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B(S)6D105
SERIES ENGINE

OPERATION & MAINTENANCE MANUAL

BEML LIMITED

MYSORE, INDIA.

FOREWORD

The **BEML B(S)6D105-1 series engine** is a reliable, fuel efficient & less lube oil consumption engine with best serviceability index.

This manual describes the procedures for operation, handling, lubrication, maintenance and trouble shooting of the engine. It is intended to acquaint the operator / user with the engine to realize peak performance through effective, economical, safe machine operation and maintenance.

- Please read this carefully before operating the machine.

- This manual describes the basic techniques. Skill is acquired as the operator and the concerned persons get the correct knowledge and performance of the machine.

- Operation, inspection and scheduled maintenance should be carefully carried out and safety must be given the first priority. The safety information contained in this manual is intended only to supplement safety guards, insurance requirements, local laws, rules and regulations etc.

- A log book shall be maintained for each engine / equipment to record the details of maintenance carried out / repairs done on the machines.

- Since periodic maintenance is based on hours of operation, ensure the functioning of the tacho-hour meter and maintenance of logbook.

CONTENTS

SAFETY HINTS

GENERAL

Learn how to use the control devices (such as **emergency controls, engine stopping** etc.), gauges and warning devices before starting the engine. Be sure you understand the meaning of the caution plates and other signs. Remember the check points and checking method for engine oil, fuel and cooling water. Always know the dimensions and capacity of your engine.

Fuel, oil and anti-freeze are dangerous. Never smoke or light matches when handling fuel, oil and anti-freeze. Do not handle these substances near any fire or flame. When selecting a place for storing them, take care to choose a place that is free from hazards due to fire.

Exhaust gas is dangerous. When running the engine for long periods in a poorly ventilated area, there is a chance of gas poisoning, so ensure a good supply of fresh air.

Do not use ether for cold starting as there is a chance of explosion in the presence of air heater. Use air heater provided for cold starting.

Avoid removing of radiator cap when the engine is hot otherwise hot water will spurt out and cause burn injuries.

BEFORE STARTING

Always carry out daily inspection and maintenance correctly. Check for leakage of fuel / lubricant / coolant and for loose or broken or missing parts.

Before starting the engine, make sure that all control levers are in "NEUTRAL".

Check the level of the fuel, lubricants and cooling water. Do not smoke or use naked flame when checking or refilling. Ensure that the radiator, oil and fuel filler caps or plugs are firmly tightened.

TRAVELLING DOWNHILL

While descending the hill, apply retarder (if provided) to the machine judiciously along with service brakes so that both engine and equipment speeds are within safe limits. Over speeding of engine (more than 5% of high idle speed r/min) is not allowed as it leads to major breakdown.

STOPPING THE ENGINE

Run the engine at low idling (at least 3 minutes) to cool the engine slowly and then stop the engine. This is important especially for a turbo-charged engine because if the engine is suddenly stopped, the lubrication for the turbo will stop abruptly. Since the turbine continues to run for some more time, in the absence of lubrication and on account of very hot turbo housing, the bearings in the turbo may seize. Do not allow the engine to idle for long periods because this will cause the cylinder walls to glaze & the engine will consume too much oil.

CAUTION: Always ensure the type of engine stop arrangement provided in your machine before starting the engine.

The arrangement may be one of the following

1. For Switching ‘OFF’ the engine, pull the Stop cable knob mounted on the Panel / Dashboard.
2. If electrical stop arrangement is provided, press the stop switch till the engine is stopped completely.
3. In some models, the throttle lever has to be pulled/pushed (opposite to throttling direction) beyond the low idle position to stop the engine.

NOTE: Ensure in the above cases that the knob or switch or the lever returns back to its original position, otherwise, the engine will not restart due to air lock.

BREAKING IN YOUR NEW ENGINE

Operate your machine gently for the first 100hrs to break-in all moving parts of engine. If you operate it up to the limit of its capacity during the break-in period, the engine potential performance and life will be drastically reduced. Take special care on the following points.

- Warm-up is important before putting the machine on load. This will re-establish the lubricating oil film between shafts & bearing and piston rings & liners and other moving parts. Otherwise, operating life of the engine will be reduced drastically.

- Avoid heavy-duty works and high speed travelling.

- Avoid abrupt acceleration and deceleration.

PREPARATION OF LONG STORED ENGINES BEFORE STARTING:

In case the engine is stored or not used for more than 6 months, change the oil and fuel cartridges and charge the engine with fresh oil & coolant. Check the condition of fuel in the tank. It is ideal to pre-lubricate (with priming pump) a long stored engine and lubricate the turbo charger by removing its oil inlet port. Also, the freeness of turbine rotation has to be ensured. The engine has to be cranked a few times without admitting fuel so that lubricating oil reaches the moving parts.
Check the condition of rubber parts like hoses, fan belts etc.

NOTE:

1. It is desirable to bar the engine once in a month to ensure lubrication to the moving parts and also to avoid rust. If the condition of engine is such as it can start, then the engine shall run for 10~15 minutes at medium speed, however, loading is not mandatory.

2. If the engine is going to be stored for a long time, then it is advisable to spray anti-rust oil inside the cylinders by removing the injectors so that pistons, piston rings and liners surfaces are protected. Similarly spray anti-rust oil on rocker arm assemblies and other exposed areas.

CHECK BEFORE STARTING

“THE CHECK BEFORE STARTING” SHALL NEVER BE NEGLECTED AS TROUBLES ARE PREVENTED BEFORE HAND BY CARRYING OUT THESE CHECKS.

1. CHECK OIL, COOLANT AND FUEL FOR LEAKAGE

Check whether there is any trace of leakage of oil, coolant or fuel. In particular, joints of fuel, oil & coolant hoses, joints of air hose, radiator and air tank should be paid special attention. In case leakage is found, inspect the leaking location and stop the leakage. When leakage is not stopped, contact the personnel concerned.

2. CHECK COOLANT LEVEL

Park equipment on flat ground, remove cap and confirm that radiator is filled with coolant up to the prescribed level. If insufficient, refill coolant.

CAUTION:
If coolant level is checked when the coolant temperature is high, turn the cap very slowly to release the inside pressure before removing it to avoid burn injury. Use protective gadgets. Most safe practice is to allow the coolant to cool down before checking the level.

3. CHECK FUEL LEVEL

Check fuel level with fuel gauge or sight gauge. At the end of the day's job, be sure to refill fuel.

NOTE:
If the breather in the fuel tank cap gets clogged, the fuel may stop flowing, hence, clean the breather periodically. Ensure that strainer is always available at the filler neck while filling the fuel.

4. CHECK ENGINE OIL LEVEL

Use dipstick to check the oil level.

Make an oil level check before starting the engine. If the oil level is to be checked at the end of the operation, wait for 15 minutes before check.

The oil level should be between mark `L' and `H' of the dipstick, if required add oil up to `H' mark through the oil filler.

The type of lubricant to be used depends on the ambient temperature. Select according to the table **"FUEL, COOLANT AND LUBRICANTS"**.

NOTE:

Do not mix different grades / brands of oils.

Before adding oil, be sure to draw the oil level gauge off the guide so that the air in the crankcase is released freely.

5. CHECK DUST INDICATOR

If the air cleaner elements clog, the red coloured band of dust indicator will reach the service level and get locked. After cleaning, depress button to reset the red band.

CAUTION: If dust indicator gets cracked or is broken, immediately replace it or plug the hole to avoid dust entry till the dust indicator is replaced.

6. CHECK FOR SEDIMENT AND WATER IN WATER SEPARATOR

The water separator separates water mixed in the fuel. If the float is at or above the red line, drain the water. Be sure the fuel tank is free from water and sediment.

7. CHECK ELECTRICAL WIRINGS

Inspect disconnection and short circuit of electric wiring and loose terminal connections.

CHECK AFTER STARTING

1. Check for any abnormal noise and vibration. If found, immediately stop the engine and investigate.

2. Check oil pressure.

3. Check for excessive smoke after starting the engine.

4. Check for any external leaks.

5. Check for any abnormal blow-by.

PERIODIC REPLACEMENT OF SAFETY PARTS

To improve safety and reliability, the user should carry out periodic replacement of the parts given in the table. These parts are particularly closely connected to safety and fire prevention.

For some parts, the material condition changes as time passes or they easily wear or deteriorate. However, it is difficult to judge the condition of the parts simply by periodic monitoring, so they should always be replaced after a fixed time has passed regardless of their condition. This is necessary to ensure that they always play their roles properly.

However, if these parts show any abnormality before the replacement interval, they should be replaced immediately.

If the hose clamps show any deterioration such as deformation or cracking, replace the clamps along with the hoses.

Sl.No	Part Name	No. of units	Recommended replacement interval
01.	Fuel hoses (water separator - FIP- Pre filter- Fine Filter- FIP)	04	Every 6000hrs or Every 3 years Whichever is earlier.
02.	Fuel supply hose (Fuel tank-Water separator)	01	
03.	Fuel overflow hose (FIP – Return junction)	01	
04.	Fuel spill hose (Spill pipe – Return Junction)	01	
05.	Fuel return hose (Return junction - Fuel tank)	01	

NOTE: On weekly basis all rubber items namely,

01) Coolant hoses
02) Turbo inlet hose
03) Turbo drain hose
04) Breather hose
05) Evacuator valve
06) Oil filler pipe hose
07) Water pump by-pass hose
08) Corrosion resistor hoses (if applicable)
09) Compressor inlet hose (if applicable)

are to be checked for any deterioration, if found the same to be replaced immediately.

PERIODIC MAINTENANCE

Proper lubrication and maintenance assure trouble-free operation and long engine life. Time and money spent for scheduled periodic maintenance will be amply compensated by prolonged machine operation and reduced operating cost.

All hourly figures given in the following descriptions are based on service meter readings. In practice, however, it is recommended to rearrange all of them into units of days, weeks and months to make the maintenance schedule more convenient. **Under rough job site / operation conditions or dust condition, it is necessary to somewhat shorten the maintenance intervals stated in this manual.**

GENERAL POINTS TO BE BORNE IN MIND WHEN CARRYING OUT MAINTENANCE

1. Always use Beml supplied genuine spare parts for replacement.
2. Always use the grades of grease and oil recommended by BEML. Choose the viscosity specified for the ambient temperature.
3. Always use clean oil or grease and be sure to use clean containers, to prevent any dirt from getting in.
4. Flame should never be brought close while checking leaks or level of fuel, oil, anti-freeze or battery electrolyte.
5. When washing the engine, ensure that water does not get into air cleaner. Be careful while cleaning the filler caps and the area around the dipsticks so that dirt and dust does not enter the system.
6. Never inspect the fan belt or attempt any maintenance when the engine is running. Always stop the engine before carrying out the maintenance.
7. Do not remove the radiator cap when the water is hot. There is danger of boiling water spurting out. First release the internal pressure before removing the cap.
8. When working in a dusty location, be careful of the following.
   a) Inspect the “Dust Indicator” frequently to see whether the air cleaner is clogged. If it is, clean the air cleaner element (outer) as soon as possible. Also, the condition of dust indicator has to be closely monitored.
   b) Clean the radiator core periodically so that it does not become clogged.
   After washing, use compressed air to remove water particularly when the equipment are working near cement or chemical factories, because the dust will permanently set or corrode the metal surfaces in the presence of water/moisture.
9. When checking or changing the oil, do it in a place free of dust and prevent any dirt from getting into the oil.
10. Before draining the oil, warm it up to a temperature of around 50°C.
11. If a strainer is located in the oil filler, the strainer must not be removed while adding oil.
12. When changing the oil or filter, check the drained oil and filter for any signs of metal particles or other foreign materials.
13. After replacing fuel filter elements, bleed the air from the circuit.
14. When dismantling & reassembling parts containing O-rings, gaskets or seals, clean the mounting surfaces and replace with new sealing parts.

MAINTENANCE TABLE

MAINTENANCE TABLE

IMPORTANT: The checks / maintenance are to be carried out as per the following tables. These are to be done in conjunction with equipment periodic maintenance. When carrying out 250hrs, 500hrs, 1000hrs, 2000hrs, etc. maintenance, it is mandatory to carryout the daily & 50hrs. maintenance also.

[A] CHECK BEFORE STARTING (DAILY MAINTENANCE):

Sl. No.	ITEM	SERVICE
a.	Oil, Water and Fuel	Check leakage
b.	Coolant level	Check and Fill
c.	Fuel level	Check and Fill
d.	Engine Oil level	Check and Fill
e.	Dust Indicator	Check and clean air cleaner element (only outer)
f.	Water Separator	Inspect Float Position and Drain Water
g.	Electrical Wiring	Check for loose connections
h.	Fan / Alternator Belt Tension.	Check and Adjust

[B] 50hrs. (For High Altitude & Sub zero operating condition only)

Sl. No.	ITEM	SERVICE
a.	Fuel Pre-filter	Replace Cartridge *

* If the ambient temperature is above 5°C or if the fuel is of good quality (i.e. the pour point of the fuel used is 5°C less than the prevailing ambient temperature), then the fuel pre-filter element can be changed as per normal recommendation.

[C] INITIAL 250 HOURS:

Sl. No.	ITEM	SERVICE
a.	Fuel Pre-Filter & Fine Filter	Replace Cartridges
b.	Engine Oil and Filter	Change Oil and Cartridge
c.	Engine Valve Clearance	Check and Adjust

[D] EVERY 250 HOURS SERVICE:

Sl. No.	ITEM	SERVICE
a.	Fuel Pre-Filter & Fine Filter	Replace Cartridges
b.	Engine Oil and Filter	Change Oil and Cartridge
c.	Radiator Fins	Check and Clean

[E] EVERY 1000 HOURS SERVICE:

Sl. No.	ITEM	SERVICE
a.	Turbocharger - Fasteners	Check and Re-tighten

[F] EVERY 2000 HOURS SERVICE:

Sl. No.	ITEM	SERVICE
a.	Alternator and Starting Motor	Check performance
b.	Turbocharger	Check Axial and Radial Play
c.	Vibration Damper	Check for any crack./breakage/leakage
d.	Engine Valve Clearance	Check and Adjust
e.	Engine Breather	Clean Element

[G] EVERY 4000 HOURS SERVICE:

Sl. No.	ITEM	SERVICE
a.	Water Pump	Check
b.	Air Compressor	Check (If applicable)
c.	Intake and Exhaust manifold fasteners	Check and Re-tighten

[H] WHEN REQUIRED:

Sl. No.	ITEM	SERVICE
a.	Water Separator	Drain Water
b.	Air Cleaner Element (outer)	Check & clean. To be replaced after '6' times of cleaning along with inner element.
C.	COOLANT	CHANGE ONCE IN A YEAR
d.	Electrical Intake Air Heater. (For cold starting)(If provided)	Check before start of winter season

NOTE:

The corrosion resistors are being dispensed with in a phased manner in lieu of Beml Anti-Corrosion Fluid (ACF). If found on engines, the corrosion resistor valves should be closed when ACF is used, hence, the corrosion resistor cartridges need not be changed.

CAUTION:

DO NOT USE BEML ANTI CORROSION FLUID (ACF) AS COOLANT DURING COLD WEATHER OPERATION BECAUSE BEML ANTI CORROSION FLUID IS NOT A SUBSTITUTE FOR ANTI-FREEZE COOLANT. "SERVO COOL" OF M/S IOC OR EQUIVALENT MAY BE USED AS ANTIFREEZE.

FUEL, COOLANT AND LUBRICANT

FUEL , COOLANT AND LUBRICANT CHART

<table>
<tr><td rowspan="9">Reservoir</td><td rowspan="9">Kind Of Fluid</td><td colspan="8">AMBIENT TEMPERATURE</td><td colspan="2">Capacity(L)</td></tr>
<tr><td colspan="8">-4 14 32 50 68 86 104 122 ºF
-20 -10 0 10 20 30 40 50 ºC</td><td>Specified</td><td>Refill</td></tr>
<tr><td colspan="8"></td><td rowspan="5">As per shop manual</td><td rowspan="5">As per shop manual</td></tr>
<tr><td colspan="8">SAE 10W 30 (For Non Emission Engine – CF4)
(For BS-I/BS-II – CH4)
(For BS-III & above – CI4)</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">SAE 15 W 40 (For Non Emission Engine – CF4)
(For BS-I/BS-II – CH4)
(For BS-III & above – CI4)</td></tr>
<tr><td colspan="8">ASTM D975 No. 2* / HSD*</td></tr>
<tr><td>ASTM D975 No. 1</td><td colspan="7"></td><td colspan="2"></td></tr>
<tr><td>Cooling System</td><td>Coolant</td><td colspan="3">Antifreeze coolant</td><td colspan="4">BEML premixed Anti Corrosion Fluid (ACF)</td><td colspan="2">Total system capacity as per O&M and shop manual</td></tr>
</table>

* Check the suitability of fuel available at the site with respect to pour/ cloud point when the temperature is very low (- 10ºC ~ + 10ºC). If not found suitable, contact fuel suppliers for proper fuel or take their advice for adding pour point depressants. If any blending is taking place at site, then the lubricity of fuel should be taken care of by adding proper additives, otherwise, the fuel injection equipment (FIE) will land up in premature failures.

NOTE :

1. When sulphur content in fuel is less than 0.5 %, change oil in the oil pan as per periodic maintenance hours described in this manual

   Change oil according to the following table if sulphur content in fuel is above 0.5 %

SULPHUR CONTENT IN FUEL	**CHANGE INTERVAL OF OIL IN ENGINE OIL PAN**
0.5 TO 1 %	1/2 OF REGULAR INTERVAL
ABOVE 1 %	1/4 OF REGULAR INTERVAL

2. Suitable multigrade oil can be used for varying ambient temperature (day/night)
3. Avoid mixing of different brands of oils even if the grade of oil is same.
4. Use oil with API classification CD or better.

COLD WEATHER OPERATION

PREPARATION FOR COLD WEATHER OPERATION PERFECTNESS

In cold weather, it is frequently experienced that an engine which gets easily started in summer becomes difficult to start and in the worst case the engine becomes frozen. Greater care should therefore be exercised in cold weather maintenance & handling of the machine as suggested below.

01) USE LUBRICANTS WITH CORRECT VISCOSITY RATING:
Since lubricating oil increases in viscosity as atmosphere temp. goes down, oil should be replaced with less viscous one, for cold weather use.

02) Fuel of low pour point shall be used. ASTM D975 No.1 diesel fuel or equivalent should be used at atmospheric temperatures lower than -10°C. The pour point of the fuel should always be lower than the prevailing ambient temperature (at least 5°C lower than the lowest temperature of the day).
For atmospheric temperature ranging from +10 ^{0}C to -10 ^{0}C, proper additives should be added to standard fuel so that the pour point is kept always lower than the atmospheric temperature to avoid premature failure of fuel injection pump and injectors. If std. diesel with lower pour point is available at the operating site, then additives may not be required. PERFECTNESS

CAUTIONS FOR USING ANTIFREEZE

1.Cooling systems must be thoroughly flushed before filling with BEML premixed ACF..
2.Below -15°C, coolant selection to be referred to manufacturer.

BATTERY

The capacity of a battery for holding electricity is low when the ambient temperature is low. This means that the battery is more liable to rundown than in warm weather. Keep the battery fully charged at all times in cold weather.
When electrolyte level in the battery is low, add distilled water in the morning before work instead of after the day's work. This is to prevent the fluid from freezing at night.

USE OF AIR HEATER

Use air heater when the ambient temperature goes below 0°C or when it becomes difficult to start the engine during cold season.

PROCEDURE:

1. Energize the circuit.

2. Switch on the heater as detailed below:
   For 0°C to -10°C: 10 to 15 sec,
   For -10°C to -20°C: 20 to 30 sec.,

1. Turn the starting key switch to ‘ON’ position. Once the engine is started, release the starting key switch. If the engine does not start, repeat the exercise after an interval of 1 to 2 minutes.

2. Put the engine in part throttle condition.

3. If the engine is rough, the heater may be used for 10 to 30 seconds more.

NOTE:

When ambient temperature starts rising, change lubricating oil and fuel to that of recommendation and add Beml ACF to coolant.

CAUTION:

Prolonged use of heaters will cause engine knock, draining of battery and failure of heaters.

! WARNING:

Do not use ether for cold starting, it may cause explosion when used with air heater.

TROUBLE SHOOTING

TROUBLE SHOOTING GUIDE

THIS GUIDE IS NOT INTENDED TO COVER EVERY CONDITION, HOWEVER, MANY OF THE MORE COMMON POSSIBILITIES ARE LISTED.

ENGINE:

- Oil pressure gauge pointer will not return to its original position, when the engine is shut down and Oil pressure gauge pointer fluctuates abnormally.

  Defective oil pressure gauge.

  Insufficient oil in oil pan.

- Oil pressure gauge pointer stays within the red range on dial.

  Insufficient oil in oil pan.
  Oil leakage due to damaged piping,
  Loose piping joints or connections.
  Defective oil pressure gauge.
  Oil leakage from full-flow filter.

- Steam spurts out through the pressure relief valve on the radiator.

  Insufficient coolant or coolant leakage.
  Loose fan belt.
  Clogged radiator fins or damaged fins
  Defective coolant temperature gauge.
  Defective thermostat or its seal.
  Leaky thermostat seal.

- Coolant temperature gauge pointer stays in the red range on dial during engine running.

  Defective thermostat.
  Defective coolant temperature gauge.
  Clogged radiator fins or damaged fins.
  Defective fan belt/tension
  Rise in oil temp. of power train.
  Lack of coolant.

- Engine fails to start.

  Insufficient fuel in fuel tank.
  Air in fuel line.
  Insufficient torque of starting motor to crank up engine.
  No fuel in fuel filter.
  Poor battery condition

- Engine does not start when the starting motor is operated.

  Check for sufficient fuel.
  Check for air leaks in the fuel system.
  Check whether fuel filters have choked.
  Replace the injection pump or the nozzle.
  Check the valve clearance.
  Check engine compression pressure.
  Use cold starting aid where required.

- Engine emits white or blue-white exhaust gas.

  Excessive oil in oil pan.
  Improper fuel use.
  Oil leaks in turbocharger.

- Exhaust gas occasionally turns black.

  Clean or replace the air cleaner element.
  Check & replace the FIP nozzle.
  Check engine compression pressure.

- Engine emits black exhaust smoke.

  Clogged air cleaner elements.
  Worn cylinder components.
  Failure of turbo charger.
  Excessive injection of fuel.

- Engine runs but operates erratically (Hunting)

  Air in fuel supply lines.
  Defective governor mechanism.

- Engine knocks.

  Use of improper fuel.
  Overheat.
  Excessive usage of air heater.
  Improper FIP timing.

- Fuel sometimes stops flowing.

  Strainer in fuel feed pump clogged.
  Breather in fuel tank clogged.
  Leak of fuel
  Air entry in the fuel system

- Engine stops during operation or does not take load.

  Insufficient supply of fuel.
  Clogged fuel filter.
  Clogged feed pump strainer.
  Leakage from fuel piping.
  Breather in fuel tank clogged.

- Engine does not pickup smoothly.

  Insufficient intake of Air
  Insufficient supply of fuel.
  Improper condition of fuel injection system.
  Improper fuel used.

- Abnormal wear of fuel system components (sub-zero operating condition).

  Improper fuel (poor lubricity of fuel).
  Premature clogging of fuel filters due to fuel gel formation.
  Excessive water in the fuel.

ELECTRICAL:

- Ammeter deflects widely when engine runs constantly. Headlamps are dark when engine speed is at maximum. Headlamps flicker when engine is running.

  Wiring is defective.
  Improper Alternator belt tension.

- Ammeter doesn't deflect when engine is running.

  Ammeter is defective.
  Wiring is defective.

- Starting motor does not operate when turning on starting switch.

  Wiring is defective.
  Starting switch is defective.
  Batteries are discharged.
  Battery switch is defective.

OPERATION AND MAINTENANCE TIPS

1.0 GENERAL

01 Compulsory habit of carrying out routine daily maintenance before starting.

02 Initial warming up of engine before putting on load.

03 Check for abnormal noise.

04 Check for abnormal smoke color (visual observation).

05 Check for abnormal blow-by (visual observation).

06 Avoid prolonged low idling and high idling of engine.

07 Before stopping the engine, put it in low idle and check for leakage.

08 Frequent monitoring of dashboard gauges while operating the equipment to avoid engine damage.

09 Avoid lugging and sudden acceleration.

10 Attend to any minor problems without postponing, particularly w.r. to leaks & fire hazards.

11 Sufficient care should be taken when the equipment is going down the gradient since there is a chance of engine being over driven (run) by the drive line, which will cause major damage to engine.

12 In the case of viscous damper, change the same for every 10000 ~12000 hours of operation and do not recondition it.

13 Ensure stocking of consumable spares like filter cartridges, air cleaner elements, belts etc.

14 Avoid cleaning and reusing of air cleaner elements beyond the recommendation (6 times max.). Don't wash & reuse fuel and oil filters.

15 Avoid non-genuine spares.

16 Any strainer such as wire mesh etc., if damaged /punctured / torn the same to be replaced immediately.

17 The engine should be started periodically (atleast once in a month) when the equipment is in storage.

18 In case the engine is stored for long periods, charge turbocharger and lube oil system with fresh oil and do cold cranking before starting the engine.

19 Use proper clamps for hose connections.

20 Whenever drive line (engine mounted assembly) is disturbed, check crankshaft endplay after re-assembly.

21 Check engine anti vibration mounts for cracks periodically and replace if necessary.

22 Disconnect electrical system (negative terminals of alternator, starter and battery) while carrying out any welding on equipment. This is to avoid failure of electrical/electronic components.

23 If any repair work needs to be carried out, it should be done in a protective environment.

2.0 AIR INTAKE SYSTEM

2.1 Maintenance Tips

01 Clean element only when required (ref. Dust indicator) to increase service life of the element.

02 Do not clean inner element (barrier filtration). Clean only the outer element to the specified number of times **(6 times max)**. Make use of the stickers marked from 1-6 on the metal portion by removing each sticker whenever that numbered cleaning is completed (For example, if you are cleaning for the 2nd time, remove the sticker numbered 2 & so on).

03 While changing the outer element change the inner element also as a set.

04 Use correct air jet and avoid excess air pressure (recommended is 2 to 5 Kg /cm.^{2}) while cleaning the element.

05 After cleaning the outer element check for puncture of filter paper, if damage is noticed, change as a set.

06 First clean the air cleaner body's inner surface after removing the outer element, but before removing the inner element (while changing both the elements). This is to avoid dust entering into intake pipe during changing of elements.

07 Check condition of rubber seal of elements, wing nut sealing and rubber seating surfaces. When in doubt immediately confirm the sealing perfectness by suitable means.

08 After removing inner element check the inner surface of intake pipe for any dust presence. This gives an indication whether sealing is perfect or not.

09 Check the condition of gasket (if disturbed) which is used in between air cleaner body and air connector flange. If surface is uneven, use double gasket or change the defective component.

10 Check the rubber hoses and elbows for proper clamping, tightness of clamps, surface cracks, aging, puncture etc periodically.

11 Check for weld joints of pipe for any cracks periodically.

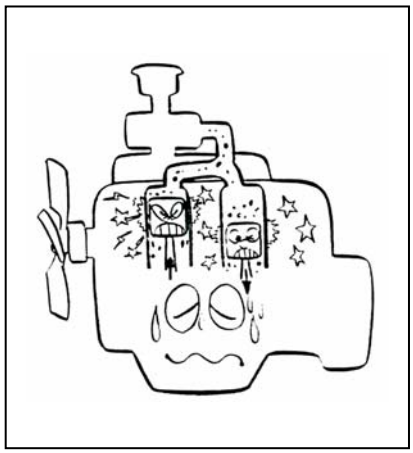
12 If piping is dismantled 'or' reworked for any reasons, then the same to be thoroughly cleaned (particularly weld spatters) and leak tested. Proper clamping of pipe structure to be ensured.

13 It is advisable to have dust indicator with wire mesh

14 When dust indicator is changed (due to damage) ensure correct specification. **Engine should not be operated with broken dust indicator. A plug should be fitted till a new dust indicator is fitted.**

15 Provide a suitable cover or shield if rain entry or dust condition at air entry point is excessive.

2.2 CHECKING AND CLEANING OF AIR INTAKE PIPE

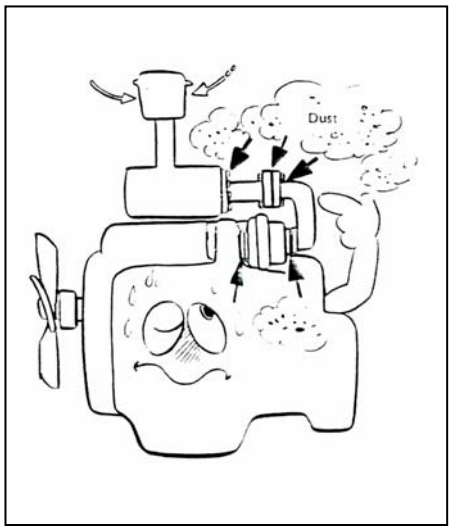


The air which does not pass through the air cleaner i.e. sucked into the cylinder due to leaks between the air cleaner & cylinder head, will cause wear of the Piston, Rings and Liners and thereby shorten the life of engine.

If there is leakage from the inlet pipe coupling part or rubber hose, or if the clamp is loose, immediately repair or replace as necessary.

When servicing the intake system, be careful to ensure that dust does not enter into it.

Possible areas of air leakage



a). Leaking or loose connecting parts of intake pipe.
b). Leaking or loose connecting part of Intake connector (cross over).
c). Broken rubber connecting hose.
d). Loose or missing hose clamps.
e). Loose intake manifold fasteners.
f). Missing plugs.
g). Broken dust indicator.
h). Improper sealing of air cleaner elements in the body.
i). Broken or damaged intake system parts.

NOTE:

If an equipment is operating in a remote area where compressed air facility is not available for element cleaning, then a dedicated air cleaner element may be provided as stand-by. Always keep in mind that the inner element also has to be replaced after 6 cleanings of the outer element i.e. both the elements together.

CAUTION:

Any lapses in 'Air Intake System' maintenance or noncompliance shortens the engine life by way of accelerated wear of cylinder liner, piston, piston rings & bearings and also results in faster deterioration of engine lube oil.

2.3 CLEANING AND CHECKING OF AIR CLEANER ELEMENT

Cleaning of Air Cleaner Element

Checking Element for crack/torn paper

2.4 DO's AND DON'Ts WHILE replacing Air Cleaner Elements:

7 Important Steps to Follow : Do's

Every time an Air cleaner element is replaced.

Note : Be sure to empty pre-cleaner bowl or cup as required

Always clean the inside of the housing carefully without allowing dust to enter the intake ducting.

Press your Air cleaner gasket to see if it springs back

Remove the old element as gently as possible.

Always clean the gasket sealing surfaces of the housing

Make sure the gasket is seating evenly

Check for uneven dirt patterns on your old element for indications of gasket leakage.

Check connections and ducts for leak-tight fit

7 Important Steps to Follow : Don'ts

Always remember about Air cleaner Servicing

Never judge your element's life by looking at it.

Don't use a dented or bunched filter element.

Don't remove element for inspection

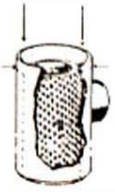
Never leave an air cleaner open longer than necessary

Never use a warped cover on a housing

Never rap an element to clean it, rap to destroy it

Don't overlook a worn or damaged gasket in the housing

Never substitute an incorrect element model



CAUTION: USE PROTECTIVE GADGETS WHILE CLEANING THE ELEMENT.

3.0 LUBE OIL SYSTEM

3.1 Maintenance Tips:

01 Use correct oil (engine oil), grade and class as per recommendations and ambient temperature.
02 Do not mix different brands, grades and classes of oils.
03 Change the engine oil & cartridge(s) if the engine is stored for longer periods (more than 6 months) before starting.
04 Always drain oil (during oil change) when it is warm.
05 Immediately after oil servicing, tightness of drain plug is to be doubly ensured.
06 New oil filter to be always filled with fresh oil before mounting the cartridge.
07 CARTRIDGE TIGHTENING PROCEDURE
a). Apply a thin coat of oil on the rubber seal.
b). Hand tighten the cartridge fully till the seating surface (seal) comes in contact with head.
c). Tighten further using a filter wrench to 90°~120°

Note :

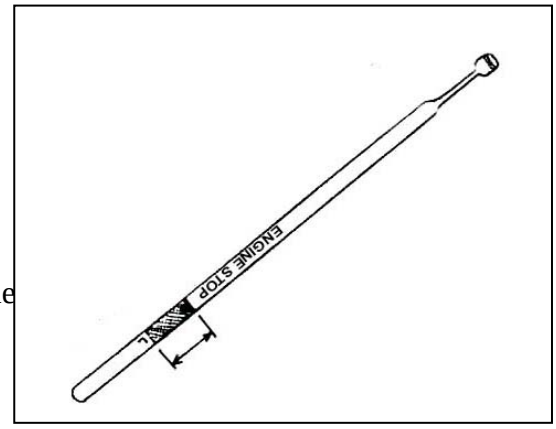
- Check for debris/metal particles in the old cartridges. If present, investigate.
- Check the condition of seal before fitting.

08 If oil becomes thin or thick check for reasons.
09 Avoid usage of bent or damaged oil level gauge (dipstick).
10 If oil consumption suddenly becomes excessive, investigate immediately.
11 If oil level increases check for reasons.
12 Never keep oil filler tube open.
13 Frequently monitor the oil pressure while operating the equipment.
14 If any oil leakage is noticed, immediately rectify as “oil starvation causes major damage to the engine”.
15 Sudden stoppage of engine will damage the turbocharger, therefore run the engine at low idle for few minutes before stopping.

3.2 Checking Oil Level :

- Check the oil level using the dip stick gauge.
- If the oil level lies between the H & L mark on the gauge, then the oil quantity is normal.

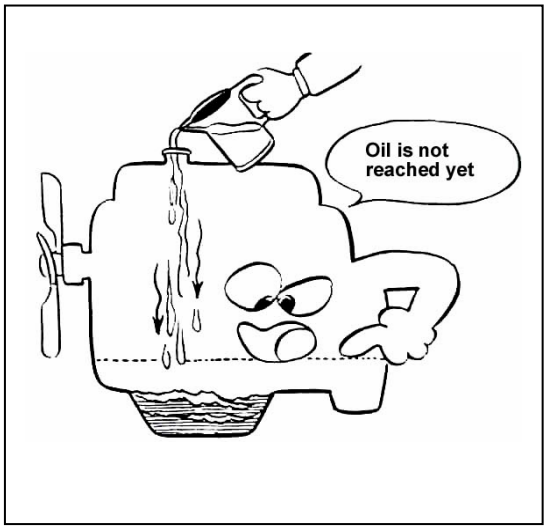
Note :
The oil level shall be checked when the vehicle or engine is in the horizontal position.



Caution :

The dip stick (level gauge) is provided with marking on both sides to enable to measure the oil level either at engine stop condition or at low idle operating condition. Therefore appropriate side shall be selected while measuring the engine oil level.

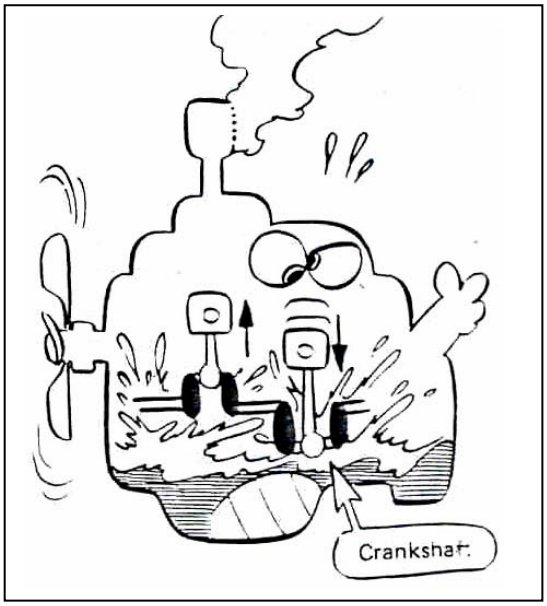
3.3 What to do when oil level is insufficient :



When oil level is insufficient add oil up to the 'H' level.

- When adding oil from the top of cylinder head, Check the level 3 ~ 6 minutes after adding the oil.
- When replenishing the oil, make a note in the logbook. If the amount added has increased by an abnormal amount or is excessive in comparison to earlier consumption pattern, make an **oil consumption** diagnosis and remove the cause of the trouble.

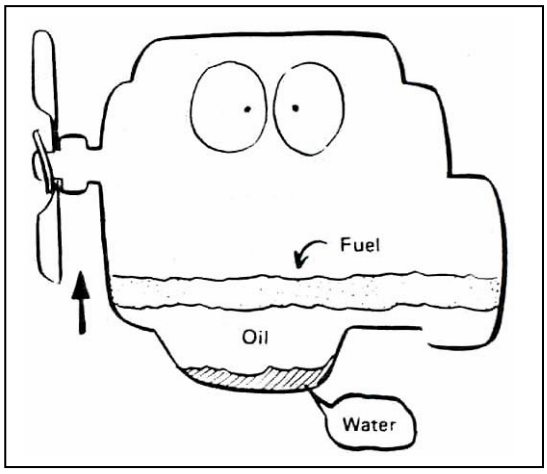
3.4 What to do when oil quantity is excessive :



1. Check why oil quantity is excessive.

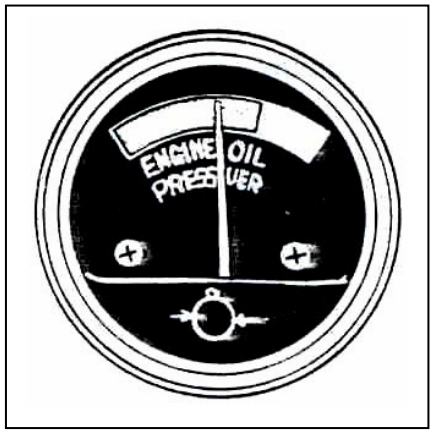
2. If oil is excessive because too much was poured in, drain OFF the excess oil until specified level is reached.

3. If there is excessive oil, one of the following problems may occur. Therefore do not ignore the problem assuming that **"The oil level will drop eventually"**
   a) Oil leaking upward and oil combustion.
   b) Output loss (due to crankshaft web hitting oil).
   c) Increased rate of contamination or deterioration of oil (due to a or b).

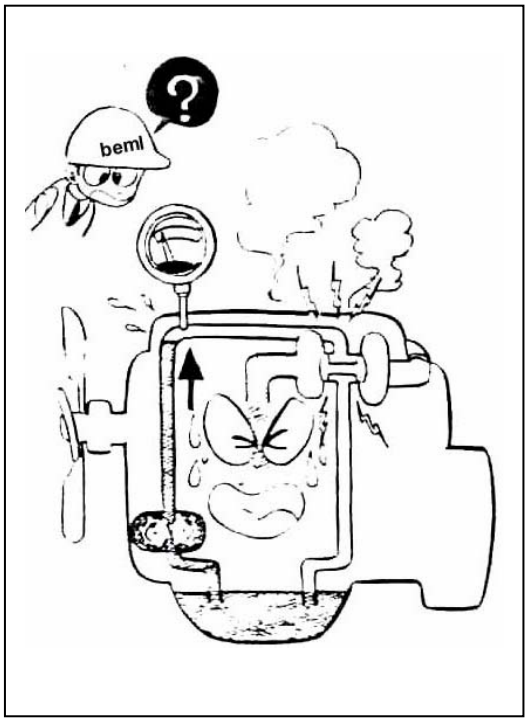


4. If the oil level increases due to ingress of cooling water or fuel, it is due to internal leakage in the engine. Such a problem may lead to seizure or other major problems of engine. Accordingly, diagnose the problem and remove the cause.

3.5 Monitoring Of Oil Pressure Gauge



1. Check whether or not the pointer of oil pressure gauge is within the green range when the engine is running. If the pointer is in the red range or the value is less than the limit specified in the shop manual, immediately stop the engine & investigate.
2. In case of an engine which has low oil pressure warning lamp (mounted on the panel), check whether or not the lamp lights up when the engine is running. If the warning lamp lights up, immediately stop the engine & investigate.

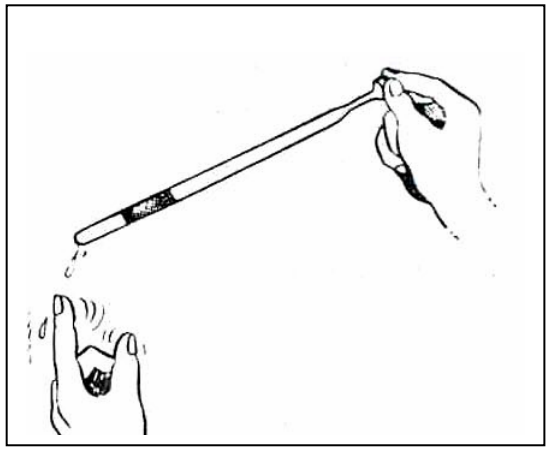


3. If the engine is started and then immediately accelerated to high speed before the oil pressure has risen (before the oil has spread to the various parts of the engine), seizure and other problems may result.
4. Immediately after starting a cold engine, oil pressure gauge pointer may swing beyond the normal operating range (i.e. green range). In such cases lower the engine speed and warm-up the engine until the oil pressure gauge pointer comes to the normal operating range.

CAUTION: When an equipment is deployed for operation on a **higher gradient**, the following precautions are mandatory.

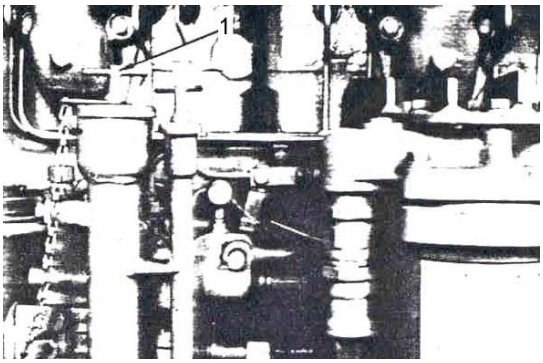
- Maintain oil at 'H' level, preferably a little more.
- Pressure gauge & warning systems (if provided) should be in good condition.
- Pressure gauge has to be continuously monitored by the operator.
- Gradient limit should never exceed the equipment recommendation for safety of operator, engine & equipment.

3.6 Checking Oil for Dirt and degradation :

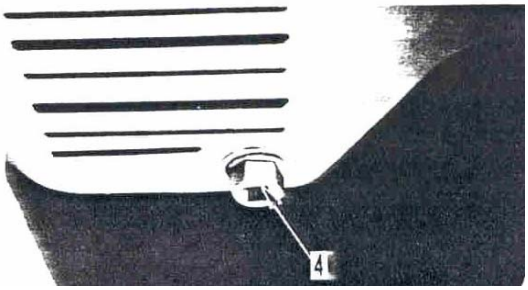


1. Check dirt in oil by observing or feeling the oil adhering to the oil level gauge.
2. With a bit of practice and experience it is possible to judge the oil to a certain extent based on its viscosity. The point to be aware of is the relationship between viscosity and temperature. (In this respect it is a good idea to use our fingers when comparing fresh and used oil).
3. In order to accurately determine the properties of oil, it is necessary to carry out oil analysis. The most important properties of oil are viscosity, flash point, alkalinity and also presence of water.

3.7 Checking Oil for ingress of Water / Coolant:

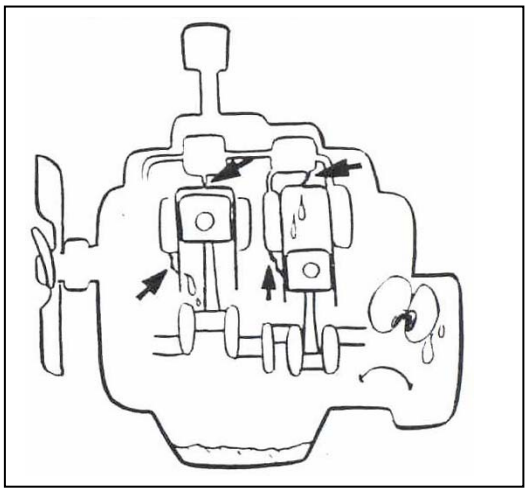


1. If water / coolant has got into the oil, this can be determined by an increase in the oil quantity, whitening of oil and reduction of coolant.
2. Remove oil filler cap (1) and check whether or not water droplets are adhering to the inside surface of the cap. This is easy to check when the engine has warmed up.



3. Before starting the engine slightly loosen oil drain plug (4) and check to see whether or not water is in the oil.

3.8 What to do if there is water / coolant in oil :



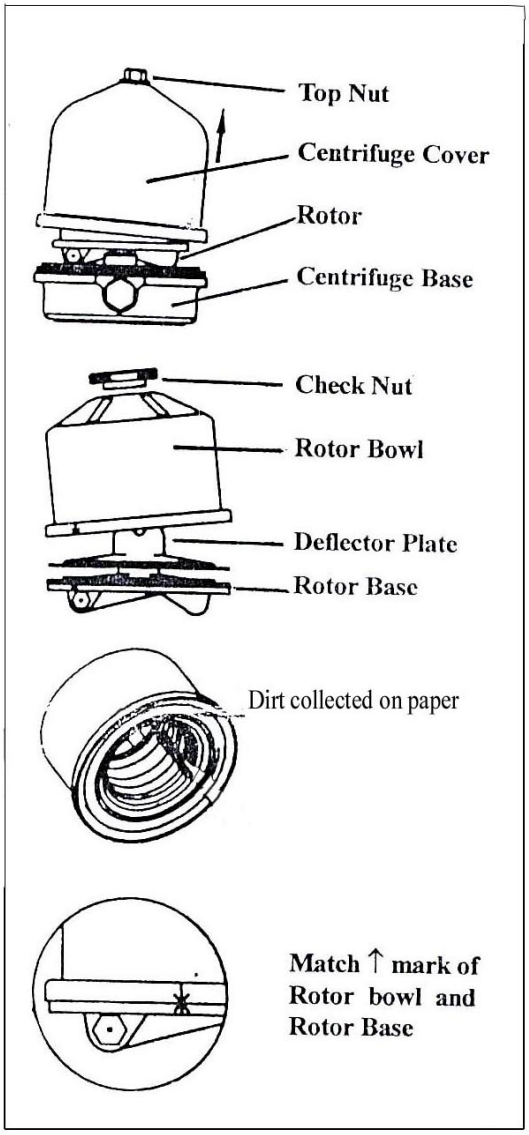
1. With the exception of airborne moisture which condenses in the engine during long term storage or water / coolant which gets into the oil during filling, water / coolant ingress is caused by cracks and leaks inside the engine.
2. If engine is run with water / coolant in the oil there is a risk of engine seizure or damage. Accordingly, investigate and remove the cause of trouble.
3. If a small amount of water / coolant has got into the oil due to some cause other than internal leakage, it is possible to remove the water/coolant by draining it or by allowing it to evaporate during operation. In all other cases, however, replace the oil.

3.9 CENTRIFUGAL OIL CLEANER

Assembly & Disassembly Instructions

Checking Centrifuge Working:

Centrifuge Rotor rotates at about 6000 revolutions per minute on an average. To confirm whether the centrifuge is functioning or not, touch the centrifuge cover immediately after stopping the engine. Rotor rotation can be felt by vibrations for approx. 30 ~ 60 seconds. If not, the centrifuge is not functioning properly.



Disassembly:

1. Lift centrifuge cover by loosening top nut.
   Lift rotor out of centrifuge base.
2. Loosen check nut of rotor (by 2 ~ 3 threads). Tap the rotor check nut by hand while holding the rotor in the other hand. Rotor bowl will get separated from rotor base.
3. Separate deflector plate from rotor bowl.
4. Remove dirt / sludge by lifting the paper provided inside the rotor bowl and discard the dirty paper.
5. Wash all parts with Diesel taking care of rotor and cover O-rings.
   (Do not dip O-rings/rubber parts in Diesel)

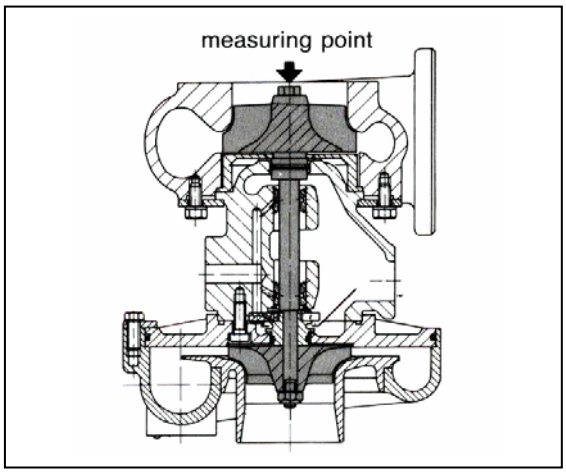
Assembly:

Locate new paper inside the rotor bowl.
Reassemble all parts removed. Replace
Rotor & Cover O-Rings if damaged.
While assembling care is to be taken to properly align match marks↓ on rotor bowl with ↑ mark on rotor base.
Insert rotor on to shaft & install centrifuge cover.
Tighten top nut to about 3 kg.m.
(Do not over tighten)
Run the engine and check for leaks. Feel the free rotation of rotor after stopping the engine.

NOTE:
CENTRIFUGAL OIL CLEANER SHALL BE CLEANED EVERY 250 HRS BY REPLACING PAPER ELEMENT.

4.0 EXHAUST SYSTEM

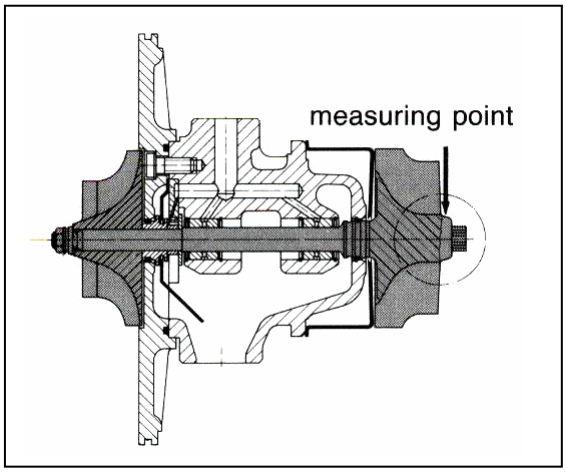
4.1 TURBOCHARGER



Determination of Bearing ENDPLAY

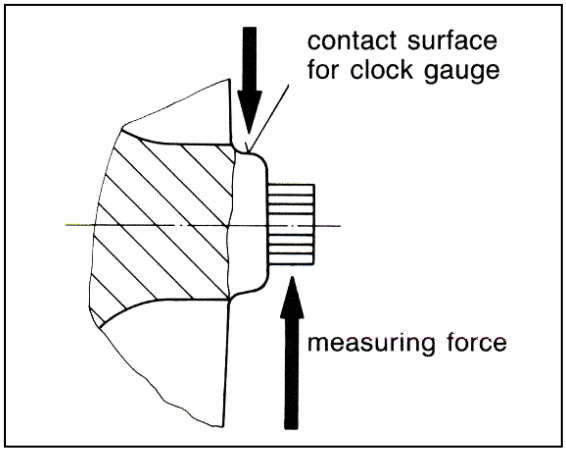
1. Measuring the Axial play

- Place measuring point of dial gauge on top face of turbine wheel hub.
- Press down shaft and turbine wheel assembly and set the dial gauge at "0".
- Press Shaft and Turbine wheel assembly against dial gauge and note indicator "THROW"
- The permissible axial play: 0.025 to 0.075mm MAX.



2. Measuring the Radial play

- Determination of radial play is only necessary at turbine side.
- Place dial gauge measuring point on the center of the cone on the Turbine wheel.
- Pull turbine wheel downward using spring scale. Measuring force : 50N. Set dial gauge at "0".



- Pull turbine wheel upward using spring scale. Measuring force 50N.
- Note the dial gauge "THROW"
- Take this measurement again, with shaft and turbine wheel assembly turned through 90°
- The permissible Radial play: 0.58mm MAX.

CAUTION:

1. Leakage of exhaust gases to be avoided to eliminate fire accidents.
2. Exhaust outlet pipe should be positioned in such a way that allows the proper dispersal of exhaust gases, as it is hazardous.

5.0 FUEL SYSTEM

5.1 Maintenance Tips:

01 Maintain storage & equipment fuel tank in clean condition.

02 Fuel tank lid to be always secured and strainer to be used in the filler pipe. Never use cotton waste for cleaning the fuel tank.

03 Always check for fuel leakage, hose condition and clamping.

04 Use correct length of fuel hoses & ensure proper clamping at the time of replacement.

05 Don't use very old diesel (eg. Stored for more than 1 year).

06 Improper & frequent use of drain cock in the water separator causes poor sealing, thus induces leakage of fuel and air lock.

07 Avoid by-passing the water separator

08 Check and maintain high idle by adjusting the stopper of the accelerator pedal. Adjust the throttle pedal stopper such that the linkage does not overload the fuel injection pump lever (0.2-mm gap to be maintained between Fuel Injection Pump (FIP) lever & stop screw). Never tamper with the FIP seals.

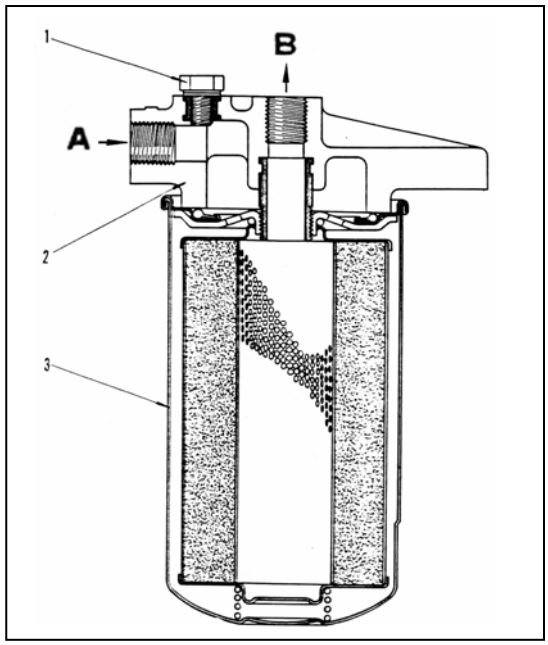
09 Don't over tighten the banjo bolt (with strainer) at the FIP feed pump inlet to avoid collapse.

10 Don't add any additional strainer or filter on the suction side of FIP.

5.2 Fuel Main Filter

1. Air Bleeding plug.
2. Filter Head.
3. Filter Cartridge.

A→ Fuel IN from fuel Pre-filter / feed pump.
B→ Fuel OUT to Fuel injection pump.



The fuel filter is of cartridge type and serves to remove dust/foreign substances of the fuel through filter paper.

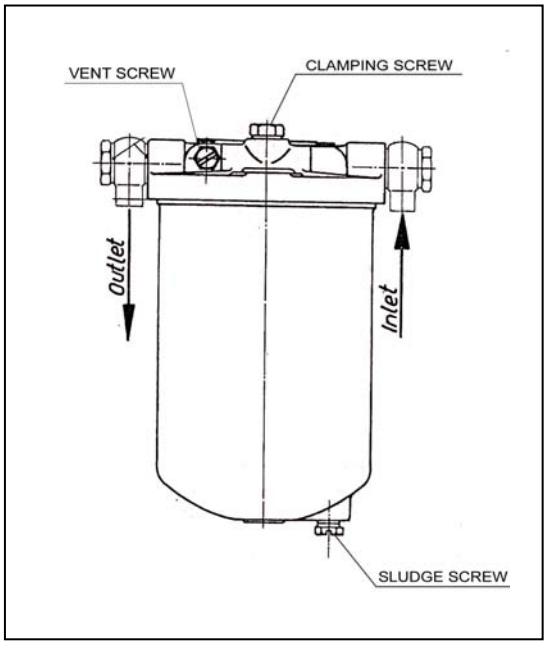
CARTRIDGE TIGHTENING PROCEDURE

1. Apply a thin coat of oil on the rubber seal.
2. Hand tighten the cartridge fully till the seating surface (seal) comes in contact with head.
3. Tighten further using a filter wrench to 90° ~ 120°.

Note :

1. Check for debris in the old cartridges, if present check the condition of fuel in the tank.
2. Check the condition of seal of new cartridge before fitting.

5.3 Fuel Pre-filter



The fuel pre-filter is of insert type in which filter insert is a cloth type element that serves to remove the coarser dust particles in the fuel.

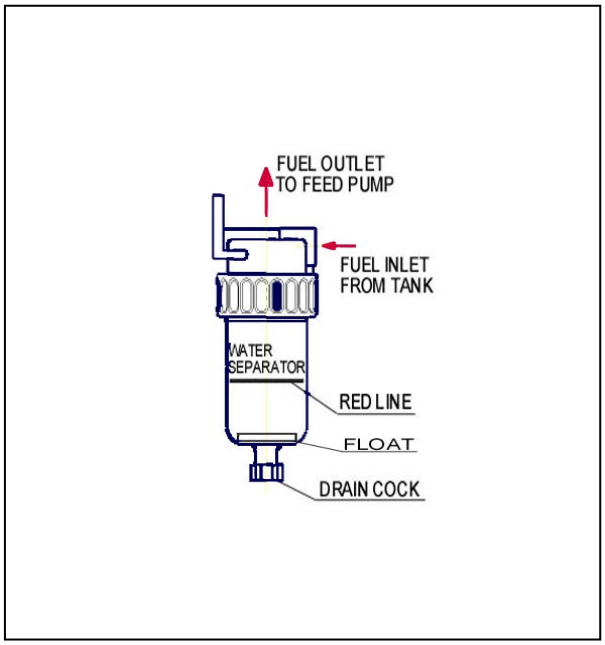
The filter inlet & outlet positions are as shown in the fig. A provision is also given at the bottom of the filter body for removing the sludge that settles at the bottom.

In this type of filter, the body tightening procedure is quite simple. A clamping screw directly fastens the filter head & the body as shown. Avoid over tightening.

Note :

1. Check for debris in the old cartridges, if present check the condition of fuel in the tank.

5.4 Water Separator



Water separator serves to remove the water collected in the fuel by centrifugal action & thereby density difference. The heavier water particles settle at the bottom of the water separator & the lighter fuel remains at the top.

A typical figure of water separator is shown here.

Drain Procedure:

The frequency of water drain has to be decided by looking at the float position in the water separator. When the float (red in colour) reaches the red line (shown in fig.), open the drain cock & drain the water collected at the bottom of the float.

Note:

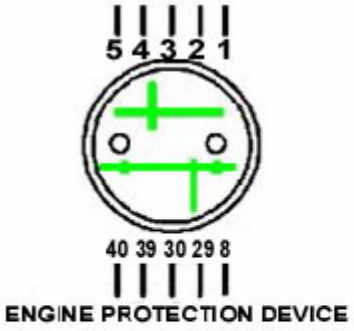
Frequent usage of drain cock may lead to leakage of fuel & air lock, as a result of poor sealing. Therefore, drain water when float reaches the red line.

5.5 ENGINE AUTO SHUT-OFF SYSTEM (Optional)

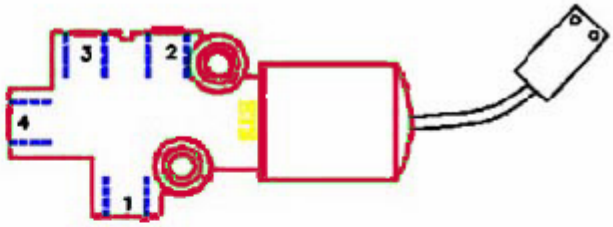
The function of engine Auto shut-off system is to shut-off the engines automatically in case of low engine oil pressure in the main gallery (less than 0.6 kg/cm²) or high water temperature (above 98 degrees Celsius) thereby protecting the engine from damage.

The system consists of

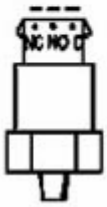
- An engine protection device mounted in the cabin.
- An engine stop valve or a stop solenoid mounted on the engine.
- An oil pressure switch mounted on the main gallery.
- A water temperature switch mounted on the thermostat.
- A wire harness inter linking all the above.



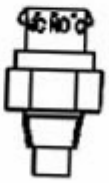
ENGINE PROTECTION DEVICE



STOP VALVE

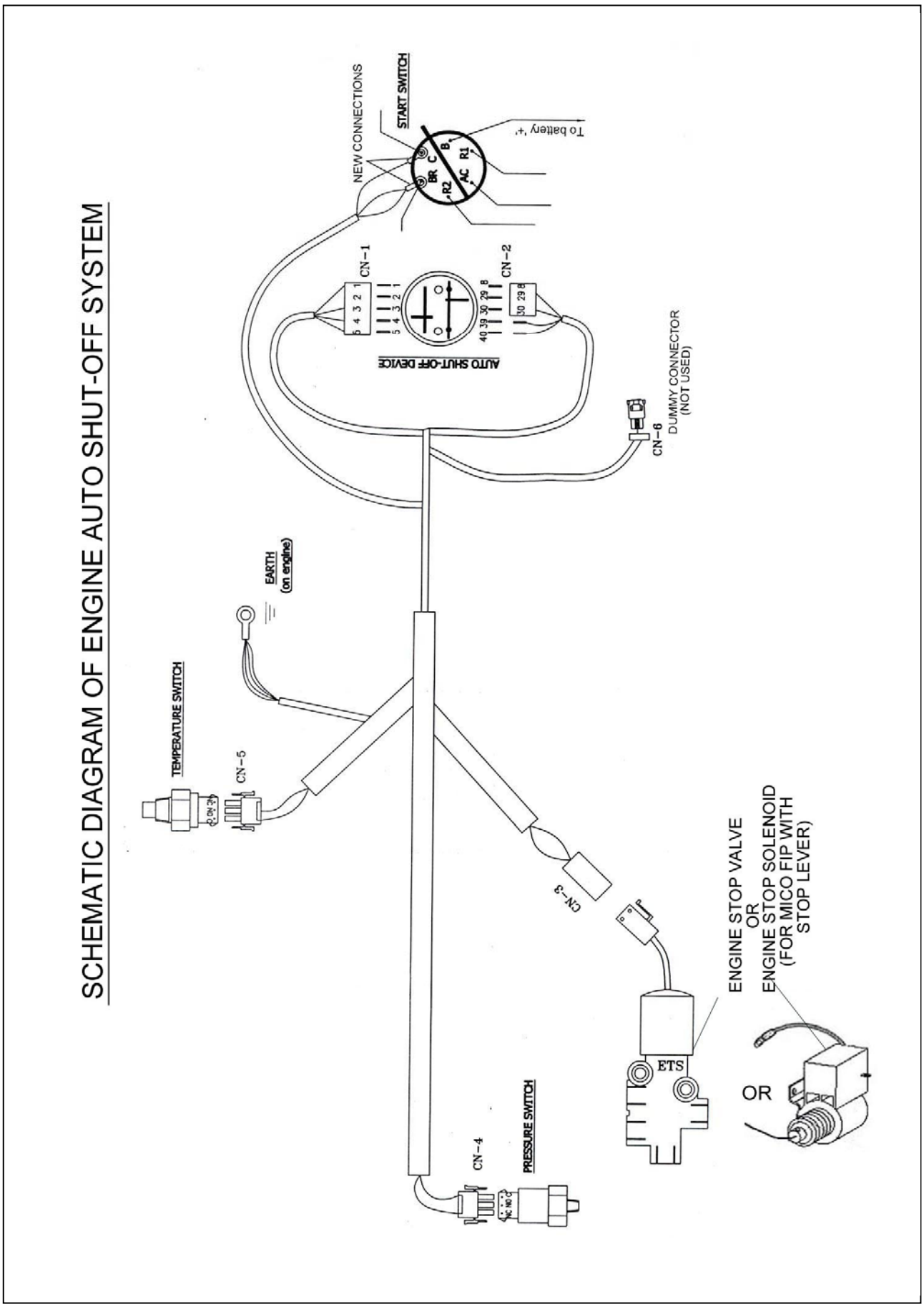


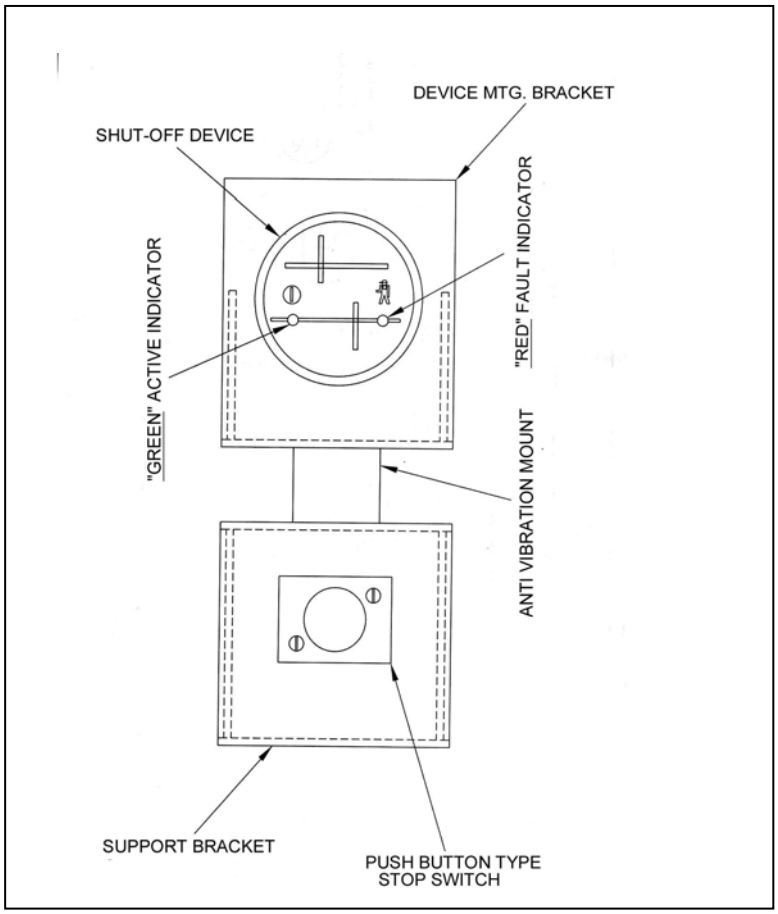
OIL PRESSURE SWITCH



WATER TEMPERATURE SWITCH

The schematic diagram & the operating instructions for the system are given in the following pages.


SCHEMATIC DIAGRAM OF ENGINE AUTO SHUT-OFF SYSTEM
NEW CONNECTIONS
START SWITCH
To battery '+'
BR
C
B
R1
AC
R2
CN-1
CN-2
AUTO SHUT-OFF DEVICE
CN-6
DUMMY CONNECTOR
(NOT USED)
EARTH
(on engine)
TEMPERATURE SWITCH
CN-5
CN-3
ENGINE STOP VALVE
OR
ENGINE STOP SOLENOID
(FOR MICO FIP WITH
STOP LEVER)
ETS
OR
CN-4
PRESSURE SWITCH



5.5.1 OPERATING INSTRUCTIONS

1. Turn the key switch to "ON" position
2. Start the engine.
3. After 20 seconds the GREEN light (refer sketch above) on the Engine Protection Device will be On. This indicates that the device has been activated.
4. In case the engine cannot be started within the first 20 seconds after the operator turns the key switch to ON position, then the fault indicator RED (refer sketch) will be ON since the oil pressure is zero at start position. In such a case the device has to be reset again by turning the start switch to OFF position and once again turned ON for starting the engine after the reason for engine not starting has been found out and rectified.
5. In case the operator turns the key switch to ON position and does not start the engine within 20 seconds then the fault indicator will be ON since the oil pressure is zero at start position. In such case bring the key switch to OFF position and start immediately within 20 seconds.
6. In case of any fault in the engine while running (low oil pressure and / or high water temperature) the RED light on the engine protection device will be ON and the engine fuel cut-off valve will be actuated for 20 seconds, within which the engine is brought to a halt and the RED light is continuously on.
7. After attending to the fault, the device has to be reset by turning the start switch to OFF position and once again turned ON for starting and activating the device.

AUTO SHUT-OFF CONTROL UNIT

Warning:

To prevent damage to sensitive electronic equipment

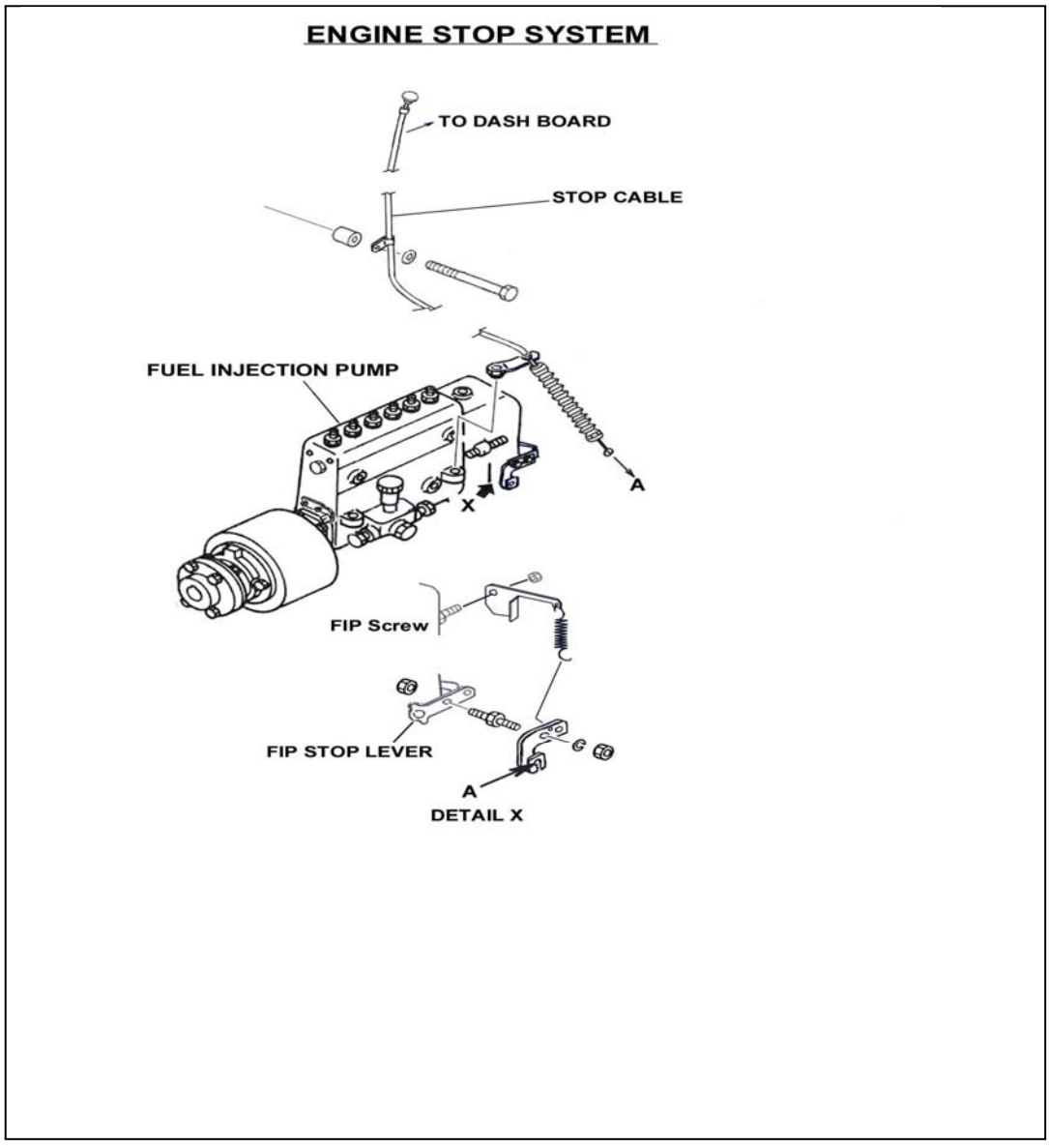
1. Disconnect the sensor and protection device connectors during
   - Equipment welding
   - Battery charging using external charger
   - Jump-starting by other equipment.

2. Follow operating instructions.

5.6 Engine Stop Arrangements

There are 2 types of arrangements in 105 series engines for engine stopping. The arrangements are as explained below with the help of sketches.

5.6.1 WITH STOP CABLE (MECHANICAL)

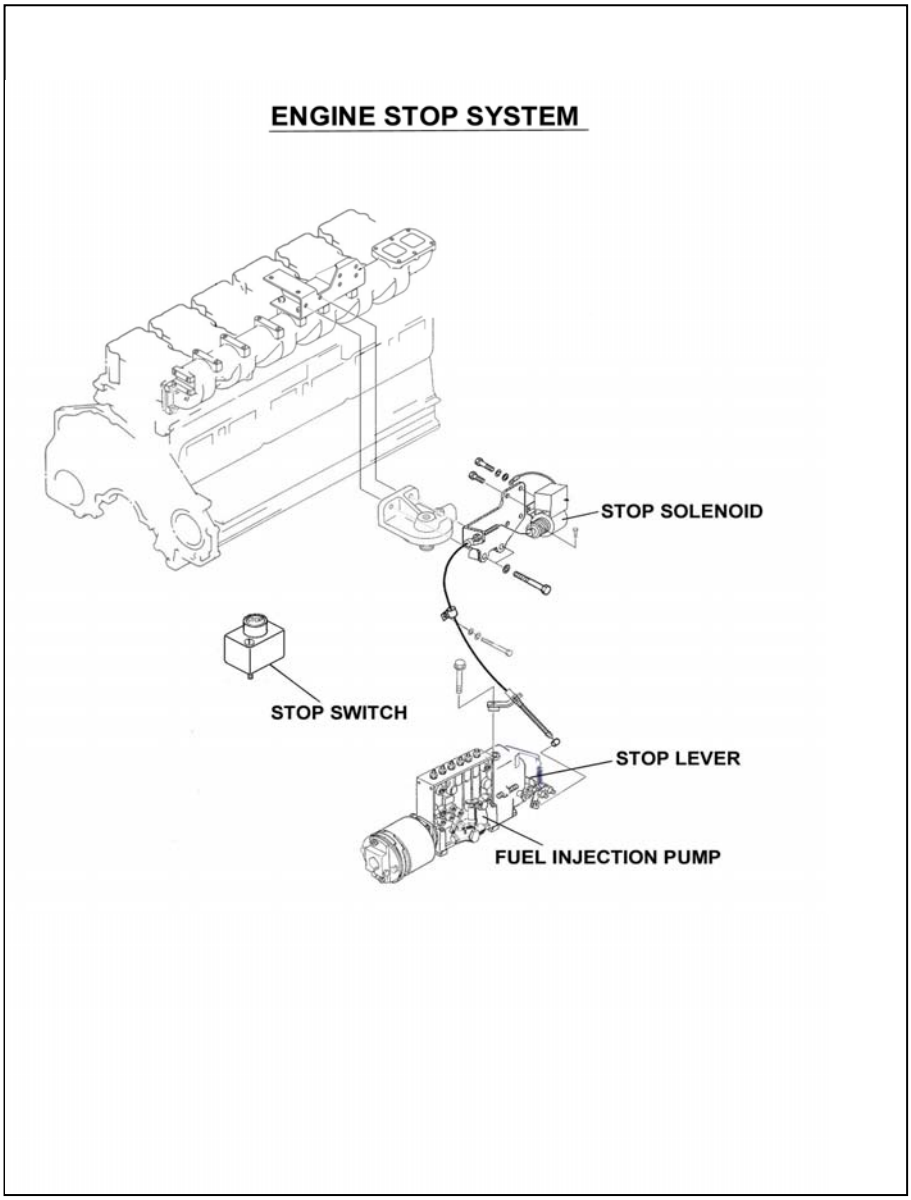


In this type of arrangement, a stop cable is connected directly to the FIP stop lever as shown above. The other end of the stop cable has a knob and is taken to the equipment dashboard. When the stop cable knob (shown above) is pulled, it pulls the FIP stop lever & cuts off the fuel supply from the FIP, thus stopping the engine. Hold the knob till the engine stops.

CAUTION:

After the engine is switched off, make sure that the knob is moved to its original position so that the engine is ready for next start.

5.6.2 WITH STOP SOLENOID (ELECTRICAL) (OPTIONAL)



The above figure shows the arrangement with electrical stop solenoid for stopping the engine. In this arrangement the solenoid is connected to the FIP stop lever through a cable as shown above. The stop solenoid & stop switch (mounted in the operator cabin) are connected through an electrical circuit. When the stop switch (button type) is pressed, the circuit gets energized & the solenoid pulls the stop lever & thus the fuel supply is cut off. The stop switch has to be pressed till the engine gets stopped completely.

NOTE: The key switch should be in 'ON POSITION' (i.e. energized condition) when the stop button is pressed as current has to be drawn from the battery for operating the solenoid.

CAUTION: It's mandatory to use spring loaded stop switch as the switch returns to its normal position when depressed and thus makes the engine ready for its next start automatically.

6.0 COOLING SYSTEM

6.1 Maintenance Tips:

01 Follow the instructions laid down in this manual for maintaining (particularly during cold season) the cooling system. This will eliminate most of the problems normally occurring during operations.

02 Radiator cap is always to be fitted. This will avoid dust collection, coolant loss and system pressure loss.

03 Clean / wash radiator fins periodically. Periodicity to be determined based on the usage and site condition. If water wash is done, in industries like cement the same should be immediately dried completely to avoid permanent setting of particles like cement, or use only air for cleaning. Do not use sharp tools for cleaning tubes / fins as it may puncture them.

04 Always use soft & clean water for preparing the coolant. If containers are used to store or carry the coolant then the same should be free from oil, dirt etc.

05 It is advisable to change the hoses and fan belts periodically since abrupt failure of these items will lead to engine seizure.

06 Always change belts in sets.

07 If anticorrosive solution or antifreeze solution is used, always keep extra solution (water + antifreeze or anticorrosive) in a container so that any loss of coolant during day to day operation could be replenished easily.

08 Check leakage of coolant during engine 'ON' and 'OFF' condition. Any air suction is detrimental to water pump and cooling efficiency. Air pockets will affect the components by way of pitting.

09 When the coolant temperature goes beyond limits, it is advisable to run the engine at medium speed without load & then investigate. Avoid switching off the engine unless there is leakage of coolant or any abnormality.

10 Change the coolant at least once in a year.

11 Observe the coolant temperature rising rate. This will give an indication about the cooling system problem / efficiency, eg. Rapid rise of coolant temperature beyond 75º C indicates that the thermostats are stuck.

12 Radiator (top tank) should not be filled up to the mouth. It should be filled only up to the filler neck. The empty space is meant for coolant expansion and de-aeration.

13 Check the coolant for any traces of oil during daily maintenance.

14 Air vent hose to be as short as possible and it should continuously rise from engine to Radiator.

15 Do not remove strainer from radiator filler tube. Any foreign matter can easily clog the radiator tubes and coolant passage holes in the cylinder head since the tubes and holes have very narrow cross sections.

6.2 BEML Anti Corrosion Fluid (ACF) :

BEML Anti corrosion fluid is being recommended for all equipment fitted with BEML engines. The details of the concentrate along with other recommendations are appended below :

1.ACF-ALP : Anti corrosion fluid aluminium protection.
2 ACF-ALP (EGB) : Anti corrosion fluid with aluminium protection (Ethylene glycol based).

The details of the concentrate along with recommendation are appended below.

ACF-ALP : Colour of diluted solution : Fluorescent Blue.
ACF-ALP (EGB) : Colour of concentrate : Fluorescent Green

The amount of concentrate required for 105 series engine for various equipment model (for initial fill) are as follows (rounded off) [Based on ratio ACF ALP 1:10, ACF-ALP(EGB) 1:2.3).

Engine & Equipment Model	ACF MODELS	Amount of Initial concentrate (litres)	Amount of concentrate (litres)
B6D105-1 on G10T (ATT)	ACF	03	01
B6D105-1 on BL200 Wheel loader	ACF	03	01
BS6D105-1 on BL220 Excavator	ACF-ALP	03	01
BS6D105-1 on BD50 Dozer	ACF-ALP	03	01
BS6D105-1 on BDG 100 DG SET	ACF-ALP	03	01

- The pH value of the mixture (water + concentrate) has to be maintained between 7.5 ~ 9.5 (Check through pH paper).
- Depending on the quality of raw water used, an additional concentration of concentrate beyond 1:15 may be required.
- If the engine is fitted with Corrosion resistor, the corrosion resistor valves should be kept shut while running the equipment with anti-corrosion fluid (the corrosion resistors are being discontinued in a phased manner).
- Before filling the radiator with the anti-corrosion fluid the radiator has to be flushed completely with clean water after closing the corrosion resistor valves.

BEML PREMIXED ACF (ETHYLENE GLYCOL BASED) Effective date applicable from August 2011

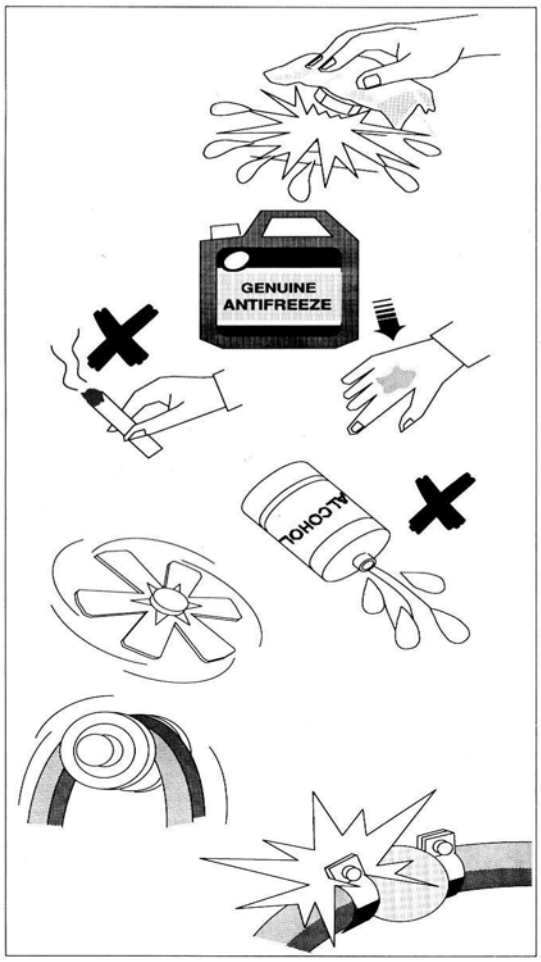
In connection with failures experienced in field due to usage of hard water in field, there was a need to ensure the quality of water to be used in field before mixing of ACF-(Ethylene glycol based).
In order to sort out the above problem, it is proposed to use coolant with ACF (EGB) in pre-mixed condition, in line with other competitors. The colour of the new BEML premixed ACF is **fluorescent yellow.**

And the details of the premixed quantity for the 6D105 series engines are appended below:

Sl.No.	Eng.Model	Application	Coolant Capacity		Total	Top-Up Qty Every 250 hours
			Engine capacity	Radiator capacity		
1	B6D105	BA10T/BL200	14	38	52	10
2	BS6D105	BE200	14	30	44	10
3	BS6D105	BE220	14	30	44	10
4	BS6D105	BD50/BD50-1	14	46	60	10
5	BS6D105	BL14TH/BD14W	14	45	59	10
6	BS6D105	BA18T	14	38	52	10
7	BS6D105	BG405A	14	38	52	10

6.3 CAUTION:

When the radiator is hot, do not remove the cap, boiling water may spurt out.



Always wait for the water temperature to go down before the radiator cap is opened. When removing the cap, use a cloth or gloves to hold down the cap, then loosen the cap slightly to release the steam and lower the internal pressure before removing the cap. (If the cap has a lever, raise the lever to release the internal pressure.) If this procedure is not followed, there is danger of getting burned.

Don't let antifreeze, rust preventive agent or cleaning agent get into your eyes or on skin. If the eyes come in contact, then wash your eyes thoroughly with plenty of clean & cold water and contact doctor immediately.

Ethylene glycol antifreeze solution is flammable. Do not bring any flame close to it.

Do not use alcohol for replacing antifreeze solution. Alcohol has a low boiling point and evaporates easily, hence, it will escape at lower temperatures.

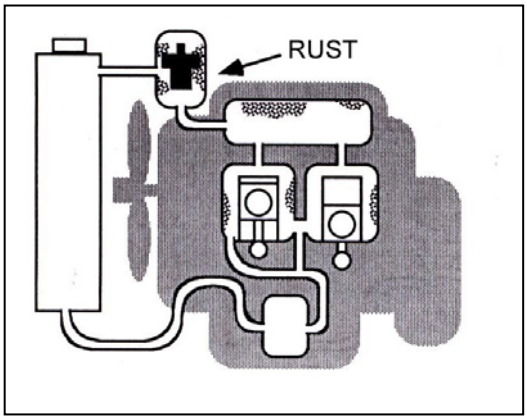
Do not run the engine when the fan guard is not installed. There is a danger of accident taking place.

When the engine is running, do not put your hand near the fan belt.

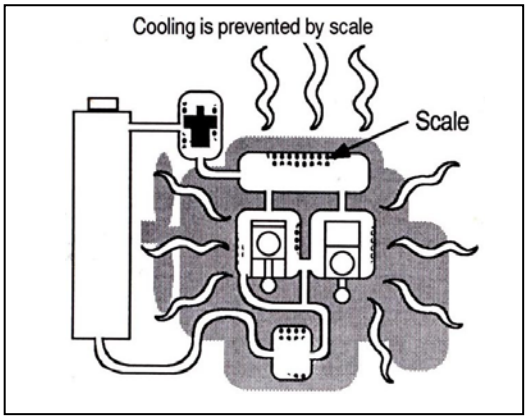
Even if there is leakage, never tighten any hose clamp that is hot or under internal pressure. If the clamp breaks, steam or boiling water will come out and cause serious burns.

6.4 Problems associated with Rust and Scaling of coolant

When engine coolant is used for a long time, it loses its properties and becomes dirty as it comes into contact with rusted surfaces of parts. The dirt in the coolant blocks the passages and radiator tubes and lowers the cooling effect and also encourages corrosion of the cylinder liner and water pump.



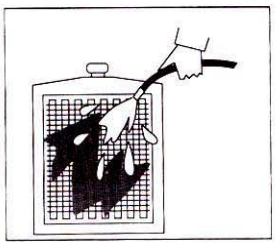
The Calcium and magnesium particles in water form scale and stick to the walls of the water passages. As a result of this, there is a big drop in heat transfer, so pitting is caused by high temperatures at places or it leads to the raise of coolant & oil temperatures and in severe cases can lead to overheating.



6.5 Problems associated with Engine cooling:

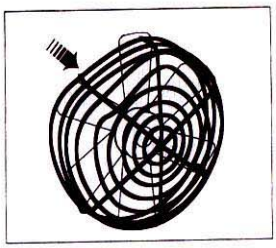
Cooling efficiency depends upon the balance between the amount of heat generated and the cooling capacity. If the balance is lost, there will be overheating or over cooling. It is necessary to check both the parts that generate heat and the part that cool.

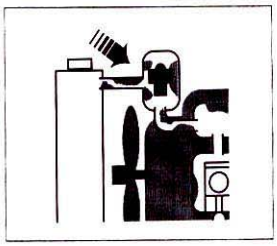
6.5.1 OVERHEATING:



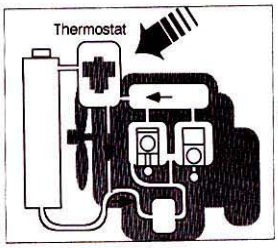
Dirty radiator, crushed fins
If the radiator is dirty or the fins are crushed, the heat dissipation effect will drop. Use high pressure water from time to time to remove the dirt.

Deformation or damage of fan guard
If the fan hits the guard or the guard blocks the flow of air, it will cause overheating.

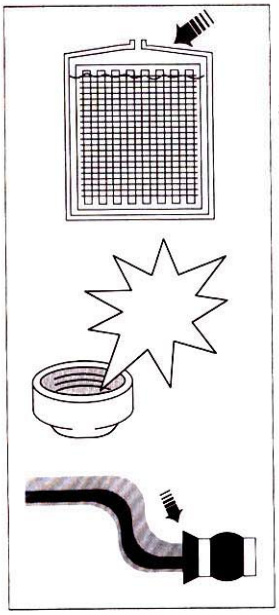




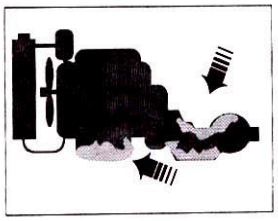
Coolant does not flow
This happens when the coolant is dirty. Clean with fresh water, and use genuine cleaning liquid.



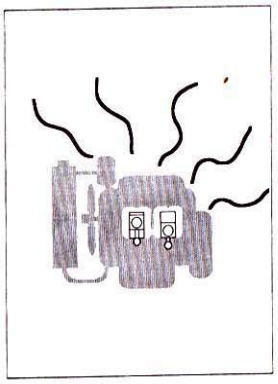
Defective operation of thermostat
If a defective thermostat is used as it is, it will remain closed and cause overheating.



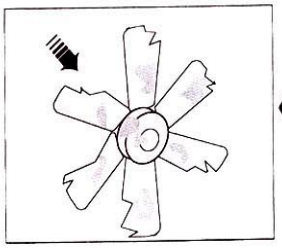
Reduction in amount of cooling water
Check the water level every day.
Breakage of radiator cap gasket, or breakage of relief valve. Leakage of water from hose connections.



Continuous operation under excessive load
If operation is continued under excessive load, the engine speed will drop below the rated speed, so the pump speed will also drop and the circulation of coolant will be reduced. At the same time, the fan speed will also drop, so the amount of wind will also drop. Furthermore, the engine will generate high heat, and this will cause engine overheating & reduce the life of engine.

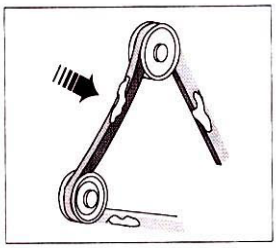


Area around oil pan or torque converter clogged with mud.
This prevents the heat from being dissipated and lowers the cooling effect.



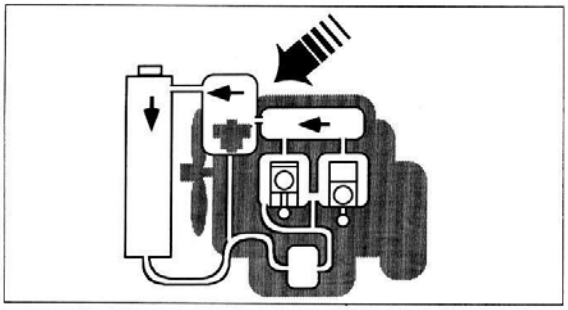
Broken fan blade
If the correct amount of wind or flow of air cannot be obtained, complete cooling becomes impossible. Damaged blades may fly off when the engine is rotating.

Loose fan belt, worn pulley grooves, oil sticking to belt or pulley
If the belt slips, the fan rotating speed will drop.

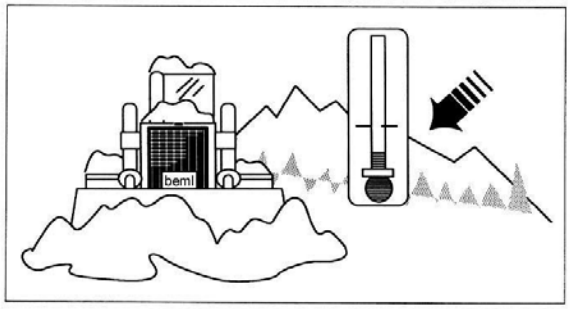


6.5.2 OVERCOOLING:

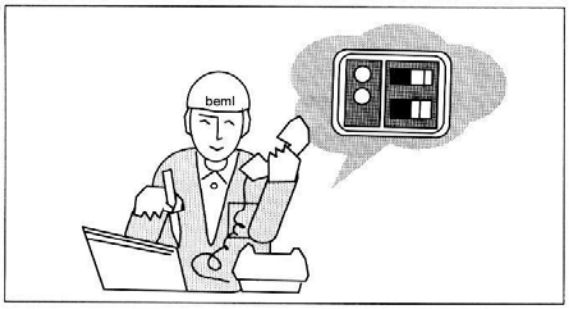
Overcooling is the condition where the engine does not reach the normal temperature however long it is run. Operation below 65°C can be called overcooling.



Overcooling is almost always caused by the thermostat remaining open
The whole amount of cooling water flows to the radiator, and this prevents the temperature from rising.



Ambient temperature is extremely low
Overcooling sometimes occurs when the ambient temperature is low, but this can be considered an exception.
Radiator shutters may be employed to overcome this drawback.



Faulty meter:
If the meter always tends to indicate overcooling, check the meter.

Points to be kept in mind during operation:
Always keep note of the water temperature gauge reading.

7.0 INSTRUMENTATION

7.1 Maintenance Tips

01 Be familiar with the engine starting & stopping procedure before the equipment is put into use since this procedure may vary a bit from equipment to equipment.

02 Oil pressure and water temperature gauges are most important as far as engine is concerned. Maintain the same in good condition.

03 Many times malfunctioning of gauges are due to loose contact/connections which can be rectified easily.

04 Clamping of wires, routing and fouling of the same on hot spots should be avoided.

05 Always use double-cables for positive & negative connections run up to battery or battery switch from Starter.

06 If audio-visual alarm is provided to safeguard the engine, switch off the engine & investigate whenever there's any alarm.

07 If auto shut off is provided, the engine will switch off if engine parameter (i.e. oil pressure or coolant temperature) goes out of limits. Investigate the reason for switching off before the engine is started again.

HIGH ALTITUDE AND SUB ZERO OPERATING CONDITION MAINTENANCE TIPS

HIGH ALTITUDE AND SUB ZERO OPERATING CONDITION

OPERATION & MAINTANANCE TIPS :

01. Be familiar with cold starting & maintenance related issues.

02. If smoke is excess (due to lack of air) even though the air cleaner element is clean, then it may be necessary to reduce the amount of fuel injected.

03. If engine is overheating (due to lack of air for cooling) even though the engine and radiator are in good condition, then it may be necessary to reduce the amount of fuel injected.

04. As much as possible, avoid mixing of 'ATF' (Aviation turbine fuel) with diesel to reduce pour/cloud point since it reduces the lubricity of the fuel and causes abnormal wear of fuel injection pump and injector elements. **If it is unavoidable** then "add proper additive(s)" to improve lubricity.

    NOTE: To avoid premature failure of fuel system components & poor starting of engine, it is very essential to use proper fuel for sub-zero operating conditions. Contact oil companies for proper fuel. As a general rule, select a fuel such that the cloud point of the subject fuel is always lower than the prevailing ambient temperature at site. Colour coding scheme may be followed for the barrels (if used for storing) for easy identification of fuel for the corresponding period or temperature range.

05. Fuel filter clogging directly depends upon the quality of fuel due to 'gel' formation (poor pour/cloud point) and as well as on the prevailing ambient temperature, in addition to dirt in the fuel. Therefore, filter element change frequency to be altered depending upon the site condition.

06. It is recommended to store the equipment in an enclosed chamber preferably with a warming facility to avoid freezing. Alternatively, it is recommended to cover the entire equipment with thick polyethylene sheet when stored in open space to protect it during cold weather/snow, otherwise, it becomes very difficult to start. Also muffler tail pipe to be covered to avoid snow entry.

07. If starting becomes very difficult in extreme cold condition even after using air heaters, then it is advisable to use hot water /hot air (using Portable air heaters) to warm fuel, water and oil instead of using naked flame. Many times naked flame is the root cause for burning of air cleaner elements, fuel hoses, water hoses etc.

08. The fuel stored in barrels shall also be protected from cold weather to avoid gel formation.

09. The engine should not be run without thermostat.

10. If any overcooling of engine is encountered, Radiator shutters/cover maybe employed to overcome the same.