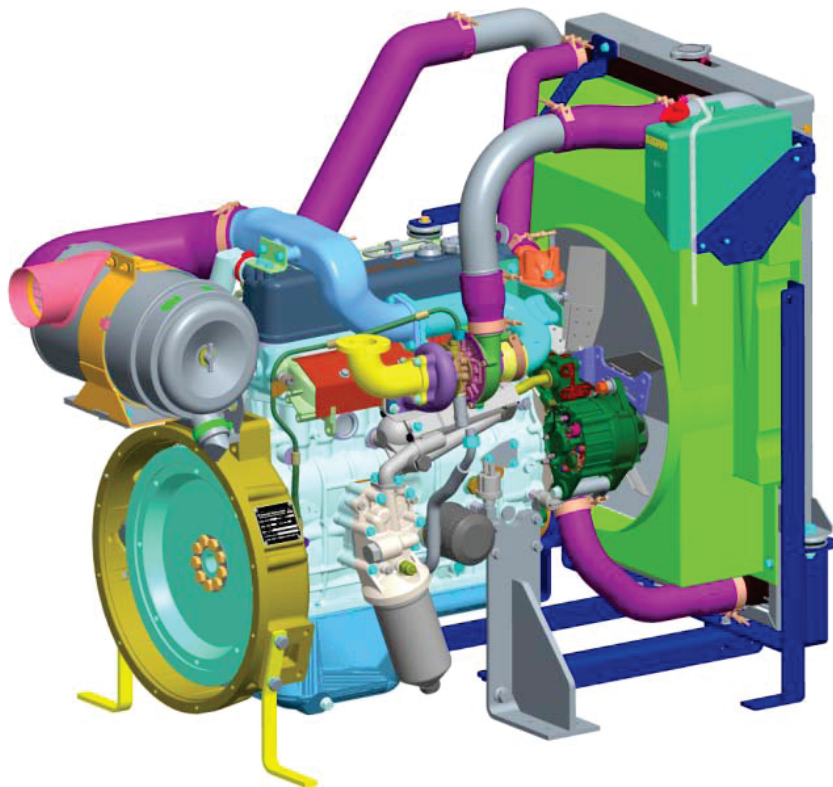


OPERATION AND MAINTENANCE MANUAL

EE483TC & EE483TCI Power Generation Engine



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PART I-INTRODUCTION - OPERATION & MAINTENANCE MANUAL

We are glad to introduce us as VE Commercial Vehicles Ltd (VECV), manufactures of EICHER EE483TC and EE483TCI Power Generation Engine owned by you. VECV is committed to being the leader in customer satisfaction in India and emerging markets. We put our best efforts to maintain global quality levels by understanding and fulfilling customer needs.

This manual presented to you gives a comprehensive understanding on Construction, operation and Maintenance aspects of Engine for the intended application.

These Engines meets current prevailing emission norms.

Due care has been taken in preparing this manual. However due to Continuous improvements product specifications and illustrations are likely to undergo change without any prior notice.

For any further information, please write to:

PRODUCT SUPPORT

NON AUTOMOTIVE ENGINES

VE Commercial Vehicles Limited

(A Volvo Group and Eicher Motors Joint Venture)

102, Industrial Area No. 1 Pithampur 454775 Dist. Dhar (M.P.) India

Phone: (07292) 402633

Fax: (07292) 402611

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PART II: EICHER ENGINE GENERAL INFORMATION:

Eicher EE483TC Engines manufactured by VE Commercial Vehicles Ltd (VECV) are direct injection, four Strokes, Water cooled, and Turbo charged Diesel Engines designed to suit Power Generation application.

Eicher EE483TCI Engines manufactured by VE Commercial Vehicles Ltd (VECV) are direct injection, four Strokes, Water cooled, Turbo charged, Intercooled Diesel Engines designed to suit Power Generation application.

The engines are eco-friendly, reliable and fuel efficient meets prevailing statutory emission standards.

While we, at manufacturing and testing have taken due care to ensure trouble free performance, as an engine owner and user, proper up keep of engine, use of genuine parts, use of Genuine oil and Lubricants, use of Genuine Coolant and adherence to scheduled and preventive maintenance shall derive the best out of your engine resulting in Value for investment.

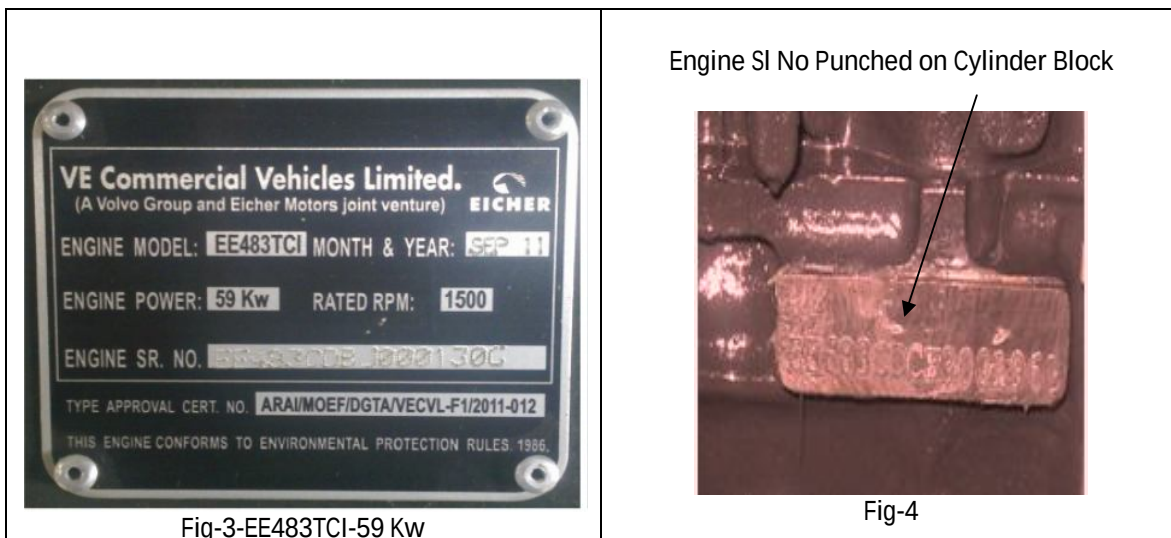
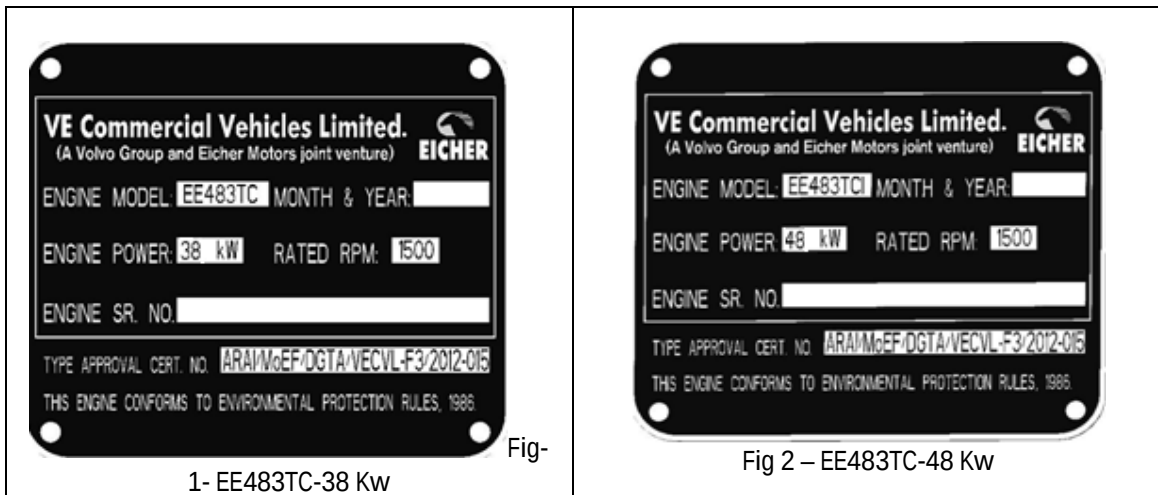
PART III: ENGINE FAMILIARIZATION

3. GENERAL

This part provides details about engine identification, engine SI No nomenclature, Orientation, technical specifications and various Systems of engine.

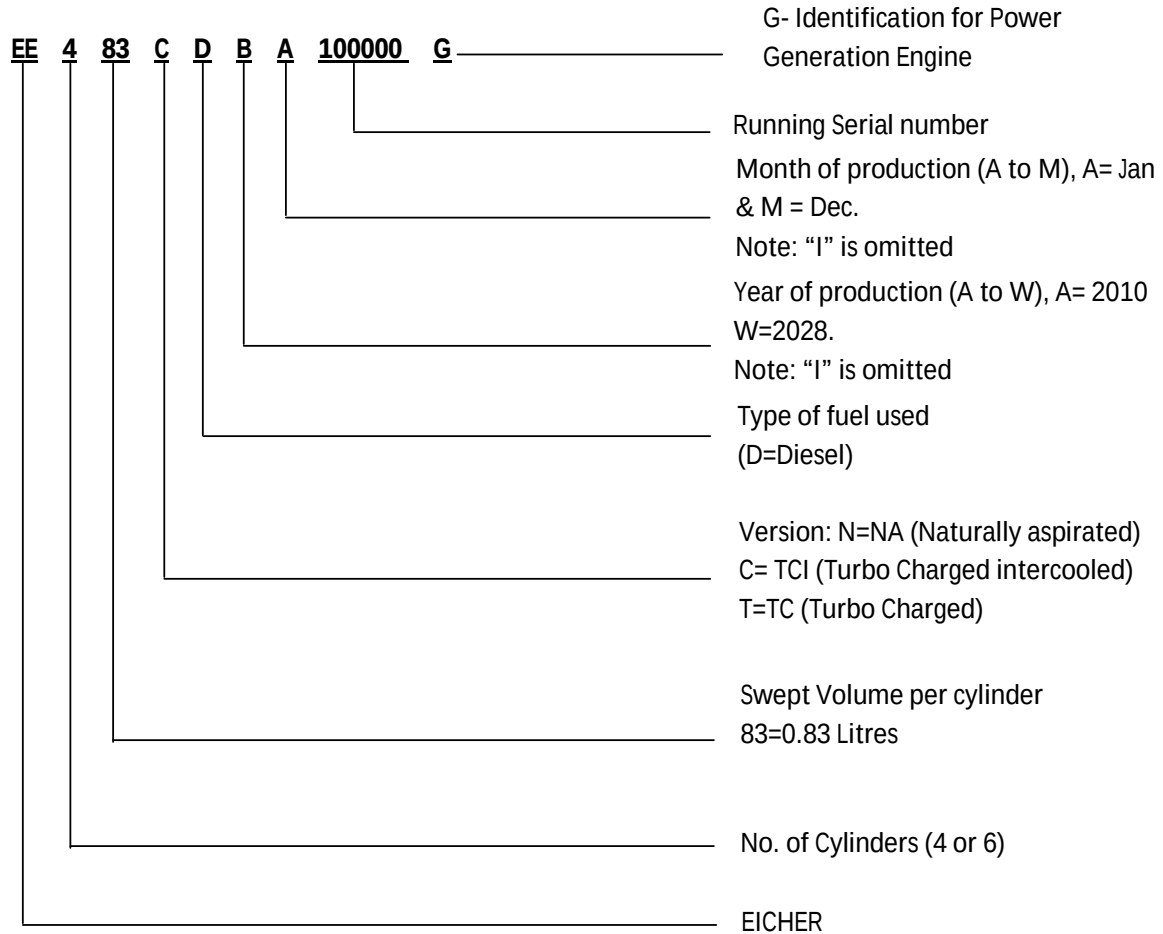
3.1 ENGINE IDENTIFICATION.

Engine is identified with the engine nameplate fitted on flywheel housing on left hand side of the engine when viewed from front. Engine name plate contains the information as shown in the figure 1, 2 and 3. Engine SI No is also punched on the Cylinder block as shown in the figure 4.

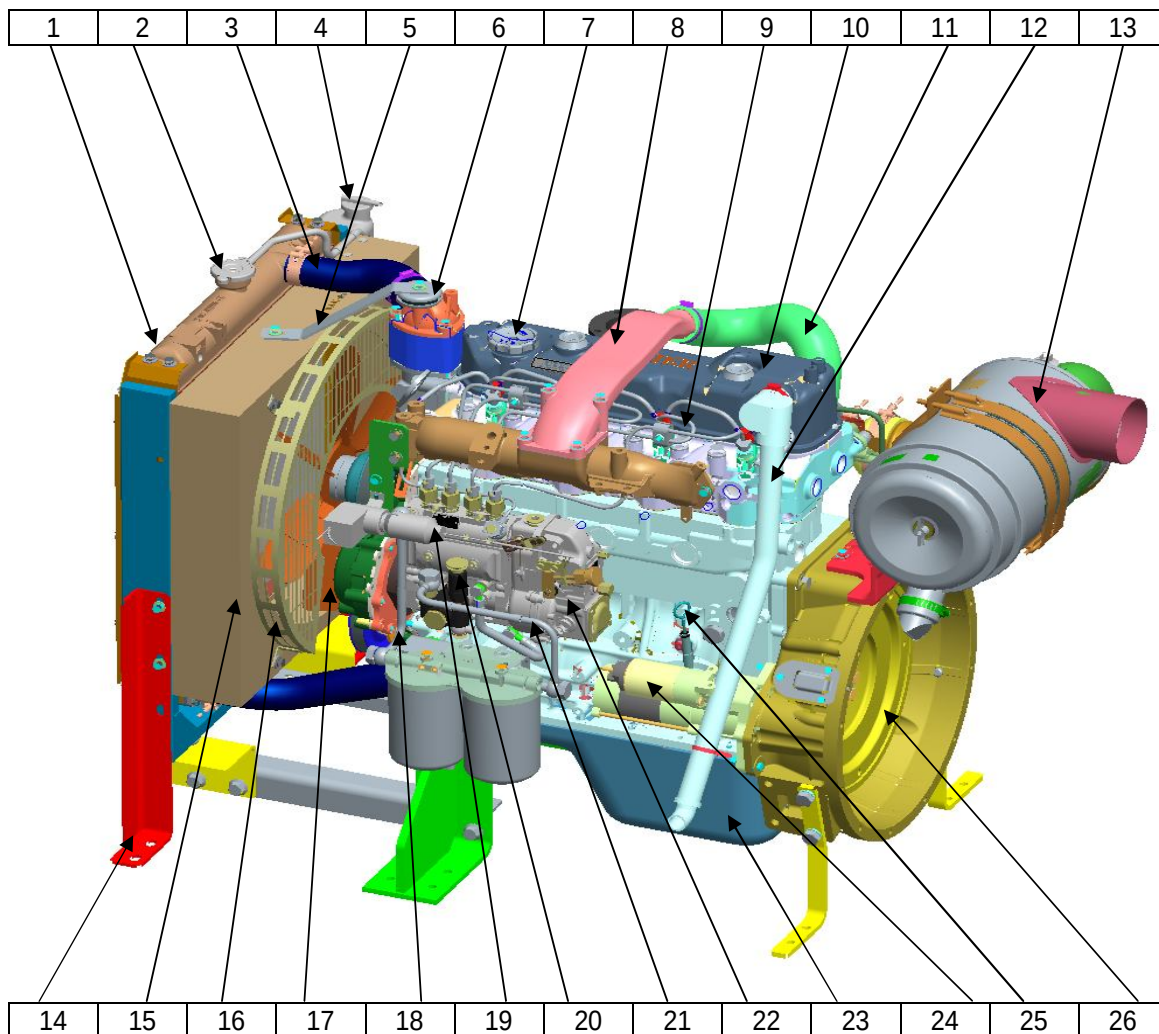




3.2 ENGINE NOMENCLATURE:

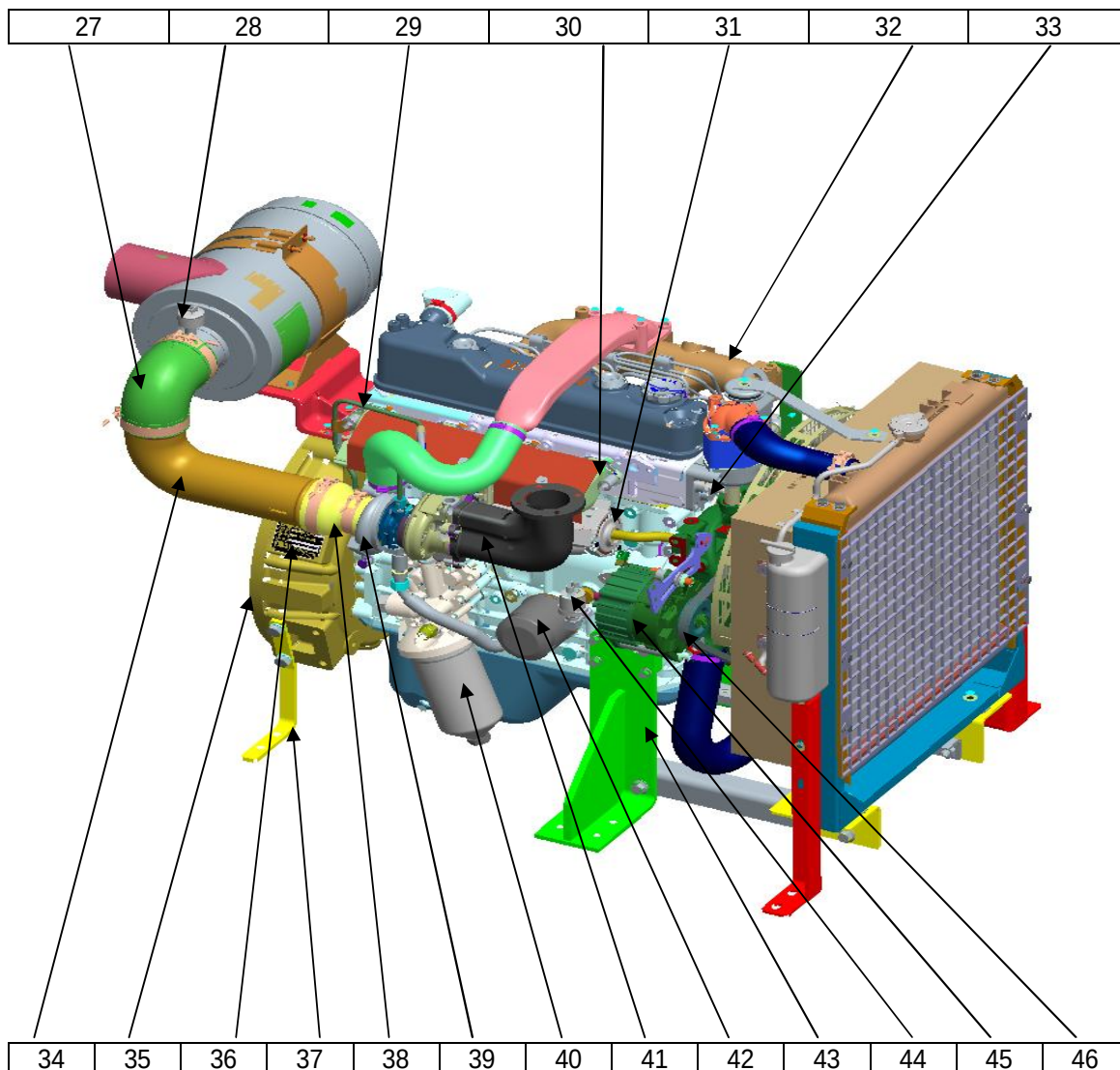


3.3 ENGINE ORIENTATION AND PARTS ILLUSTRATION (EE483TC -TURBO CHARGED ENGINE):



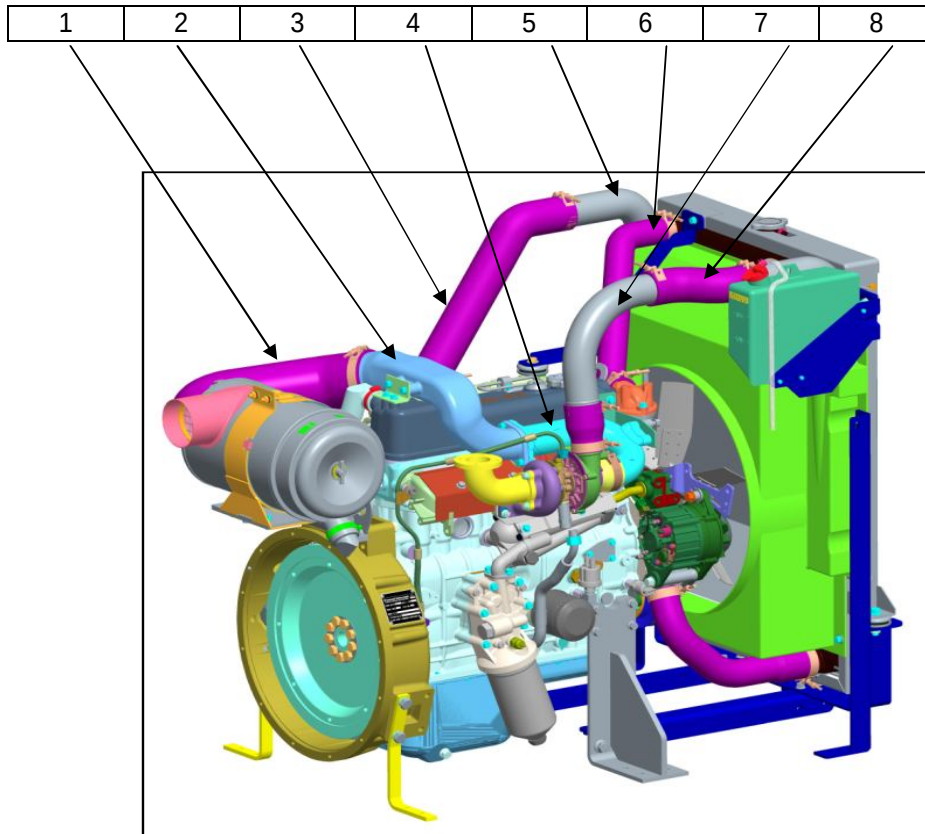
1	Radiator	14	Strip-Support radiator
2	Radiator Cap	15	Shroud Radiator
3	Hose- Radiator In	16	Guard Fan Radiator
4	Tank Condenser	17	Fan Cooling Radiator
5	Bracket – Radiator Support	18	Pipe- Fuel filter to Fuel injection pump
6	Cushion-Radiator Support Bracket	19	Stop Solenoid
7	Cap Oil Filler	20	Feed pump
8	Pipe- Turbo to Intake Manifold	21	Pipe fuel- Feed Pump to fuel filter
9	High Pressure Pipe	22	Fuel injection Pump
10	Rocker Cover	23	Oil Sump
11	Hose- Turbo out	24	Starter Motor
12	Hose Breather	25	Dip Stick
13	Air cleaner Assembly	26	Flywheel

ENGINE ORIENTATION AND PARTS ILLUSTRATION (EE483TC -TURBO CHARGED ENGINE) CONTD:



27	Hose – Air cleaner	37	Pedestal- Rear for Transportation
28	Switch-Choke Air Cleaner	38	Hose- turbo charger in
29	Pipe- Lubrication Turbocharger	39	Turbo charger
30	Manifold- Exhaust	40	Filter Oil – Main
31	Cooler- Oil	41	Bend Exhaust
32	Manifold- Intake	42	Filter- By Pass
33	Switch Cum Sensor- Water Temperature	43	Pedestal – Front
34	Pipe- Air Cleaner to Turbo	44	Sensor-oil Pressure
35	Housing flywheel	45	Alternator- Battery charging
36	Engine Identification plate	46	V Belt- Engine/Alternator/Water pump

ENGINE ORIENTATION AND PARTS ILLUSTRATION (EE483TCI -TURBO CHARGED INTERCOOLED ENGINE):



1	Hose-Air Filter to Pipe TC in B	5	Intercooler Assy
2	Pipe TC in B	6	Hose – Thermostat to Radiator
3	Hose- Intercooler Outlet	7	Pipe-Turbo Charger to Intercooler inlet
4	Pipe TC in A	8	Hose-Pipe Intercooler inlet to Intercooler in

3.4 ENGINE TECHNICAL SPECIFICATIONS:

Parameters	Unit	Details		
		40 Kva	50 Kva	62.5 Kva
Engine Manufacturer	Name	VE Commercial Vehicles Ltd		
Engine Make	Make	EICHER		
Engine Model	Model	EE483TC	EE483TC	EE483TCI
Emission Compliance	Standard	CPCB1 – As Per GSR 448 (E) 12.07.2004		
No of Cylinders	Nos.	4		
Engine Configuration	Configuration	Inline / 4 Stroke		
Engine Aspiration	Type	Turbo Charged		Turbo Charged Inter cooled
Engine Fuel	Type	High Speed Diesel		
Combustion Chamber Type	Type	Direct injection		
Cylinder Bore X Stroke	Mm	100 X 105		
Engine Displacement	Litres	3.3		
Compression ratio	Ratio	17:1 ± 0.5 mm		
Engine Rated Output	Kw (HP) @ RPM	38 (52) @ 1500	48 (65) @ 1500 RPM	59 (80) @ 1500
Standard Operating Conditions	Ambient / Relative Humidity / Altitude	25°C / 40 % / 1000 mbar		
Engine Deration	Applicability	Above 4000 feet		
Rating Standard	Standard	IS10000		
Overload	Permissibility	10 % over load Permissible for 1 Hour in Every 12 Hours of Operation		
Governing Standard	Standard	BS5514 / IS 10000		
Governing Class	Class	A 1		
Engine Low Idling Speed	RPM	700 ± 50		
Engine Fly Up Speed	RPM	1560 ± 10		
Engine Firing order	Sequence	1-3-4-2		
Direction of Rotation	Direction	Anti Clock wise when viewed from Flywheel End		
Flywheel Standard	SAE J 620	SAE 10		SAE 11.5
Flywheel Housing Standard	SAE J 620	SAE 3		SAE 2
Lubrication Method	Method	Oil Pump Forced feed system		
Oil Pump	Type	Gear Type		
Oil Filter-Main	Type / Nos.	Paper Type / Single		
Oil Filter-By Pass	Type	Spin on Type Paper		
Oil Cooler	Type	Shell Type		
Engine Lubricating Oil	Specification / Grade / Recommendation	API CH4-SAE 15W40 / EICHER Premium Diesel Engine Oil		

Parameters	Unit	Details		
		40 Kva	50 Kva	62.5 Kva
Lubricating Oil Consumption	% of Fuel Consumption	< 0.15 %		
Minimum Lubricating Oil Pressure @ Low Idle	Bar	1.5		
Max Lubricating Oil Pressure @ Fly up Speed	Bar	5.5		
Fuel Injection Pump	Make/Type	Bosch / Inline		
Fuel Filter	Type / Nos.	Cartridge type / 2 Nos.		
Cooling Method	Method	Liquid Cooling / Forced Circulation		
Water Pump	Type	Centrifugal		
Coolant	Specification / Recommendation	JIS-K-2234-94 / EICHER GENUINE RADIATOR COOLANT		
Engine Cooling Fan	Type	Pusher		
Electrical System	V	12		
Starter Motor	Make / V / Kw	Bosch / 12 / 1.9 Kw		Bosch / 12 / 3.2
Battery Charging Alternator	Make / V / Amps	Bosch / 14 / 49		
Shut off Solenoid	Type	Energise to Stop		
Switch – Low Oil Pressure	Applicability	Yes		
Switch – High Coolant Temperature	Applicability	Yes		
Switch- Air Cleaner Choke	Applicability	Yes		
Sensor-Water temperature	Applicability	Yes (Integral Design with Switch)		
Sensor-Lubricating Oil Pressure	Applicability	Yes		

3.5 ENGINE SYSTEMS AND ITS FUNCTION:

As we all know, Diesel engine is a prime mover developing useful power. Air and fuel is required to produce power. Lubrication is necessary for the moving parts of the engine. Continuous cooling is required to dissipate heat generated during combustion. Electrical system is required for engine starting, battery charging and sensing of critical engine operating parameters.

The construction of Eicher diesel engine is divided in to five parts as below.

- 1 Air intake and Exhaust System
- 2 Lubrication System
- 3 Fuel System
- 4 Cooling System
- 5 Electrical System

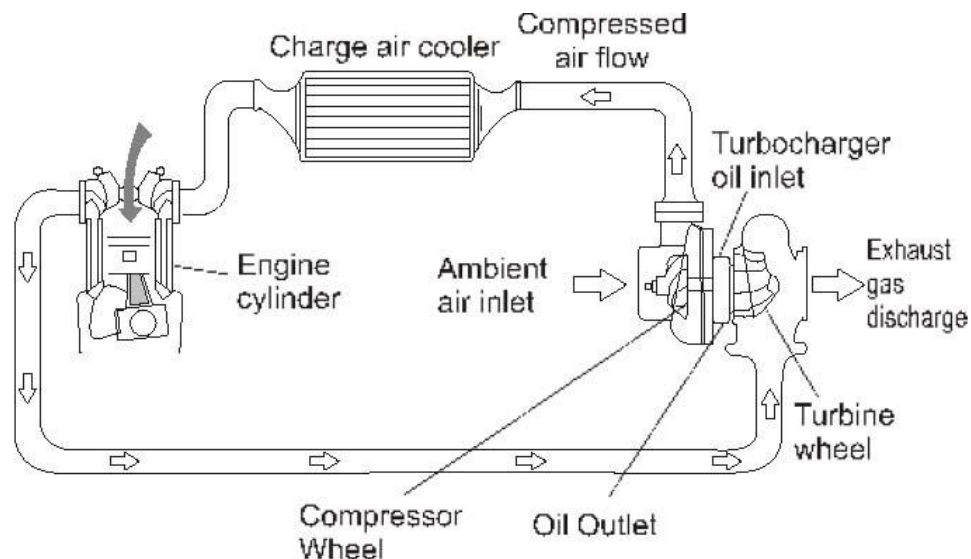
The below section provides details of function, key components and working principle of respective system to understand better about Engine aspects.

3.5.1 AIR INTAKE AND EXHAUST SYSTEM

TURBO CHARGED INTERCOOLED ENGINES:

The function of air system is to supply clean, cool and sufficient quantity air required for proper combustion of the fuel which results in designed power output of the engine and maintains emissions as per statutory norms.

Air intake system facilitates cleaning of air, induction of air, compression of air through turbocharger and cooling by intercooler.



Air is sucked from atmosphere and passed through the Air filter to restrict dust and other foreign particles from entering into air intake system. Clean air is then induced and compressed by the turbocharger compressor wheel. Turbocharger increases the temperature of the air. This high temperature air is then passed through an intercooler which decreases its temperature. As air inducted cools down its density is

further increased. Due to more air with desired density of air inducted into the engine there will be complete combustion resulting in:

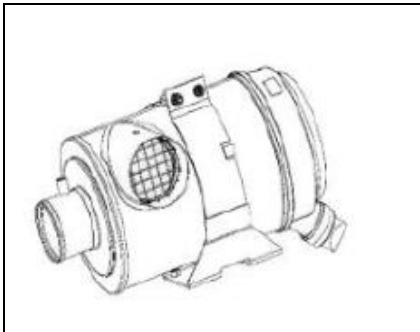
- Increase in power and torque without increasing the size of the engine.
- Improves fuel economy.
- Reduce engine noise.
- More complete combustion resulting in cleaner emission

TURBO CHARGED ENGINES:

In turbo charged engines, intercooler will not be present. The Compressed air from turbo charger will be directly inducted into the combustion chamber. The combustion parameters will be designed to suit the air temperature inducted in to the combustion chamber and accordingly desired quantity of fuel will be supplied to ensure better fuel economy and complete combustion to achieve emission characteristics.

AIR FILTER:

Air filter is fitted on the Suction Side. It is paper cartridge dry type air filter comprising of inner and outer element. Air filter prevents dust and other foreign particles entering into the air inlet system. The restriction Indicator fitted on the filter gives indication when air filter gets clogged.



Do not run the engine with clogged air filter. Clogged air filter reduces power output, fuel efficiency; higher exhaust emissions and affects engine performance.

Air filter outer element shall be cleaned whenever the restriction indicator gives indication. There are limitations for cleaning as frequent cleaning affects air filter filtration efficiency. Follow the recommendation for cleaning procedures and permissible number of cleaning.

The inner element should not be cleaned and it should be replaced.

Never run the engine without air filter. Running without air filter will cause foreign object entering into air system and results in turbocharger and engine failures.

TURBO CHARGER:

The exhaust gases discharged from the combustion chamber are driven out through the exhaust manifold into the turbo charger and accelerated in the turbine housing to turn the turbine wheel driving away the Exhaust gases through the muffler to the atmosphere.

Simultaneously, the compressor wheel mounted on the same shaft spins at the designed speeds. The centrifugal action draws air from air cleaner and builds up the boost pressure in the intake system.

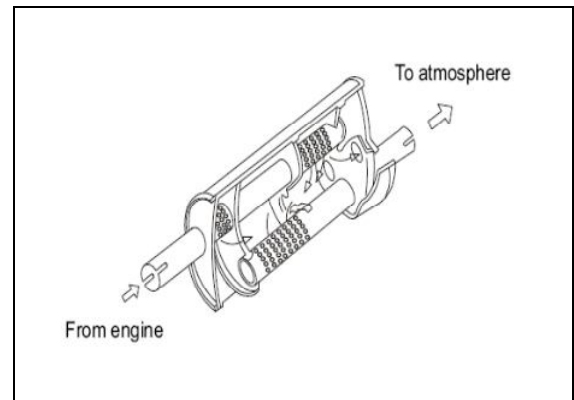
SILENCER:

Silencer is used to reduce the noise of exhaust gas / Smoke.

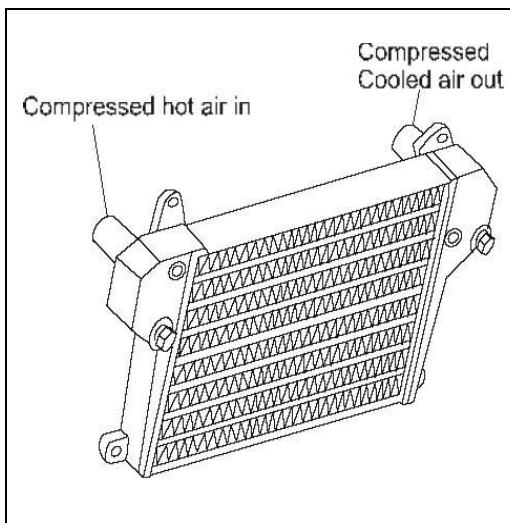
The exhaust gas is sent through a number of small holes provided inside the silencer which results in sudden expansion of exhaust gases.

This results in reduction in exhaust noise.

For specific applications like Power Generation residential mufflers are used to achieve reduction in noise levels.



INTER COOLER (APPLICABLE FOR TURBO CHARGED INTERCOOLED ENGINES):



Compressed hot air from turbocharger flows through the tubes of intercooler.

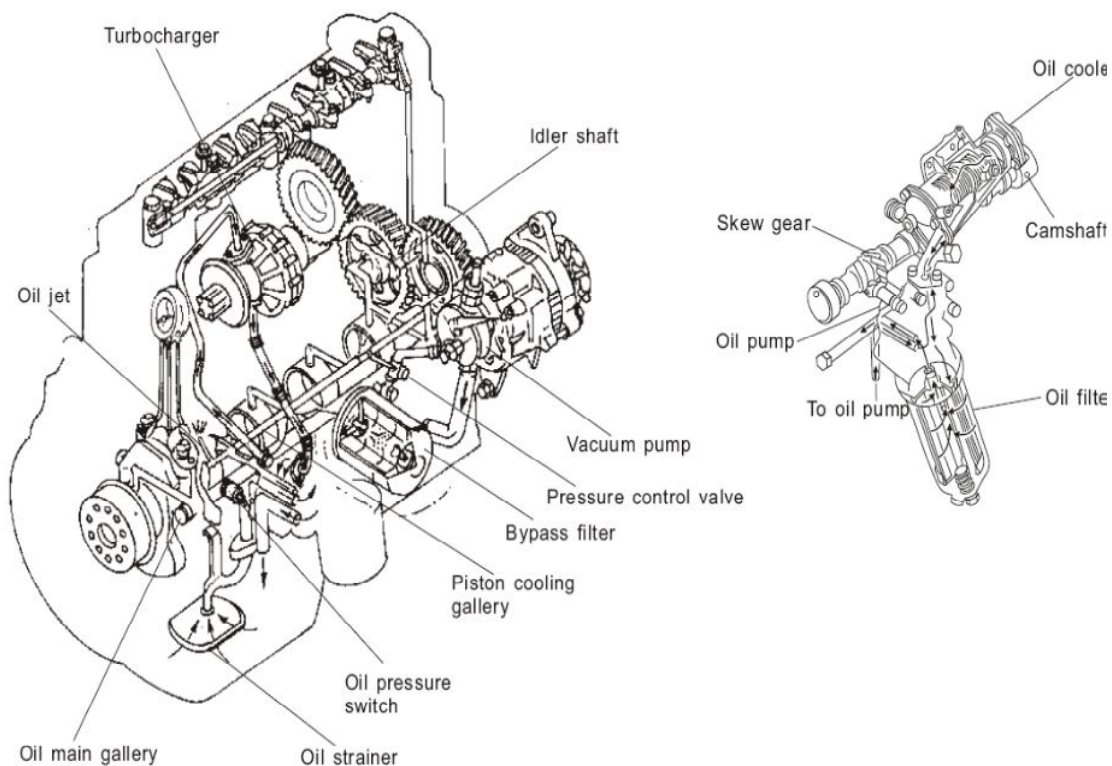
Pusher type radiator cooling fan charges **Cold air** through the intercooler fins carries away the heat from compressed hot air flowing through the intercooler tubes thereby reducing the temperature of air to the designed temperature levels. This **compressed cold air** rushes in to the combustion chamber.

3.5.2 LUBRICATION SYSTEM:

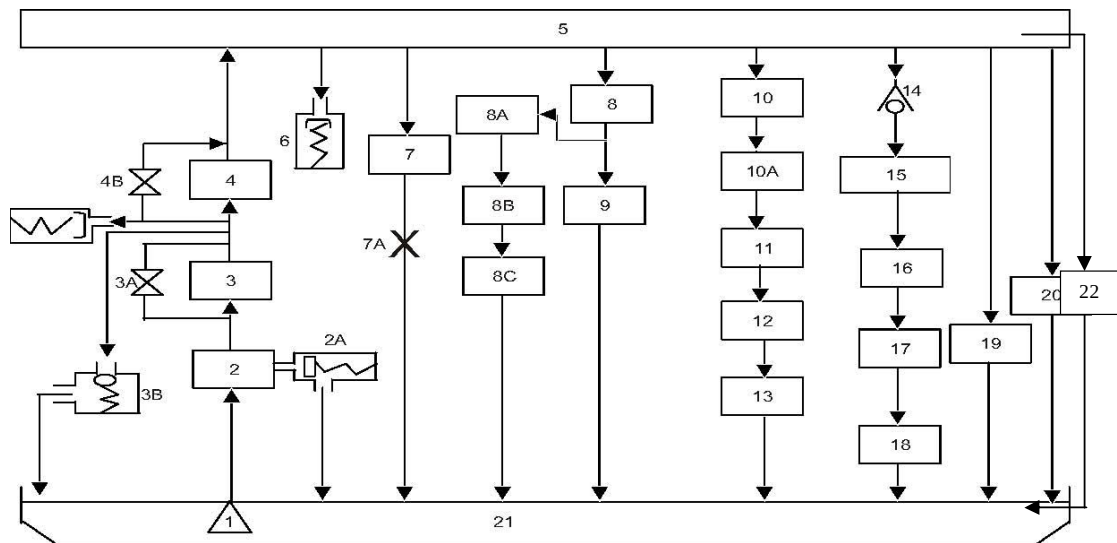
The engine has a forced lubrication system. The main functions of the Lubrication systems are as follows:

- Lubricates moving engine parts by forming a **thin film of oil** between components and prevents metal to metal contact
- This oil film is capable of **absorbing shocks** in Con-rod Bearings and Gear train
- Flowing **oil absorbs heat** and cools engine parts
- Oil also **collects** carbon & metal particles formed during engine operation and **flows it to the oil pan**
- Oil **neutralizes** the acids and alkali produced during engine operation & **prevents corrosion**
- **Seals** compression by forming a thin oil film on cylinder liner walls

ENGINE OIL FLOW PATH:



SCHEMATIC DIAGRAM OF LUBE OIL FLOW:



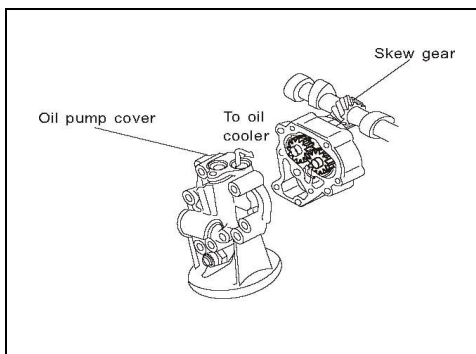
- | | | | |
|----------------------|-----------------------------------|----------------------------|--------------------------------|
| 1. Oil Strainer | 4B. Bypass valve | 8C. Timing gear | 15. Auxiliary gallery |
| 2. Oil Pump | 5. Main oil gallery | 9. Connecting rod bearing | 16. Oil jet for piston cooling |
| 2A. Relief valve | 6. Engine oil pressure switch | 10. Camshaft bushing | 17. Piston |
| 3. Oil cooler | 7. Bypass filter | 10A. Camshaft bushing no.1 | 18. Con rod bushing |
| 3A. Bypass valve | 7A. Restriction orifice | 11. Rocker bushing | 19. vacuum pump |
| 3B. Regulator valve | 8. Crankshaft main bearing | 12. Push rod | 20. Turbocharger |
| 4. Filter element | 8A. Crankshaft main bearing no. 1 | 13. Tappet | 21. Oil sump |
| 4A. Oil bypass alarm | 8B. Idler bushing | 14. Pressure control valve | 22. Fuel Pump |

The oil required for lubricating the engine parts is sucked by the oil pump from the sump through the strainer.

The pressurised engine oil is then sent to oil cooler, where the oil is cooled and then it is sent to the oil filter for filtration.

The filtered oil is then sent to all engine parts through main oil gallery. By pass oil filter is provided for fine filtration.

LUBE OIL PUMP:



The oil pump is of gear type and is driven by the skew gear mounted on the camshaft.

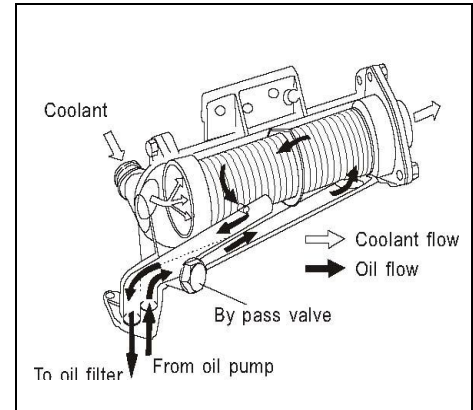
The oil pump cover also serves as the oil filter head, requiring no oil pipe.

Engine oil is pressurised to the required pressure by the oil pump and sent to various parts for lubrication and cooling.

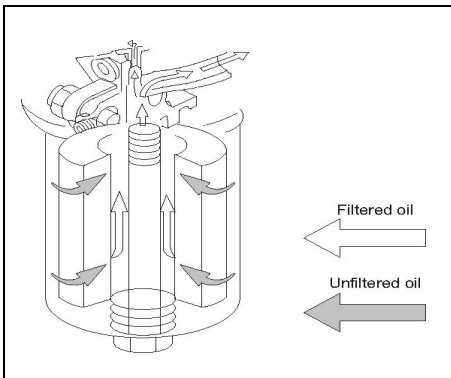
OIL COOLER:

Shell type oil cooler facilitates heat dissipation from engine lubricating oil and maintains engine lubricating oil temperature and viscosity to the desired levels.

The Pressurised oil from oil pump is sent into the oil cooler for cooling the hot engine oil. The coolant from the cylinder block is passed through oil cooler element, which takes away the heat from the engine oil.



LUBE OIL FILTER:



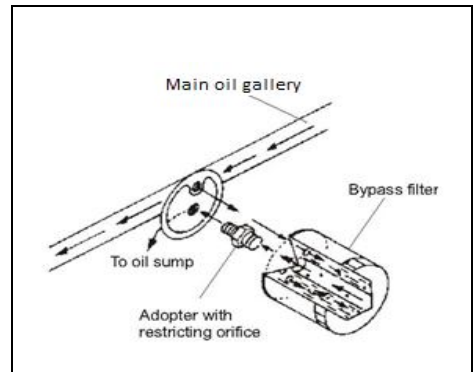
The full flow barrel type paper filter removes carbon and fine metal particles formed during normal operation of engine. The filtered oil is sent to Main oil gallery.

BY PASS FILTER:

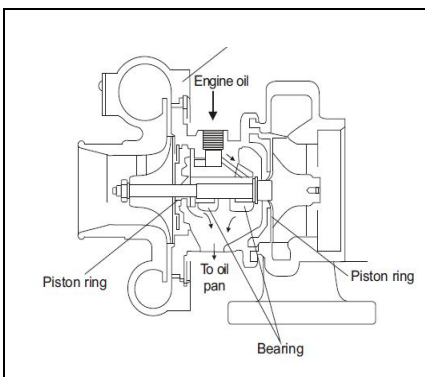
The Spin on type by pass filter mounted on engine block through adopter which has a small orifice is used for fine filtration of lubricating oil.

The bypass filter allows a portion of main gallery oil to flow through it & back to the oil pan through an adopter having a small orifice.

During replacement the whole filter to be replaced



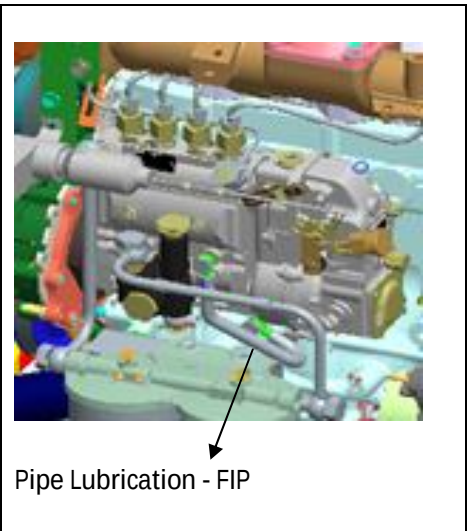
TURBO CHARGER LUBRICATION:



Oil from oil main gallery flows through the oil tube to bearing housing of turbocharger to lubricate bearing and is returned through the outlet tube at the bottom of the bearing housing through the crank case and to the oil pan.

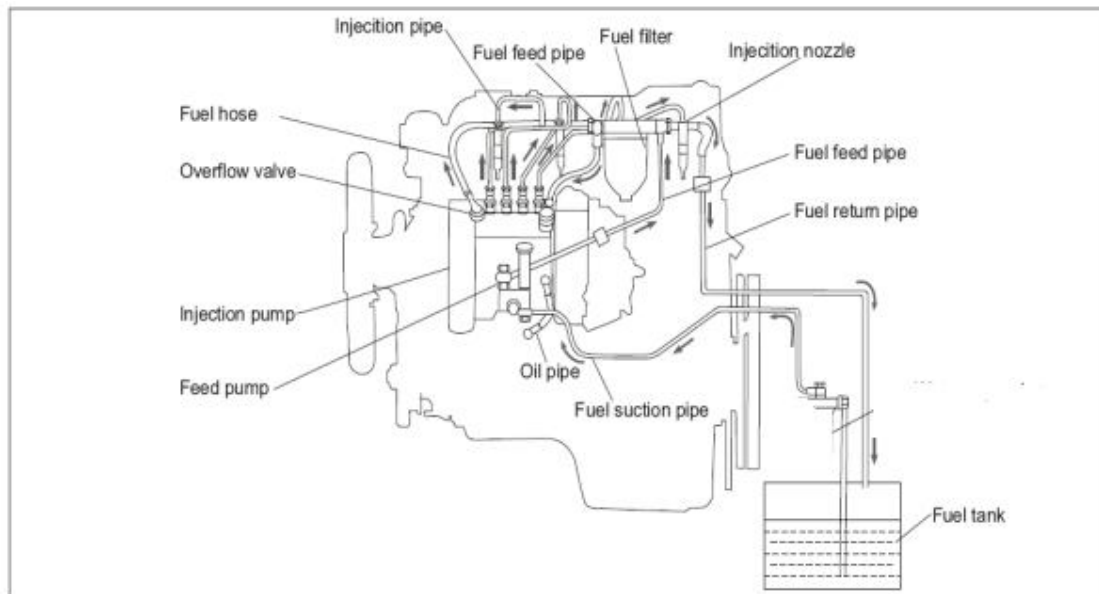
FUEL INJECTION PUMP LUBRICATION:

Oil from oil gallery flows through benzo tube to FIP & lubricates camshaft and governor mechanism and then drained to the oil sump from the FIP gear side of FIP housing.



3.5.3 FUEL SYSTEM:

The function of fuel system is to feed the engine with clean and sufficient quantity of fuel as per designed requirements.



The fuel system consists of the injection pump, fuel filter, injection nozzle, injection pipe and other parts. Fuel is fed from the fuel tank through suction pipe to the feed pump of the fuel injection pump assembly and then to the fuel filter, injection pump and injection nozzle.

The excess fuel is returned from the Nozzle to injection pump and to the fuel tank.

WATER SEPARATION FROM FUEL:

The air moisture trapped inside the fuel tank gets condensed during night time, becomes water and mixes with diesel. If this water is allowed to flow through the fuel system it can damage the FIP and nozzle.

Since the engines are used for power generation application which is operated under stationery condition, the fuel tank acts as water separator. The foreign particles in fuel are collected as sediments in fuel tank bottom and water in fuel are collected at the bottom of the fuel tank. Ensure periodical draining of water from fuel tank through the drain plug provided in the fuel tank.

Ensure periodical cleaning of Fuel tank to make it free from Sediments.

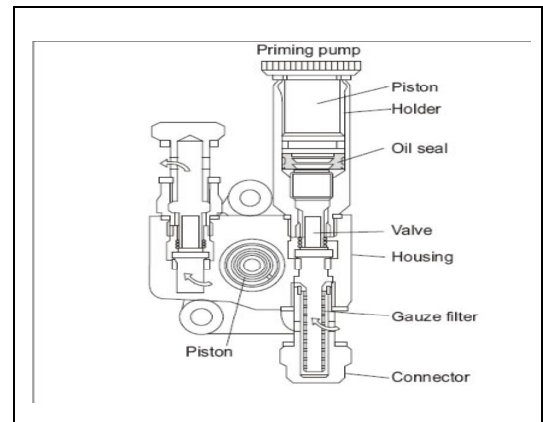
Do not top up fuel in fuel tank when the engine is under operation as the process will allow sediments and water to float and gets carried away along with fuel. Always top up fuel in fuel tank when the engine is not in operation. Wait for few minutes and allow sometime for sediments and water to settle at the bottom of the fuel tank before starting the engine.

FEED PUMP:

The feed pump is driven by the Fuel injection pump camshaft.

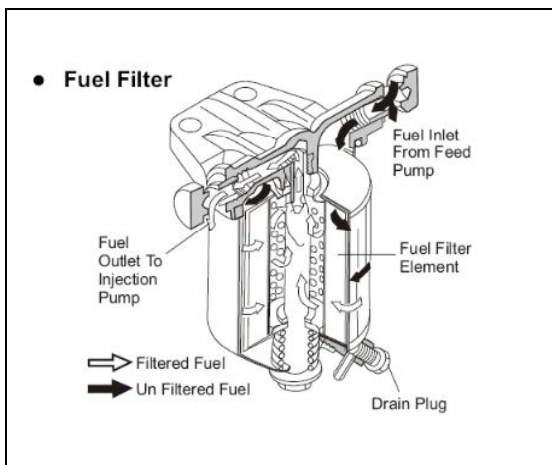
The priming pump allows manual lift of fuel when the injection pump is stationary. It may be used when bleeding the system.

The gauze filter removes large particles of dust from the fuel lifted from the fuel tank, preventing the feed pump from getting clogged. The filter must be washed in clean diesel periodically.



FUEL FILTER:

The fuel from the feed pump is supplied to fuel filter for filtration. The dual filter is of element type and replaceable individually.

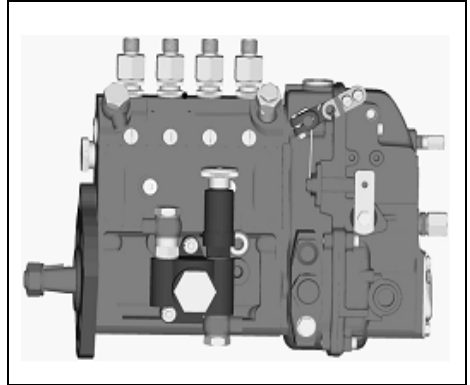


Fuel from feed pump flows into the outer side of the filter housing and filtered by the element and supplied to the fuel injection pump. The above diagram shows the flow path of fuel in fuel filter.

FUEL INJECTION PUMP:

The Bosch in line type fuel injection pump is used. The injection pump, that forces fuel into the injection nozzle under pressure is provided with a mechanism to increase or decrease the amount of fuel. It has one plunger and delivery valve for each cylinder.

The plunger pushed up by the camshaft and pushed back by the plunger spring, moves up and down in the plunger barrel on a predetermined stroke to feed fuel under pressure. In doing so it opens and closes the suction and discharge ports to adjust the fuel injection rate.

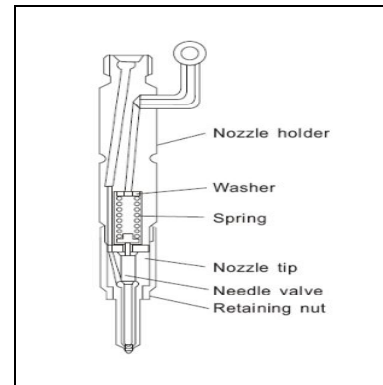


The Constant speed governor of the fuel injection pump is capable of holding rated speed steadily irrespective of variation in loads.

INJECTION NOZZLE:

The injection nozzles are of the hole type. The fuel delivered the injection pump enters the nozzle holder. When it reaches the specified pressure value, the fuel overcomes the spring force to up the needle valve of the nozzle tip, spraying from the injection orifice at the end of nozzle into the cylinder.

The injection pressure can be adjusted by increasing or decreasing the number of washers in the spring.

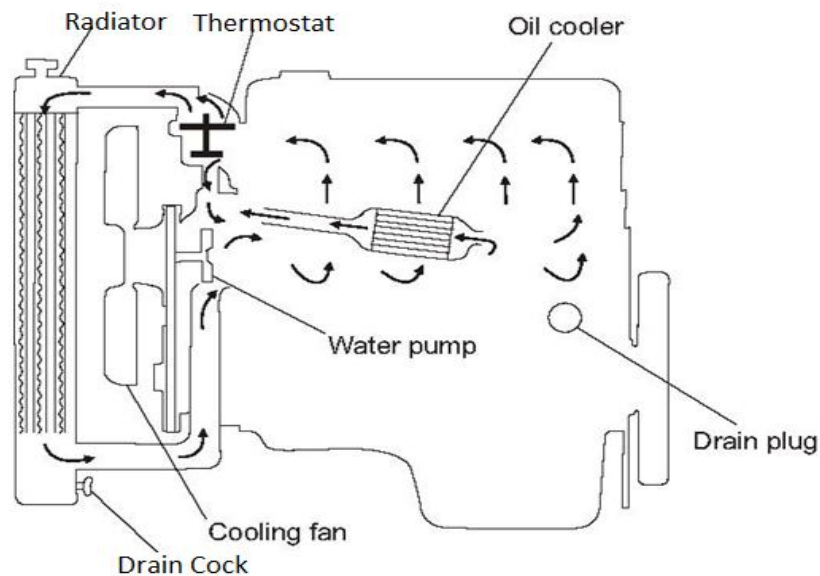


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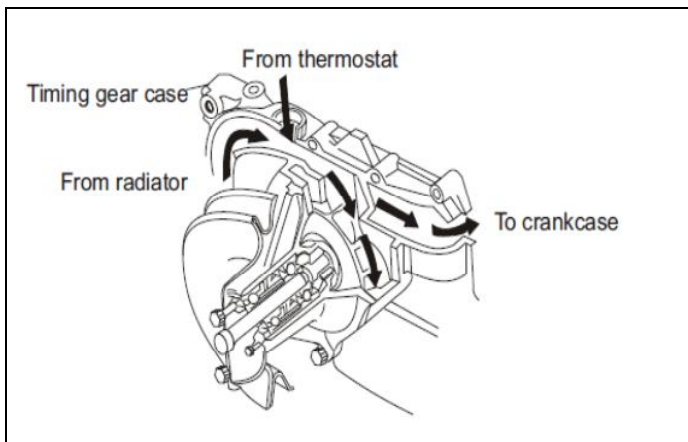
3.5.4 COOLING SYSTEM:

The function of the cooling system is to absorb and dissipate heat generated during combustion thereby maintaining engine coolant temperature as per designed parameters. To ensure the same the engine is cooled by forced circulation of coolant by the water pump. Radiator cooling fan driven by the V Belt from the water pump pulley charges cold air through the radiator fins which carries away the heat from the coolant. This continuous process of circulation and heat dissipation ensures the operating temperature of the engine is maintained.

The coolant temperature around the combustion chamber should be maintained at optimum levels for satisfactory performance of the engine. It takes more time to achieve the desired operating temperatures at low ambient temperatures, engine warm up periods and light loading conditions. Hence a thermostat is installed in the cooling system which controls the coolant temperature around the combustion chamber to the desired level all times during engine operation.



WATER PUMP:

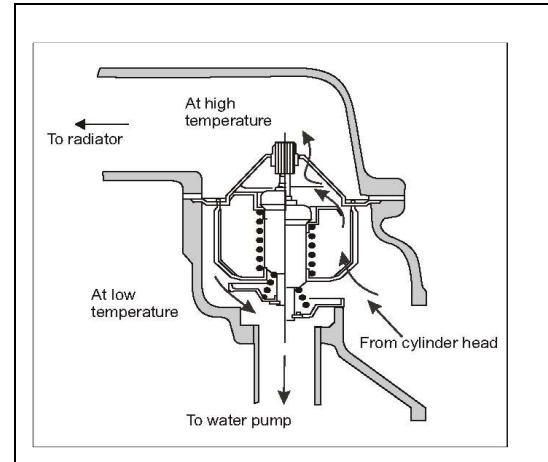


The water pump is of centrifugal type and it is driven by the V-belt from the crankshaft pulley. A unit seal is installed between the impeller and Water pump to prevent leakage of coolant. There is drain hole provided at the bottom of the water pump case which ensures that coolant, should it leak from the unit seal, does not enter the bearings. The water pump is mounted on the timing gear case provided with a suction pipe and swirl chamber. Pressed into one end of the water pump shaft is the impeller with backward blades which feeds coolant under pressure into the engine.

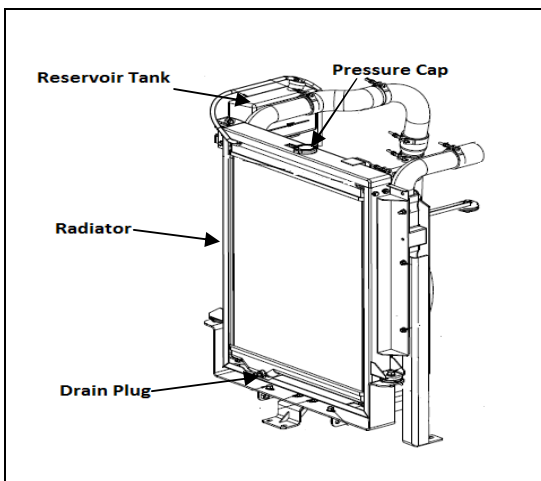
THERMOSTAT:

The thermostat is of a bottom bypass configuration, has a valve controlled by a special wax enclosed in a pellet. The wax changes from solid to liquid as it is heated, involving volumetric change for regulating the flow of coolant.

The changes in the valve position with varying coolant temperatures regulate the flow rate of coolant into the radiator and water pump (bypass side), thus controlling coolant temperature



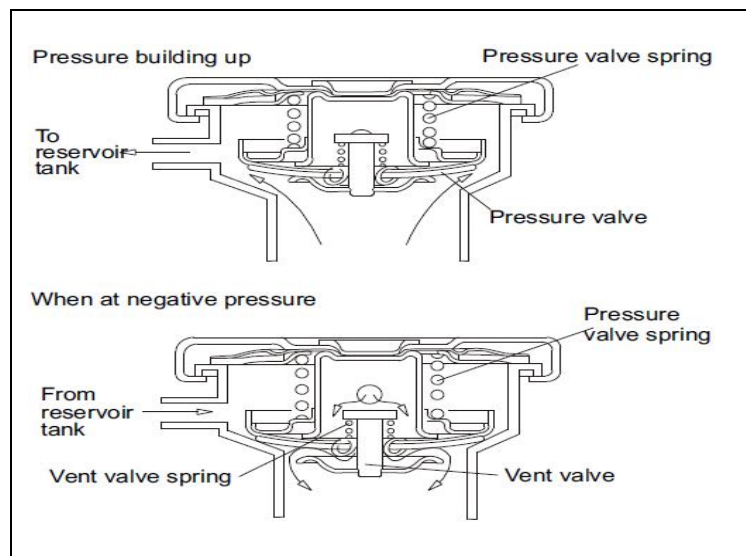
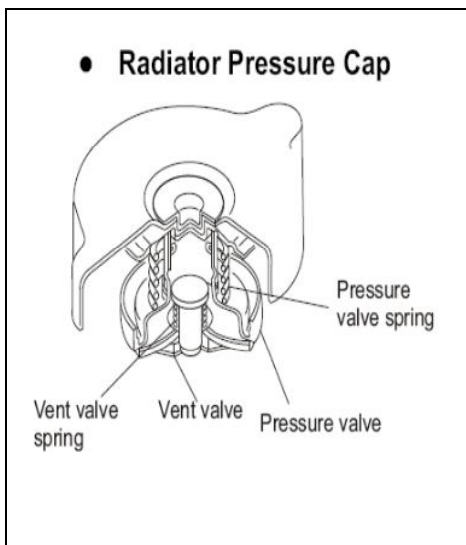
RADIATOR:



The radiator, with a tube-and-corrugated-fin type core, not only cools the engine coolant but also separates vapour from liquid water and regulates pressure in the cooling system.

The radiator is of simple closed type, equipped with a pressure cap. The reservoir tank is open to atmosphere. The coolant overflowing from the radiator is therefore stored in the reservoir full with coolant at all times.

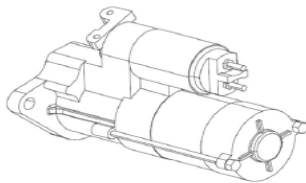
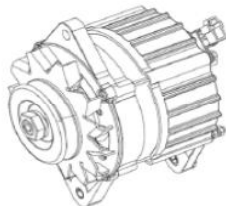
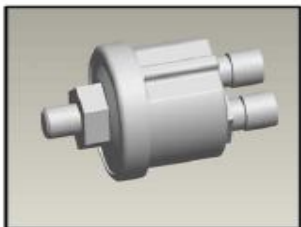
RADIATOR PRESSURE CAP:

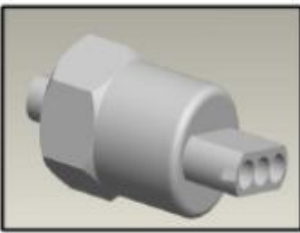
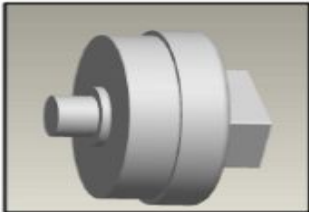
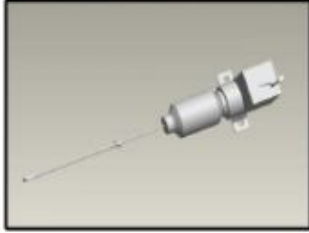


The pressure cap regulates the pressure in the cooling system. When the pressure builds up exceeding the predetermined level, the pressure valve compresses the pressure spring relieving the excessive pressure to the atmosphere. As the coolant temperature falls forming a vacuum in the radiator, the vent valve opens to admit air into the radiator, thus preventing the radiator from being deformed by the vacuum.

PART IV- ENGINE ELECTRICAL SYSTEM:

12 V, Negative Earthing Electrical systems is used on the engine. Electrical systems consist of the following and its usage is discussed as below.

Sl No	Name of Component	Operating Voltage	Usage	Illustration
1	Starter Motor	12V	Engine Starting	
2	Battery Charging Alternator	12V	Battery Charging / W Point Signal for RPM Sensing	
3	Temperature Sensor Cum Switch	12V	1.Signal to Engine Control Unit / Temperature Gauge for Coolant temperature indication 2.Signal to Engine Control Unit / Stop Relay for Stopping the Engine in the event of High Coolant Temperature 3. NO – Normally open	
4	Pressure Sensor	12V	Signal to Engine Control Unit / Gauge oil pressure for oil pressure indication	

5	Pressure Switch	12V	1.Signal to Engine Control Unit / Stop Relay for Stopping the engine in the event of Low Lubricating Oil Pressure 2. NC-Normally Closed	
6	Choke Switch	12V	1.Signal to Engine Control Unit / Stop Relay for Stopping the Engine in the event of Air Cleaner Element Clogging leading to High Intake air restriction 2.NO-Normally Open	
7	Engine Stop Solenoid	12V	Engine Normal stopping through Key Switch/ Stops the engine based on the command received from Stop relay in the event of Low Lubricating Oil Pressure, High Coolant Temperature and High Air restriction	

Proper earthing, recommended Voltage, proper Crimping of wiring connections and avoiding loose connection is mandatory for satisfactory performance of electrical system.

The basic engine is supplied with the above features for integration to Engine control unit / Instrumentation. The Equipment manufacturers are requested to refer engine manufacturer for necessary details.

PART V-SAFETY GUIDELINES

This section laid guidelines for safety of personal and equipment. Safety should be the utmost priority during installation, operation and maintenance of the engine and equipment.

General safety instruction, accident prevention regulations and safety precaution defined by law must be observed.

Use of personal protective equipment must be worn during installation, operation and maintenance of the engine and equipment.



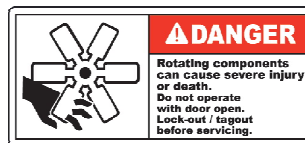
ACCIDENTAL STARTING



Accidental starting of the engine can cause severe injury or death when working on engine. Safety must be observed when working on engine.

Disconnect the battery before start of work negative (-) lead first. While reconnecting battery leads connect negative (-) last.

Use lock out/tag out procedures when doing maintenance work on the engine. In case engine is under remote start/ stop operation.



ROTATING PARTS

Never operate equipment without guards and electrical enclosures. Rotating parts like Flywheel, Pulleys and radiator fan can cause severe injury or death.



ELECTRICAL SHOCK

Never touch electrical terminals with bare hands or metal tools, always cut off the power and use insulated handled tools. Electric shock can cause severe injury or death.

Always open the outgoing circuit breaker or isolator before starting any maintenance work on engine.

Never make contact when standing in water or wet shoes.

Never ground live terminals. It can cause electrocution.

Loose wiring is a hazard for spark and short circuit. Electrical wiring should be done properly using gland and cable harnesses.



HOT SURFACES

While running engine and exhaust system surface are at elevated temperature contact with them can cause severe burn injury.

Always wear personnel protective equipment (PPE's) when working on hot surfaces. Start working on engine when it cools down.



HANDLING ENGINE FLUIDS

Most Chemicals used in engines such as old engine oil, corrosion inhibitors; coolants and adhesives are hazardous to health. Direct contact to Skin will cause allergy. Use of personnel protective equipment (PPE's) is recommended when using. Storage of the same should be done as per suppliers recommendations. Oral consumption of these fluids can cause death.

Exhaust emitted from the engine exhaust is poisonous and inhalation of the same can cause harm. Always provide proper ventilation of exhaust gases to the atmosphere.

Never smoke or permit flame near flammable fluids.

High pressure fluids can cause severe injury when pipes burst. Care should be taken when working with high pressure fluids. Always release pressure before working on pressurized systems. Use safety goggles and personnel protective equipments (PPE's) while working.



HEAVY EQUIPMENT HANDLING/LIFTING

During handling heavy equipment always use proper lifting techniques. Lifting hooks should always be used. Unbalanced load can cause injury to personal and damage to equipment.

Always use proper lifting arrangements. Check slings condition and capacity before using them.

Do not stand under the lifted loads.

Always lift load from the specified lifting points of the equipment.

Use soft/nylon slings of adequate capacity to prevent damage of equipment.

Always check operation of the crane/lifting tools before start of work.

PART VI: RECOMMENDED ROUTINE CHECKS BY USER

While all due care has been taken to ensure trouble free performance of the engine, a few simple routine checks by the actual user will help to identify and fix the issue at right time which will avoid major breakdown and down time of the equipment. It is recommended to monitor as below at regular intervals and immediately report to authorized service centre if any abnormality noticed for necessary rectification.

DETAILS	ACTIVITY
Engine Lubricating Oil	Inspect for Leakage and Correct / Top up if required
V Belt	Inspect for Looseness, Cracks / Damage and Correct if required
Coolant	Inspect for Leakage and correct if Required Inspect for Level and top Up If required
All Rubber Hoses	Inspect for Cracks / Damage and Correct If required
Instruments & Gauges	Inspect for Proper Operation and correct if required

ENGINE LUBRICATING OIL CHECKING:



Ensure the equipment is placed on flat surface before checking the oil level. Do not check the oil level immediately after stopping the engine. Allow 15 minutes after stopping the engine so that all the oil is completely drained to the oil sump. The Engine oil level shall be checked through DIPSTICK of the engine. Always ensure the level is maintained to the full level mark. Do not mix up different brands of oil.

Never operate the engine with oil level at Low level marks.

If any oil leakages noticed from any parts or location of the engine, report to the authorized service centre and correct the same.

COOLANT CHECKING AND TOPPING UP:



Keep observing the reservoir tank coolant level and top up with genuine recommended coolant to the maximum Level mark.

RUBBER HOSES:

Perform visual checks of all rubber hoses for cracks / damage. Report to the authorized service centre and correct if necessary.

INSTRUMENTS & GAUGES:

All the instruments and gauges are critical for monitoring the operating parameters of the engine. The Hour meter feature records the operating hours of the engine which is critical for planning scheduled maintenance.

Any abnormality shall be immediately reported to the authorized service centre and corrected as required.

V BELT:

V BELT Main which connects Engine Crank pulley/Battery charging alternator/water pump/ Fan Radiator is used for driving water pump for effective Coolant circulation, battery charging alternator for delivering Battery Charging DC out Put and W Point Signal to Engine Control Unit for RPM and Hour Indication and driving radiator cooling fan for keeping the coolant temperature within designed parameters.

Operating the engine with belts in loose condition will result in belt slippage affecting coolant circulation, Engine cooling performance, and battery charging alternator output and improper RPM and Hour reading.

Excessive tension will result in cracks/damage to belts and more stress on bearings affecting components reliability.

Whenever any abnormality is observed, it is recommended to correct the defects through the authorized service centre.

ENGINE STARTING CARE:

During Starting of the engine, long cranking and holding the ignition key in on condition keeping starter motor engaged with flywheel ring gear for longer period will affect the life of starter motor. The precautions are as below.

- Release the ignition key immediately once engine firing noise is heard.
- If engine does not start, do not hold the ignition key more than 10 seconds.
- Re crank after 1 minute. If Engine does not start in three attempts, Check and correct the issue.

PART VII: ENGINE INSPECTION & MAINTENANCE

Needless to say, any equipment needs scheduled and preventive maintenance care. Engine being a prime mover also needs attention at right time in order to ensure trouble free performance of the equipment. By strictly adhering to the following Scheduled & preventive maintenance, use of genuine spares, Lubricants and coolant will deliver satisfactory performance of the engine and avoid down time of the equipment.

INSPECTION & MAINTENANCE SCHEDULE

LEGEND: C-CLEAN / D – DRAIN / I – INSPECT, ADJUST, CORRECT, REPLACE, TOP UP IF REQUIRED / L – LUBRICATE / R – REPLACE / T – TIGHTEN TO SPECIFIC TORQUE

SL NO	PART NAME	ACTIVITY	Every 500 Hrs	Every 1000 Hrs	Every 1500 Hrs	Every 2000 Hrs	Every 2500 Hrs	Every 3000 Hrs	Every 4000 Hrs
1	Engine- Lubricating Oil	Replace at Specified interval / 6 Months Whichever occurs earlier	R						
2	Filter – Lubricating Oil Main	Replace at Specified interval / 6 Months Whichever occurs earlier	R						
	Filter-Lubricating Oil By Pass	Replace at Specified interval / 6 Months Whichever occurs earlier	R						
	Filter- Fuel	Replace at Specified interval / 6 Months Whichever occurs earlier	R						
	Filter- Gauze Feed Pump	Clean	C						
3	Filter- Air Primary	Clean Primary Cartridge Whenever Choke Indicator Provides alarm Replace with new Primary Cartridge after two cleanings or 24 Months Whichever Occurs earlier							
4	Filter-Air Safety	Replace with new Safety Cartridge during 3 rd replacement of Primary Cartridge or 24 Months whichever occurs earlier Caution: Safety Cartridge Should not be cleaned							
5	Coolant	Replace Coolant at Specified Interval / 24 Months Whichever occurs earlier	I						R
6	Engine – V Belt	Inspect Belt tension and adjust if required	I						
		Replace at Specified interval / 24 Months whichever occurs earlier					R		
7	Valve Clearance	Inspect and Adjust Valve Clearance if required Inspect and retighten Cylinder Head Bolts		I					
8	Rubber Hoses-Air intake / Turbo Charger/Intercooler/ Radiator	Replace at Specified Interval / Every 24 Months Whichever occurs earlier							I
9	Fuel Hoses	Inspect for Leakage. Correct and Replace if required Replace at Specific interval/ Every 24 Months Whichever Occurs earlier	I						R

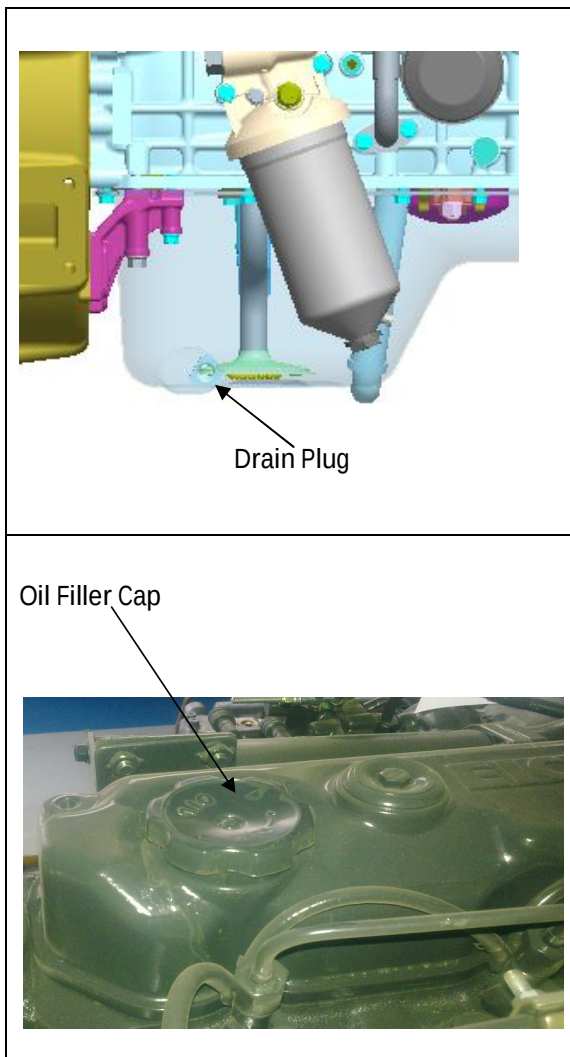
It is always recommended to carry out the above maintenance activities at the authorized service centre as it needs skilled, trained manpower to perform the job.

MAINTENANCE ACTIVITY CARE:

Before starting the scheduled / preventive maintenance activity, ensure the engine is started and run for around 15 minutes to confirm the engine starting ability, abnormal noise, vibrations, oil leakage, fuel leakage, function of electrical instruments and gauges. This will facilitate in better understanding of the engine before proceeding for the maintenance activity.

ENGINE LUBRICATING OIL REPLACEMENT:

Always perform engine lubricating oil replacement when the engine is in warm condition to ensure complete draining of lubricating oil from oil sump.



The following steps shall be followed:

Ensure equipment is positioned on flat surface.

Unscrew the oil drain plug and drain the oil in tray.

Install and retighten the Drain Plug.

Ensure to replace the Copper Gasket of the drain plug with new.

Fill with recommended quantity of EICHER GENUINE lubricating oil through the Filler Cap.

Allow 10 Minutes to facilitate oil to reach the oil Sump.

Reconfirm the oil level through dip stick after starting and stopping of the engine. If found less top up to the level. Ensure sufficient time is allowed as discussed above before checking the oil level.

CAUTION!

Necessary care shall be taken while working as high temperature will result in burns.

Do not mix different brands of oil.

Clean the surface thoroughly.

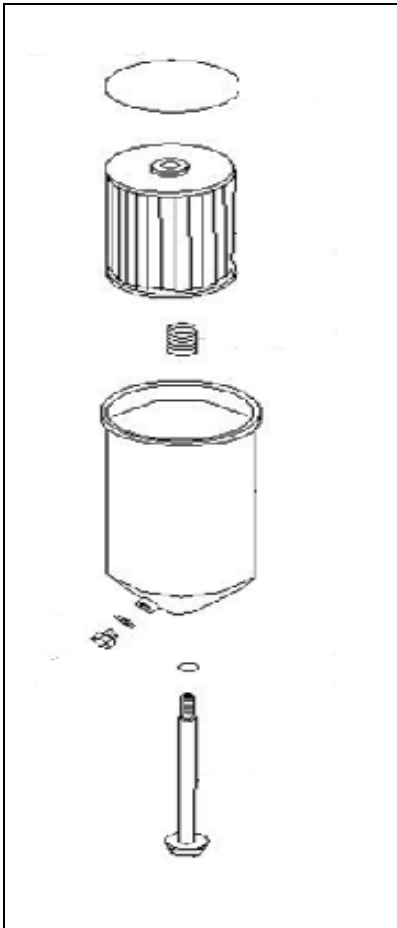
Do not dispose the used oil on the ground as it is hazardous to environment safety. Always collect, store

and dispose the old used oil in a container and dispose as per safety rules.

ENGINE LUBRICATING OIL RECOMMENDATION:

DETAILS	ENGINE
SPECIFICATION	EICHER EE683TCI
	API CH4 /CI4 SAE15W40
EICHER GENUINE OIL & LUBRICANTS	EICHER PREMIUM DIESEL ENGINE OIL
QUANTITY REQUIRED FOR REPLACEMENT DURING SCHEDULED MAINTENANCE	11 LITERS (Including Filters)

ENGINE MAIN OIL FILTER REPLACEMENT:



Unscrew the drain plug and remove oil from main oil filter casing.

After draining retighten the drain plug. Ensure to replace the Copper gasket.

Unscrew the centre bolt and remove the filter casing along with element.

Remove the used main oil filter element and clean the housing. Damage and discard the same to avoid misuse.

Insert the centre bolt in its location of the casing.

Secure the spring driving through the centre bolt.

Locate the new filter element driving through the centre bolt.

Secure main oil filter o'ring with new and ensure its seating in its location.

Tighten the centre bolt to specific torque (3 to 3.5 Kgf m / 29 to 34 N m).

CAUTION!

Cleaning and reuse of element is not recommended.

ENGINE BY PASS FILTER REPLACEMENT:

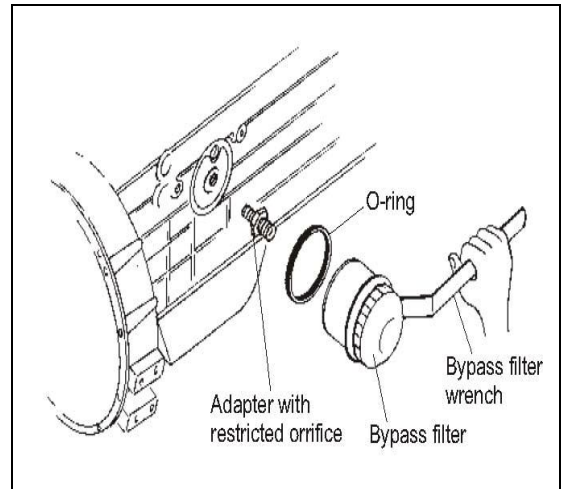
Remove used spin on type by pass filter by using bypass filter wrench (Part No153801).

Damage and Discard the same.

Apply oil film on the bypass filter gasket before fitment

Fit the new bypass filter by fully tightening with the hand and then using bypass filter wrench.

After ensuring complete tightness tighten filter by rotating 90°.



ENGINE FUEL FILTER REPLACEMENT:

Unscrew the drain plug and drain diesel in a clean container. Pour back the fuel in the fuel tank.

Unscrew the centre bolt and remove the fuel filter casing along with filter.

Remove the old O'ring from its location and discard the same.

Clean the fuel filter casing with clean diesel.

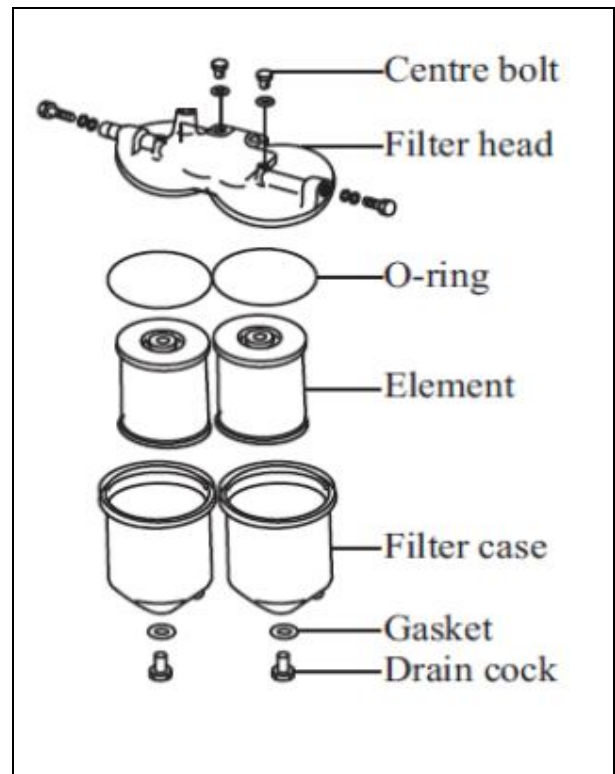
Install the drain plug and tighten to 0.8 to 1.5 Kgf m (8 to 15 Nm) torque. Replace the copper gasket with new.

Install the fuel filter O'ring with new in its location.

Install new fuel filter element in the filter housing.

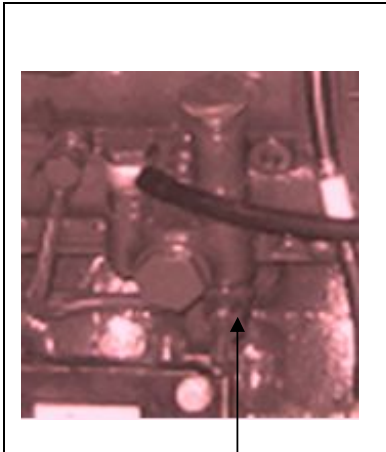
Secure the fuel filter housing on the filter head and tighten to 2.5 Kgf m torque (25 Nm).

Ensure the copper gasket is replaced with new.



Bleed the fuel system through Hand primer of feed pump. Wipe and clean any spilled diesel fuel as it can cause fire.

ENGINE FUEL FEED PUMP GAUZE FILTER CLEANING:



Feed Pump Gauze Filter

Since the fuel from fuel tank is passed first through feed pump, due to suction process foreign particles / dust from Fuel if allowed through the fuel system affects the reliability of Fuel injection pump components. Hence a gauze filter (Baby Filter) is provided at the inlet side of fuel pump which filters any foreign particles/dust that is being passed through it.

Remove the filter by unscrewing the Banjo Bolt and clean with diesel as per recommendation.

ENGINE AIR FILTER ELEMENT INSPECTION AND CLEANING:

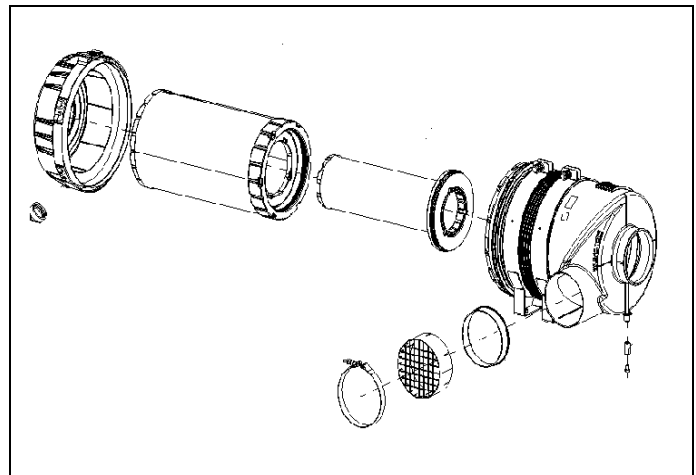
Remove the Air cleaner assy cover.

Loosen the nut and remove the Primary air filter element.

Remove air cleaner safety cartridge.

Visually inspect both the filters for clogging / tear of element.

If there are thin portions in the filter paper, replace the element. If the sealing of the air filter element is found damaged, replace element.



If there is dry dust on the element, clean the dust by blowing 7 Kg/cm² or lower compressed air against the element.

Blow the compressed air from inside the element up and down along the frills of the filter paper and clean the whole element evenly.

After the element has been cleaned, put an electric lamp inside the element to check for damage and pin holes.

If the element is contaminated with moist soot, replace it regard less of the specified replacement frequency.

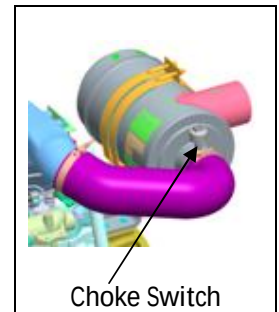
CAUTION! :

- Do not strike the element or strike it against a hard object to remove dust.
- Primary Element Should be removed for cleaning only when Choke switch provides alarm.
- Clean only the primary filter element. The safety Element should never be cleaned but only replaced at the recommended intervals.
- Frequent cleaning of elements will only result in damage to the paper, sealing washers and rings and wing nut which will ease the entry of unfiltered air into the engine. It will thus reduce the air cleaning efficiency of the element leading to serious engine damage.

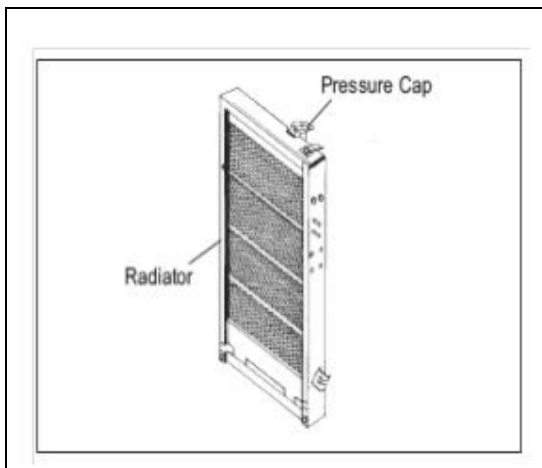
CHOKE INDICATOR:

The choke indicator functioning shall be confirmed after starting the engine and closing the inlet port of air cleaner assy gradually to increase negative pressure. The Choke switch will covert to NC and send signal to the stop relay there by commanding the stop solenoid to shut off the engine.

If it does not stop the engine then replace the Choke switch.



ENGINE COOLANT REPLACEMENT:



In order to prevent corrosion of the cooling system, it is recommended to add coolant at a ratio 50:50 of quantity of water.

A drain cock is provided at the bottom tank of the radiator for draining coolant from the engine.

Unscrew the drain cock and drain the coolant. Secure the drain cock in its position after draining.

Remove Pressure cap and fill the recommended coolant as per ratio through the Pressure cap opening.

Allow sufficient time for the coolant to get filled as air will be removed from the engine slowly during the coolant refilling process.

With pressure cap removed from the radiator, allow the engine to run at idle with coolant temperature of 90°C to bleed the system completely.

After the system is bled with air, add recommended coolant to radiator as required.

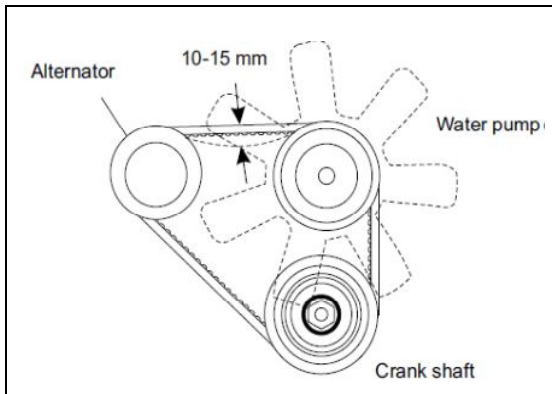
ENGINE COOLANT RECOMMENDATION:

DETAILS	ENGINE COOLANT		
SPECIFICATION	JIS-K-2234-94		
EICHER GENUINE OIL & LUBRICANTS	EICHER GENUINE RADIATOR COOLANT		
USAGE RECOMMENDATION	1: 1 by Volume i.e. 50% COOLANT & 50 % WATER		
COOLANT CAPACITY (LITERS)	40 Kva	50 Kva	62.5 Kva
	14.8	17	17

Refer to "Engine Technical Specification" for Qty of Coolant Required for the respective Engine

CAUTION! :

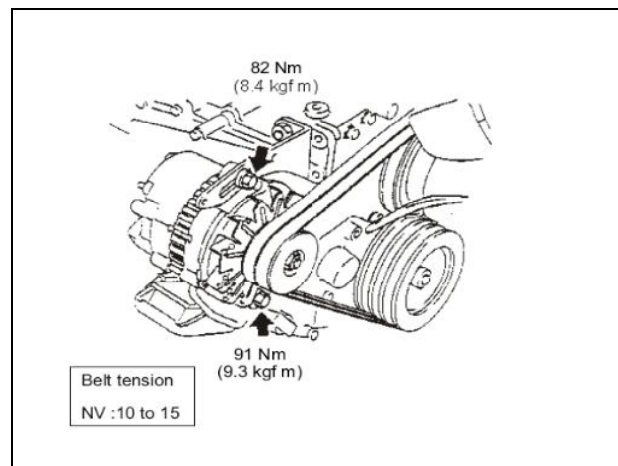
- Be sure to use EICHER Genuine Coolant
- Never Mix it with any other coolant, anti-freezes or anti rusts.
- Ensure that the caps of the radiator assembly and that of coolant are tightened.

BELT TENSION CHECKING AND ADJUSTMENT:


As shown in figure, press the V belt and check whether there is a deflection of 10-15 mm.

In case the deflection is less or more than the above value then loosen two bolts of alternator which is shown in the figure with arrows.

With the help of a long rod move the alternator assembly in required direction and retighten the two bolts.

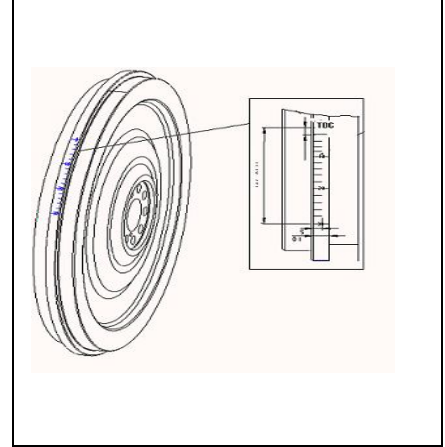


INSPECTION AND ADJUSTMENT OF VALVE CLEARANCE:

Valve clearance adjustment should be performed when the engine is cold. The engine was warm while performing the maintenance activities as the engine was started before starting the maintenance activities. The engine will become cooler by the time lubricating oil and filter replacements were completed.

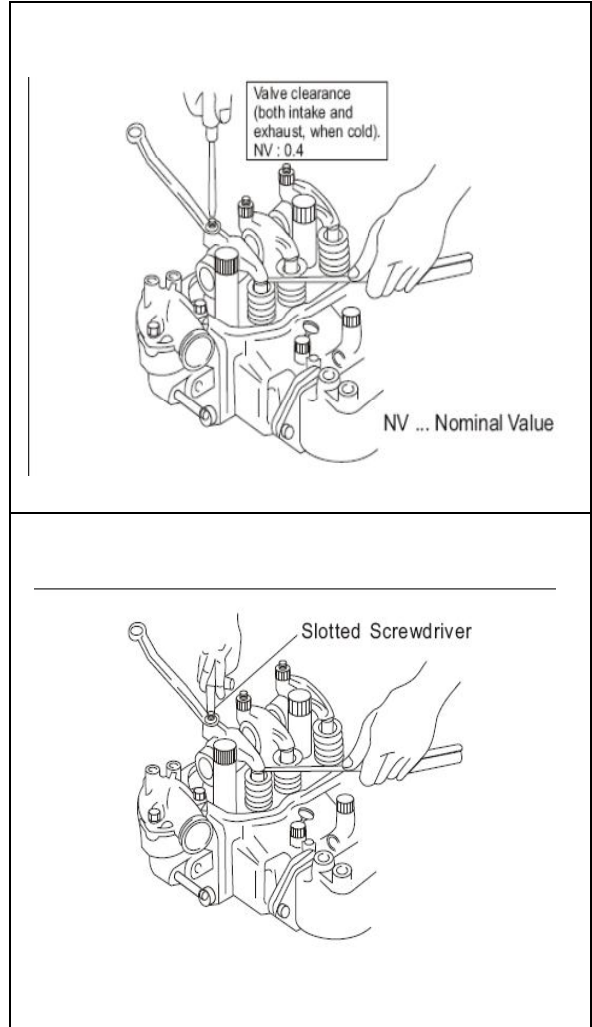
Inspect and adjust the valve clearance when the engine is cold by using the following procedure.

- 1 Remove the inspection cover on the flywheel housing. You will observe a pointer is fitted on the flywheel housing and also access to the flywheel periphery.
- 2 Remove the Rocker cover.
- 3 Crank the engine with cranking handle (Standard tool) in the direction of engine rotation (Anti clockwise when viewed from Flywheel End).
- 4 Align the TDC Mark with the pointer.
- 5 Check the cylinder no 1 valves for freeness (The Push rod of No 1 Cylinder not pushing the intake and exhaust valves). This confirms that Cylinder No 1 piston is at TDC position of the compression stroke.
- 6 Perform valve clearance adjustment as per the table given below. The nominal value is 0.4 mm.



Cylinder No.	1		2		3		4	
Valve arrangement	In.	Ex.	In.	Ex.	In.	Ex.	In.	Ex.
Valve No.	1	2	3	4	5	6	7	8
No. 1 at TDC on compression stroke	O	O	O			O		
No. 4 at TDC on compression stroke				X	X		X	X

- 7 Install the specified thickness gauge between the rocker and valve cap to check for clearance.
- 8 If the valve clearance is out of nominal value, loosen the lock nut and turn the adjusting screw to the extent that the thickness gauge moves slightly tight.
- 9 After adjustment hold the adjusting screw in position with a screw driver and tighten to secure the lock nut.
- 10 Recheck the valve clearance with the thickness gauge.
- 11 Rotate the engine one full turn and bring the Cylinder no 4 piston to compression stroke and perform the valve clearance adjustment for other Cylinder as per table given above.
- 12 Assemble the rocker cover assembly.



ENGINE STARTING AFTER MAINTENANCE:

Before starting the engine, ensure tightness all fasteners, Lubricating oil level and coolant level. The fuel systems needs bleeding of air and proceed as below.



The feed pump has a hand primer arrangement for the purpose.

Turn the feed pump primer counter clockwise until it becomes loose.

Loosen the air plug of the fuel filter.

Move the hand primer up and down by hand to feed fuel until air bubbles do not come out from the fuel filter air plug.

When no air bubbles come out along with fuel, tighten the air plug. Press the hand primer down and turn clockwise until it fits into its position.

Wipe out spilled fuel around the fuel filter and floor.

Actuate Starter to discharge air from Fuel Injection Pump.



After bleeding the air check for performance of engine on load, Oil leaks, Coolant leaks, Engine noise level and for any other abnormalities before handing over to the end user.

PART VIII: ENGINE TROUBLE SHOOTING GUIDLINES:

Sl no	Symptom	Probable Cause	Remedy
1	Engine Difficult to Start	Inadequate fuel quantity	Add Fuel
		Poor Quality of fuel or oil used	Change fuel or Oil
		Air trapped in fuel system	Bleed the system. If trouble persists Check for • Loose Piping & Connectors • Restriction for fuel flow due to blockage in fuel pipes • Possibility of air being sucked in from the feed pump
		Water trapped in fuel system	Drain water from fuel tank, fuel filter
		Fuel leakage from injection Pump piping	Repair/ Replace Cracked or loose pipes and other parts
		Feed Pump defective	Repair
		Fuel Pipes, feed pump gauze filter, fuel filter, air cleaner clogged	Clean/Replace
		Incorrect fuel injection timing	Reset
		Incorrect Valve Clearance	Reset
		Injection Nozzles not clean	Clean
		Injection pressure not ok	Rectify
		Injection Spray Pattern Poor	Repair / Replace Nozzle
		Low engine Compression (Worn out piston and sleeve/valve seat leakage/ cylinder head gasket leakage)	Repair / Replace worn out parts
		Ignition key defective	Replace
		Starter Motor defective	Repair / Replace
		Fuel injection Pump defective	Check for: • Starting delivery • Variation between cylinders
		Battery Discharged	Recharge Battery

Sl no	Symptom	Probable Cause	Remedy
2	Idling Not Smooth	Incorrect fuel or oil used	Change fuel or oil
		Idling speed setting not ok	Adjust idling stopper bolt
		Air trapped in fuel system	Bleed the system. If trouble persists Check for • Loose Piping & Connectors • Restriction for fuel flow due to blockage in fuel pipes • Possibility of air being sucked in from the feed pump
		Water trapped in fuel system	Drain water from fuel tank, fuel filter
		Fuel Pipes, feed pump gauze filter, fuel filter, air cleaner clogged	Clean/Replace
		Incorrect fuel injection timing	Reset
		Incorrect Valve Clearance	Reset
		Injection Nozzles not clean	Clean
		Injection pressure not ok	Rectify
		Injection Spray Pattern Poor	Repair / Replace Nozzle
		Low engine Compression (Worn out piston and sleeve/valve seat leakage/ cylinder head gasket leakage)	Repair / Replace worn out parts
		Incorrect Engine control adjustment	Reset
3	Loss of Power Output	Air trapped in fuel system	Bleed the system. If trouble persists Check for • Loose Piping & Connectors • Restriction for fuel flow due to blockage in fuel pipes • Possibility of air being sucked in from the feed pump
		Water trapped in fuel system	Drain water from fuel tank, fuel filter
		Fuel Pipes, feed pump gauze filter, fuel filter, air cleaner clogged	Clean/Replace
		Incorrect fuel injection timing	Reset

Sl no	Symptom	Probable Cause	Remedy
3	Loss of Power Output	Incorrect Valve Clearance	Reset
		Injection Nozzles not clean	Clean
		Injection pressure not ok	Rectify
		Injection Spray Pattern Poor	Repair / Replace Nozzle
		Low engine Compression (Worn out piston and sleeve/valve seat leakage/ cylinder head gasket leakage)	Repair / Replace worn out parts
		Air cleaner Clogged	Clean/Replace
		Air leakage in intake System	Repair
		Muffler or Exhaust pipe clogged	Repair/Replace
		Feed Pump delivery quantity and Pressure low	Rectify
		Air restriction in intake system	Rectify
		Turbo Charger - Gas leak at turbine inlet / exhaust manifold joint	Overhaul at Manufacturer authorized service centre
		Excessive dirt built up on turbo charger compressor wheel or diffuser vanes	Overhaul at Manufacturer authorized service centre
		Insufficient oil supply to turbo charger	Check and rectify
4	Black Smoke	Air cleaner / Muffler not in good condition	Correct or replace defective parts
		Engine oil level is not Ok	Restore Proper level
		Incorrect fuel injection timing	Reset
		Incorrect Valve Clearance	Reset
		Improper fuel used	Change fuel
		Restricted Exhaust system	Check and rectify
		Injection Nozzles defective	Clean nozzles and adjust injection pressure if required. Check spray pattern and change Nozzle if required

Sl no	Symptom	Probable Cause	Remedy
4	Black Smoke	Poor Compression Pressure	Check / Correct or Replace. - Defective Cylinder head gasket - Worn Valve and Valve Seat - Valve Spring set - Worn or damaged piston ring - Excessive clearance between piston and cylinder sleeve
		Restricted air duct from turbo compressor to intake manifold	Rectify
		Restricted air duct from air cleaner to turbo charger	Rectify
		Air leak between Intake manifold and engine	Retighten manifold Nuts
		Gas leak at Turbo charger turbine inlet / Exhaust manifold joint	Retighten Mounting nuts
		Excessive dirt build up on compressor wheel and or diffuser vanes	Overhaul at manufacturer authorized service centre
		Foreign body damage on compressor or turbine	Find out the cause of entry of foreign particles and rectify.
		Turbine housing flap damaged	Find out the cause of entry of foreign particles and rectify. Overhaul at manufacturer authorized service centre
		Insufficient oil supply to turbocharger	Check and rectify
		Air filter clogged	Clean/ Replace
		Restricted turbo charger oil drain line	Rectify / Check Quality of fuel
		Turbo charger bearing housing sludge or coked	Overhaul at manufacturer authorized service centre
		Worn Engine Piston rings or Liners	Replace
		Burnt Valves and or Piston	Replace
		Turbo Charger Piston ring sealing defective	Overhaul at manufacturer authorized service centre
		Turbo charger bearing defective	Overhaul at manufacturer authorized service centre
5	Improper Exhaust Colour	Improper fuel used	Change fuel
		Engine oil level not Ok	Restore Proper Level

Sl no	Symptom	Probable Cause	Remedy
5	Improper Exhaust Colour	Full Load stopper on governor control lever loose	Adjust and tighten the stopper bolt
		Excessive Valve clearance	Adjust
		Incorrect fuel injection timing	Reset
		Injection Nozzle defective	Clean nozzles and adjust injection pressure if required. Check spray pattern and change Nozzle if required
		Air cleaner or muffler not in good condition	Correct or replace defective parts
		Poor Compression Pressure	Check / Correct or Replace. - Defective Cylinder head gasket - Worn Valve and Valve Seat - Valve Spring set - Worn or damaged piston ring - Excessive clearance between piston and cylinder sleeve
6	Engine Over Heating	Fan belt loose	Adjust belt tension. Check for damage and cracks
		Coolant level incorrect	Add Coolant and if level continues to reduce inspect for leakages, loose hose, clamps and damaged hoses
		Radiator fins Clogged	Clean and correct core bends if any
		Thermostat defective	Replace
		Radiator Cap Pressure Valve defective	Replace
		Water Pump Impeller damaged / Malfunction	Replace
		Inferior Engine oil quality	Change oil
		Low engine oil level	Replenish
		Coolant Contaminated	Flush Cooling system and change coolant
		Oil Cooler defective	Repair
		Oil Pump defective	Repair
		Cylinder head gasket leaky	Replace
		Air cleaner or muffler clogged	Replace

Sl no	Symptom	Probable Cause	Remedy
6	Engine Overheating	Engine overloaded	Avoid Overload
7	Engine Noise- Comes from outside the engine	Piping's and hoses not securely installed	Rectify
		Injection Pump, water Pump and other auxiliaries not in good condition or improperly installed	Check and adjust
		V Belt Loose or damaged	Adjust belt tension and replace if damaged
		Crankshaft pulley not installed properly	Rectify
		Alternator bearing worn out	Replace
	Noise comes from rocker cover and neighbourhood	Incorrect valve clearance	Adjust
		Valve Spring deteriorated or damaged	Replace
		Valve and Valve seat contact improper	Rectify
		Oil Supply to rocker shaft inadequate	Rectify
		Injection opening pressure low	Repair/Replace
		Injector spray pattern poor	Repair / Replace
	Noise comes from Gear case & Neighbour hood	Timing gear backlash not ok	Replace gear
	Noise comes from cylinder head & Crank Case	Excessive ply in camshaft	Rectify
		Piston, Piston ring and cylinder sleeve worn out	Replace
		Connecting rod small end and big end bush worn out	Replace
		Main bearing worn out	Replace
		Excessive crankshaft end ply	Correct by using correct thrust washer
		Piston pin worn out	Replace
		Loose flywheel or crankshaft	Rectify
		Worn Cam and tappet	Replace
		Inferior quality of fuel (Low cetane number)	Use correct fuel

Sl no	Symptom	Probable Cause	Remedy
7	Noise from around the injection pump	Injection Pump Coupling loose	Align timing marks and retighten bolts
		Injection pump piping cracked or loose connection	Rectify / Replace
		Injection timing incorrect	Reset
	Noise in Intake and Exhaust System	Clamping bolts & nuts of intake & exhaust System loose	Tighten
		Turbo charger bearing defective	Rectify through manufacturer's authorized service centre
		Foreign body damage on compressor or turbine	Rectify through manufacturer's authorized service centre
		Turbine housing / flap damage	Find out the cause of entry of foreign particles and rectify the same
		Insufficient Oil Supply to turbocharger	Check and rectify
		Exhaust Pipe or muffler damage	Repair or Replace
		Air leakage in intake / exhaust system	Rectify
8	Oil Pressure too low	Oil cooler defective	Repair
		Incorrect oil level	Check for leaks or oil trapped in. Repair trouble spot and restore oil level
		Oil Viscosity not Ok	Change oil with correct viscosity
		Oil Pressure switch / Gauge defective	Replace
		Oil filter clogged	Replace
		Oil Strainer Clogged	Clean
		Oil Pump defective	Rectify
		Connecting rod bearing worn out	Replace
		Oil Temperature high	Rectify
	Oil Pressure too high	Oil Pump relief valve faulty	Repair/Reset
		Oil Main gallery clogged	Clean
		Oil Pump Joints loose or Piping Cracked	Repair/Replace

Sl no	Symptom	Probable Cause	Remedy
9	Excessive Oil Consumption	Improper Engine oil Viscosity	Use correct grade of oil
		Check for oil Leaks – Oil filter/Oil cooler/Oil Pan/Piping's/Rocker cover	Repair leaks
		Lines in cooling system leaking	Repair leaks of oil cooler, water jacket etc
		Bearings worn	Replace
		Front or Rear Crankshaft oil seals leaking	Repair defective parts or replace
		Dirty air cleaner	Clean
		Valve stem seal worn	Replace
		Valve to Valve guide clearance not ok	Replace
		Piston ring and groove worn	Replace Piston rings or Piston
		Piston and sleeve worn	Replace Piston or sleeve
		Turbo charger bearing housing sludge or coked	Overhaul at manufacturer authorized service centre
		Excessive dirt build up on turbocharger compressor / diffuser vanes	Overhaul at manufacturer authorized service centre
		Turbo charger sealing defective	Overhaul at manufacturer authorized service centre
		Turbo Charger Bearing defective	Overhaul at manufacturer authorized service centre
10	Excessive fuel consumption	Fuel leakage from Piping's	Rectify
		Improper fuel being used	Use correct fuel
		Incorrect setting of idling speed	Reset
		Incorrect Engine control adjustment	Reset
		Incorrect fuel injection timing	Reset
		Incorrect Valve clearance	Adjust

Sl no	Symptom	Probable Cause	Remedy
10	Excessive fuel consumption	Injection Nozzles defective. Check for Injection Pressure/Spray Condition/Seat tightness	Clean Nozzle/Adjust injection pressure if incorrect/Replace nozzles tip or Nozzle if required
		Engine Overloaded	Avoid overloading
		Defect in FIP	Repair/Calibrate FIP from Bosch authorized service centre



Regd. Office & Works : 102, Industrial Area No.1, Pithampur - 454 775. Distt. Dhar (M.P.) India. Tel.: 91 - 7292 - 402633. Fax : 07292 - 402611 Website : eicher.in