

FOREWORD

Dear Customer,

Congratulations! We welcome you to the family of Ashok Leyland.

This **User Guide** has been prepared to acquaint you with the operation and maintenance of **Industrial, Marine and Genset Engines**. Care has been taken to include as much useful information as possible. Operators are requested to get familiarised with this guide, before operating the engine.

Every reasonable effort has been made to ensure that this manual is accurate. Neither Ashok Leyland nor any of AL Dealer shall in any circumstances be held liable for any inaccuracy or the consequences thereof.

In accordance with Ashok Leyland Limited (the Company's) policy of continuous product improvements, the company reserves the right to change the procedures, material, specifications, dimensions or design referred to in this manual, at any time and without prior notice.

Operators are strongly advised to get the service and repairs done at the workshops of Ashok Leyland authorised Dealers/Service Centres and use only Leyparts. This would ensure smooth implementation of warranty supports extended.

We welcome your suggestions and feed back on the contents of this manual. Should you require any clarifications concerning the contents of this manual, please write to:



ASHOK LEYLAND

POWER SOLUTIONS BUSINESS

No.1, Sardar Patel Road, Guindy, Chennai - 600 032.



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1. Model coverage

**MODEL COVERAGE: H SERIES GENSET**

MODEL	ALGPWO4D.E4	ALGPWO4DMK1/HA4D	AL4DTG3/HA4DT	AL4DTIG2/HA4DTI
Rating (KVA)	30	40/45	50/62.5	82.5
Type	Diesel, 4 stroke, 4 cylinder in-line, overhead valve, water cooled			
Aspiration	Natural	Natural	Turbocharged	Turbocharged, After cooled.
Engine Max (HP)	46.4	53.5	84	109.4
Engine rated (HP)	42.2	48.7	76.4	103.2
Engine rpm	1500			
Bore & Stroke (mm)	104 x 118			
Displacement (litres)	4.009			
Compression ratio	17.9 : 1			
Engine oil capacity - Sump (litres)	8.5			
Cooling system capacity (litres)	17.5			
Electrical system	12 V			
Direction of rotation	Anti-clockwise from rear			
Firing order	1-3-4-2			
Battery capacity (AH)	120			

**MODEL COVERAGE - H SERIES - GENSET ENGINES**

MODEL	HAG6DTI2U	HAG6DTI2S
Rating (KVA)	100	125
Type	Diesel, 4 stroke, 6 cylinder in-line, overhead valve, water cooled	
Aspiration	Turbocharged, After cooled	
Engine Max (HP)	134	167.6
Engine rated (HP)	122	152.8
Engine rpm	1500	
Bore & Stroke (mm)	104 x 113	
Displacement (litres)	5.759	
Compression ratio	17.5 : 1	
Engine oil capacity - Sump (litres)	12	16
Cooling system capacity (litres)	19	22
Electrical system	12V / 24V	
Direction of rotation	Anti-clockwise from rear	
Firing order	1-4-2-6-3-5	
Battery capacity (AH)	150	

**MODEL COVERAGE: H SERIES INDUSTRIAL**

1

MODEL	ALUWO4D	ALUWO4CT
Type	Diesel, 4 stroke, 4 cylinder in-line, overhead valve, water cooled	
Aspiration	Natural	Turbocharged
Engine Max (PS)	43 - 88	48 - 116
Engine rpm	1500 - 2800	1200 - 2600
Bore & Stroke (mm)	104 x 118	104 x 113
Displacement (litres)	4.009	
Compression ratio	17.9 : 1	
Engine oil capacity - Sump (litres)	7.5	
Electrical system	12 V - 24 V	
Direction of rotation	Anti-clockwise from rear	
Firing order	1-3-4-2	

**MODEL COVERAGE - AL SERIES - INDUSTRIAL AND MARINE ENGINES**

MODEL	370	6.65	400/401/402/411/412	412	412 MK I
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GENERAL DATA

Type	Diesel 4 stroke cycle, vertical 6 cylinder, in line overhead valve, water cooled
Combustion system	Direct injection system
Cylinder bore x stroke	107.18 mm x 120.65 mm
Piston displacement	6.540 ℓ
Compression ratio	16 : 1
Firing order	1 - 5 - 3 - 6 - 2 - 4
Direction of rotation	Anti-clockwise from flywheel side
Engine shutoff	Fuel cut off by stop lever

OUTPUT DATA**Industrial Engines**

Maximum output (PS)	—	62-115	72-152	—	—
RPM	—	1200-2400	1200-2400	—	—

Marine Engines

RPM	BHP		BHP		BHP		BHP		BHP	
	Cont.	Max.	Cont.	Max.	Cont.	Max.	Cont.	Max.	Cont.	Max.
1500	69	76	—	—	—	—	90	100	100	110
1800	81	89	—	—	—	—	110	122	119	131
2000	89	98	—	—	—	—	122	135	127	140

**MODEL COVERAGE - AL BSIII CEV SERIES - INDUSTRIAL ENGINES**

1

GENERAL DATA			
Type	Diesel 4 stroke cycle, vertical 6 cylinder, inline overhead valve, water cooled, turbocharged, EGR filtered & EGR cooled		
Combustion System	Direct injection system		
Cylinder bore X stroke	107.18 mm X 120.65 mm		
Piston displacement	6.540 Lit		
Compression ratio	17.5 : 1		
Firing order	1-5-3-6-2-4		
Direction of rotation	Anti-clockwise from flywheel side		
OUTPUT DATA			
Industrial Engines			
Maximum output (KW)	96	98	100
Rated rpm	2200	2300	2400



MODEL COVERAGE - AL SERIES - INDUSTRIAL AND MARINE ENGINES

MODEL	680TC	680
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GENERAL DATA

Type	Diesel 4 stroke cycle, vertical 6 cylinder, in line overhead valve, water cooled	
Combustion system	Direct injection system	
Cylinder bore x stroke	127 x 146 mm	
Piston displacement	11.1 ℓ	
Compression ratio	15.8 : 1	
Firing order	1 - 5 - 3 - 6 - 2 - 4	
Direction of rotation	Anti-clockwise from flywheel side	
Engine shutoff	Fuel cut off by stop lever	

OUTPUT DATA

Industrial Engines

Maximum output (PS)	128 - 207	—
RPM	1200-2200	—

Marine Engines

RPM	BHP		BHP	
	Cont.	Max.	Cont.	Max.
1500	146	161	129	142
1800	167	184	148	164
2000	175	193	156	172

**MODEL COVERAGE - AL 680 SERIES - GENSET ENGINES**

MODEL	AL 680TAG2	ALGP 680TAG3
GENERAL DATA		
Rating (KVA)	140	160
Type	Diesel 4 stroke cycle, vertical 6 cylinder, inline overhead valve, water cooled, turbocharged & after cooled.	
Aspiration		
Engine Max (HP)	196.8	224.1
Engine rated (HP)	179.0	203.8
Engine rated rpm	1500	
Bore & Stroke (mm)	127 x 146	
Displacement (litres)	11.1	
Compression ratio	17 ± 0.5 :1	
Engine oil capacity - Sump (litres)	17	
Cooling system capacity - Engine + Radiator (Lit)	52	
Electrical system	24 V DC	
Direction of rotation	Anti-clockwise from flywheel side	
Firing order	1-5-3-6-2-4	
Battery capacity (AH)	150	



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2. Preservation and pre-recommissioning procedure



PRESERVATION AND PRE-COMMISSIONING PROCEDURE

STORAGE OF ENGINES AT NORMAL AMBIENT TEMPERATURE

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

If stored for a short period:

- (a) The engine should be thoroughly washed, to remove any deposits of mud which may be salt-laden.
- (b) The engine should be stored in a covered area, on plain hard surface.
- (c) Disconnect battery terminals.
- (d) Once a week the engine should be started and run for a few minutes.

If stored for longer periods:

- (a) The batteries should be removed and prepared for storage in a dry place. Top up with distilled water and charge fully before storage. Check and charge at regular intervals during storage.
- (b) Remove the injectors and spray 20 cc of engine inhibiting oil (Shell Ensis oil SAE 10, Castrol storage oil 30, Servo preserve 30) through injector hole.

Crank the engine for about 30 seconds. Then fit back the injectors.

- (c) Spray liberally anti-corrosive oil over rocker levers, push rods, FIP plunger springs and tappets.
- (d) Drain the lubricating system and replenish the same with engine inhibiting oils.
- (e) It is advisable to drain the cooling system. A board is to be hung on the engine indicating that cooling system has been drained out to avoid accidental starting of the engine.
- (f) It is advisable to drain the fuel tank as well as the fuel filters to avoid formation of gum deposits and the possibility of difficult starting later.
- (g) Completely seal with masking tape the engine intake, exhaust tail pipe and the vent hole of the fuel tank.

PRE-COMMISSIONING HINTS

De-preservation procedure

1. *De-preserve the engine as per procedure given below:*

- 1.1 Clean all external parts thoroughly. Direct the jet of air to remove all dust.

1.2 Uncover all openings and appropriate connections should be made.

- Remove the tapes from fuel inlet to the feed pump of the fuel injection pump.
- Remove the tape from the outlet of the breather pipe.

1.3 Remove fuel filters and fit new ones. Please refer to Service Manual for procedure.

1.4 Remove injectors and check for correct opening pressure and refit as follows:

- Loosen high pressure pipe connections at pump and injector end and remove. Also remove the injector leak off pipe.

- Extract the injector. Plug the inlet and leak off opening with protection caps. Wipe off dirt and loosen carbon from injector with a cloth.

- Connect the injector to the nozzle tester. Operate the hand lever of the tester for about 10-12 strokes. The nozzle should spray in a well atomised form.

- For checking the opening pressure depress the hand lever until the nozzle ejects the test oil and the pressure



gauge reading suddenly drops. Note down the reading at this stage. If the reading differs from the prescribed value adjust by changing the total thickness of the shims.

- While refitting the injector, check and clean the nozzle bore in the engine. The sealing washer originally fitted can be made use of since the injectors were not fully tightened earlier. If they are indented or damaged then they should be replaced. Tighten the nozzle clamp to the recommended torque of 4.20 to 4.80 kgm. Flush the high pressure pipes thoroughly and connect to injector. Connect the leak off pipes to the injector.

2. Now the engine is ready for installation.

If the engine is stored beyond one year, represervation and repacking must be carried out

1. If the period of Preservation exceeds one year - Represervation must be carried out during the 12th month. The date of Represervation must be entered in a label attached to the engine. Cancel the label showing the first

preservation. This must be repeated every 12 months, if the period of storage exceeds a period of one year.

2. The engine must be prepared for Represervation.

- 2.1 Clean all external parts, thoroughly. Direct the jet of air to remove all dust.

- 2.2 Uncover all openings and appropriate connections should be made.

- Remove the tapes from fuel inlet to the feed pump of the fuel injector pump and outlet of the breather.

- 2.3 Remove fuel filters and fit new ones. Please refer to Service Manual for the procedure.

- 2.4 Remove injectors and check for correct opening pressure and refit.

- Loosen high pressure pipe connections at pump and injector end, and remove. Also remove the injector leak off pipe.

- Using special tool, extract the injector. Plug the inlet and leak off opening with protection caps. Wipe off dirt and loosen carbon from injector with a cloth.

- Connect the injector to the nozzle tester. Connect the pressure gauge to the nozzle tester to the injectors. Operate

the hand lever of the tester for about 10 - 12 strokes. The Nozzle should spray in a well atomised form.

- For checking the opening pressure depress the hand lever until the nozzle ejects the test oil and pressure gauge reading suddenly drops. Note down the reading at this stage. If the reading differs from the prescribed value adjust by changing the total thickness of the shims.

- While refitting the injector, check and clean the bore in the engine, the sealing washer originally fitted can be made use of since the injectors were not fully tightened earlier. If they are indented or damaged they should be replaced. Tighten the nozzle clamp to the recommended torque of 4.20-4.80 kgm. Flush the high pressure pipes thoroughly and connect to injector. Connect the leak off pipes to the injector.

3. Run the engine for 15 minutes with the following rust preventive agents:

- a) Fill water jacket with water containing 1% shell bocut cutting compound or any water soluble cutting compound.
- b) Connect fuel feed pump to a mixture of diesel and 10% flushing oil such as lubrex or equivalent.



- c) Fill engine sump with Servo Preserve SAE - 40 or equivalent.
- d) After 15 minutes disconnect the fuel line and allow the engine to run so that the fuel in the filter and pump are exhausted.

3.1 Stop engine and remove

- a) Air cleaner and cylinder head cover
- b) Injectors
- c) Fuel pump inspection cover

Crank engine with starter motor.

During cranking spray 10 cc of rust preventive oil (Servo Preserve SAE - 40) into each injector hole in the cylinder head and 20 cc through the inlet manifold.

Stop cranking after spraying oil into the cylinders and manifold.

Spray oil (Servo Preserve (SAE 40) on

- a) Rocker assembly
- b) Fuel pump plunger springs and tappets

3.2 Replace all components and seal all openings:

- a) Air cleaner
- b) Coolant - inlet and outlet
- c) Fuel inlet
- d) Breather

3.3 Drain

- a) Coolant from water jacket
- b) Oil from FIP

Attach a label showing 'NO OIL' and date of preservation.

4. Repacking

Cover the engine with polythene sheet and place inside the packing case. Close the case and keep in an area free of moisture.

5. After a long storage the engine must be checked and gaskets and seals (removed and fitted back during representation) must be replaced, along with fuel and oil filter elements. The Depreservation procedure must be strictly adhered.

To start the engine after a long storage

- (a) Flush the cooling system completely. Refill the cooling system. Add anticorrosive oil and anti-freeze compound as the climatic conditions warrant.
- (b) Remove masking tapes from the engine intake, the exhaust manifold and the vent hole of the fuel tank.
- (c) Drain the oil from the engine sump. Fill the sump with the recommended engine oil to the required level.

- (d) Clean the fuel filter elements. Check the injectors thoroughly for correct spray characteristics and pressure setting.
- (e) Check the complete electrical charging circuit. Clean starter solenoid point and battery terminals. Also check starter motor and alternator brushes for proper contact with the commutator.
- (f) Crank the engine until the oil pressure builds up.
- (g) Start the engine and ensure that the recommended oil pressure is attained.

Running-in period

it will be advantageous if the engine is attended to with special care and attention when all parts are new, to ensure proper 'bedding-in'. If the following recommendations are adhered to during the first 200 hrs. of operation, it will assist proper "bedding-in".



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



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3. Gauges and Engine Fail Safe System



GAUGES

OIL PRESSURE GAUGE

Under normal engine operating conditions, the needle registers in the centre section of the gauge.



Should the indicator move into low oil pressure section of the gauge, stop immediately and switch off the engine. After approximately ten minutes (to allow the oil settle in the sump) check the oil level and top up as required. If the oil level is found to be within maximum/minimum marks on the dip sticks, do not run the engine as the cause of the low oil pressure is other than low-oil-level.

Contact our authorised dealer for investigation.

TEMPERATURE GAUGE

Normal operating temperature is reached when the needle registers in the 75° - 85° of the gauge. If the needle enters into the over heating range during normal operation, a fault may be indicated. In the case of overheating an indicated fault should be investigated immediately. Stop the engine and allow the engine to cool for several minutes.

Look for coolant leaks. If the temperature does not drop, stop the engine. Check drive belt condition and coolant level, if fault is not found, do not start the engine. Contact your authorised dealer for rectification.

- During normal operation, the cooling system contains very hot coolant under pressure.



For topping up use only LEYPOWER COOLANT 5000 pre mixed coolant directly. Do not dilute with plain or demineralised water for top up.

AMMETER

It indicates the rate at which the battery is being charged while in operation.

When the engine is started, it is normal for the pointer to go towards the negative side and when once the engine starts running at the rated rpm the pointer should normally shift to the positive side and show charging rate. Battery charging indicator lamp on the dash board, will also go off when the engine speed crosses the idling speed.

RPM AND HOUR METER:

In order to assess the engine performance and for proper maintenance, the RPM and Hour meter have been fitted on the engine. The drive is taken from the oil pump drive shaft.

BATTERY

For battery specification, please refer to respective OEM/PEM.

For specific gravity, please follow the instructions of respective battery manufacturer.



ENGINE FAILSAFE SYSTEM

This system consists of the following items

1. Engine Failsafe Unit
2. Stop solenoid
3. Pressure Switch
4. Temperature Switch
5. Wiring Harness

The Engine Failsafe System is an electrical system to protect the Genset Engine against low oil pressure and high coolant temperature. Engine will be automatically shutdown when the oil pressure decreases below 0.55 ± 0.15 ksc or the coolant temperature increases beyond $98 +2 -1^{\circ}\text{C}$ (i.e $97 - 100^{\circ}\text{C}$).



Linkage between Stop Solenoid and FIP Stop Lever is preset at the factory and it should not be disturbed in the field. Improper linkage adjustment would cause solenoid burning / solenoid malfunctioning. If the setting is disturbed, contact our authorised dealer to correct the setting.



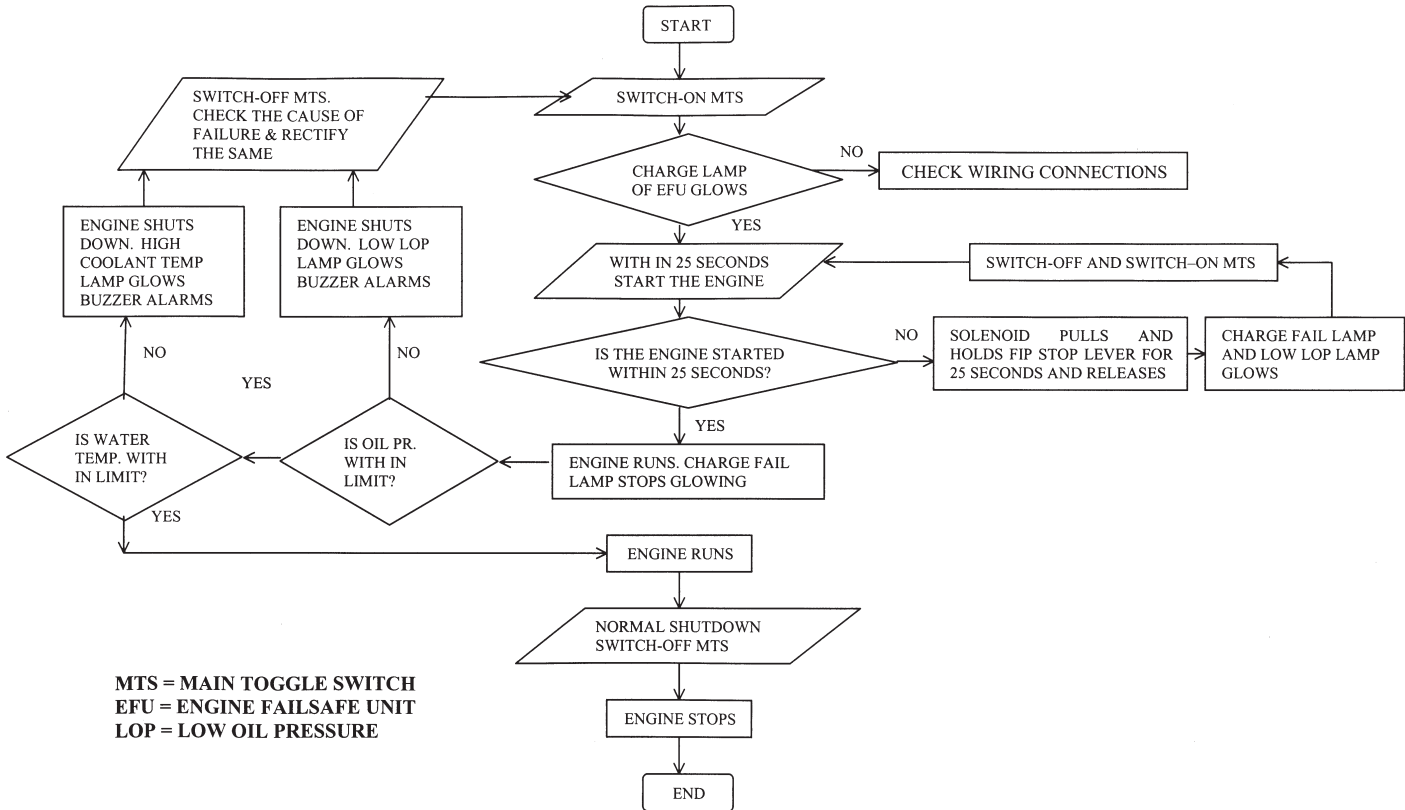
While starting the Genset Engine for the first time for a day, run the engine for few seconds and switch-off the Main toggle switch and check whether the engine stops. If engine stops, it ensures the proper functioning of Engine Failsafe system. If the engine does not stop, identify the cause of problem and rectify.



1. Use socket for tightening the solenoid terminals and lock nut. Do not use combination plier.
2. Wires connected at solenoid terminal should not touch the body.. Bare wire end not to be connected at solenoid terminals as it may touch the solenoid body. Use 5 mm eyelet end.



FLOW CHART – FOR ENGINE FAILSAFE SYSTEM OPERATION





GENERAL/OPERATING INSTRUCTION:

1. Switch on the Main toggle switch.
2. After switching on toggle switch the “charge indicator” lamp glows. It stops glowing as soon as Engine starts running and indicates charge alternator is functioning.

3. Start the Engine within 25 seconds.

If the Engine is not started within by pass time of 25 seconds, solenoid will pull and hold the FIP Stop lever for 25 seconds due to which low oil pressure lamp glows and buzzer alarms.

4. Wait till the solenoid releases the FIP stop lever. Now switch-off Main toggle and again switch-on the same and make an attempt to start the Engine within 25 seconds, Engine should start. If not trace the problem and rectify.

5. If the oil pressure (or) coolant temperature crosses the set limit, while the engine is running, Engine will be shutdown automatically and corresponding lamp glows and buzzer starts alarming till the main toggle is switched-off.
6. For normal stopping of the engine, switch-off the main toggle switch.
7. The entire power circuit of Failsafe Unit is protected by a 30-amp fuse link that can be rewired easily in the field.
8. “Fuse Fail” lamp glows only when fuse wire is cut.
9. Fault condition will be latched and provides audio (by built-in buzzer) visual (by glowing lamps) indication.
10. Initial low oil pressure during starting has been bypassed for 25 seconds.

DO’S AND DON’TS – ENGINE FAILSAFE SYSTEM

Do’s

1. Apply specified voltage to the system.
2. If the solenoid connection with FIP stop lever is disturbed, please follow “Solenoid Assembly Procedure”.
3. Terminals of wiring harness should be intact.
4. Keep the Stop solenoid, temperature switch and pressure switches free from oil / water / dust.
5. Welding, if any, to be carried out only after removal of battery supply in order to protect the failsafe system.
6. When solenoid fails to stop the engine (or) overheats in normal shutdown operation, disconnect the electrical



supply and stop the engine manually by pulling longer arm of solenoid.

7. If fuse blown-out, replace with specified rated fuse.

Don'ts

3

1. Don't over tighten the terminals of Engine Failsafe Unit, Stop solenoid, temperature switch and pressure switch.
2. The terminal connections at switches should not touch each other.
3. The terminal connections at Stop solenoid should not touch each other.
4. Don't splash water on Engine Failsafe Unit, Stop solenoid, temperature switch and pressure switch.
5. Don't attempt to connect / disconnect the wirings of Stop solenoid,

temperature switch and pressure switch when the engine is running.

6. Don't keep hand in front of solenoid when it is in operation as it may cause injury.
7. Don't assemble the wire cable, which is connecting solenoid and FIP stop lever, too tight or too loose.
8. Don't connect solenoid with AC supply.



TROUBLE SHOOTING OF ENGINE FAILSAFE SYSTEM		
Defects	Causes	Remedy
Engine stops immediately after starting.	Wrongly connected Temperature / Pressure switch terminals.	Correct connection for switches: Temp switch = COM & NO Pr. Switch = COM & NC
	Low oil level & adequate pressure not developed	Check and fill oil.
	Short-circuited wiring harness.	Check and rectify.
Solenoid overheats / burns & sparking at solenoid terminals.	Loose connection at stop solenoid terminals	Tighten the terminals.
	Wire rope is too tight and not allowing stop solenoid to come to hold mode from energizing mode.	Loosen the lock nut and slightly slacken the wire rope and tighten the lock nut.
	Wire rope is connected to FIP stop lever without LINK PLATE.	Assemble the link plate and connect the wire rope through link plate.
	Loose connection at Engine Failsafe Unit's Solenoid terminal.	Tighten the terminal.
Engine not stops when Main Toggle Switch is switched-off.	Wire rope is too loose.	Connect the wire rope properly.
	Loose connection at stop solenoid terminals.	Tighten the terminals.
	Loose lock nut.	Tighten the lock nut fully.
	Low volt batteries.	Connect healthy batteries.
	Solenoid electric cables cut.	Check and rectify the connecting cables.
	Defective Main toggle switch.	Rectify / replace.
	Loose connection at Engine Failsafe Unit's Solenoid terminal.	Tighten the terminal.



TROUBLE SHOOTING OF ENGINE FAILSAFE SYSTEM		
Defects	Causes	Remedy
Solenoid chatters while stopping the engine.	Wire rope is tight.	Connect the wire rope properly.
	Low volt batteries.	Connect healthy batteries.
	Loose connection at stop solenoid terminals.	Tighten the terminals.
	Loose connection at Engine Failsafe Unit's Solenoid terminal.	Tighten the terminal.
Solenoid fuse often blowing.	Loose connection in fuse terminals.	Tighten the terminals gently. Do not over tighten.
	Fuse carrier's plastic base broken.	Replace with new spare fuse. (Spare fuses are provided in the solenoid rubber boot externally.
	Fuse wire touching the body.	Keep the fuse wire away from the body/ replace new fuse.
	Wire rope too tight.	Connect the wire rope properly.
	Low rated fuse wire connected.	Use 30A fuse.
"Fuse fail" lamp glows in the Engine Failsafe Unit.	Engine Failsafe unit fuse wire is loose / cut.	Rectify / replace with 30A fuse wire.
"Charge fail" lamp glowing even after few minutes of engine operation.	"IND" wire connection at alternator end or Engine Failsafe unit end has come out / loose terminals.	Connect "IND" wire properly at Engine failsafe unit. Fully insert the "IND" cable lucar terminal at Alternator end.



4. Operating procedure

The following subjects are discussed in this section

- Before starting the engine
- Frost precautions
- Do's and don'ts



BEFORE STARTING THE ENGINE

- (a) The radiator is full of coolant.
- (b) There is sufficient fuel in the tank.
- (c) Engine oil level is correct (dipstick)

TOPPING UP THE ENGINE SUMP

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

TO START AND STOP THE ENGINE

Follow the instructions as given in the fail safe system (Chapter 3)

FROST PRECAUTIONS

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

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

Drain tap/plug should be tested at frequent intervals by inserting a length of wire to ensure that they are clear. This should be done as soon as they are opened, so that an obstruction freed by the wire may be flushed out by the water,

After draining, place a notice on the engine to the effect that the cooling system is empty and the drain taps are open.



Engine with anti-freeze mixture in their cooling systems, need not drain the cooling system.

ENGINE ANTI-CORROSION OIL

Useful for engines stored for long periods.

- (1) Shell Ensis oil, SAE. 10.

PRECAUTIONS-SUB-ZERO TEMPERATURE OPERATION

Cold start aid is not fitted in the engine. It can be made available as optional fitment. The following instruction has to be followed if the engine is subjected to operate in sub-zero temperatures.



1. Upto 0°C the engine does not require any special starting aids.
2. Below 0°C and upto-15°C cold start aid “Thermostart” has to be fitted depending on ambient temperature.

0°C to -7°C Excess fuel

-7°C to -15°C Thermostart to be fitted in the intake manifold.
3. Battery should be kept in fully charged condition (Rating to suit the temperature).
4. Select the oil grade from recommended lubrication chart to suit the ambient temperature.
5. Use the correct grade of fuel as recommended for the prevailing ambient temperature.
6. Injectors must be maintained in good condition.
7. Engine timing should be as recommended. Never adjust by advancing or retarding the injection timing.

DO'S AND DON'TS

GENERAL

- Study this manual carefully and follow the operating procedures.
- Engine life to a great extent depend upon clean fuel oil. Always use clean diesel. Before filling the diesel to tank filter it with fine cloth.
- Keep the suction pipe at least 1” from the bottom so that water can settle down and can be drained periodically.
- Never use kerosene. This will cause permanent wear of FIP components and injectors and ultimately result in major expenditure of engine over haul.



- use always correct grade of engine oil and coolant as per AL recommendations.
- Use always genuine engine oil and fuel filters and replace them as recommended.
- Never use spurious filter elements especially gauge type filter elements.

Marine Engines

- Clean sea cock filter atleast once a week.
- Check condition of bilge pump and see that bilge water is always pumped out periodically.
- Maintain the batteries properly.

- Periodically clean the hull during dry-dock so that hull surface is free from sea weeds, algae and shell growth. It is recommended to paint outer surface of hull with special marine paints.
- It is recommended to have ballast tanks, so that stability and seaworthiness of the vessel can be maintained at all weather conditions by ballasting and deballasting.
- Always remember that increase in other board weights, and increase in length of fishnet always results in increased fuel consumption and impose excess load on engine, clutch and gear box.

- Propellers can be safeguarded by providing zinc anodes.
- In case of vibration felt in propeller and shafting check the conditions of propeller and stern tube.
- Check the propeller once in a month for stone hitting cavitation and crack in the blades.
- Check that sea cock is in open position before starting the engine.
- Check zinc anode condition in oil cooler and heat exchanger and replace if necessary.



5. Maintenance instructions

Your engine has been designed to ensure ease of access to mechanical components.

This will enable you to carry out a number of simple maintenance tasks.

Therefore, keep to instructions provided on the following pages and you will be able to perform the basic maintenance work yourself.

USED ENGINE OILS

WARNING: Prolonged and repeated contact may cause serious skin disorders, including dermatitis and cancer.

- Avoid excessive contact, wash thoroughly after contact.
- Keep out of reach of children.



FUEL SYSTEM

Fuel additives should not be used.

Use good quality diesel.

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

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

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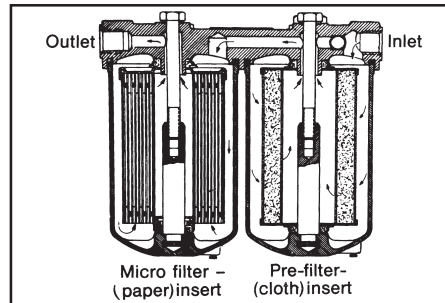
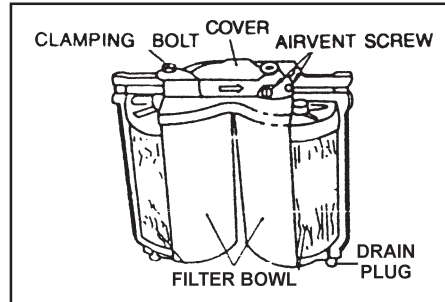
FUEL TANK

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

FEED PUMP

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

DUAL FUEL FILTER



Maintenance

Filter inserts must be replaced at regular intervals.

Filter Element Filter Changed Period

Every 250 hours of operations.

Renew Fuel Filter Element

- Unscrew centre bolt and withdraw the bowl and filter insert. Install new sealing ring and ensure it correctly located.
- Clean the bowl free of sediments. Replace a genuine filter insert and refit the bowl. Bleed the fuel system.



Fuel Filter cum Water separator - (Fleet guard) - 6DTI Engine



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

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

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

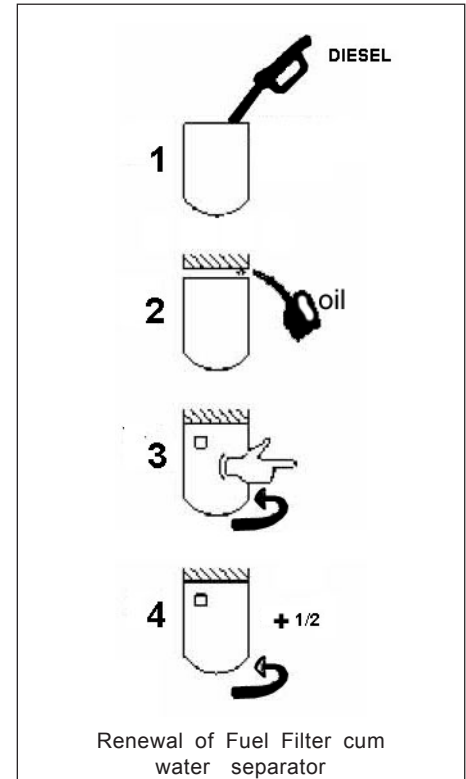
Maintenance

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

Renewal procedure for Fuel Filter cum Water separator.

- Remove old filter cartridge using appropriate filter wrench and discard.
- Clean filter head base and ensure that all the unwanted material is completely removed.
- Check the filter mounting head for tightness.
- Apply/thread seal on the thread portion in the filter head.
- Apply a thin coat of clean engine oil to the rubber ring surface of the new filter. Press the rubber ring firmly into the retaining groove in the filter. Do Not Use Grease.
- Carefully read the installation instructions printed on the periferal of the filter, before fitment
- Pre-fill the new filter with clean fuel.
- Mark a reference point on the filter and filter head to identify the point. Ensure that the rubber sealing ring first makes contact with the sealing surface of the head.
- Screw on the filter fully in and rotate 1/2 turn further.

- Start the engine and ensure no fuel leakage around the sealing rubber ring and filter assembly.

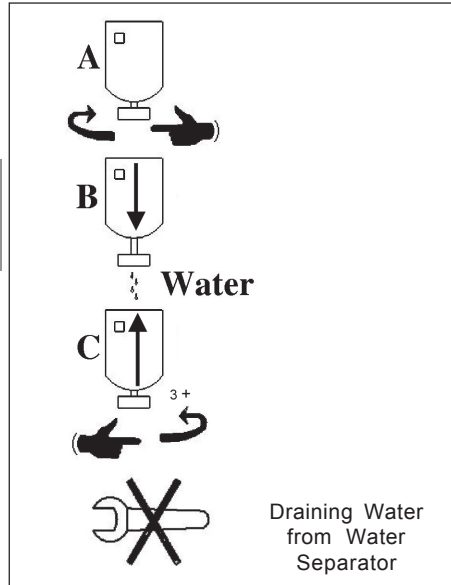




Procedure for draining water

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

- Rotate the drain cock anti-clockwise (as shown in the instructions printed on the outside of the filter)
- Drain the water till the fuel starts to flow.
- Rotate the drain cock clockwise the number of turns as indicated by the



installation instructions printed on the side of the filter canister.

- Start the engine and check for fuel leakage around the sealing gasket and filter assembly.
- Never use a spanner for rotating the drain cock.



Drain water daily. Drain cock should be hand tightened fully. Never use any spanner.

Fuel additives should not be used.

Use good quality diesel. Use always low sulphur diesel fuel (BS II Fuel) as per IS1460-2000.

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

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

Since nozzle tip is very sensitive, do not use emery sheet or any hard material to clean the tip of nozzles.

Bleeding Procedure for Fuel System

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



Use always genuine fuel filter inserts supplied by Ashok Leyland.



Fuel Filter cum Water Separator – AL BSIII Engine

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

Fuel system maintenance

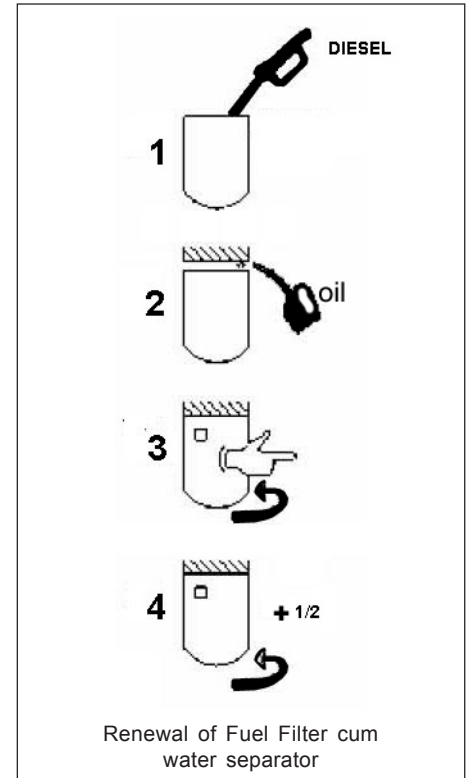
Under normal operating conditions, fuel filter cum water separator to be replaced at every 250 hours of operation and mud strainer to be replaced at every 1500 hours of operation



Renewal procedure for Fuel Filter cum Water separator.

- Remove old filter cartridge using appropriate filter wrench and discard.
- Clean filter head base and ensure that all the unwanted material is completely removed.
- Check the filter mounting head for tightness.
- Apply/thread seal on the thread portion in the filter head.
- Apply a thin coat of clean engine oil to the rubber ring surface of the new filter. Press the rubber ring firmly into the retaining groove in the filter. Do Not Use Grease.
- Carefully read the installation instructions printed on the peripheral of the filter, before fitment
- Pre-fill the new filter with clean fuel. - Mark a reference point on the filter and filter head to identify the point. Ensure that the rubber sealing ring first makes contact with the sealing surface of the head.
- Screw on the filter fully in and rotate $\frac{1}{2}$ turn further.

- Start the engine and ensure no fuel leakage around the sealing rubber ring and filter assembly.

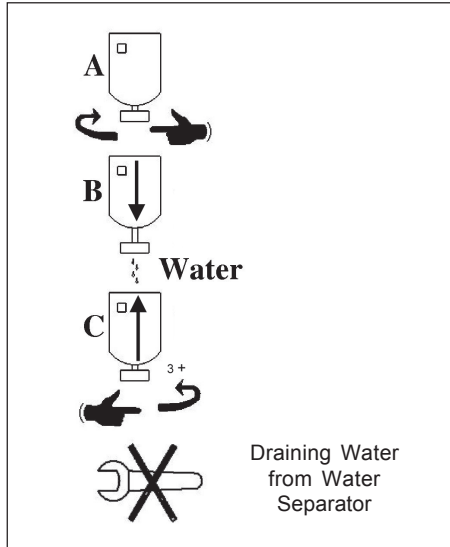




Procedure for draining water

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

- Rotate the drain cock anti-clockwise (as shown in the instructions printed on the outside of the filter)
- Drain the water till the fuel starts to flow.
- Rotate the drain cock clockwise the number of turns as indicated by the



installation instructions printed on the side of the filter canister.

- Start the engine and check for fuel leakage around the sealing gasket and filter assembly.
- Never use a spanner for rotating the drain cock.



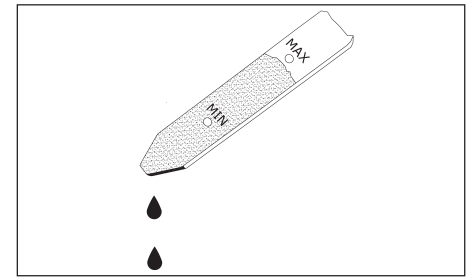
Drain water daily. Drain cock should be hand tightened fully. Never use any spanner. Fuel additives should not be used.

Use good quality diesel. Use always low sulphur diesel fuel (BS II Fuel) as per IS1460-2000. Keep fuel clean and prevent water from entering the fuel tank in the rain or snow care should be taken not to allow water in the fuel tank. Do not forget to close the fuel tank cap securely. Since nozzle tip is very sensitive, do not use emery sheet or any hard material to clean the tip of nozzles

LUBRICATION SYSTEM

Engine Oil level Checking

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



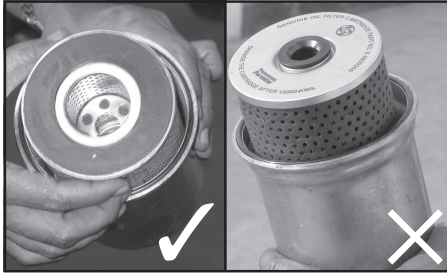
Withdraw the dipstick. If oil level is found to be between Min. and Max. marking oil level is sufficient for running. If oil level is at Min. mark or below topup engine oil to the Max. level

Engine Oil and filter change (H Series)

Ensure that the engine is warm. Draining of oil should be done within 10 minutes, from shutdown.



When the oil is completely drained install the drain plug with new washers and tighten securely.



Using suitable spanner loosen centre bolt of filter bowl and withdraw the bowl assembly. Discard the used filter element and sealing 'O' rings at centre bolt and bowl fitting face. Fit a new oil filter element after placing the spring and the plate washer in position. Fit filter bowl with filter element to the filter head by centre bolt. Ensure that oil filter is not fitted in the inverted position.

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

ENGINE OIL CHANGE (AL SERIES)

- Unscrew drain plug and drain the oil into a suitable container.
- Remove oil filter bowl by unscrewing dome nut provided on filter head.
- Withdraw the oil filter element gently and drain out engine oil.
- Wash the oil filter bowl with fuel and blow dry.
- Replace new filter element and sealing ring.
- Fill the oil filter bowl with new engine oil and refit using dome nut.
- Open oil filler cap. Refill the engine with the correct quantity of the specified grade of engine oil. Check the oil level on the dipstick and run the engine for a short time. Allow 5 - 10 minutes for the oil to settle down. This is essential when the oil filter has been changed and engine oil top.



Do not forget to fit the conical spring provided below oil filter element as this provides suspension and sealing for the filter element.

TO CLEAN CRANK CASE BREATHER (AL SERIES)

Clean crankcase breather fixed on the tappet side cover.

Soak breather in a suitable solvent and clean it by blowing with compressed air.



No need to clean the breather for 6DTI engine. Breather arrangement for 100 KVA is different from 125 KVA.



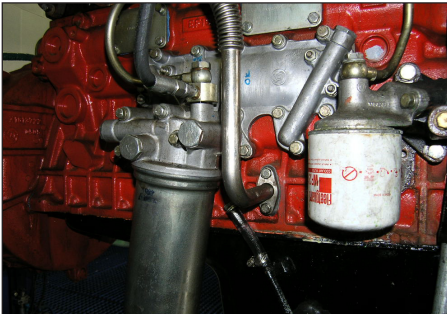
COOLING SYSTEM

Charge air cooler and Radiator core cleaning and fin repair

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

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

5 Coolant Filter (For 125 kVA Engines only)



125 kVA engine is fitted with coolant filter (Spin on type) in the cooling system to filter the impurities present in the system. Replace coolant filter at every 500 hours.

Changing Coolant in Radiator

1. Do not loosen the drain plugs while the engine is still hot. If you do so, hot liquid coolant can come out resulting in personal injury.
2. Stop the engine. Loosen-the radiator drain plug to drain the coolant. Drain will improve if you remove the cap from radiator.
3. Drain the complete system and tighten the radiator drain plug.
4. Slowly feed coolant into the radiator through the filler until the radiator is full. When supplying coolant from a pail, pour it slowly to prevent air from mixing with the coolant.
5. When the level of the coolant reaches the filler neck, squeeze the upper radiator hose two or three times. This will cause air inside the hose to be expelled, and the level of the coolant will fall.
6. Properly close the radiator cap.

7. To ensure that the air in the engine and the piping is properly expelled, set the engine speed slightly higher than normal idling speed. Raise the coolant temperature above 82°C, then continue to idle the engine for another 10 minutes.
8. Stop the engine and after the engine has cooled down sufficiently, check the coolant in the radiator. Add coolant to make up for any drop in the coolant level.

Recommended Coolant

Use **LEYPOWER COOLANT 5000** pre mixed coolant. No need to add water.

The recommended coolant change interval is 5000 Hrs. or 18 months whichever is earlier. The coolant is available in package sizes of 5 lts. & 1 lt.



For topping up use only LEYPOWER COOLANT 5000 pre mixed coolant directly. Do not dilute with plain or demineralised water for top up.



Radiator stay Rod & Cowl arrangement

Do not run the engine without radiator cowl. Ensure that the radiator cowl mounting and fan blade clearance are in proper order.

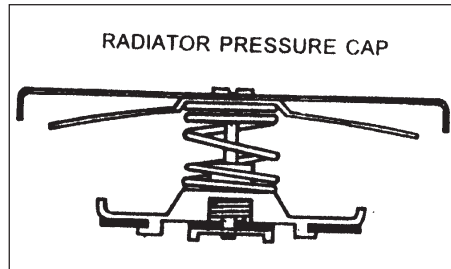
Check radiator stay bracket mounting bolts for tightness. Also check the silent block bush in stay rod and replace if found defective.

Check radiator mounting bracket bolts for tightness and the condition of the rubber pads and replace if found defective.



Improper radiator mounting can result in radiator hose failures as well as core cracks at dip soldered joints of top and bottom tanks.

Radiator Cap



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

Water Pump (H Series)

"H" Series engines are fitted with "integral shaft and bearing" type water pumps with prepacked grease. No further greasing required.

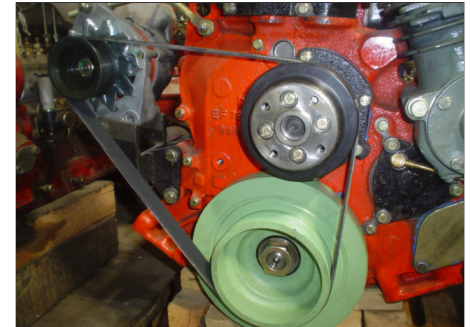
WATER PUMP (AL SERIES)

Water circulation is by a centrifugal vane type pump. The pump bearings are taper roller type with spacer at the middle.



The pump bearing require lubrication during running as it is having a grease filled cup. Turn 1/2 to hear a click sound to feed in grease to water pump bearing. Refill the grease cup immediately after reaching the last possible 1/2 turn.

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



Installation Procedure

1. Loosen the necessary fasteners, slacken the pulleys & remove the old belt.
2. Check pulley grooves for wear / damage and replace the pulley if required.
3. Clean the pulley grooves for debris and ensure not to apply oil or grease on the pulley grooves at the time of fitment.
4. Check alignment of the pulleys.



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

5. Mount the belt over pulleys and ensure that the belt ribs are seated in the respective pulley grooves.



6. Tension the belt and tighten all the fasteners.
7. Run the engine for 3 to 5 minutes with the applied tension to allow the belt to seat in the respective pulley grooves properly. Reset tension.
8. Apply initial belt tension of 700N by adjusting the alternator position.
9. To ensure the applied tension, measure it in the middle of span between water-pump pulley and alternator using electronic type tension gauge.

Belt Tension Measurement Procedure

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

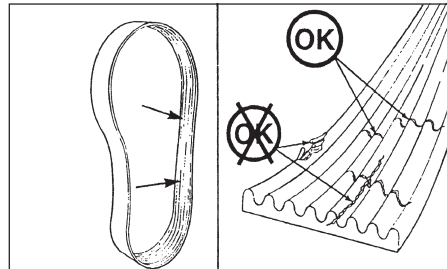
DO's:

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

DON'TS:

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

Visually inspect the belt.



Replace the belt if it is frayed or pieces of material missing or longitudinal cracks intersect with transverse cracks.

REMOVAL AND REFITMENT OF FAN BELT (COGGED BELT)

- Dismount the radiator side stay and loosen radiator bottom mounting to sway out a little to clear the cowl covering the fan.
- Loosen alternator link bracket and loosen the fan belt fully. Inspect the pulleys for damage and wear.
- Replace the new fan belt and redo the above in reverse.
- For marine application - PTO to be loosened to insert water pump belt.

ADJUSTMENT OF THE DRIVING BELT TENSION OF WATER PUMP

Loosen the alternator link bracket and swing the alternator away from engine to increase the fan belt tension. 1" to 1½" deflection on longest side of fan belt is the limit.



AIR INTAKE SYSTEM

Poor air cleaner maintenance will result in excess liner wear, high engine oil consumption, excess blow by and poor pick up.

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

Servicing of Dry type Air cleaner

Follow maintenance recommendations strictly.

- Remove dust deposit weekly by squeezing the dust evacuator valve.
- Replace dust evacuator valve immediately if it is torn, cracked, remains open or missing.
- Never operate the engine, if the restriction indicator is either broken or missing.
- Ensure that the washers are in place before tightening the wingnut.

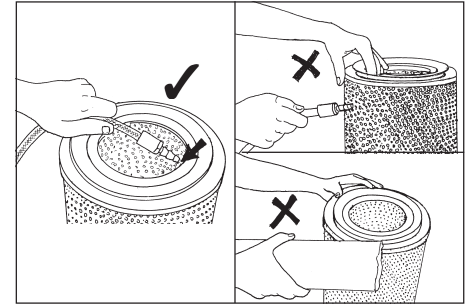
- Replace primary filter element every 1000 hrs. or as soon as red band appears fully on the transparent portion of the vacuum indicator even after cleaning the air cleaner element and in this position red band will not regain its position when the engine is switched off.
- Replace the secondary filter element at the time of every third replacement of the primary filter element.



The wing nut should be tightened with hand alone. Excessive tightening would damage the air cleaner.

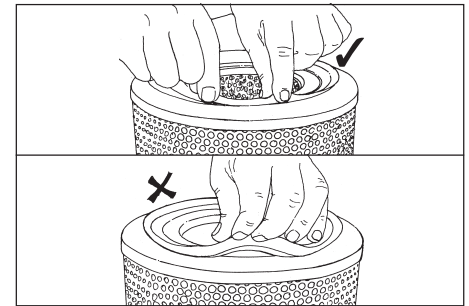
Maintenance and Servicing of Air Cleaner

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



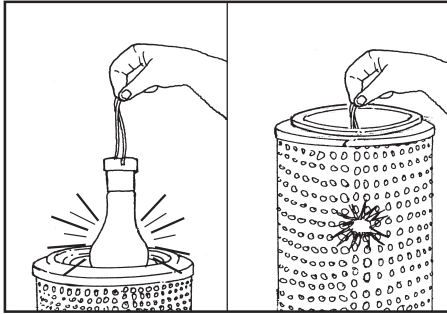
Always clean the element with pressurized air of 15 PSI. Keep a distance between the nozzle and the element. Use the pressurised air from inside to outside of the primary element.

Don't tap on the element and never try to clean it with compressed air, flowing from outside to inside of the element.





Check for proper adhesion between end plate of the element and the sealing ring.



Glow an electric bulb inside the element. Check for any holes / puncture. If light comes out through any hole, replace the element.

- 5 - Change air filter element as recommended



It is not the recommended to operate the engine without air filter, otherwise the dust and impurity will lead to early failure.

TURBOCHARGER

INITIAL RUNNING

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

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

MAINTENANCE

DO'S

1. Turbocharger does not require any maintenance.
2. Adhere strictly to recommended maintenance schedule.
3. Use of specified grade of engine oil and oil filter and periodic change as recommended in maintenance schedule.
4. Replace air filter element as recommended.
5. Check for oil pressure at engine idling condition minimum oil pressure should be 1 kg/cm^2 .

6. Allow the engine to run for 2 minutes after starting the engine.
7. Allow the engine to run for 2 minutes before switching off the engine.
8. When carrying out maintenance work on the engine, the piping leading from or to the turbocharger must be removed, and the pipe openings on the turbocharger to be closed properly.
9. Regularly check the oil feed and return pipes for leaks, air intake system pipes and hoses for leakage, blockage and exhaust piping connections for leakages, blockage.
10. Prior to fixing turbocharger to the engine, fill the central housing with clean engine oil and ensure that, all pipes are thoroughly cleaned before connecting to the turbocharger.
11. Check the fuel injection system for its proper functioning.
12. Close all the turbocharger openings with protective plugs when it is not in use.
13. Contact Ashok Leyland dealer / authorised centres for turbocharger complaints / service / overhaul.



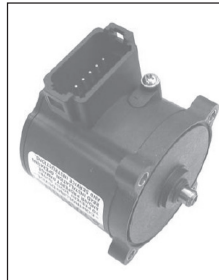
DON'TS

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

L SERIES INTEGRATED SPEED CONTROL (Applicable to 100 - 125 KVA)

The Woodward L-Series combines the L-Series electric actuator with integrated speed control software to control the speed of an engine. The L-Series is a microprocessor-based control that is incorporated into the actuator, creating a single integrated package. This eliminates the need for an additional driver box and speed control box. The control uses state-of-the-art speed sensing and control algorithms. The L-Series also performs comprehensive diagnostics for easy troubleshooting. It can be configured and tuned using the L-Series Service Tool. The L-Series provides a building block approach to total engine management. The modular bi-directional actuator design is attached to the fuel pump.

The L-Series speed control accepts a speed signal (MPU), compares this to the



speed set point, and drives the 0–60 degree output shaft to the commanded position based on an internal shaft position sensor. The high efficiency torque motor delivers 0.34 N-m nominally over 60° travel range to operate fuel injection pump.

There are 4 AUX inputs for I/O functions, configurable as digital inputs, analog inputs, or RS-232 Service Tool communications. The functions available for AUX input configuration are:

For status purposes, a relay driver output is available on the L-Series control which changes state whenever a fault or error condition is experienced by the L-Series control. If the system so requires, the L-Series provides a direct position output signal in the form of a dc voltage. The throttle position (TPS) output represents full counterclockwise (ccw) to clockwise (cw) rotation of the actuator shaft, and thus gives the operator an external position indication after installation and while the unit is operating.



WARNING / EMERGENCY STOP

The L - Series control should not be used as the primary means of shutting down the engine.



Setup and tuning features can be individually password protected for security purposes. If security is applied, these features will not be accessible without the password.

5



Many applications are delivered pre-configured, calibrated, and tuned. For most applications, the default gains do not need to be changed. Min Position and Fail Direction should be checked.



TRAINED PERSONNEL

An unsafe condition could occur with improper use of these software tools. Only trained personnel should have access to these tools.



ACTUATOR SET UP

The actuator must be properly set up using the L-Series Service Tool prior to starting the prime mover.



All parameters are set at factory. No adjustment / realignment is required in the field. Do not attempt to rectify the problem experienced. Please get in touch with our authorised dealer.

INSTRUCTIONS

- Ensure proper fitment of respective mating connections to the wiring harness and speed sensor and 12P-Deutsche Connector.
- Ensure the gap between the speed sensor and the flywheel ring is between 0.25 to 1.05 mm.
- Ensure lubrication of leakage rod end bearings.

Do's

- Calibration of linkage is mandatory, if for any reason linkage is loosened or disturbed.
- Ensure that calibration and/or reflashing of the program is done only by the Ashok Leyland authorised service engineer / dealer.

Don'ts

1. Do not dismantle or disturb the governor linkage assembly.
2. Do not wash engine.
3. 12-Pin connections of the governor should not be in contact with oil or water when connector / wiring harness is not assembled.



6. Maintenance schedule

SCOPE AND PROCEDURES OF REGULAR MAINTENANCE

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

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



CHECK LIST	Daily	First 50 hours only	Every 250 hours	REMARKS
1. Check level and top up				
a) Oil in engine	✓	✓		
b) Coolant level in heat exchanger (for marine application)	✓	✓		
c) Coolant in radiator (for industrial application)	✓	✓		
d) Oil in aircleaner		✓		
e) Oil in gear box (for marine application)		✓		
f) Electrolite in battery		✓		
g) Oil in FIP		✓	✓	
2. Check tightness of				
a) Battery terminals & apply petroleum jelly		✓	✓	
b) Fan belt and tighten if necessary		✓	✓	
c) Hose connections in cooling systems		✓	✓	
d) Hose clamp of charge air cooler / turbocharger		✓	✓	
e) Connections at seawater pump (for marine application)		✓	✓	
f) Fuel piping connections		✓	✓	
g) Exhaust piping connections		✓	✓	
h) Engine mountings		✓	✓	



CHECK LIST	Daily	First 50 hours only	Every 250 hours	REMARKS
i) Engine to drive unit coupling		✓	✓	
j) Electrical connections at instrument panel		✓	✓	
k) Radiator mtg, stay & gap between fan and cowl (for industrial application)		✓	✓	
l) Turbocharger mounting (411/412)		✓	✓	
m) Injection pump mounting		✓	✓	
n) Cylinder head nuts				First 250 Hours and thereafter every 2500 Hours
3. Run the engine, check and record				
a) Oil pressure	✓	✓		
b) Battery charging	✓	✓		
c) Idling RPM	✓	✓	✓	
d) Maximum RPM	✓	✓	✓	
e) Maximum operating temperature	✓	✓	✓	
4. Check leakage from				
a) Fuel piping & injector high pressure lines		✓	✓	
b) Exhaust manifold, flange & connections		✓	✓	



CHECK LIST	Daily	First 50 hours only	Every 250 hours	REMARKS
c) Engine oil filter and other areas		✓	✓	
d) Coolant hoses		✓	✓	
e) Gear box and PTO (for marine application)		✓	✓	
5. Check proper engagement (for marine application)				
a) Gear box	✓	✓		
b) Power Take Off	✓	✓		
6. Check proper routing to avoid any kink formation				
a) RPM cable		✓	✓	
b) Capillary tube to temperature gauge		✓	✓	
7. Check condition of				
a) Zinc anode (for marine oil cooler application)			✓	
b) Alignment of engine to driven unit		✓	✓	
c) Check water pump. Recondition if necessary				Every 1250 Hours
8. Lubricate				
a) Throttle linkages		✓	✓	
b) Water pump bearing (AL series)		✓	✓	
c) Clutch engaging sleeve (for marine application)		✓	✓	



CHECK LIST	Daily	First 50 hours only	Every 250 hours	REMARKS
9. Clean				
a) Fuel feed pump strainer		✓	✓	
b) Fuel filter bowl, drain till clear fuel appears and then bleed the system		✓		
c) Strainer in fuel tank			✓	
d) Engine breather				Every 1250 Hours
e) Engine sump and oil pump strainer				Every 1250 Hours
10. Replace/Fill				
a) Replace engine oil and oil filter at scheduled hours				Refer page No. 6.09, 6.10, 6.11 and 6.12
b) Change oil in oil bath type air cleaner			✓	
c) Change gear box oil			✓	
d) Fuel filter and seal ring			✓	Refer page No. 5.02, 5.03 and 5.05
e) Coolant (Refer page 5.08 for recommended coolants)				Every 5000 Hours or 24 months
f) Cooling system hoses and rubber pads for radiator mounting and stay rods				Every 2500 Hours



CHECK LIST	Daily	First 50 hours only	Every 250 hours	REMARKS
g) Fuel hoses				Every 3500 Hours
h) Air filter element - oil bath type, check and replace if necessary - (Refer Page No. 5.11 for dry type air cleaner)				Every 3500 Hours
11. Check & reset				
a) Injection pump timing		✓		
b) Adjust valve clearance				During every oil change
c) Injector opening pressure				Every 500 hours.
d) Recalibrate Fuel Injection Pump				Every 3500 Hours.
12. Check charge air cooler				
a) For any blockage of fins and clean the cooler if necessary			✓	
b) Hoses for any damage			✓	

**RECOMMENDED LUBRICANTS - "H" SERIES - ENGINES**

			Co-branded Lubricant	Approved Lubricant
Aggregate	Ashokleyland Specification	Ambient Temp °C	Gulf Oil India	Indian Oil Corporation
H Series Engine (Naturally aspirated / turbocharged / turbocharged aftercooled)	API CF-4 + MB228.1	-15 and above	Leypower Diesel Engine Oil / Super fleet Max SAE 15W-40	Servo Premium ALT 15W-40
Oil bath Air cleaner				
HA6DTI Engines	API CH-4, SAE 15W40	-15 and above	Superfleet LE Max SAE 15W-40	Servo Pride ALT 15W-40
Ashok Marine Gear Box	API GL-4 (or) MIL-L-2105 (or) IS 1118 - EP Type GL-4	>30	Gear EP Max SAE 140	Servo Gear ALT 140

NOTE : Do not mix lubricants of different brands/grades.

FILLING CAPACITIES (l)**1 Engine Oil**

H Series WO4d/4CTI Engines	8.5
H Series 6DTI Engines - 100 KVA	12
H Series 6DTI Engines - 125 KVA	16

2 Air Cleaner

0.5

3 Cooling system (for Genset)

H series WO4D/4CTI Engines	17.5
H Series 6DTI Engines - 100 KVA	19
H Series 6DTI Engines - 125 KVA	22

For other aggregates follow PEM recommendations:

**RECOMMENDED LUBRICANTS - AL SERIES ENGINES**

			Co-branded Lubricant	Approved Lubricant
Aggregate	Ashokleyland Specification	Ambient Temp °C	Gulf Oil India	Indian Oil Corporation
AL Series Engine - BSI,BSII (Naturally aspirated / turbocharged / turbocharged aftercooled)	API CF-4 + MB228.1	-15 and above	Leypower Diesel Engine Oil / Super fleet Max SAE 15W-40	Servo Premium ALT 15W-40
Oil bath Air cleaner				
AL Series - BSIII Engine	API CI-4 +	-15 and above	Gulf Super fleet LE Dura Max 15W40	Servo Pride ALT PLUS
Engine Water Pump	IS 12203		MP Grease Max NLGI 2	Servo Grease ALT
Ashok Marine Gear Box	API GL-4 (or) MIL-L-2105 (or) IS 1118 - EP Type GL-4	>30	Gear EP Max SAE 140	Servo Gear ALT 140

Note : Don not mix lubricants of different brands / grades.

SUMP DESCRIPTION		LUB OIL FILLING CAPACITY (in litres)	
		Up to "LOW" level mark in Dipstick	Up to "FULL" Level mark in Dipstick
1	Flat Bottom Sump	8.2	10.9
2	1 in 1 Sump	12.5	15.5
3	Front Deep Well Sump	13	15
4	Commonised Sump	8.7	11.7
5	Central Deep Well Sump	14	12.5



OIL CHANGE INTERVALS - H SERIES ENGINES - GENSET APPLICATION						
	H4 Series - NA Engines		H4 Series - Turbocharged Engines		HA6DTI Engine	
Type of Service	with use of LEYPOWER Diesel Engine Oil (LPDE Oil), Gulf Oil India / Indian Oil Corporation - CF4 15W-40				with use of Gulf Oil India/ Indian Oil Corporation CH4 15W-40	
	Hrs	Days	Hrs	Days	Hrs	Days
1st Free Service Inspection	50	30	50	30	50	30
2nd Free Service	400	60	250	60	500	60
Paid Service - 1	800	120	500	120	1000	120
3rd Free Service	1200	180	750	180	1500	180
Paid Service - 2	1600	240	1000	240	2000	240
Paid Service - 3	2000	300	1250	300	2500	300
4th Free Service	2400	360	1500	360	3000	360
Paid Service - 4	2800	420	1750	420	3500	420
Paid Service - 5	3200	480	2000	480	4000	480
5th Free Service	3600	540	2250	540	4500	540
Paid Service - 6	4000	600	2500	600	5000	600

- NOTE:-**
- 1 Oil change interval in Hours / Days Applicable Whichever occurs Earlier**
 - 2 3rd,4th & 5th Free Services are subject to availing of intermediate paid services**
 - 3 Ashok Leyland reserves the right to change the above schedule, procedures at any time and without any prior notice. Kindly check with authorised AL Dealer / Company Executives for any clarification**
 - 4 Subsequent services to be carried out on paid basis thru our dealer till completion of warranty period, to avail warranty benefits**

**OIL CHANGE INTERVALS - AL SERIES ENGINES - GENSET APPLICATION**

	AL Series - NA Engines		AL Series - Turbocharged Engines	
	Hrs	Days	Hrs	Days
Type of Service				
1st Free Service Inspection	50	30	50	30
2nd Free Service	400	60	250	60
Paid Service - 1	800	120	500	120
3rd Free Service	1200	180	750	180
Paid Service - 2	1600	240	1000	240
Paid Service - 3	2000	300	1250	300
4th Free Service	2400	360	1500	360
Paid Service - 4	2800	420	1750	420
Paid Service - 5	3200	480	2000	480
5th Free Service	3600	540	2250	540
Paid Service - 6	4000	600	2500	600

- NOTE:-**
- 1 Oil change interval in Hours / Days Applicable Whichever occurs earlier
 - 2 3rd,4th & 5th Free Services are subject to availing of intermediate paid services
 - 3 Ashok Leyland reserves the right to change the above schedule, procedures at any time and without any prior notice. Kindly check with authorised AL Dealer / Company Executives for any clarification
 - 4 Subsequent services to be carried out on paid basis thru our dealer till completion of warranty period, to avail warranty benefits



OIL CHANGE INTERVALS - H &AL BS-I, BSII SERIES ENGINES - INDUSTRIAL AND MARINE APPLICATION		
	with use of LEYPOWER Diesel Engine Oil (LPDE Oil), Gulf Oil India / Indian Oil Corporation - CF4 15W-40	
	Hrs	Days
Type of Service		
1st Free Service Inspection	50	30
2nd Free Service	250	60
Paid Service - 1	500	120
3rd Free Service	750	180
Paid Service - 2	1000	240
Paid Service - 3	1250	300
4th Free Service	1500	360
Paid Service - 4	1750	420
Paid Service - 5	2000	480
5th Free Service	2250	540
Paid Service - 6	2500	600

- NOTE:**
- 1 Oil change interval in Hours / Days Applicable Whichever occurs earlier
 - 2 3rd,4th & 5th Free Services are subject to availing of intermediate paid services
 - 3 Ashok Leyland reserves the right to change the above schedule, procedures at any time and without any prior notice. Kindly check with authorised AL Dealer / Company Executives for any clarification
 - 4 Subsequent services to be carried out on paid basis thru our dealer till completion of warranty period, to avail warranty benefits

**OIL CHANGE INTERVALS - AL BS-III SERIES ENGINES - INDUSTRIAL APPLICATION**

with use of Gulf Oil India / Indian Oil Corporation - C14 + 15W-40

Hrs**Days****Type of Service**

1st Free Service Inspection

50

30

2nd Free Service

250

60

Paid Service - 1

500

120

3rd Free Service

750

180

Paid Service - 2

1000

240

Paid Service - 3

1250

300

4th Free Service

1500

360

Paid Service - 4

1750

420

Paid Service - 5

2000

480

5th Free Service

2250

540

Paid Service - 6

2500

600

- NOTE**
- 1 Oil change interval in Hours / Days Applicable Whichever occurs earlier**
 - 2 3rd,4th & 5th Free Services are subject to availing of intermediate paid services**
 - 3 Ashok Leyland reserves the right to change the above schedule, procedures at any time and without any prior notice. Kindly check with authorised AL Dealer / Company Executives for any clarification**
 - 4 Subsequent services to be carried out on paid basis thru our dealer till completion of warranty period, to avail warranty benefits**



7. Marine engine and accessories

- Installation instructions with mechanical gear box
- Seacock and strainer
- Marine oil cooler (AL Engine)
- Marine heat exchangers
- Sea water pump
- Gear box (for AL Engine)
- Ghatge patil gear box
- Screw propeller
- Marine hydraulic gear box 135A



INSTALLATION INSTRUCTIONS WITH MECHANICAL GEAR BOX

ALIGNMENT OF GHATGE PATIL GEARBOX/ ASHOK GEARBOX WITH THE ENGINE

In case the gear box or adaptor flange is removed for any repairs, during reassembly the following are to be checked to ensure proper alignment.

- a) The face out of the face plate fitted on the flywheel should not exceed **0.127 mm (0.005")**.
- b) The face out of the adopter flange and the run out of its bore with respect to the flywheel should not exceed **0.127 mm (0.005")** and **0.076 mm (0.003")** respectively.
- c) Before fitting the clutch on the flywheel check that the dimension between the outer member face and the pressure plate is **9.728 mm (0.383")**. This must be checked at 3 places 120° apart to ensure that the pressure plate is parallel to the outer member face. If any scoring is present on the pressure plate, it should not be skimmed and reused but a new pressure plate is to be used.

- d) While fitting the clutch on to the flywheel, the clutch plate must be held in position such that, boss which projects out of the flinger plate is towards the flywheel side.
- e) Position and tighten the outer member assembly with the clutch plates inside on to the flywheel locating it on the dowels. The permissible runout of the outer member is **0.076 mm (0.003")**.

ALIGNMENT OF POWER TAKE OFF

Whenever the engine or PTO is removed for any repairs, the front and driving flange shaft and the PTO shaft should be properly aligned before fitting the tyre coupling. In order to ensure that the two shafts are properly aligned a sleeve could be fabricated.

The PTO is so positioned, if necessary by inserting packing (metal pieces) between the front mounting base and skid of the engine that the sleeve easily slides from the driving flange shaft and the PTO shaft. Now the PTO is removed. The sleeve is removed and the PTO is replaced on the position.

If the sleeve is not available, one portion of the hub of the tyre coupling could be taken

out of the tyre coupling. This hub could be used as sleeve, to align the PTO and driving flange shafts in the manner mentioned earlier.

To remove the tyre coupling for replacing the front belts, (front pulley to sea water pump) loosen the clamping screws (holding the tyre on to the hub) and pull the tyre out. After replacing the belt, the sequence of operation is reversed for reassembly.

ADJUSTMENT PTO CLUTCH

If the clutch does not pull, overheated or operating lever jumps out, the clutch must be adjusted. To adjust the clutch, remove the hand hole plate in the housing and turn the clutch until the adjusting lock pin can be replaced. Disengage the adjusting lock pin and turn the adjusting yoke or ring to the right or clockwise until the operating lever requires a distinct pressure to engage. A new clutch generally requires several adjustments until the friction surfaces are worn.

ENGINE FOUNDATIONS

The engine is mounted on L section channels and the latter can be bolted on to the runners of the boat. To ensure that the



gearbox transmission and its bearings are not subject to severe strain. It is important that the propeller shaft flange and the gearbox flange must be square with each other. (The rear output flange of the gearbox is fitted with an adaptor which is to be machined to suit the prop. shaft.) Before tightening the two flanges, a **0.508 mm (0020")** feeler gauge is inserted to ensure that the gap between the two flanges is uniform around their outer periphery. It is important that the gap or alignment should be checked and rechecked when the boat is lowered into the water as also after the boat is in water sometime as there is a tendency for the hull to distort in water and cause misalignment. If this is not checked, there is every likelihood of damage to the gearbox bearings and spigot bearings in the input shaft due to misalignment of these two flanges. The same care must be taken to align flanges (if used) in the drive line located near the plummer block (or any pedal bearings.)

FUEL SYSTEM

It is advisable to fit a water separator and a 1.1 lit. capacity pre-filter between the fuel tank and the feed pump of FIP, to ensure longer life of the feed pump. Open the drain cock of the water separator weekly to

ensure that the fuel is free from the traces of water. Periodical cleaning of the diesel tank to remove impurities is also necessary. Care should be taken to see that the level of the fuel tank is not less than 60 mm (2 ft) below the level of the feed pump. The injector leak off pipe and the filter leak off pipe must be taken separately to the fuel tank.

AIR INDUCTION SYSTEM

All the marine engines are fitted with heavy duty oil bath type air filter to ensure that the air intake is absolutely free from any impurities. It is advisable to ventilate the engine cabin so that hot air is not sucked through the intake system.

EXHAUST SYSTEM

The back pressure of the engine exhaust manifold should not be more than 101.6 cm of water column for naturally aspirated engine and 50.8 cms for TC engines. The silencer is to be suitably located and sharp bends are to be avoided. Care must be taken to see that the rain water does not enter the exhaust system.

ELECTRICAL SYSTEM

Always keep the battery terminals clean of all dust and foreign matter. Attention should be paid to smear the terminals with

a thin layer of petroleum jelly or vaseline to insulate the terminals from moisture, before tightening. All electrical connections and terminals of electrical unit must be protected from coming into contact with the sea water.

PRECAUTIONS BEFORE COMMISSIONING THE ENGINE

- Maintenance manual accompanying the engine to be studied carefully.
- Engine oil level to be checked. Only recommended engine oil to be used.
- Oil level in the air filter to be checked.
- Engine to be cranked for a couple of minutes with care to ensure oil circulation in the engine system. Cranking to continue till oil seeps out of the rocker assembly which can be checked by removing the rocker cover.
- Fuel system to be bled.
- The gearbox lever should be kept in neutral position before starting the engine.
- Always engage or disengage the gear lever when engine is at idling speed.
- Check the alignment of propeller shaft after launching the craft preferably in loaded condition.



SEACOCK AND STRAINER

The sea water being drawn the system should be free from sand, as otherwise it may damage the pump etc. of the system. Similarly steps must be taken to see that the sea water flow is not restricted by the sea weeds and other organisms.

In case the sea water pump is removed for reconditioning while refitting care should be taken to see that the pulley fitted on the sea water pump is properly aligned with driving flange pulley. In case, the engine fan belt is to be replaced, the PTO is to be removed.

A sea cock is normally fitted in the suction side of the sea water line. This is fitted below the water line in the majority of the cases. **When the engine is not working and the boat is not in operation, the sea cock must be closed to prevent the water entering the system. Similarly before starting the engine the sea cock must be opened.**

The sea cock inlet is fitted on to the hull.

PRECAUTIONS:

1. Sea cock with filter arrangement should be provided in the sea water system.
2. Sea cocks are of metallic type having small perforated holes. The perforations should be capable of filtering sand and other minute particles in the seawater.
3. The filter in the sea cock must be cleaned everyday.
4. The duplex type sea cock is advantageous as one filter can be cleaned while the other is working.
5. To prevent entry of sea weeds etc. into the sea water inlet a strainer in the form of grating may be used on the hull.
6. This grating must be free from any deposit of sea weeds.
7. As soon as the engine is started, sea water on the delivery side must be checked.
8. Always there must be a watch on the delivery of sea water. In case there is no water coming out of the delivery side immediately, thorough check must be made in the system.

MARINE OIL COOLER (AL ENGINE)

INSPECTION ANODE

The Zinc anode when fitted new is 25 mm long. With service a white or yellowish deposit appears on the surface due to decomposition of Zinc. This has to be scraped off with a pen knife and fresh zinc surface exposed during Inspections. If the first inspection shows a very slight deposit of decomposition of zinc the frequency of Inspection can be altered accordingly. It is very important to replace the anode when the length of active Zinc remaining in the plug reduces to 3 mm failing which will result in rapid corrosion of the tubes due to lack of protection offered by zinc anode. It is also recommended to use zinc anodes supplied by the manufacturer.

Cleaning inside of tubes

To ensure efficient transfer of heat from oil to water it is imperative that all tubes should be clean, free of scale, deposits etc.



Under no circumstances should steel wire or sharp edged rods be used as they are likely to puncture the tubes.

Cleaning the shell & tube bundle assembly oil side

The engine lubricating oil has been changed as per engine manufacturers instructions there will be no necessity to clean the oil side of the oil cooler. However, when sludge has formed the inside of the shell may be soaked in kerosene and flushed with any good brand of flushing oil. Drain plug is to be opened and all traces of flushing oil removed by blowing air through the oil ports.

Fresh engine lubricating oil may be used to clean out any remaining flushing oil. The drain plug may be refitted with a fresh Aluminium washer and the Oil cooler put back into the oil stream.

MARINE HEAT EXCHANGERS

INSPECTION:

Examine both the interior and exterior condition of all tubes. Remove blockages If any, using scrapers or rotating wire/nylon brush. It is advisable to clean the tube bundle and headers once in a month.



Avoid removing the blockages with any sharp instruments as these are likely to puncture the tubes.

Examine the headers for corrosion and clean them if found necessary. The condition of the Zinc anode will give an indication of the extent of corrosion. The deposits on the Zinc Anode may be scraped to expose the parent metal. If the exposed material is less than 5 mm a new plug with Zinc Anode should be fitted. It is also recommended to use Zinc Anode supplied by the manufacturer.

SEA WATER PUMP

OPERATION

Sea water pump is of self priming centrifugal pump mounted overhung on the bearing pedestal which is belt driven and takes drive from engine crankshaft through pulleys.

The pump is self priming type with inbuilt positive suction head and valve. The pump has to be filled with liquid once. When it has been switched on the air is evacuated from the suction line.

The air is evacuated from the suction line and the liquid level in this piping rises. Once all air has been evacuated, the pump starts working as a normal centrifugal pump.

The pump has a non-return valve, so the suction and discharge lines can not be siphoned empty, when the pump has been stopped. The remaining liquid in the pump is always sufficient for the next suction phase.

PIPING CONNECTIONS

The following points should be strictly adhered while installing the pipings for the seawater pump.

- * The piping to the suction and delivery connection must fit exactly and must not be subjected to stress during operation.



- * The passage of the suction pipe must be amply dimensioned. This pipe should be as short as possible and run towards the pump in such a way that no air pockets can arise. If this is not possible, a venting facility should be provided at the highest point of pipe.
- * If the inside diameter of the suction pipe is larger than the suction connection of the pump, an eccentric reducer should be applied to prevent air pocket and whirls.
- * It is advisable to install a foot valve when a suction line is long one or static lift is high.
- * It is not advisable to have a common suction pipe for two or more pumps and similarly two or more suction lines from different sources.
- * Select the suction line diameter as function of its length. It must not be smaller than the pump suction connection. It should not be too oversized for self priming pumps. Foot valve is not required unless suction line is too voluminous or the operating conditions are so unfavourable that suction time is longer than approximately 8 minutes.

PREPARATION START UP

- * Check the direction of rotation and ensure that it is as indicated in the pump casings (by an arrow).
- * Before commissioning the pump, remove any preservatives and flush the pump with the hot water.
- * Check whether the oil seal chamber is filled with oil. If not, fill with the recommended lubricant. Never allow the seal to run dry.
- * Check whether the pump shafts turns freely do this by turning the shaft end a few times by hand .
- * Fill the pump with water or the liquid to be handled through the filling plug on the top of the pump until the liquid starts to over flow.
- * Never run the pump dry.

START-UP-PROCEDURE:

- * Check whether driving pulley and belt are free from any obstructions.
- * Start the pump.
- * During the self priming phase, ensure the air can escape unhindered and without causing any back pressure in the discharge pipe.
- * Check if connections and seals are not leaking.

- * Ensure that the system pressure and temperature are maintained with in recommendations.



If no sea water is pumped or if excessive noise is apparent, the pump must be stopped immediately. Contact Authorised Service Dealers.

MAINTENANCE

For smooth and trouble free running of the pump, Maintenance instructions given below should be followed strictly.

- * Keep both the surface of the pump and the surroundings as clean as possible.
- * Ball bearing are sealed and packed with grease for life and no lubrication is necessary.
- * Open the sealing chamber of mechanical seal at least every month and top up with oil (SAE 15W/40), if necessary.
- * Drain off and replace oil once a year or every 2000 running hours. (SAE 15W/40)
- * In case of long stand-still, the pump must be started or its shaft turned by hand at least every week.
- * If there is any danger of freezing, the pump must be drained and preferably flushed with oil after having been shut down.



MARINE GEAR BOX (FOR AL ENGINE)

Make	Ashok Marine Gearbox	Ghatge Patil Gear box
Type	3/1 or 411	GPMG6/GPMG7
Ratio	3 : 1, 4 : 1	3 : 1, 4 : 1
Clutch	Twin plate dry type / 11" outside dia / Frictional Area 125 Sq. in.	Wet type
Maximum input Torque	325 lb. ft.	325.6 lb. ft
Maximum Speed	2400 Rpm.	2400 RPM
Weight (dry) approx.	180 Kg.	for 3 : 1 - 165 kg / for 4 : 1 - 180 kg
Oil Capacity approx.	4.0 litres	for 3 : 1 - 3.25 ltrs. / for 4 : 1 - 3.5 ltrs.
Lubricating oil	SAE 90	SAE 30/40
Flywheel Housing	SAE 2	SAE 1

ASHOK MARINE GEAR BOX

Gear box is available with either 4:1 or 3:1 ratios for ahead drive and with 3:1 ratio for astern drive. The running gears are in constant mesh and the selection of the forward and astern gear trains, is by two dry type friction clutches, which is arranged in such a way that as the forward clutch engages the astern clutch disengages and vice versa. The forward astern hand operating lever can be fitted on either side of the gear case depending on requirement.



IMPORTANT

The user will benefit attending to the following instructions before commissioning the gear in service.

- a) Fill the same lubricating oil as is used for the Engine, in the Reverse Gear as well as the Reduction Gears. Use oil with viscosity equivalent to S.A.E. 30 for temperate conditions. S.A.E. 10 for arctic conditions.
- b) The Special Aft Thrust bearing of the Reverse Gear of the Gearwheel Bearings of the Reduction Gear should be replaced by a Ball Journal Bearing of the same size, if a Thrust Block is fitted to the shafting between the Gearbox and the Propeller. Otherwise early failure of the Aft Thrust Bearing or the Gearwheel Bearings will follow.
- c) Before starting up an Engine for the first time, it is essential to ensure that both the ahead and the astern positions can be fully engaged.
- d) Check and make sure that the rotation of reverse Gear and Reduction Gear match the rotation of the engine.



- e) It should be noted that during the first 100 hours running or so, the Brake Band will probably require periodical adjustment whilst the lining of the Band settles down and high spots are removed.
- f) A multiple plate Clutch is provided to lock the bevel wheel assembly for ahead drive, A brake band locks bevel wheel casing to obtain reversal of the output shaft-the Aft Shaft to go astern.

The Gear is mechanically controlled either by means of the hand operated operating Lever or by a suitable remote control mechanism, incorporating drop arms, rods, drag links etc.
- g) The method of lubrication in the Reverse Gear and the Reduction Gears is by oil splash. All bearings are of the Ball/Roller/ Needle type. So there is no need for pressure lubrication.

GHATGE PATIL (FOR AL ENGINE)

MARINE POWER TAKE OFF MODEL C - 107

Introduction

Ghatge patil C - 107 Marine Power Take-Off is specially designed to suit marine applications and widely used as front Power take off to drive the winch on fishing boats. This power take-off is also suitable for any industrial application where self contained and self supporting power takeoff is desired.

Special Features

- Self contained & self supporting.
- Water tight casing provides protection against corrosion.
- Flexible input coupling assures safety to the engine as well as to the power take off against mis-alignments.
- Out put shaft is provided with a pulley ('V' groove, 3 Belts) for drive to the winch shaft.

Transmission Capacity

Maximum Torque (lb. ft.)	Maximum Horse Power			Maximum Speed (RPM)	Normal Engaging force with Std. hand lever provided (Lbs.)	Torque operating (Kgs.)	Strokes of operating lever		
	Light Duty	Normal Duty	Heavy Duty				Lbs.	Kg. cm	Angular
131	48	38	26	3000	73	33	940	1085	13°



SCREW PROPELLER

A screw propeller is basically an axial flow pump.

The rotation of the propeller (RPM) and the angle of the propeller blade, known as pitch, combine to form a thrust force on the propeller shaft. Thrust is transmitted through the shaft to the thrust bearing, which is the principal point where the forces generated by the propeller rotation act upon the hull.

There is no known formula which will automatically give the ideal propeller size for a given boat. One can merely approximate. The only true test is the “trial and error” method.

The major terms used when discussing propellers are:

1. Diameter
2. Pitch
3. Slip
4. Pitch Ratio

DIAMETER

Diameter is twice the distance from the centreline of the propeller hub to tips of the blade, or the diameter of the circle scribed by the tips of the blade.

PITCH

Pitch is the angle the blade makes in relationship to the centreline of the hub and is normally expressed as the distance, in inches, that the blade would advance in one revolution, if the propeller were a screw working in a solid substance. Thus, the theoretical distance in inches covered in one minute could be measured by RPM X PITCH. However, we are not dealing with a solid and it is here that a loss of forward motion occurs known as “slip”.

SLIP

Slip is the difference between the theoretical distance and actual distance covered in a given period of time. This relationship is usually expressed in a percentage calculated as follows:

$$\frac{\text{Theoretical distance} - \text{Actual distance}}{\text{Theoretical distance}} \times 100\%$$

PITCH RATIO

Pitch ratio expresses the relation between the diameter and the pitch of the propeller. To obtain pitch ratio, divide the pitch by the diameter. If a 60” wheel has a pitch ratio of 0.7, it has a pitch of 42” (60” x 0.7) and is known as a 60 x 42 propeller.

It is to be remembered that all propellers are a compromise. However, it is generally good practice to utilize the largest propeller diameter possible within practical limitations. These limitations are:

1. Size of aperture in which propeller is to be installed.
2. Type of operation - towboat, crew boat, pleasure craft, etc.
3. Shaft angle required for large propeller.
4. Weight of propeller, shafting and gear boxes relative to boat's size.



NUMBER OF PROPELLER BLADES

Three-bladed propellers are more efficient over a wider range of applications than any other propeller. Hence most of the calculations are based on this type of wheel.

In theory, the prop with the least number of blades (i.e. two) is the most efficient. Diameter and technical limitations in most cases, make a greater number of blades necessary. Four and sometimes five-bladed propellers are used in cases where an objectionable vibration peak is developed within the operating range when using a three blade propeller.

All other conditions being equal, the efficiency of a four blade propeller is approximately 96% that of three blade propeller having the same pitch ratio and blades of the same proportion and shape.

An old water front rule of thumb for all propeller selection is:

“Tow boats - big wheel, small pitch”

“Speed boats - little wheel, big pitch”

All other applications can be shaded between these two statements of extremes.

PROPELLER TIP SPEEDS

Propeller tip speed is the speed, in MPH, travelled by the tips of the propeller blades. The greater the tip speed, the more power consumed in pure turning effort. A 30” propeller with a tip speed of 60 MPH will absorb about 12 horsepower in pure turning effort. This in itself, is a horsepower loss because it contributes nothing to the forward thrust. Generally propellers greater than 30” in diameter should not have a tip speed over 60 MPH. On smaller propellers, under 20”, tip speed should not exceed 120 MPH.

$$T = \frac{D \times \text{Shaft RPM} \times 60 \times 3.14}{12 \times 5280}$$

Where

T = Tip speed in MPH

D = Propeller diameter in inches.

CAVITATION

When propeller RPM is increased to a point where suction ahead of the propeller reduces the water pressure below its vapour pressure, vapour pockets form, interrupting the solid flow of water to the propeller. This condition is known as cavitation.

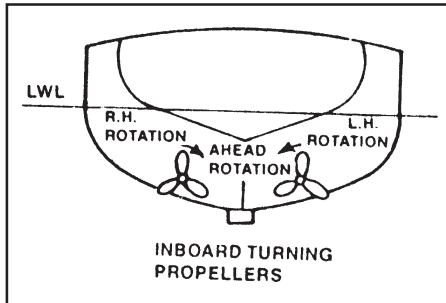
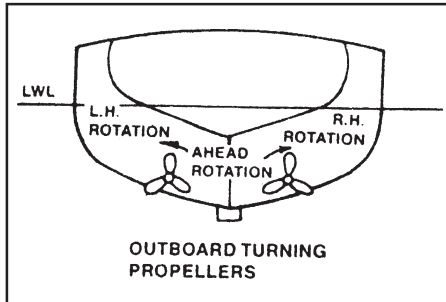
One of the more common causes of cavitation is excessive tip speed (a propeller turning too fast for water to follow the blade contour). Cavitation can usually be expected to occur at propeller tip speeds exceeding 130 mph. Cavitation results in a loss of thrust and damaging erosion of the propeller blades.

PROPELLER OVERHANG

The maximum distance from the stern bearing to the propeller should be limited to no more than one shaft diameter. Propeller shafts are apt to vibrate and produce a whip action if these limits are exceeded. This condition is greatly accelerated when a propeller is out of balance due to faulty machining or damage.



MULTIPLE PROPELLERS:



The most efficient method of propelling a boat is by the use of a single screw. However, there are other factors which when taken into consideration, make the use of a single propeller impossible.

If a boat has to operate in shallow water, the diameter of the propeller is limited.

Therefore it may be necessary to install two and sometimes three propellers to permit to a proper pitch ratio for efficient propulsion.

Propeller rotation is determined from behind the vessel, facing forward. The starboard side is on the right and the port side on the left. Rotation of the propeller is determined by the direction of the wheel when the vessel is in forward motion. Thus a clockwise rotation would describe a right hand propeller and a counter clockwise rotation would be left hand propeller.

Right hand propellers are more frequently used in single screw installations. But twin screw vessels are equipped with two possible combinations of wheels viz., a) Outboard turning propellers and b) Inboard turning propellers.

A rotating propeller tends to drift sideways in the direction of rotation. In a single screw vessel this can be partially offset by the design of the stern post and the rudder. In a twin screw vessel this can be completely eliminated by using counter rotating propellers.

PROPELLER SHAFTS

The connecting link in a boats propulsion package is the propeller shaft. This portion of the drive train serves the dual function of transmitting engine torque to the propeller and propeller thrust to the thrust bearing.

Propeller shafts are classified into two groups, tail shafts and line shafts. The section or sections of the shafting totally within the hull are termed line shaft. Tail shafts are that portion which is partially or totally exposed to water outside the hull. Because this portion of the shaft is subjected to such erosive forces as water, sand and bending movements due to propeller over hang, it is generally good practice to use a tail shaft that is heavier than the line shaft.

Reduction Gears:

Selection of the reduction gear ratio is one of the most important decision to be made in any marine power installation. A range of reduction ratios is normally provided to assure optimum performance under a given set of operating conditions. Factors taken into account while selecting the



reduction gear ratio are anticipated boat speed, usage of boat, proper pitch ratio, propeller tip speed, engine horse power.

Specific type of hull for fishing vessels

Vessels in this classification that fish by means of nets drawn through the water offer a special problem. For example, a shrimp boat may travel as far as 500 miles or more to the fishing grounds. Owners usually want to cut this travel time as much as possible. However, when fishing, the boat has to tow large doors performance requirements calls for a compromise in the propeller selection and reduction ratio to obtain the maximum usable power for both operating conditions. These "optimum" conditions are as a rule achieved when the speed in knots divided by the square root of the waterline length (in feet) equals either 0.9 or 1.0.

i.e.
$$\frac{V}{\sqrt{LWL}} = 0.9 \text{ or } 1.1$$

Where V = speed of boat in knots and
= loaded water line length (in ft)

This assumes the hull to be a normal displacement form with a reasonable beam to length ratio.

The optimum of $V/\sqrt{LWL} = 0.9$ or 1.1 is simply used as a base to establish the most practical speed of a displacement hull. Beyond this point the horsepower per knot increase becomes economically unfeasible. Thus, from data taken on a large sample of displacement hulls, a general formula for estimating a boat's "maximum feasible" speed was developed where 1.34 times the square root of the loaded waterline length (in. ft) equals the boat's speed in knots i.e. $1.34\sqrt{LWL} = V$, where

V = Speed in knots, and
 LWL = Loaded Waterline Length (in. ft)

ALIGNMENT

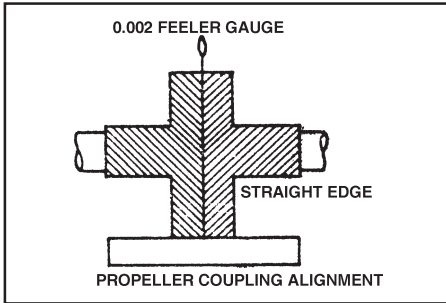
Proper alignment of an engine is critical... both during the initial installations and at frequent intervals during the life of the boat. It is rather common for a boat to change its form under various loads and with age. A bend is actually formed in the keel which

changes the original engine and shaft alignment.

Engine alignment to Propeller shaft

The face out of the couplings should be checked before the engine is placed in the boat. It is important to align the engine only when the boat is afloat and NOT dry docked. During this alignment period, it is also advisable to fill the fuel tanks and add any other ballast that will be used when the boat is in service.

With the engine in position on the engine bed, arrangement must be made to have a controlled lifting and lowering of each of the four corners of the engine. This can be accomplished with jacking screws. In this case a threaded hole is provided in each of the engine mounts. By inserting screws in these holes, the engine can be raised by screwing down or lowered by backing off the desired amount. Steel plates must be inserted under the jacking screws so that the bolts will not damage the engine bed. Lifting can also be accomplished by the use of chain hoists or properly placed jacks. Adjustable shims also are available



and can simplify the whole problem, particularly for future realignment.

It will also be necessary to move the engine from one side or the other on the bed to secure horizontal alignment. This can be done with a jack placed horizontally between the engine and the foundation.

As the engine then comes to its aligned position, it will be possible to match the male and female halves of the propeller coupling and prepare for bolting together. Care should be taken not to burr or mar this connection because the fit is very critical. A 0.002 feeler gauge is inserted between the flanges of the coupling at the same time a straight edge is laid across the edges of the flanges at the top and

sides to check the parallel alignment of the coupling edges. The feeler gauge is run completely around the coupling.

Then the engine coupling is rotated 90°, 180° and 270° with the feeler being run around the flange again at each successive position. If the alignment is correct, the feeler gauge fits snugly with the same tension all around the coupling. The straight edge should continually show the edges to be parallel.

If the alignment varies during rotation then further alignment is necessary or the shaft couplings should be checked for improper face run-out. Face run-out on the engine coupling can usually be corrected by repositioning the coupling on its splines. Shaft coupling run-out is usually due to inaccuracy of taper fit or key interference.

Some boats are not structurally rigid and some carry their load in such a way that they will “hog” or go out of normal shape with every loading and unloading. When this condition exists, it may be necessary to make a compromise between the top and bottom coupling clearance by leaving a greater clearance at the bottom of the

engine and propeller couplings. This clearance might be 0.005 to 0.007 while the top would maintain the standard 0.002.

During the process of securing final alignment, it may be necessary to shift the engine many times. When it becomes apparent that the alignment is reasonably close, the holes for the lag studs are marked and drilled. Then with final alignment secured, the necessary steel or hard wood shims are made up and the engine is fastened in place. The alignment is then rechecked, and if satisfactory, the coupling is bolted together and rechecked again.

Although it is not necessary to align a flexible coupling as accurately as a solid coupling, the closer it is in the initial alignment, the more vibration free it will be. The most accurate method of alignment is to align the shaft on to the engine with flexible coupling out of the system. This can be done with a spacer the same size as the coupling but not flexible in nature. Flexible couplings are used only for noise and vibration dampening ... not to correct inadequate alignment.



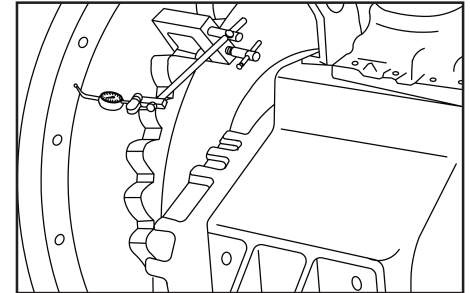
MARINE HYDRAULIC GEAR BOX 135A

TECHNICAL DETAILS

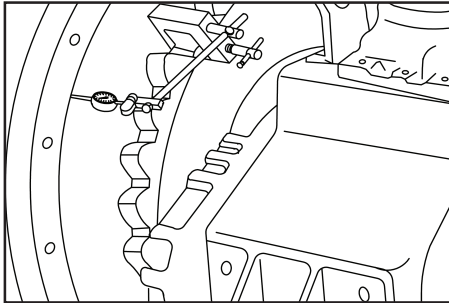
Transmission mode	: Five helical gears with three shafts
Clutch type	: Hydraulic control, wet type multiplate clutch
Type of input coupling	: Toothed rubber block coupling
Rated speed of the engine	: 1000 – 2000 rpm
Reduction ratio	: 4.11:1
Rated Trans.capacity	: 0.115 KW/(r.min ⁻¹) / 0.156KW (HP/r.min ⁻¹)
Centre distance	: 225mm
Direction of rotation of input shaft (viewed from output end)	: Anti-clockwise
Direction of rotation of output shaft in “Ahead” position (viewed from output end)	: Clockwise
Lubricating oil grade	: SAE 30 (SAE 40 in summer)
Lubricating oil capacity	: 20 litres
Max. oil temperature	: 80° C
Permissible angle of inclination	: Longitudinal 10°, Transverse 15°
Type of connecting with engine	: Bell housing
Overall dimensions (L x W x H)	: 578 x 792 x 830mm
Net weight	: 480 kg

INSTALLATION

1. Ensure that the direction of engine rotation is identical to that of the gear box input shaft.
2. It is necessary to open the side inspection door only to observe whether the parts surfaces are rusted, the input and output couplings should rotate freely by hand.
3. Cooling water required for oil cooler should not be less than 2m³/ h, and the water temperature not grater than 35° C.



4. Gearbox should be coupled to engine flywheel housing, and firmly fastened. If without bell housing the axial line

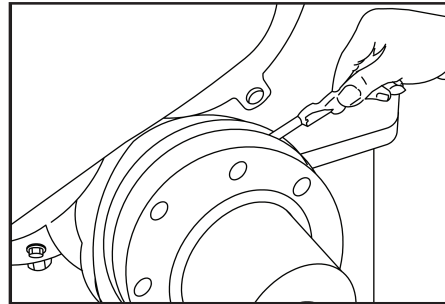


should be checked so as to make the input coupling and engine flywheel coaxial and the unparallelism of the coupling faces less than 0.25mm

- When the engine running at rated speed, and the valve at "AHEAD" or "ASTERN" position, the hydraulic oil pressure should be 8-10 kgf/cm². The lub. Pressure should be 1-2.5 kg/cm²
- After 50 hours of operation, the oil filter should be cleaned. After 100 hours of operation, the oil should be renewed.** Later on, it is required to keep the conventional rule of maintenance.

COOLERASSEMBLY:

- The cooler is located on the outside wall of the housing, into which the cooling water is led from both ends with pressure of 4 kgf/cm².
- If the atmosphere temperature is below 0°C, the cooling water should be drained out completely, when gearbox stopped.



- The output shaft flange of the gearbox and the companion flange of its tail shaft should be co- axial and the unparallelism should be less than 0.10 mm.

OPERATION

- After the installation, fill the gearbox with clean recommended oil, then start

the engine and make it in trail running at stable speed.

- If the oil pressure gauge shows no sign of pressure after running one minute, stop the engine to inspect and remove any obstructions, for any running without sufficient oil is not permissible.
- When the oil pressure is built up, speed up the engine to its rated speed.
- After continuous running, for 5- 10 minutes then operating the control valve two or three times at its 50% rated speed.
- When operating the control valve, the time for rising oil pressure should be 2- 5 seconds. The rated hydraulic operating pressure should be 8-10 kgf/cm².
- After operating the control valve, note for any abnormal noise or any leakage of oil or water.
- In case of normal operation, speed down the engine to about its half speed, lagging 2-3 sec at stop position, then operating the control valve to the desired direction.

**MAINTENANCE SCHEDULE**

NO.	ITEMS	DAILY	1000	5000	10000
1	Check oil level	✓			
2	Clean gearbox external surface	✓			
3	Inspect leakage of oil and water	✓			
4	Inspect any abnormal noise	✓			
5	Clean the filter element		✓		
6	Clean hydraulic control system		✓		
7	Inspect the inlet sealings		✓		
8	Check the clearance of the toothed rubber block and input coupling		✓		
9	Check the clearance of connecting bolts and output coupling		✓		
10	Remove the inspection cover, turn the couplings by hand and inspect gears and clutches		✓		
11	Inspect the hydraulic oil and lub. hose		✓		
12	Change lub.oil. Clean the strainer of the oil pump			✓	
13	Inspect the oil pump			✓	
14	Inspect and clean the oil cooler			✓	
15	Dismantle and inspect rubber sealings of input and output shaft			✓	
16	Check the friction plates, thrust rings and sealings			✓	
17	Disassemble gearbox housing. Inspect the input and output shaft assemblies and bearings				✓

**TROUBLE SHOOTINGS:**

NO	PROBLEM	CAUSE	REMEDY
1	Vibration of gearbox	Misalignment at Installation	Re-adjust it accordingly
		Toothed rubber block of input coupling damaged	Renew in sets
		Loose bolts of couplings and supports of gearbox	Tighten
		Torsional vibration	Avoid resonance speed.
2	Unsteady, low or no oil pressure	Pump damaged	Repair or replace
		Choked filter	Clean it
		Oil level too low or seating at suction end damaged	Fill oil or renew sealing.
		Sealing at inlet end damaged	Renew sealing.
		Oil gauge damaged.	Renew gauge.
3	Hydraulic oil failed to reach specified value	Throttling hole in control system obstructed	Clean and refit
		Piston in control system choked	Clean and repair control valve.
4	Clutch slipping	Oil pressure too low or fluctuate	Refer to No. 2 and 3
		Excessive worn of friction plates	Renew the plates.
		Oil passage choked or sealings damaged	Clean passage or renew sealings.
5	Too large residual torque	Friction plates seriously warped	Renew
		Usage of non-recommended oil	Use recommended oil.
6	Excessive rise of oil temp.	Clutch plates (Friction plates) slipped	Refer to No.5
		Too high oil level.	Lower the oil level.
		Choked oil cooler or insufficient coolant	Clean cooler or top up coolant.



NO	PROBLEM	CAUSE	REMEDY
	Excessive rise of oil temp.	Bearings and thrust rings or other moving parts damaged	Renew the damaged parts.
		Contaminated oil	Renew oil
		Broken lub. oil pipe	Renew
		Too high lub. oil pressure	Lower the pressure.
7	Turning in company	Incorrect installation of the oil pipe	Reinstall it
		Warped or stuck friction	Renew
		Damaged or worn of Piston back spring	Renew
		Stuck piston	Clean and overhaul
		Oil viscosity too high	Use specified oil
8	Abnormal noise	Damaged toothed rubber block of the input coupling	Renew
		Damaged bearings	Renew
		Loose screws	Tighten
9	Difficult to engage	Improper position of remote control device.	Adjust the control unit
		Stuck friction plates or piston	Repair or renew
		Too low hydraulic pressure	Refer to No.2
		Incorrect installation of oil pipe	Correct
10	Leakage of oil or water	Sealing damaged	Renew
		Sealing surface damaged or dirty	Repair and Clean
		Bolt loose	Tighten the bolt.



ASHOK LEYLAND

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- Marine Engine Dealers

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Ph : 044-2220 6000, Fax : 044-2220 6001

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SECUNDERABAD	Ashok Leyland Ltd, 3rd Floor, Dhraupathi Chambers, 31, Sarojini Devi Road, Next To ITC Agri Marketing Office, Secunderabad – 500 003. Phone No. 040-40662000, Fax No. 040-27711009.

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INDORE	Ashok Leyland Ltd., 320, Orbit Mall, A B Road, Vijaynagar, Indore - 452 010. Tel : 0731-2529677, Fax : 0731-2522268.
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MADURAI	Ashok Leyland Ltd., TMAK Building, 180 North Veli St, Madurai - 625 001. Tel : 0452-2340998, Fax : 0452-4371612.
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RAIPUR	Ashok Leyland Ltd., B S Arcade, Trans-Connect & Reliance Building, Near Shivnath Hyundai, G E Road, Tatibandh, Raipur-492099, Chhattisgarh. Phone Nos. 0771-2573953,2573001,2573923,2573902, Fax no - 0771-2573953/01.
VIJAYAWADA	Ashok Leyland Ltd., 1st Floor, Sreepra Towers, 40-5-5/1A & 1B, M.G. Road, Adjacent to Sweet Magic, Vijayawada – 520010. Phone : 0866 – 2493451/2, Fax : 0866 - 2493453

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	Dee Gee Tech , Mangal Ram Tower, AT Road, Opp Police Reserve, Guwahati 781001. Tel : 0361-2510607 / 9435732022
	Radiant Engineers , R.Dutta Market, A T Road, Dist Kamrud, Assam, Guwahati 781001. Tel : 0361-25133040 / 2733557(Fax) / 9864034828
	Mechfield Trade & Industries Pvt Ltd , Lahkar Commercial Complex, Opp Police Reserve, AT Road, Guwahati 781001 Tel : 0361-2541329 (Fax) / 9435040374
BIHAR	Narayana Sales & Services , GF-1 Friend's Regency Apartment, Harishankar Verma Lane, Boaring Patliputra road, Patna -13 Tel : 0612-3202354 / 9931617205
	DVM Electricals Co , Devi Sthan, Jankpur, Sumitrasadan, Mourva Nagar, Manpur, Gaya Bihar 823 003. Tel : 0631-6990063 / 9934660144
	Rai Industrial Power (P)Ltd , 2/29 Sri Krishna Nagar, Patna (Bihar) Pin code 800001. Tel : 0612-2522050011-43582765 / 9308257577
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	V.K.Enterprises , Leoniza Gomes Mansion, Rua De Saudade, Pajifond, Margao, Goa-403601. Tel: 0832-2714567, 2732715, 2863533
HARYANA	Rahul Power and Trans , Opp: Transportnagar, Near Lashkari Mal Petrol Pump, G T Road, Panipat-132104. Tel : 0180-2669425 (TF) / 9813100001
	Amrit Power & Compressor Care , Opp Sec -4, Sohna Road, Dharuhera, Rewari - 123016, Haryana. Tel : 01493-230242 / 9812024630
	Generator Aids , E-142-144, Sanjay Colony, Sec 23, Faridabad, Haryana -121005. Tel : 0129-2233512 / 9810123810
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	Sri Sai Engineering , D-109 ,2nd Gate Industrial Estate, Gokul Road, Hubli-580020. Tel : 0836-6450214, 2355730, 2352308
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	Tushar Enterprises , S-46 Sanjay Complex, Jayendraganj, LashkarGwalior 474009. Tel : 0751-2440956 / 9425109901
	L.K.Engineering Services ,132 S.R Compound, Dewas naka, Lasudiya morlIndore 452 001. Tel : 9425312366
	Naresh Mechanical Services , No 8, Shristi Complex, Statium Road, Opp Maruti Show Room, TP Nagar, Korba 495679 Tel : 07759-645148 / 9425532767
	Chhabra Marine Spares , 38,Maugal Udyog Nagar, Near Choti Lakhani, ColIndore. Tel : 9407478880
MAHARASHTRA	Kabra Engineering , Plot No B-11, Co Op Industrial Estate, Mul Road, Chandrapur-442401. Tel : 07172-251782 / 9423115817
	Synergy Engineering Services , Nargessic, First Floor, Near UCO bank, 47, Mukund Nagar, Pune-411037. Tel: 020-24272372 / 9444045712
	Synergy Engineering Services , 34/11-8, Behind BP Petrol Pump, Dhapodi, Pune-411012. Worshop Address: Ground Floor -7,Aswini -B, Akashganga Housings Complex, Thane(W)-400601. Tel : 022-25392870
	D.B.Automobiles , 1325/36,Shivaji Udyamnagar, Kolhapur-416008. Tel : 0231-2656410, 2666275 (F) / 9823178637
	Gopal Industries , NH-3, Chalisgaon Crossing, Autonagar, Mohadi-424 311, Dhule. Tel : 02562 – 230074 (F) / 9422296261.
	Green Power Solutions , Plot No 39 -1C Sector 24, Turbhe, Navy Mumbai 400 705. Tel : 022-27836559022-27832879 (F) / 9821014453
Maharashtra Boring Works , Goankar Industrial Estate, Near Meena Crane Services, Panchapakhadi, Thane, Maharashtra 400 602 Tel : 022-25431401 / 9821668281	

**INDUSTRIAL ENGINE DEALERS**

LOCATION	DDEALER NAME AND ADDRESS AND CONTACT NUMBERS
MAHARASHTRA	United Engineers Co , Plot No : H5/10, MIDC, Chilkalthana, Aurangabad-431 210. Tel : 0240-2326566, 2487998, 2321812 (F)
	Global Power Servoces , G-2/A -05, Shubhalaxmi Appts, Adhyapak layout, Hingna Road, Nagpur. Tel : 0712-2229540 / 9860799770
NEW DELHI	Premnath Auto P Ltd , 42-43, Scindia House, New Delhi-110001. Tel : 011-23755168, 23329408, 9871090170
	Premier Power Equipments , 171/1, Main IGNOU Road, Neb Sarai, New Delhi-110068. Tel : 011-65654220, 29535370 (F) / 9810032289
	Super Tech Engineers , S-283 Ground Floor, School Block, Shakarpur Delhi. Tel : 011-22173729 / 9891149489
ORISSA	Shree Jagannath Motors , Nirmal Market Complex, Power House Road, Rourkela-769001. Tel : 0661-2504959, 2507959, 2503515 (F)
	Shree Jagannath Motors , AT-Gopapali, NH-23,Vedvyas, Rourkela-769041. Tel : 0661-2661197 / 9437043799
	Nigam Enterprisers , Plot No 250, Bomikhal, Bhubaneswar, Orissa 751 010. Tel : 0674-69413510674-25834209338215192
	Pratap Electrical Engineering , Plot no -A/9, Mancheswar, Industrial Estate, Bhubaneswar, Orissa 751 010. Tel : 0674-25824631/6571331
	Diamond Engineering , 142,Cuttack -Puri Road, Bhubaneswar-751006, Orissa. Tel : 0674-25724509431121674
PUNJAB	K.K.Trading Corporation , 3479/6, Shivaji Nagar, Opp: Transport Nagar, Link Road, Ludhiana 141010. Tel : 98884-60000
	Rahul & Company , Adjoining Heera Palace, Patiala Road, Nabha-147201. Tel : 01765-522511 / 9813100001
	Yashodha Motors , Lower Mall, Patiala, Punjab 147 001. Tel : 0175-5001574,5011394 (F) 9872424004
	Suchitra Sales (P)Ltd , S.C.F. No 381, Motor Market, Mani Majra, Chandigarh-160101. Tel : 0172-2732873, 0172-4613328 / 9872203328
RAJASTHAN	Pranay Generators , S-16, State Woolen Mill, Opp Police Motor Driving School, Sr Ganga Nagar Road, Bikaner-334006. Tel : 0151-2251388 / 9414143888
	Rajasthan Diesel Motor Workshop , 1-2, Gotewalon Ki Bagichi, Transportnagar, Agra Road, Jaipur-302003. Tel : 0141-2643596, 9414073561
	Rajasthan Diesel Motor Workshop , C-II-8, Automobile Nagar, Delhi Road, Jaipur-302003. Tel : 0141-2643596 / 9414071561
	Sarweshwar Diesel India Pvt Ltd , G-1-68, Makhupura Industrial Area,Parbatpura By pass, Ajmer-305001. Tel : 0145-3202120, 2695514 (F) / 9829072524
	AR Power Solutions , Shop No 2, Firoz Complex, Jhalwar Road, Anantpura Circle, Kota -324005, Rajasthan. Tel : 0744-2431655/2360963

**INDUSTRIAL ENGINE DEALERS**

LOCATION	DEALER NAME AND ADDRESS AND CONTACT NUMBERS
	SPS Tech Services , 34 Kamal Vihar, 200 Feet Gopalpura Bye Pass Road, Near Bhank Rota Pullia, Jaipur 302026. Tel : 0141- 3230529 / 9351367822
	Drillcon (Raj) Pvt Ltd , 12 A, Ambamata Scheme, Opp IG Police Residence, Udaipur 313004 Tel : 0294-2430976,2431670 / 9929033368
TAMIL NADU	Chakrapani Engineering Works , No.51,(New No134), Moore street, Chennai-600 001. Tel : 044-25228853, 25246542, 25227898 (F)
	Chakrapani Engineering Works , No279 (New No869)T.H.Road, Chennai-600021. Tel : 044-25952212, 42167119, 25961767 (F)
	Chakrapani Engineering Works , No151/a(New No 56), Bangalore High Road, Mullipalayam, Vellore-632008. Tel : 0416-2291290 / 9940201231
	Maruti Diesel Power , 1/1- B, Salai Street (Opp to Dist Science Centre) Tirunelveli-62700. Tel : 0462-2500907, 2500036 (F) / 9444222403
	M.S. Engineers , PB No 54085-B,Thiruvalluvar Street, Ramakrishna Nagar, Kaundampalayam, Coimbatore-641030. Tel : 0422-2441943, 2448151 (F) / 9443149920
	M.S. Engineers , North Street, Back side of Select Steel, Suramangalam Road, Leigh Bazaar Road, Salem-636009. Tel : 0427-2449886, 2331908 (F) / 9364169037
	M S Engineers , 73B, VS Reddy Complex, Old Bangalore Road, Hosur-635109. Tel : 9344169027
	M.S. Engineers , No.182, Amma Towers, Behind Guruvayuranppan Temple, Vallipalayam Road, Tirupur-641601. Tel : 0421-2202778 / 9344469017
	Sri Meenakshi Gen Power Agency , 45/19, Workshop Road, Madurai-625 001. Tel : 0452-2347640, 2347641, 9843233433
	Vinayaka Agencies , 115,2nd Cross, Ponnagar, Trichy-620001. Tel : 0431-2482472, 2481772 (F) / 9443763447
	Vinayaka Agencies , G5, 152, Jawahar Plaza, Jawahar Bazaar, Karur-1. Tel : 04324-261952 / 9443703447
	Four Stroke Diesel Sales & Service , No 2 Sai Amritha Flats, No 10 Gopal Street, Annai Indira Nagar, Velacherry,Chennai 42 Tel : 044-22435987 / 9841048446
UTTAR PRADESH	Premier Power Equipments , 13, V N Marg, (Nr Luxmi Hotel), Allahabad. Tel : 011 – 55654220, 05322400046, 9335025396
	Oshonic Motors & Traders , 658,S Block, Vinoba Nagar,Juhi Depot, Kanpur-208014 (U.P). Tel : 0510-2321584, 9918185839
	Oshonic Motors & Traders , Sudama Building, Opp Bundelkhand Universty, Kanpur Road, Jhansi-284001. Tel : 0512-2604513 / 9918185839

**INDUSTRIAL ENGINE DEALERS**

LOCATION	DDEALER NAME AND ADDRESS AND CONTACT NUMBERS
UTTAR PRADESH	Syndicate Motors , Near Police Station,Transport Nagar, Meerut-250002. Tel : 0121-2511934 / 9837156913
	Accurate Enterprises , 8 / 237, Raghuveer Puri, Aligarh-202001. Tel : 0571-3290933 / 9319310289
	Vidhan Enterprises , Dharmashala Bazaar, Opp. Police Chauki, Gorakhpur-273001. Tel : 0551-2203445 / 9506031003
	Ruhelkhand Diesels , G-1 Pallav Puram-1Phase 1, Meerut, UttarPradesh. Tel : 0581-3241752 / 9719115575
	Agrico Machines , 12 Shivalik Ganga Appt., Ramghat Rd, Aligarh 202001. Tel : 0571-24056942405694(F) / 9412273903
	Balaji Enterprises , Niyawan Machhali Mandi, Faizabad 224001. Tel : 05278 - 212937 / 9889801223
	Global Power Solutions , M-1145, Sec 1, LDA Colony, Kanpur Road, Lucknow, Uttar Pradesh 226012. Tel : 0522-402902, 99453139456
	Rohelkhand Engines & Machines Pvt Ltd , No 5, Dev Nagar, Near Khandari Crossings, Agra, UttarPradesh 282 001 Tel : 0562-4006172 0562 -2507738 (Fax) / 9811057657
	Parmet Techno Crats ,D35/66-5 ,Jangamwadi, Varanasi 221001. Tel : 0522-3255230 / 9839279661
	Power Diesel , 1/573 Sector-17,Jankipuram, Lucknow, UP226021. Tel : 98392352209756702030
MK Enterprises , 77 1st Floor, Dushyant Nagar, Bodla-Sikendra Road, Agra UP282007. Tel : 0562-6453340 / 9719841000	
UTTRANCHAL	Puri Automobiles , Tickonia Shopping Centre, Haldwani-263139. Tel : 05496-227262, 222806 / 9837039614
WEST BENGAL	Mitose Diesel Sales & Service , 22 Chittaranjan Avenue, Kolkata-700072. Tel : (033) 22126132, 22126427, 9831118273
	Mitose Diesel Sales & Service , Fulbarihat, Baikuntapur, Bhaktinagar-734034. Tel : 9832031909
	Mitose Diesel Sales & Service , Pratap Market, 2nd Mile, Sevoke Road, Siliguri-734401. Tel : 0353 – 2546245 (F) / 9434497117
	Mitose Diesel Sales & Service , Bye-pass Road, Near Mecheda Road, Contai-721401. Tel : 032-20256425 (F) / 9434180226
	Mitose Diesel Sales & Service , Susamaly, Near Doly lodge, Burnpur Road, Asansol-713304. Tel : 9830168740
	Mitose Diesel Sales & Service , Vivekananda College Road, Barddhaman-713103. Tel : 034 -22543724 (F) / 9434255419
	Mitose Diesel Sales & Service , Baikunthapur, PO-Phulbari Hut Dist-Jalpaiguri. Tel : 0353 – 2568910 / 9832334153

**MARINE ENGINE DEALERS**

LOCATION	DDEALER NAME AND ADDRESS AND CONTACT NUMBERS
GUJARAT	Gujarat Fisheries Centarl Co-operative Assn Ltd , GIDC Estate, Patan Road, Veraval Post, Junagadh Tel : 079-6583054,Fax 6583054 / 9427340004
	Gujarat Fisheries Central Co-operative Assn Ltd , Boat Building Yard, Bhidiya Plot, Veraval - 362267. Tel : 231331, 9427340006
	Kalpna Marine Agencies , Plot No.B/3 Somnath Road, Near Bhidiya Circle, Veraval - 362267. Tel : 02876-231288, 9825221688
KARNATAKA	Sundaram Motors , 17-6-1312/9, Nandigudda Road, Shankar Vittal Motor Compound, Attavar, Mangalor-575001 Tel : 0824-2446110/2446556/24473-42/ 9448386326
KERALA	TVS & Sons Ltd , National Highway,Kaloor, Kochi - 682017. Tel : 0484 - 2536277/2537843 / 9847014506
	TVS & Sons Ltd , XII/646, National Highway, Near Chungam, Feroke, Kozhikode - 637631. Tel : 0495-2481563/2484986
MAHARASHTRA	Jayashri Marine Services (P) Ltd ,10, Bagkar House ,Sasoon Dock, Colaba, Mumbai - 400005. Tel : 022-22186119,22186135
ORISSA	TVS & Sons Ltd , Plot No: 785/1911(Near Suraj Hotel)Sahadevkhunta-P.O., Balasore - 756001. Tel : 06782-240679 / 9861086325
TAMILNADU	TVS & Sons Ltd , 2/14B, II & III, Madurai Bye Pass Road, Madathur-PO, Tuticorin - 628008. Tel : 0461-2341516/ 9443143028
	Sundaram Motors , Bye pass Road, Poonamallee, Chennai - 600056. Tel : 044-26492180/88/26272151
WEST BENGAL	Mitose Diesel Sales & Service , 22, Chittranjan Avenue, Kolkatta - 700072. Tel : (033) 22126132,22126427, 9831118273
	Mitose Diesel Sales & Service , Pratap Market, 2nd Mile,Sevoke Road, Siliguri - 734401. Tel : 0353-2546245 / 9434497117