table. 2.4.1.3. Maintenance Schedule

UNIT 25: Preservation and Pre-Commissioning of Engine

Unit Objectives

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

1. Check the engine for cleanliness.
2. Visually inspect various parts of the engine.

2.5.1. Preservation of Engine

Storage of engines at normal ambient temperature.

Whenever engines are kept in storage, proper care should be taken, as detailed below:

1. **If Stored for a Short Period:**
 - a. The engine should be thoroughly washed, to remove any deposits of mud which may be salt-laden.
 - b. The engine should be stored in a covered area, on plain hard surface.
 - c. Disconnect battery terminals.
 - d. Once a week the engine should be started and run for a few minutes.
2. **If Stored for Longer Periods:**
 - a. The batteries should be removed and prepared for storage in a dry place. Top up with distilled water and charge fully before storage. Check and charge at regular intervals during storage.
 - b. It is advisable to drain the cooling system. A board is to be hung on the engine indicating that cooling system has been drained out to avoid accidental starting of the engine.
 - c. It is advisable to drain the fuel tank as well as the fuel filters to avoid formation of gum deposits and the possibility of difficult starting later.
 - d. Completely seal with masking tape the engine intake, exhaust tail pipe and the vent hole of the fuel tank.

2.5.2 Pre-Commissioning Hints

Support during De-Preservation:

De-preserve the engine as per the procedure given below:

1. Clean all external parts thoroughly. Direct the jet of air to remove all dust
2. Uncover all openings and appropriate connections should be made
3. Remove fuel filters and fit new ones as per the procedure in Service Manual.

Installation of Engine:

If the engine is stored beyond one year, Re -Preservation and Repacking must be carried out.

2.5.2 Contd...

1. If the period of Preservation exceeds one year – Re-Preservation must be carried out during the 12th month. The date of Re-Preservation must be entered in a label attached to the engine. Cancel the label showing the first preservation. This must be repeated every 12 months, if the period of storage exceeds a period of one year.
2. Prepare the Engine for Re-Preservation.
3. Run the engine for 15 minutes with the rust preventive agents.
4. Stop engine and remove
 - a. Air cleaner and cylinder head cover
 - b. Injectors
 - c. Fuel pump inspection cover
5. Crank engine with starter motor (During cranking spray 10 cc of rust preventive oil (Servo Preserve SAE - 40) into each injector hole in the cylinder head and 20 cc through the inlet manifold).
6. Stop cranking after spraying oil into the cylinders and manifold. Spray oil on Rocker assembly & Fuel pump plunger springs and tappets.
7. Replace all components and seal all openings:
 - a. Air cleaner
 - b. Coolant - inlet and outlet
 - c. Fuel inlet
 - d. Breather
8. Drain
 - a. Coolant from water jacket
 - b. Oil from FIP
9. Attach a label showing 'NO OIL' and date of preservation
10. Repacking.



Avoid accelerating the engine to very high speeds without load. Operate the engine a two third of its maximum load

Exercise

Briefly answer the following questions.

List the maintenance activity for the Air Intake Assembly.

List the maintenance activity for the Turbocharger.



3. Maintain Workshop Area, Tools & Machinery

Unit 3.1 - Workshop area maintenance

Unit 3.2 - Tools & machinery maintenance at work

Unit 3.3 – Reporting & documentation



Key Learning Outcomes

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

1. Know the importance of running maintenance and regular cleaning.
2. This will enable you to carry out a number of simple maintenance tasks.
3. Assist in mechanic in different ways of minimizing waste.
4. Know and understand the importance of taking action when problems are identified.
5. Assist the mechanic in maintaining a checking/maintenance logbook to record all activities.
6. Inform the mechanic of problems that are beyond scope of junior mechanic role.
7. Understand importance of reporting.
8. Identify and understand mechanic pre-use checklist.
9. Identify and understand mechanic workshop and do necessary inspection checklist.

UNIT 31: Workshop area maintenance

Unit Objectives

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

1. Assist the mechanic in inspecting the workshop for safe operations.
2. Know and understand the communication symbols used to guide the mechanic.
3. Know the symbols used for site safety.

3.1.1: Inspection of the Workshop

Inspecting for workshop area for engine maintenance:

Enough spacious workshop area is to be planned and well maintained

The workshop floor should be free from oil spillages.

The right tools to repair the engine are to be well arranged before starting the maintenance of engine.



Fig. 3.1.1. Inspection of the Workshop

3.1.3 Sample Site Safety Notice



Fig. 3.1.3. Sample Site Safety Notice

3.1.2 Signals to Guide a Mechanic

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

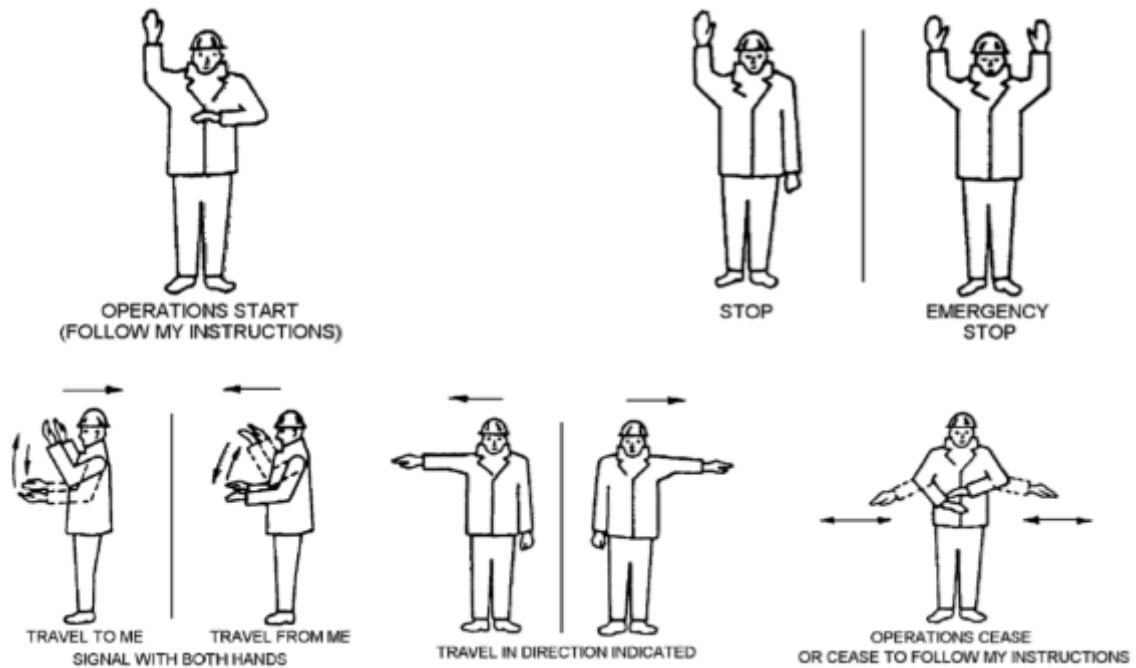


Fig. 3.1.2. Signals to Guide Mechanic

3.1.4 Safety While Mounting and Dismounting

3.2.4.1: Mounting and dismounting are the major causes of personal injury, so you should:

Always use the handholds and steps that have been provided by the manufacturer for safe entry and exit.

Keep three points of contact (both hands and one foot or both feet and one hand) at all times and always face the machine for safe entry or exit.

Do NOT use the controls as hand holds for entry or exit.

NEVER mount or dismount a moving side/closer by of engine components.

Be careful when conditions are wet or slippery.

3.2.4.2: Do's & Don'ts

Allow engine to cool before starting to dismount from the equipment.

Never allow any person with less knowledge about the engine and working near or to allow repair.

Never open Radiator cap when the temperature of the engine is hot.

Stop the machine immediately if the transmission hose or chamber Hose pipe fails out.

Never inspect anything below or near the chamber or Loading arm is at lift position.

Always Replace Parts with Genuine spare parts.

Crush the hydraulic oil filter and other filters just after the usage, in order to avoid the reuse of old one.

UNIT 3.2 Tools/Machinery Maintenance at Work

Unit Objectives

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

1. Know about engine operations.
2. Know about to follow various instructions given by mechanic.

3.2.1 Maintenance of Engine on Equipment

Below are the maintenance activities for hydraulics components on equipment;

Fuel System:

Fuel additives should not be used.

Use good quality diesel.

Keep fuel clean and prevent water from entering the fuel system.

When filling the fuel tank in the rain or snow care should be taken not to allow water in the fuel tank. Do not forget to close the fuel tank cap securely.

Fuel Tank

Remove the fuel tank. Thoroughly clean the inside surface and strainer once in every 6 months.

Feed Pump:

Plunger type - mounted on Fuel Injection Pump. Plunger is operated by the integral cam as a part of FIP Cam Shaft.

Fuel filtering system consists of a strainer (Fitted before feed pump) and fuel filter cum water separator (Fitted on pressure side before FIP). For easy identification, fuel inlet and outlet ports are embossed clearly on the filter head. Further, as a fool proof, the fuel inlet port is provided with M14 size and fuel outlet port is provided with M12 size threads.

Under normal operating conditions, fuel filter cum water separator to be replaced at every 500 hours of operation and mud strainer to be replaced at every 1500 hours of operation.

Renewal procedure for Fuel Filter cum Water separator.

- Remove old filter cartridge using appropriate filter wrench and discard.
- Clean filter head base and ensure that all the unwanted material is completely removed.
- Check the filter mounting head for tightness.
- Apply/thread seal on the thread portion in the filter head.
- Apply a thin coat of clean engine oil to the rubber ring surface of the new filter. Press the rubber ring firmly into the retaining groove in the filter. Do not use Grease.
- Carefully read the installation instructions printed on the peripheral of the filter, before fitment.
- Pre-fill the new filter with clean fuel.
- Mark a reference point on the filter and filter head to identify the point. Ensure that the rubber sealing ring first makes contact with the sealing surface of the head.
- Screw on the filter fully in and rotate 1/2 turn further.
- Start the engine and ensure no fuel leakage around the sealing rubber ring and filter assembly.

3.2.1 Contd.

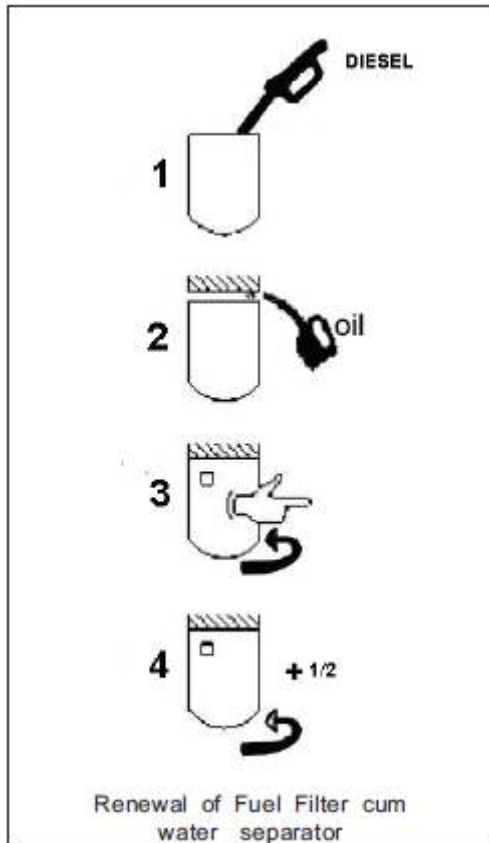


Fig. 3.2.1.2. Maintenance of Engine on Equipment

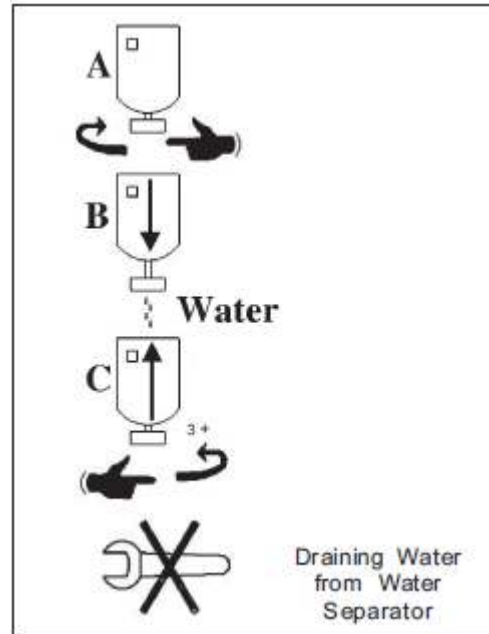


Fig. 3.2.1.1. Maintenance of Engine on Equipment

Procedure for draining water

Drain water from the unit as per the instructions provided on the component.

- Rotate the drain cock anti-clockwise (as shown in the instructions printed on the outside of the filter).
- Drain the water till the fuel starts to flow.
- Rotate the drain cock clockwise the number of turns as indicated by the installation instructions printed on the side of the filter canister.
- Start the engine and check for fuel leakage around the sealing gasket and filter assembly.
- Never use a spanner for rotating the drain cock.

3.2.1 Contd.

Bleeding Procedure for Fuel System

1. Ensure that diesel is available in the tank. Arrest leakages if there are any, And ensure there is no blockage in the filter/ pipe lines.
2. The suction strainer in fuel tank is clean.
3. Diesel filters and their seals are in good condition.
4. The filter in the banjo bolt on feed pump suction pipe is clean
5. Pump the plunger on lift pump and ensure that air free diesel flow occurs at the filter bleeding screw.
6. Crank the engine few times by loosening the high pressure injector pipes at the injector end and retighten after clear delivery takes place.
7. Start the engine
8. Even after priming if diesel does not appear at the outlet, remove the feed pump assembly. Check and rectify the defects.

Engine Oil level Checking

Withdraw the dipstick located on the LH side of engine. With a clean cloth wipe the dipstick scale and re insert fully.

Withdraw the dipstick. If oil level is found to be between Min. and Max. Marking oil level is sufficient for running. If oil level is at Min. mark or below top-up engine oil to the Max.Level.

Engine Oil and filter change

Ensure that the engine is warm. Oil need to be drained within 10 minutes, from shutdown. Using suitable spanner loosen center bolt of filter bowl and withdraw the bowl assembly. Discard the used filter element and sealing 'O' rings at center bolt and bowl fitting face. Fit a new oil filter element after placing the spring and the plate washer in position. Fit filter bowl with filter element to the filter head by center bolt. Ensure that oil filter is not fitted in the inverted position.

Open oil filler cap. Refill the engine with the correct quantity of the specified grade of engine oil. Check the oil level on the dipstick and run the engine for a short time. Allow 5 - 10 minutes for the oil to settle down. This is essential when the oil filter has been changed and engine oil top.

Charge air cooler and Radiator core cleaning and fin repair

When mud, debris, etc. are stuck up at the front of the radiator or charge air cooler core, the passage of cooling air is impaired. Hence such matter should be removed completely by washing with water. Deformed fins also can impair cooling and these should be repaired.

Replace cooling system rubber hoses. Check hoses for cracks, swelling or deterioration and replace if necessary.

3.2.1 Contd.

Changing Coolant in Radiator

1. Do not loosen the drain plugs while the engine is still hot. If you do so, hot liquid coolant can come out resulting in personal injury.
2. Stop the engine. Loosen-the radiator drain plug to drain the coolant. Drain will improve if you remove the cap from radiator.
3. Drain the complete system and tighten the radiator drain plug.
4. Slowly feed coolant into the radiator through the filler until the radiator is full. When supplying coolant from a pail, pour it slowly to prevent air from mixing with the coolant .
5. When the level of the coolant reaches the filler neck, squeeze the upper radiator hose two or three times. This will cause air inside the hose to be expelled, and the level of the coolant will fall.
6. Properly close the radiator cap.
7. To ensure that the air in the engine and the piping is properly expelled, set the engine speed slightly higher than normal idling speed. Raise the coolant temperature above 82°C, then continue to idle the engine for another 10 minutes.
8. Stop the engine and after the engine has cooled down sufficiently, check the coolant in the radiator. Add coolant to make up for any drop in the coolant level.

Radiator Cap

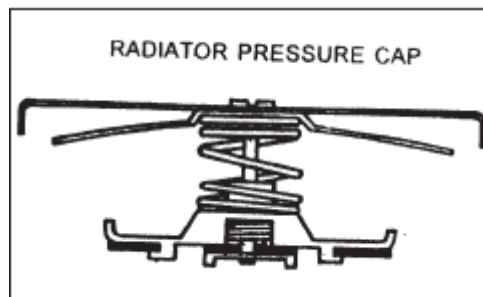


Fig. 3.2.1.3. Maintenance of Engine on Equipment

The presence of the radiator cap prevents loss of coolant, entry of foreign particles and raises boiling point of coolant. The absent can lead to engine overheating and reduction in engine life.

3.2.1 Contd.

Adjustment of the driving belt tension of water pump (Poly V belt arrangement)

Installation Procedure

1. Loosen the necessary fasteners, slacken the pulleys & remove the old belt.
2. Check pulley grooves for wear / damage and replace the pulley if required.
3. Clean the pulley grooves for debris and ensure not to apply oil or grease on the pulley grooves at the time of fitment.
4. Check alignment of the pulleys.
5. Mount the belt over pulleys and ensure that the belt ribs are seated in the respective pulley grooves.
6. Tension the belt and tighten all the fasteners.
7. Run the engine for 3 to 5 minutes with the applied tension to allow the belt to seat in the respective pulley grooves properly. Reset tension.
8. Apply initial belt tension of 700N by adjusting the alternator position.
9. To ensure the applied tension, measure it in the middle of span between water pump pulley and alternator using electronic type tension gauge.

Belt Tension Measurement Procedure

- Hold the sensing head steadily across the belt span within 5 - 10 mm distance above the top surface of the belt.
- Tap the belt gently near the mid span using a rod or with similar tool to cause the belt span to vibrate.
- Check the required tension display on the LCD panel on the tension meter.
- If a reading is not obtained check that the sensing head and ensure that it is positioned properly.
- Repeat the same procedure to recheck.



Fig. 3.2.1.4. Maintenance of Engine on Equipment

DO's and DON'TS:

- Check belt tension at regular intervals and adjust as needed.
- Check for any abnormal wear and damage in pulleys / Belt
- Check for pulley alignment
- Make belts free of fluffs and dirt

- Don't over tension the belt
- Don't apply oil/grease or paint on pulley grooves
- Don't fix the belt improperly aligned
- Don't use worn out belts
- Don't pry the belt using sharp tools.

3.2.1 Contd.

Air Intake System

Poor air cleaner maintenance will result in excess liner wear, high engine oil consumption, excess blow by and poor pick up. The maintenance schedule has been recommended to ensure adequate checks on air induction system, air cleaner element and oil changes for normal service requirements. More frequent servicing may be required in severe dust conditions. Consult our authorized dealer for specific requirements.

Servicing of Dry type Air cleaner

- Follow maintenance recommendations strictly.

Remove dust deposit weekly by squeezing the dust evacuator valve. Replace dust evacuator valve immediately if it is torn, cracked, remains open or missing.

Never operate the engine, if the restriction indicator is either broken or missing. Ensure that the washers are in place before tightening the wing nut. Replace primary filter element every 1000 hrs. or as soon as red band appears fully on the transparent portion of the vacuum indicator and in this position red band will not regain its position when the engine is switched off.

Replace the secondary filter element at the time of every third replacement of the primary filter element.

Turbocharger:

- INITIAL RUNNING

Keep the engine at rated rpm for minimum 2 minutes before applying load and also before switching of the engine. Do not run engine at full load with oil pressure less than 1.5 kg/cm².

Check all air ducts and gaskets for leak.

Repair any leaks before proceeding. Inlet of air compressor must be free from dust and contamination.

-MAINTENANCE DO'S

1. Turbocharger does not require any maintenance.
2. Adhere strictly to recommended maintenance schedule.
3. Use of specified grade of engine oil and oil filter and periodic change as recommended in maintenance schedule. Replace air filter element as recommended.
5. Check for oil pressure at engine idling condition minimum oil pressure should be 1 kg/cm².
6. Allow the engine to run for 2 minutes after starting the engine.
7. Allow the engine to run for 3-5 minutes before switching off the engine.
8. When carrying out maintenance work on the engine, the piping leading from or to the turbocharger must be removed, and the pipe openings on the turbocharger to be closed properly.
9. Regularly check the oil feed and return pipes for leaks, air intake system pipes and hoses for leakage, blockage and exhaust piping connections for leakages, blockage.
10. Prior to fixing turbocharger to the engine, fill the central housing with clean engine oil and ensure that, all pipes are thoroughly cleaned before connecting to the turbocharger.
11. Check the fuel injection system for its proper functioning.

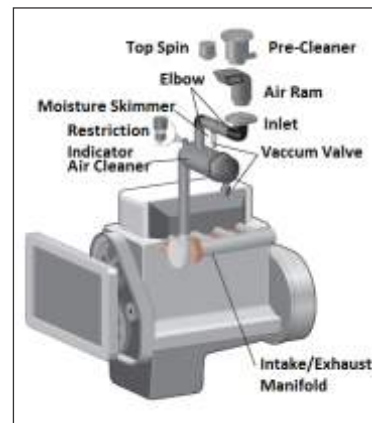


Fig. 3.2.1.5. Maintenance of Engine on Equipment

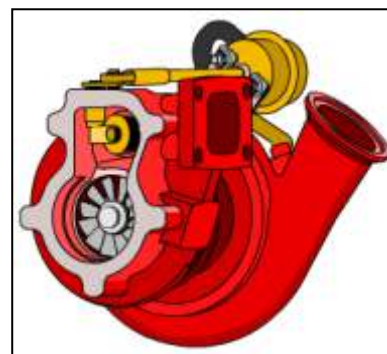


Fig. 3.2.1.6. Maintenance of Engine on Equipment

3.2.1 Contd.

Turbocharger-Contd.:

12. Close all the turbocharger openings with protective plugs when it is not in use.
13. Contact Authorized dealer / authorized centers for turbocharger complaints / service / overhaul.

DON'TS

- Don't run the engine with low oil pressure.
- Don't run the engine with leaky, restricted oil feed and drain pipes.
- Don't run the engine with blocked, punctured, aged, deformed hose / pipe connections from the air cleaner to the turbocharger, turbocharger to charge air cooler and charge air cooler to the inlet manifold.
- Don't run the engine with leaky connections, blocked, and deformed connections to the turbocharger turbine inlet and from turbine outlet.
- Don't tamper the fuel injection system.
- Don't dismantle the turbocharger center.

UNIT 3.3: Reporting and Documentation

Unit Objectives

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

1. Identify and understand a mechanic pre-use checklist.
2. Identify and understand a mechanic workshop inspection checklist.
3. Assist mechanic in filling the report and checklist documents suitably.

Exercise

Briefly answer the following questions.

What all do you inspect in a workshop?

List steps to monitor and be sure of right engine starting after the maintenance.

Tips 

Following are recommended tips;

- Visit an engine workshop.
- Observe engine operations on equipment and talk to a mechanic.

Notes



A large rectangular area with a thin orange border, containing 25 horizontal black lines for writing notes.

4. Worksite Health & Safety



Unit 4.1 – Environmental Safety, Health Policies

Unit 4.2 – Types and Uses of Personal Protective Equipment

Unit 4.3 – Common Hazards and Preventive Measures

Unit 4.4 – Segregation and Disposal of Waste

Unit 4.5 – Basic Fire Fighting Equipment and Use

Unit 4.6 – Common Injuries and Appropriate First Aid



Key Learning Outcomes

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

1. Closely understand environmental, safety, health (ESH) policies and guidelines of the company & their importance's.
2. Identify contact details of personnel responsible for ESH related matters & in case of emergencies.
3. Identify the location of first aid room / station and assembly points.
4. List the types, use and importance of Personal Protective Equipment (PPE)
5. List the types of common hazards and risks at workshop and preventive measures.
6. Understand to prevent common injuries and appropriate basic first aid treatment.
7. Acquire Firefighting equipment basic knowledge of handling and using them.
8. Guidelines for transport, storage and disposal of hazardous materials and waste.
9. Safety signs/symbols and warnings used in workshop and their meaning.
10. Comply with safety, health, environment and security related regulations & guidelines at work.

UNIT 4.1: ESH Policies And Guidelines

Unit Objectives

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

1. Know about the safety precautions that junior mechanic needs to follow while at work.
2. Strictly follow various Dos and Don'ts while working with the equipment.

4.1.1 Safety Precautions To Be Taken

It is in the interest of every employer and employee involved in the use of mobile plant and equipment to promote safety within their workplace.

The **junior mechanic Engine** too 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 mechanic engine or any other person, as far as necessary, to enable them 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 Engine mechanic procedures and the manufacturer's instructions which apply to the care and safe operation of the machine they are responsible for.
6. Inform the Engine mechanic, 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.

4.1.2: Do's and Don'ts During Operation

Do's

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

Don'ts

- Assist on machine unless you have received appropriate training and are authorized to do so.
- Ignore hazards.
- Misuse, tamper or interfere with your machine and any associated safety equipment provided.
- Endanger your own health and safety, or that of anyone else, by being negligent.

UNIT 4.2: Types and Uses of PPE

Unit Objectives

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

1. Understand common personal protective equipment's.
2. List and know the various uses of PPE.

4.2.1: Personal Protective Equipment

PPE is equipment worn to minimize exposure to a variety of hazards. Examples of PPE include such items as gloves, foot and eye protection, protective hearing devices (earplugs, muffs) hard hats, respirators and full body suits.

Safety Helmets (Don'ts)

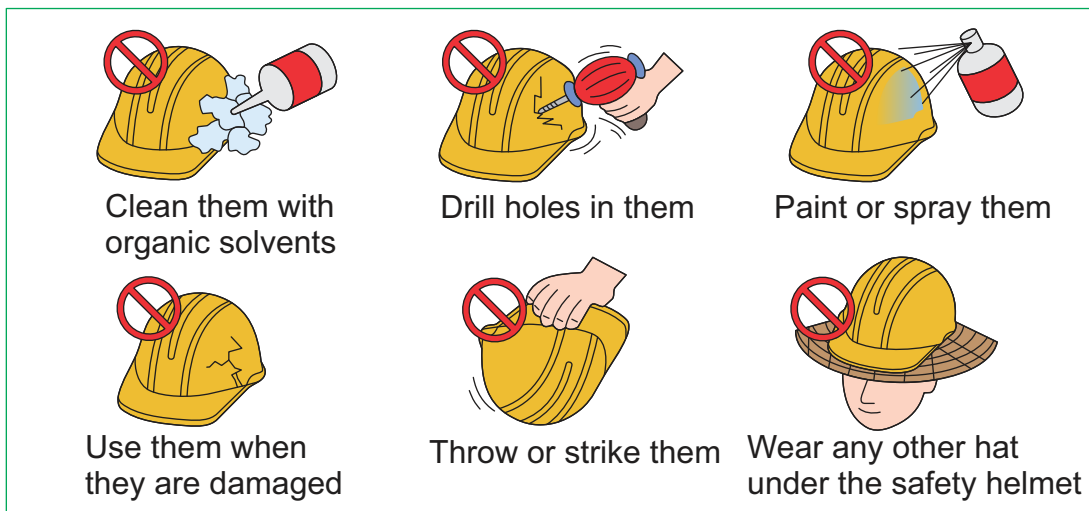


Fig 4.2.1a: Personal Protective Equipment

Eye Protectors



Fig 4.2.1b: Personal Protective Equipment

4.2.1 Personal Protective Equipment Contd..

Ear Protectors

Protective Gloves

Safety Footwear

Protective Clothing



Fig. 4.2.1.2. Personal Protective Equipment



Fig. 4.2.1.3. Personal Protective Equipment

UNIT 4.3: Common Hazards & Preventive Measures

Unit Objectives

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

1. Understand the common hazards and preventive measures.
2. Follow the necessary Dos and Don'ts that may help avoid accidents at work.

4.3.1 Accident Prevention and Control Do's and Don'ts

Common accidents with Engine are overturns, falls, run overs 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)
- Take advantage of any training program offered by your employer or contractor. You are never too old to learn new practices or techniques

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 Ignore warning instructions or safety signs.

UNIT 4.5: Basic Fire-Fighting Equipment And Use

Unit Objectives

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

1. Identify various type of fire-fighting equipment's for different types of fire.
2. Understand and acquire suitable fire-fighting equipment operating.
3. Understand the usage of right firefighting equipment on type of fire.

UNIT 4.4: Segregation And Disposal Of Waste

Unit Objectives

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

1. Understand to segregate different type of wastes.
2. Identify various ways to safely dispose of waste.

4.4.1 Waste Management

- Waste if not dealt properly is a big environmental issue. A junior mechanic needs to remember some basic waste management rules:
- Use ONLY authorized waste disposal sites
- Never store lubricants in open or unlabeled containers.
- Never pour used engine oil into sewers, drains or on the ground.
- 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 4.4.1: Waster Management

4.5.1 Fire Extinguisher

To operate an extinguisher:

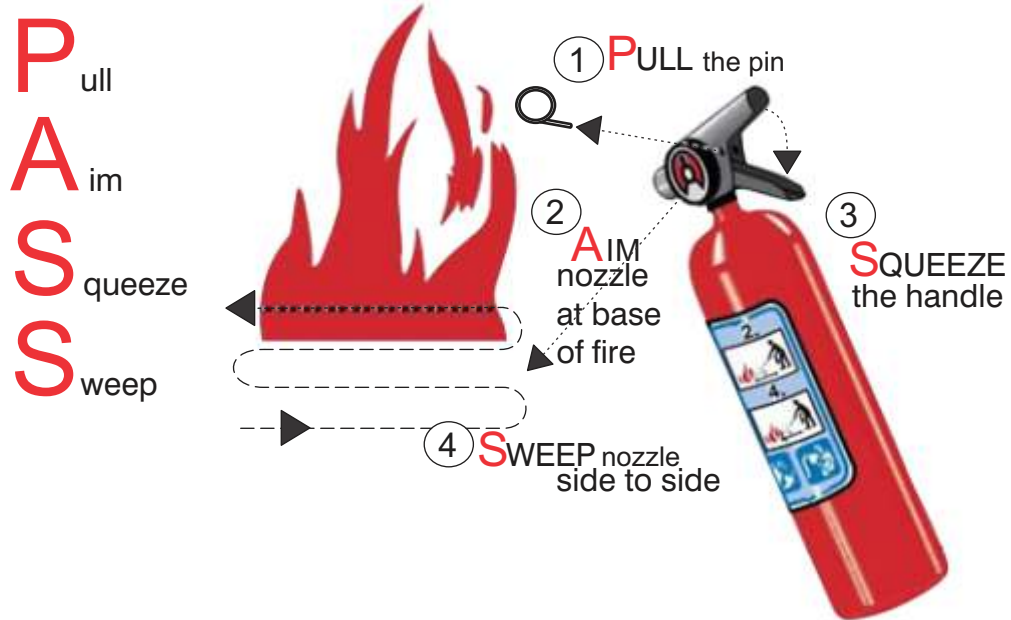


Fig. 4.5.1. Fire Extinguisher

4.5.2 Sand Bucket



Fig. 4.5.2. Sand Bucket

4.5.3 Administer Aid

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.

Steps



Fig 2.3.4 (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.

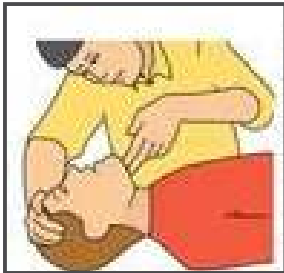


Fig 2.3.4 (b) Step 2

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



Fig 2.3.4 (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 2.3.4 (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.

4.5.3 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.

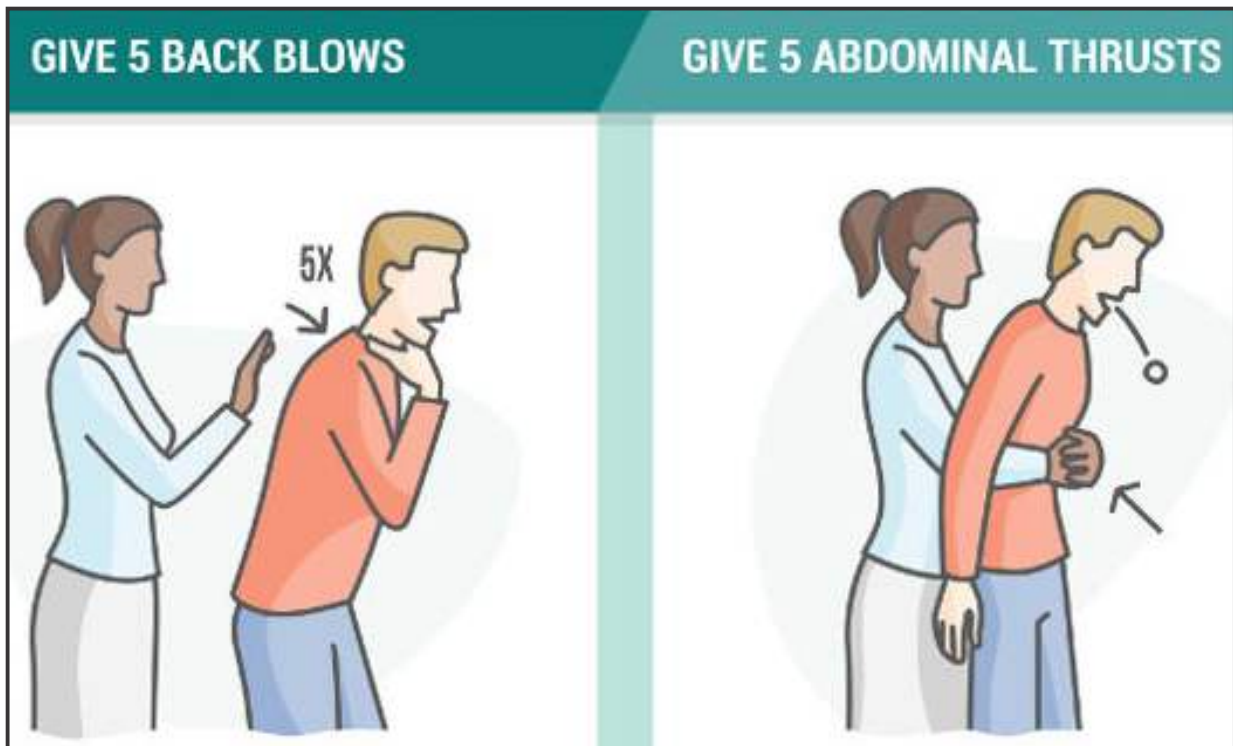









Fig 2.3.4 (e) First Aid for Choking

-  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.

4.5.3 Administer Aid

Chemical Burns in an Eye:

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

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






-  Tell the person not to rub his/her eye – this could cause scratches on the eye surface.
-  Ask the person to sit down and gently, separate his/her eyelids with thumbs or thumb and finger.
-  Ask the person to look right, left, up and down and examine the eye for foreign objects.
-  If something is present in the white of the eye, wash it out by pouring clean water or a sterile eye wash from the inner corner of the eye towards the outer corner.
-  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 2.3.4 (f) Washing Eyes in Running Water

4.5.3 Administer Aid

Severe Bleeding:

For severe bleeding, take these actions immediately:

- ✚ 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.

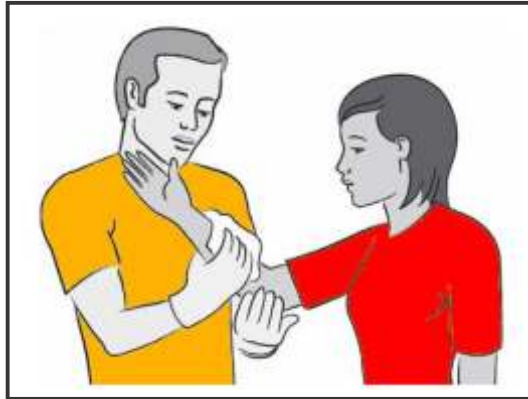


Fig 2.3.4 (g) Controlling the Bleeding

- ✚ Apply a dressing firmly to control bleeding. Ensure that it is not so tight that it restricts circulation.
- ✚ Prevent/treat shock by lying the casualty down with his/her feet raised (if possible).
- ✚ If the casualty has a head injury, lay himself/herself down and slightly raise his/her head and shoulders.



Fig 2.3.4 (h) Controlling the Bleeding

- ✚ If blood comes through the dressing apply another bandage on top.
- ✚ If blood seeps through this too, remove both dressings and re-apply a new sterile dressing using direct pressure to the wound.
- ✚ Support the injured area in a raised position.
- ✚ Seek medical attention if the bleeding does not stop or if the casualty goes into shock.

4.5.3. Administer Aid

Fracture:

In case of a fracture, provide first aid before taking the injured to professional care

Aptly follow the few first-aid treatment till the professional medical treatment is given:

- ✚ 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.
- ✚ 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 have fracture in one of his/her limbs, immobilise the area using a strap or suspend.
- ✚ 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.
- ✚ 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.
- ✚ Help the injured get to the emergency department for medical care.



R-Rest

I-Ice

C-Compression

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.

Use an ice pack to reduce the pain and swelling in the affected area. Apply ice for 15 minutes every two hours for 24 hours, then for 15 minutes every four hours for 24 hours.

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.

Fig 2.3.4 (i) Rest Ice Compression Method

4.5.3 Administer Aid

Electric Shock:

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

- 🚑 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.
- 🚑 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.
- 🚑 Check for signs of circulation (breathing, coughing or movement). If absent, begin resuscitation (CPR) immediately.
- 🚑 Lay the person down and, if possible, position the head slightly lower than the trunk, with the legs elevated.
- 🚑 Figure 2.3.4 (j) shows a man moving the power source away from the affected person using a wooden stick.



Fig 2.3.4 (j) Electric Shock

Shock due to Injury:

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

- 🚑 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.
- 🚑 Loosen any tight clothing around the neck, chest and waist to make sure it doesn't constrict their blood flow.
- 🚑 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.
- 🚑 Keep checking their breathing, pulse and level of response.
- 🚑 If they become unresponsive at any point, open their airway, check their breathing and prepare to treat someone who has become unresponsive.

4.5.4 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, 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.

How can the junior engine mechanic help create a safer work place?

List some common PPE?

What precautions a junior hydraulic mechanic has to follow when dealing with waste?

What makes up a basic first aid kit?

UNIT 4.6: Common Injuries And Appropriate First Aid

Unit Objectives

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

1. Identify various contents in first aid kit.
2. Administer first aid for common injuries.

4.6.1 Basic First Aid Kit

A junior hydraulic mechanic must have basic knowledge of emergency medicines that can be used as primary medical service for cuts, wounds, fever, etc.



Scissor



Glove



Tweezers



Antiseptic Wipes



Roller Bandage



Thermometer



Alcohol



Antibiotic ointment packets (Approx. 1g)

Fig. 4.6.1. 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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Address: # 23-29, FF- 5 White House Building St Marks Road (Opp. SBI)
Bengaluru 560 001
Email: standards@iescindia.com
Web: <http://www.iescindia.com/>
Phone: +91 80 42126666
CIN No.: 00000000