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LEHMAN POWER

Owners Manual and Parts Identification

Engine models SP90, SP135 SP185, SP225 & SP275

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This manual may be made available in several different languages.
Please contact your nearest Lehman company for availability.

Dear Lehman Owner:

Welcome to the growing family of Lehman Power Marine diesel engine users. You'll be happy to know that you have chosen an engine which is heartily endorsed by leading boat builders for its quality, performance, fuel economy and long life. Your engine is simple but highly efficient. Its power, stamina and fuel economy will delight you – especially if you've previously operated gasoline power.

To obtain the best performance and the longest life from any machine, it must be serviced properly and regularly. Filters should be changed, coolant checked, oil changed at specified times, etc. Follow the suggested schedule shown herein – it will add to your boating safety, economy and enjoyment.

Perhaps the most important single recommendation I can make to the new engine owner is "do not tinker"! If the unit is running well – leave it alone! Adjustments and repairs should be performed only by a competent diesel mechanic who has the proper knowledge and tools. Many times we are requested to assist an owner who has attempted his own repairs. Unless you know what you're doing, please "hands off!

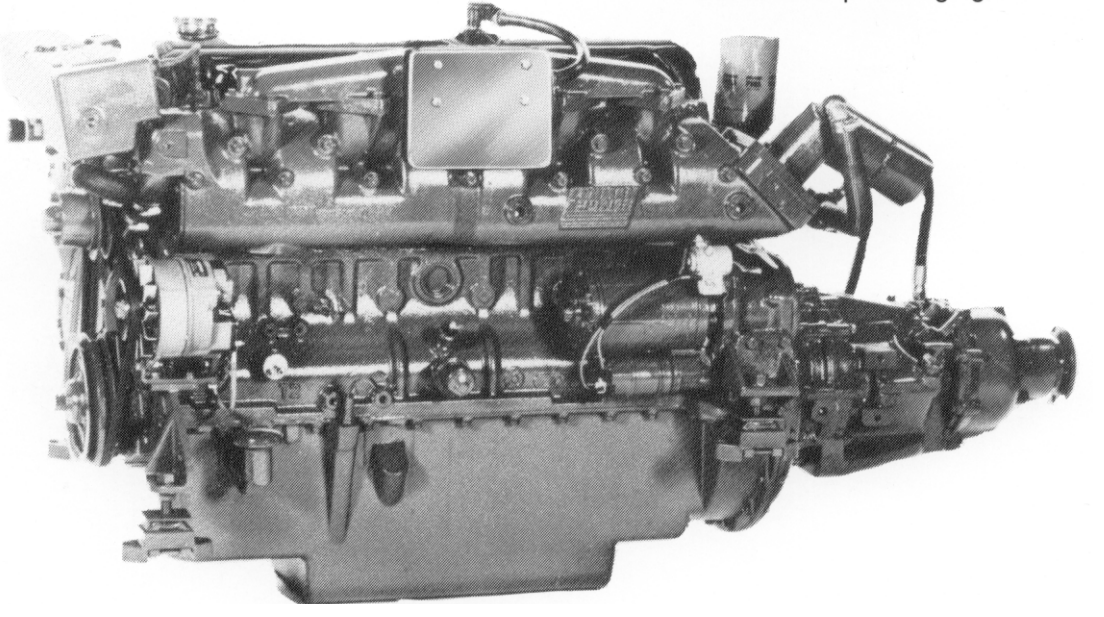
Lehman has a world-wide Service Network of Distributors and Dealers. Get to know your local one through the Lehman Start Up Program and they will be on hand to help you, should you need it.

Finally, always insist on genuine Lehman Parts. There are many examples of good boating days ruined by the use of spurious engine and cooling circuit parts. Always specify Lehman parts. If you have difficulty in obtaining them, please contact Lehman.

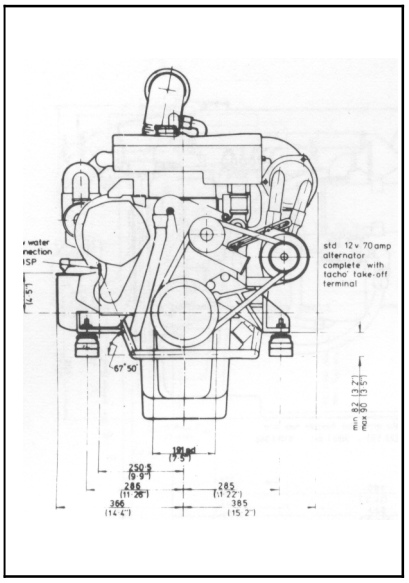
With proper care your Lehman Power engine will provide many hours of carefree boating. Thanks for the confidence you have shown in our Company by selecting our equipment. You will not be disappointed.

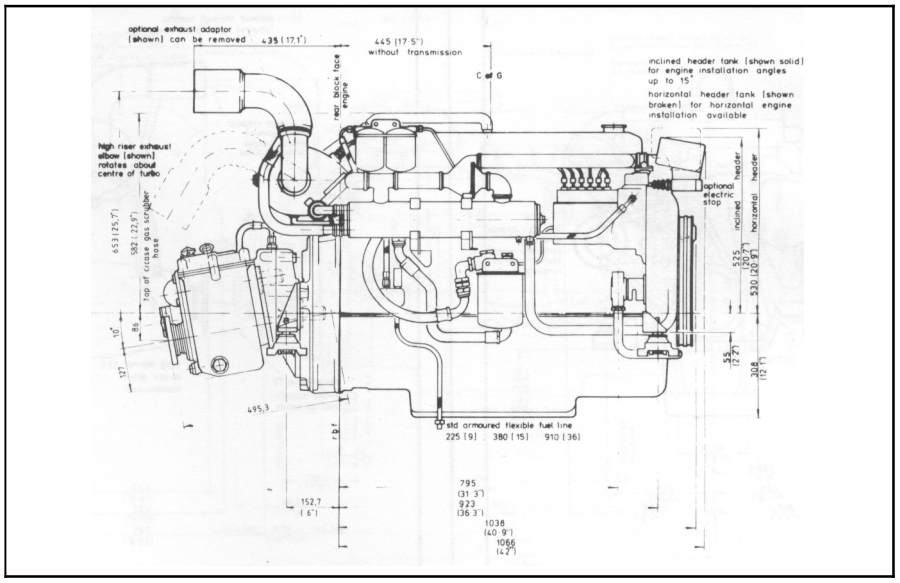
Allan Howell

Lehman Group Managing Director

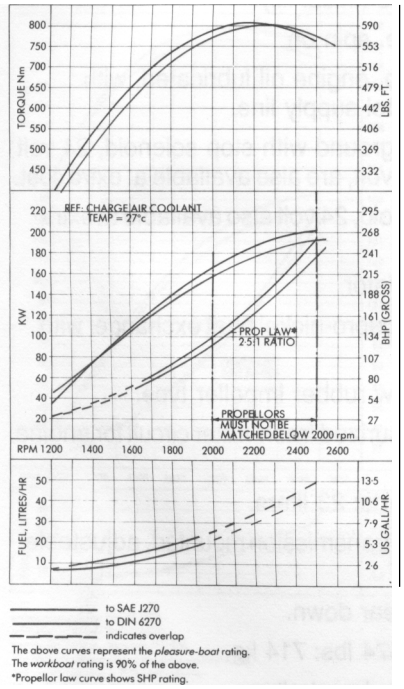


Installation drawings and power curves





Super 275 DIN 6270
Super 275 SAEJ270



Fuel consumption for typical Hull

Specification Lehman Super 275

TYPE – 6 cylinder, 4 cycle overhead valve diesel engine. Turbo charged and twin flow intercooled.

BORE/STROKE – 4.125 ins x 4.524 ins; 105 x 115mm.

DISPLACEMENT – 363 cu ins; 5.95 liters.

GROSS POWER – 275 bhp at 2500 rpm.

COMPRESSION RATIO – 14.7:1

FUEL – ASTM D975 Class 2D or BS2869 Class A1.

OIL CAPACITY – 24 US quarts: 22.5 liters (initial fill)

OIL FILTER – full flow, disposable cartridge, spin on.

FUEL SYSTEM – in line fuel injection pump, engine oil lubricated, with mechanical governor, and flexible braided fuel supply line.

ELECTRICAL SYSTEM – 12 volt negative ground with stop solenoid, 24 volt negative ground and insulated return 12 or 24 volt, are also available at extra cost.

STARTING MOTOR – 12 volt electrical solenoid, 24 volt also available at extra cost.

ATLERNATOR – 70 amp with voltage regulator.

RAW WATER COOLING SYSTEM – cupro-nickel heat exchanger with zinc anti-corrosion pencil.

RAW WATER PUMP – gear driven high flow rubber impeller type.

FRESH WATER COOLING SYSTEM – pressurized fresh water circuit for engine and exhaust manifold.

FRESH WATER CAPACITY – 24.3 US quarts; 23.0 liters.

ENGINE MOUNTINGS – in line, adjustable high grade anti-vibration mounts – see price list.

MAXIMUM INSTALLATION ANGLE – 15" rear down. 4" front down.

DRY WEIGHT LESS TRANSMISSION – 1574 lbs; 714 kg.

EXHAUST OUTLET – 5 inch water cooled exhaust elbow.

TRANSMISSIONS – Twin Disc, PRM – others available on request.

FINISH – Lehman Red, with chrome rocker box, and filler caps

APPROVAL STANDARDS – Lloyds, RINA, DNV, ABS, JCI and others available.

Specifications

TYPE	254 cu/in. 4 Cyl.	380 cu/in. 6 Cyl.	363 cu/in 6 Cyl. Turbo. and 6 Cyl. Turbo/Int.
MODEL	4 CYCLE, OVERHEAD VALVE, DIRECT INJECTION		
MODEL (LEHMAN)	2722E SP90	2725E SP135	2728E SP185 / 2728E SP225/SP275
COMPRESSION PRESSURE MIN	300lbs per sq. in inl at 215 rpm ± 80 PSI between Cyl		
FIRING ORDER	1–2–4–3	1–5–3–6–2–4	1–5–3–6–2–4
CRANKSHAFT ROTATATION	C.C.W facing flywheel		
GOVERNED SPEED (Max) NO LOAD	2850	2850	2800
UNDER LOAD	2600	2600	2500
IDLING SPEED	6		
EXHAUST SIZE	3.5" ID		)SE
EXHAUST BACK PRESSURE (Max)	1½ lb/sc		
COLD START	Auto Excess fuel device		
VALVES	Free turr		
VALVE CLEARANCE (hot/cold)	Inlet & Exhaust 0.015'		3"
PISTONS	Aluminium alloy		
COMBUSTION CHAMBER	Machined in piston crown		
PISTON RINGS	2 Compression; 1 Oil control.		3 compression – + 1 oil control
CAMSHAFT	Cast iron alloy; Gear driven		
CRANKSHAFT	Steel forging		
MAIN BEARINGS	5	7	7
LUBE SYSTEM:			
MIN OIL PRESSURE	41 PSI at 1600 RPM & 47 at 2000 RPM		
OIL TEMPERATURE (range)	165 – 230°F		
LUBRICANT			
Above 90°f ambient	SAE 30		
20 to 90°f ambient	SAE 20W/20		
Below 30°f ambient	SAE 10W		
OIL COOLER	Shell and tube type heat exchanger		
TIMING	22" BTDC No. 1 piston	22° BTDC No. 1 piston	24° BTDC No. 1 piston*
INJECTORS	4 hole type		
PRESSURE	SP275 – Test Pressure 265/275 Bar – others 208/218 bar		
FUEL LIFT PUMP	Diaphragm with hand priming lever		Piston type
OPERATING TEMP.	82" – 94°C		
MAXIMUM TEMP.	99°C		
CIRCULATION	159 liters/min		180 liters/min
SUGGESTED BATTERY	120 AMP/HR		
LOCK TORQUE	37.5 ft/lbs., 1240 amp. draw Max		
RUNNING TORQUE	15ft/lbs 690 amp Draw Max		
HEAT EXCHANGER	Shell and tube type, 2 pass		
RAW WATER PUMP	Bronze, single impeller type, gear driven		
MANIFOLD, EXHAUST	Gray iron, fresh water, cooled		
MANIFOLD, INTAKE	Integral with exhaust		
AIR FILTER ELEMENT	Polyurethane, 40 pore, replaceable.		Wire Mesh
ENGINE MOUNTINGS	Rubber compound, adjustable		
FUEL LINE	3/8" Recommended. Reduce to 5/16" at engine		
TACHOMETER ADAPTOR	Turns C.C.W. at 1/2 engine speed. Adapts to 7/8" – 18 ferrule		
FAN BELT TENSION	1/2 free movement		

*May be adjusted in certain conditions to 20° BTDC No. 1 Piston

HOW TO USE THIS MANUAL

This manual is divided into sections as follows:

SECTION A – Pages Nos. A1/on – General data. specifications. installations. adjustments. maintenance. etc. See index below.

SECTION B – Page Nos. B1/on – Parts identification of Ford base engines. See index on page B-1.

SECTION C – Page Nos. C1/on – Parts identification of Lehman Marine parts. See index page C-1.

In order to provide a simple method of identification. all models included herein have been assigned a "code". letter as follows: –

ENGINE CODE	CU/IN	NO. CYLS.	YEARS
M-Super 90	254	4	6/82 –
N-Super 135	380	6	6/82 –
S-Super SP185	363	6	6/82 –
P-Super SP225	363	6	6/82 –
T-Super SP275	363	6	6/82 –

Instructions for Ordering Parts

Parts listed in this manual may be ordered through any Lehman distributor or dealer or. in areas not served by a distributor/dealer, direct from the Lehman companies. Prices will be quoted upon request. In order to prevent errors. please order any required items by exact part number and name of part. When ordering parts. please advise model number and serial number of the engine.

Index – Section A

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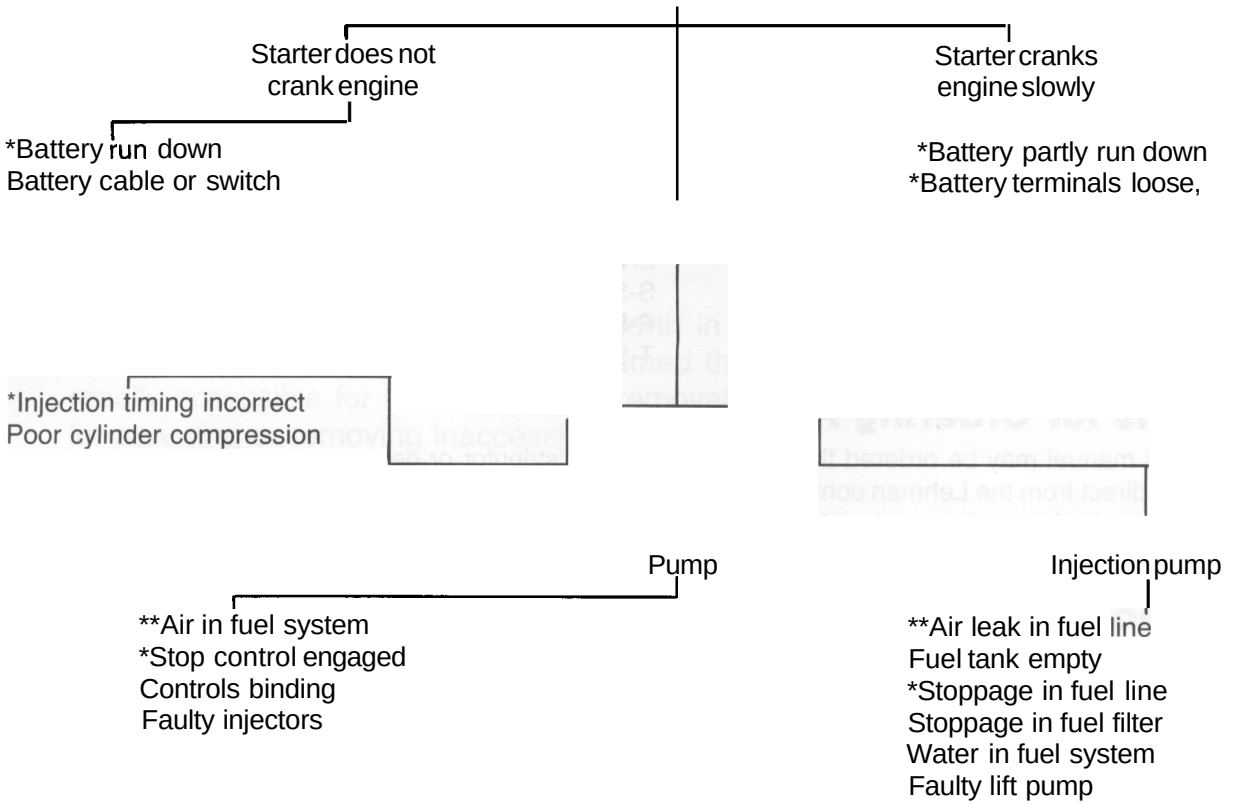
LEHMAN DIESEL OWNER'S FAULT-FINDING GUIDE



ENGINE STARTS

ENGINE RUNS INTERMITTENTLY

Idle Adjustment too low
*Air – Leaking fuel system
Fuel (lift) pump diaphragm worn
Fuel filter *(s)* clogged
Sticking valves
Fuel Tank near empty

ROUGH IDLING

*Air in fuel system
*Idle adjustment set too low
Dirty or faulty injectors
Injector pipes loose, cracked or broken
Incorrect injection timing
Restricted fuel filter
Faulty lift pump
Sticking valves
Broken valve springs

ENGINE MISFIRES

*Injector pipe loose, broken or cracked
Injectors dirty
*Air leaking in fuel system
Sticking valve or rocker arm
Sticking piston rings
Engine needs top overhaul

ENGINE KNOCKS

*Air in fuel system
Oil level (pressure) low, worn bearings
Incorrect grade fuel oil
Incorrect injection timing
Faulty injector
Sticking valve or rocker arm
Piston slap

ENGINE NOT DELIVERING FULL POWER

**Air fuel system
Engine overheated
Injection timing incorrect
Incorrect valve clearances
Dirty air cleaner(s)
Faulty injectors
Faulty injection pump
Stop control partly engaged
Sticking valves
Worn piston rings, or bores
Faulty lift pump
Restricted fuel filters

ENGINE OVERHEATS

*Insufficient water supply
Fresh water not circulating
a) Loose or broken vee belt
b) Hoses clogged or collapsing while running at high speed
c) Faulty thermostat
d) *Clogged heat exchanger
e) Clogged bleed hole in thermostat
Raw water flow insufficient
a) *Clogged sea water strainer
b) Water intake scoop damaged or lost
c) Sea cock closed
d) Water pump impeller damaged
e) *Heat exchanger or oil coolers clogged.
Low crancase oil level
Incorrect injection timing
Engine needs top overhaul

ENGINE EXHAUST SMOKES

Fuel, poor grade (black smoke)
Crankcase overfilled (blue smoke)
Cold engine temperature (white or lite blue)
*Propeller too large (black smoke)
Max. speed stop screw set too high for load (black smoke)
Propeller too small (white smoke)
Incorrect injection timing
Faulty boost control unit

Controls, Starting & Stopping Engine

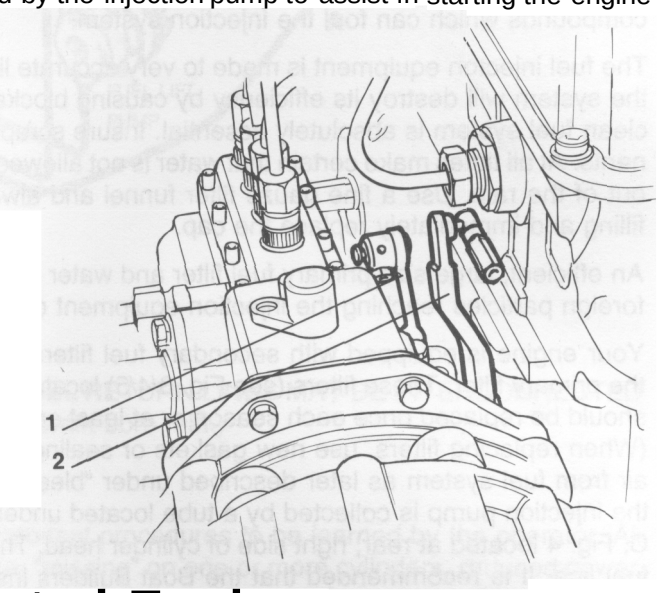
No amount of engineering ingenuity or care in manufacture can substitute for the need of knowledge on the operation and avoidance of mis–use by the operator. It is important to be familiar with all controls so as to know how to properly operate your engine.

Refer Fig. 1. To stop engine, the stop lever should be moved as far as it will travel towards the front of the engine and held until engine is fully stopped. This lever cuts off the supply of fuel to the injection pump. (NOTE before shutting down engine it should always be allowed to idle for about two minutes, particularly after extended periods of cruising – This is particularly important with Turbo and Turbo Intercooled engines).

Engine speed control is the longer lever at side of injection pump (Fig. 2.) Moving toward front of engine increases engine speed.

An excess fuel device permits additional fuel to be supplied by the injection pump to assist in starting the engine from cold. This device is fully automatic in operation.

NOTE: All engines are equipped with an electric shut down solenoid. To stop press stop button until engine stops running, then release button.



Injection Pump Controls
1. *Stop Lever*
2. *Speed Control Lever*

Starting all Naturally Aspirated Engines

To start engine when cold – make certain that transmission is in neutral position and that all boat accessory equipment (bilge pump, extra alternator or generator, hydraulic pump, winch, etc.) is disengaged. Check that engine stop lever is fully towards rear (flywheel end) of engine. Set throttle lever to ¼ open position. Press starting button to operate starter. As soon as engine starts, release starting button to operate speed control lever to warm–up (idling) speed of 700– 800 RPM. If engine fails to start within 5 seconds, release starting button. Try again after allowing sufficient time for all moving parts to stop. Once engine has started, it should be allowed to reach 170°F before full load is applied.

To restart engine when warm, same procedure as above except set speed control lever to approximately mid–point of its travel.

Starting all Turbocharged Engines

Serious damage to the turbocharger bearing can result from inadequate lubrication if the following recommendations are not observed.

Prior to the first start after a turbocharger has been newly installed or if for any reason the oil supply to the turbocharger has been disconnected, you should insure that the turbocharger housing is filled with engine oil before reconnecting the oil feed pipe. In these circumstances, or in cases where the engine is being started *for* thefirst time after an oil change or after a period of **4** weeks or more without use, the following procedure must be used;

1) Engage either manual or electric stop control
2) Crank the engine with the starter motor for 15 seconds
3) Disengage stop control
4) Start engine in normal fashion and allow to idle for 30 seconds minimum before applying load

This ensures an adequate oil supply to the turbocharger bearing, The engine should be allowed to idle, without load, for 2 minutes prior to shut down to enable the oil to dissipate the heat from the turbocharger bearing.

Stopping all Engines

The engine should be allowed to slow idle for approximately 2 minutes before stopping, especially after extended periods of full load and full speed operation. This is particularly important in the case of turbocharged engines.

Fuel System

CAUTION: Your injection pump is a very accurately machined piece of equipment and requires careful handling and adjustment. No repairs other than shown herein should be entrusted to other than a diesel repair facility having the required tools, knowledge and test/calibration equipment.

CAUTION: Never bend the injection pipes (which connect injection pump to injectors) as this may unbalance the volume of fuel delivered to each cylinder.

CAUTION: Do not use a galvanized fuel tank as the zinc coating reacts with the fuel oil and forms undesirable compounds which can foul the injection system.

The fuel injecton equipment is made to very accurate limits and therefore, even the smallest particle of dirt entering the system will destroy its efficiency by causing blockage or scoring or premature wear on highly finished parts. A clean fuel system is absolutely essential. Insure scrupulous cleanliness when handling fuel or fuel system components. At all times make certain that water is not allowed to contaminate the fuel oil. Try to make a practice ofrefueling out of the rain. Use a fine gauze filter funnel and always wipe the fuel tank around the filter cap before andafter filling and immediately replace the cap.

An efficient, large size primary fuel filter and water separator (coalescer) is deemed a necessity in order to prevent foreign particles reaching the injection equipment on your engine.

Your engine is equipped with secondary fuel filters which filter out contaminates that may find their way through the primary filter. These filters (see Fig. 3/4/5) located towards rear of engine block, right side, have elements which should be replaced once each season or at least each 200 hours (which ever comes first) under normal conditions. (When replacing filters, use new gaskets or sealing rings to prevent air leaks.) Following filter replacement, blead air from fuel system as later described under “bleeding the fuel system”. Excess fuel delivered to the injectors by the injection pump is collected by a tube located under the rocker arm cover (see A, Fig. 2) and delivered to fitting C, Fig. 4 located at rear, right side of cylinder head. This fitting should be connected to top of fuel tank by ¼” (min.) fuel line. It is recommended that the Boat Builders installs a short section of flexible tubing in this line to prevent breakage due to engine vibration.

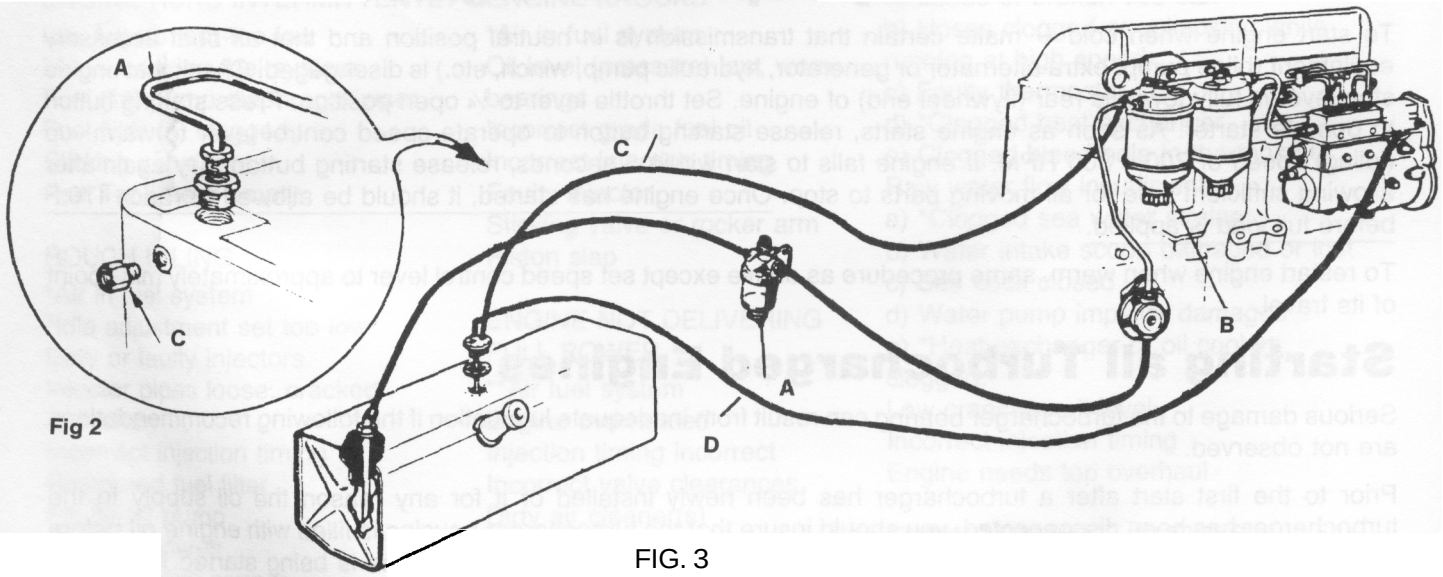


Fig 2

FIG. 3

TYPICAL FUEL SYSTEM, NATURALLY ASPIRATED ENGINES

A – Primary fuel filter water separator
B – Secondary fuel filter
C – Excess fuel return tube
D – Injection pump return tube

NOTE: All N/A Engines are fitted with a common fuel return line C D.

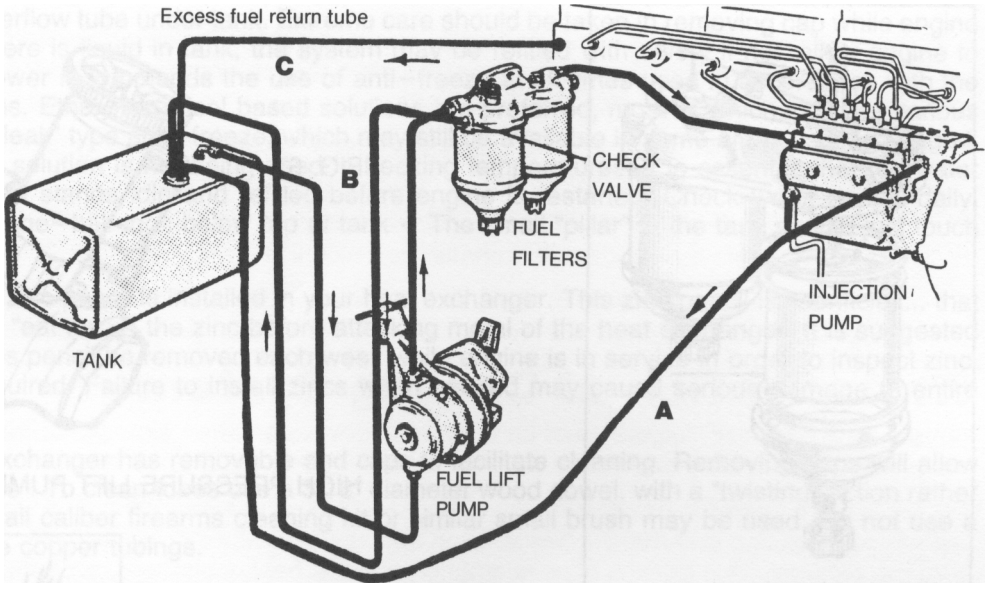


FIG. 4.

TYPICAL FUEL SYSTEM, TURBO ENGINES

A – Injection pump return tube
B – Filter Press Relief Line
C – Injector Leak Off Line

*NOTE: "ON ENGINES MADE IN LATE 1985 ONWARDS – FUEL RETURN LINES MAY BE INTERCONNECTED TO SIMPLIFY PIPING" (Return line to tank must be 10mm bore min.)

Bleeding the Fuel System

Bleeding air from the fuel system may well be one of the important procedures to be learned by the operator. Air in the injection system may cause erratic engine performance, "missing" on one or more cylinders, reduced power, stop fuel from reaching engine and prevent or cause hard engine starting.

It must be remembered that the lift pump draws fuel from the tank, so any accumation of air in the fuel system makes all connections, filters, etc. between fuel lift pump and tank suspect. In any new installation one must "bleed" the system of air for, obviously, air will be in the new fuel lines, filters, etc. If the fuel tank should run dry, bleeding will be needed when the boat is refueled. Bleeding will also be required after changing fuel filter elements. (Time and effort may be saved if filter is charged with fuel by removing the bleed plugs on top and slowly pouring fuel into the filter until it overflows.) Occasionally, after an extended run, an engine may slow down, or "miss", or lose RPM or stop. Although there may be other causes, air in the fuel system should not be overlooked. Many times a tiny leak in a fuel line fitting may allow air to enter the system and accumulate until there is sufficient to cause the above mentioned symptoms.

To bleed system, follow this procedure;

1. Ascertain that there is sufficient fuel in tank, (Note: low fuel level may result in intake pipe being exposed due to "sloshing" of fuel, thus drawing air into system – try to keep your tanks topped up.)
2. Make certain that fuel shut–off valve is turned on.
3. Loosen the bleed screw on the inlet side of the fuel filter (Fig. 6 & *7)* about two or three turns.
4. Operate the priming lever at the side of the fuel lift pump on naturally aspirated unit (Fig. 7.) or the pump plunger (Fig. 6.) on turbocharger engines until a flow of fuel, free of air, is expelled. Then close screw.

No bleeding of the injection pump is required as these are fitted with a self purge device.

NOTE: On Turbo Charged engines a third fuel return line from the pressure relief valve or the secondary filters must be connected direct to the fuel tank. This is obligatory unless a factory fitted common return is present.

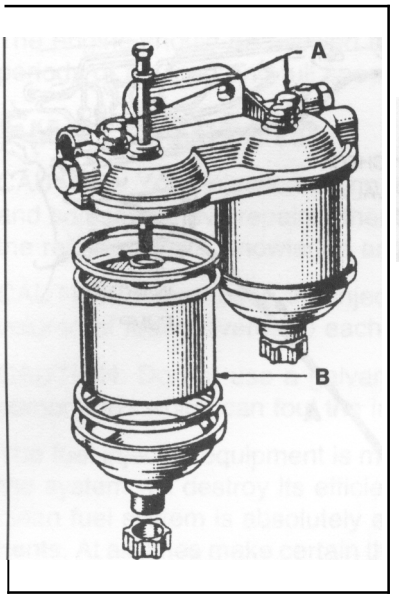
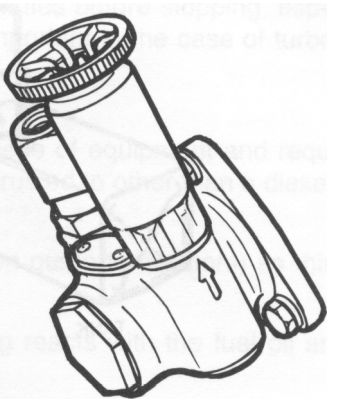


FIG. 5.

FUEL FILTER

A – Bleed screws
B – Replacable element

FIG. 6.



HIGH PRESSURE LIFT PUMP (ALL TURBO ENGINES)

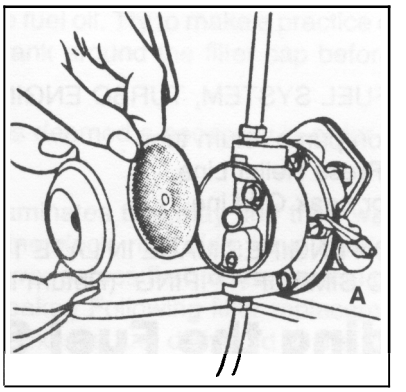


FIG. 7.

FUEL LIFT PUMP – (ALL N.A. ENGINES)

A – Priming lever

Timing and Maintaining the Fuel Injection Pump

The injection pump delivers an accurately metered quantity of fuel to each cylinder to suit any engines speed and load conditions. The pump is a very accurately machined piece of equipment and requires careful handling and maintenance, which is beyond the scope of normal owner servicing. Since this pump should not require retiming except when being removed and reinstalled, and this is beyond the scope of normal owner servicing, the procedure will not be covered in this manual. Please contact your authorized Lehman Power distributor for this service. Warranty claims resulting from owner mishandling of the fuel injection pump will not normally be considered.

Cooling System

Your engine is cooled by the circulation of fresh water (contained in the system) through the water jackets surrounding the cylinders, cylinder head and exhaust manifold. The heated water flows by thermo– syphonicaction, assisted by a pump at the front of cylinder block around the tubes of a “heat exchanger” located above the fuel lift pump on the starboard side of the engine. Raw water from outside the boat flows through the heat exchanger tubes, and the heat from the fresh water is thus transferred to the raw water which is expelled overboard. Please see Figures *8* and 9. A Thermostat located in the cylinder head under the expansion tank on naturally aspirated units and in a separate unit on the starboard side of the turbo charged units promotes rapid warm up and maintains constant engine temperatures.

The fresh water system is filled through a cap atop the expansion tank at front of engine. Water level should be checked daily and maintained to the top of the aluminium pillar. These engines are fitted with a cooling system de– airation service and no bleeding of the manifold is required during system filling.

When filling cooling system, fill to top of aluminium pillar, then run engine for several minutes to insure system is completely filled. Add coolant as necessary.

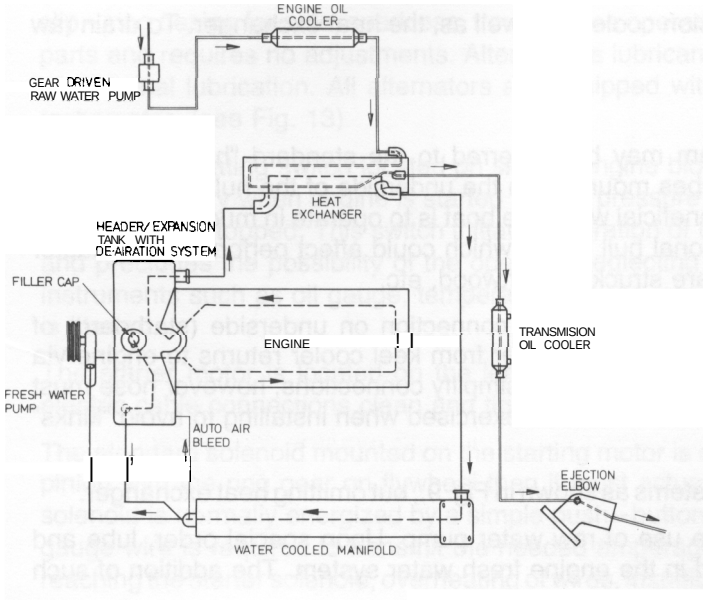
The Fresh water system is pressurized by the cap atop expansion tank. When proper pressure is reached, excess water is expelled through the overflow tube under tank. Extreme care should be taken in removing cap while engine is hot. While engine is hot, if there is liquid in tank, the system may be refilled with safety if not, allow engine to cool before refilling. Lehman Power recommends the use of anti–freeze at all times used in accordance with the manufacturer's recommendations. Ethelyne Glycol based solutions are preferred, most of which includes various rust inhibitors. The use of "stop leak" type anti–freeze, which may still be available in some areas, is discouraged. If, for some reason anti–freeze solution is not being used in freezing temperatures, it is essential that the water systems be drained while engine stands idle and refilled before engine is restarted. Check water supply daily. Maintain level to approximately one–half inch below top of tank – The small "pillar" in the tank should just touch the water surface.

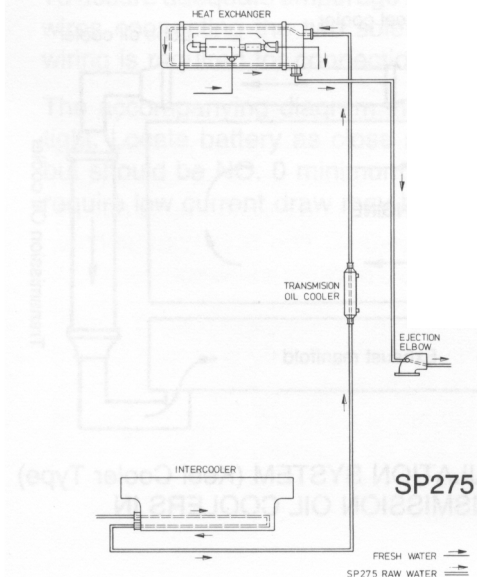
To assist in corrosion control, a zinc pencil is installed in your heat exchanger. This zinc pencil is sacrificial.... that is, the raw water will attack and "eat away" the zinc before attacking metal of the heat exchanger. It is suggested that the plug accommodating this pencil be removed each week while engine is in service in order to inspect zinc. Replace zinc element when required. Failure to install zincs when needed may cause serious damage to entire cooling circuit.

It will be noted that your heat exchanger has removable end caps to facilitate cleaning. Removing caps will allow access to end of the tube "bundle". To clean tubes use a 3/16" diameter wood dowel, with a "twisting" action rather than a hammering action. A small caliber firearms cleaning kit or similar small brush may be used. Do not use a metal rod which may rupture the copper tubings.

LEHMAN NATURALLY ASPIRATED ENGINES

FRESH & RAW WATER CIRCUITS





SP275 CIRCUIT

LEHMAN TURBO INTERCOOLED

FRESH & RAW WATER CIRCUITS

(TURBO – SIMILAR MINUS INTERCOOLER)

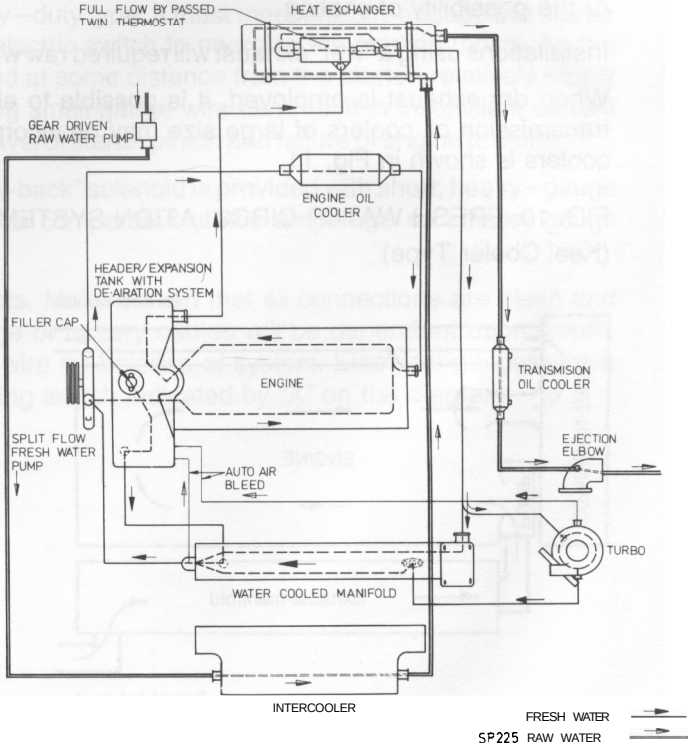


FIG. 9. – RAW WATER CIRCULATION SYSTEM

A – Intake scoop of standard marine design, minimum 1" NPT should be used for raw water inlet. Reduce to ¾" NPT at pump. Recommended scoop has bars across opening to prevent entry of large pieces of foreign matter – Lehman part NO. EW–3 is perferred.

B – Sea–cock should be 1" NPT minimum size, "gate" type opens fully to allow full, unrestricted flow of water – Lehman part NO. EW–22 preferred.

C – The use of an efficient, full–flow raw water strainer is strongly recommended to prevent clogging of pump and exchangers by weeds, etc. Lehman part NO. EW–102 preferred.

D – If hose is employed for intake, same should be reinforced type of extra heavy construction to prevent collapse under powerful suction of raw water pump – Lehman can provide such hose if required.

Winterization of Cooling System

Inboard type heat exchangers must be drained of raw water when exposed to freezing temperatures. Raw water, pump, water inlet piping and intake strainer should likewise be drained when subjected to extreme cold.

If however, the vessel is being permanently laid up for the duration of the cold weather, we recommend mixing an anti–freeze solution and running this solution through the sea water system with the engine idling until discharged from the exhaust. This insures the sea strainer, coolers, heat exchanger, even the muffler and exhaust system will be protected.

Drain points for the fresh water system will be found on the port side of each engine block, on the aft end of the exhaust manifolds and on the heat exchanger.

Raw water drains are found on both engine and transmission coolers, **as** well as, the heat exchanger. To drain raw water pump, loosen rear cover.

"Keel Cooling" Systems

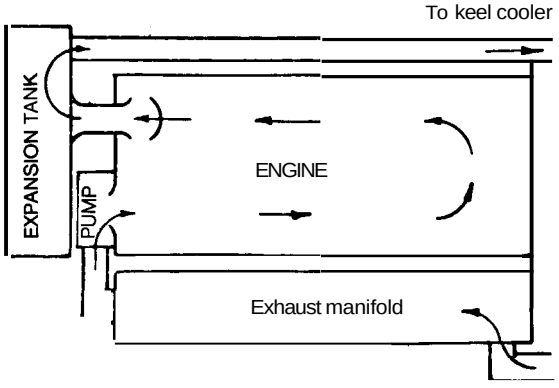
In some cases the installation of a "keel cooling" system may be preferred to the standard "heat exchanger" previously discussed. This system employs a series of tubes mounted on the underside of the hull through which the engine cooling water is circulated. Such a system is beneficial when the boat is to operate in muddy or silt-laden areas, however, the cooling element does produce additional hull "drag" which could affect performance in faster boats and creates a potential hazard if tubes fracture or are struck by driftwood, etc.

Piping engine to keel cooler is quite simple. As shown in Fig. 10. the connection on underside (starboard) of expansion tank deliver hot water from engine to keel cooler. Cooled water from keel cooler returns to engine via connection on aft end of exhaust manifold. The use of 1¾" I.D. hose will simplify connections, however hose must be reinforced type to prevent collapsing under suction and care must be exercised when installing to avoid "kinks" or the possibility of chafing.

Installations using a "wet" exhaust will required raw water systems as shown in Fig. 9., but omitting heat exchanger.

When dry exhaust is employed, it is possible to eliminate use of raw water pump. Upon special order, lube and transmission oil coolers of large size may be incorporated in the engine fresh water system. The addition of such coolers is shown in Fig. 11.

FIG. 10. FRESH WATER CIRCULATION SYSTEM
(Keel Cooler Type)



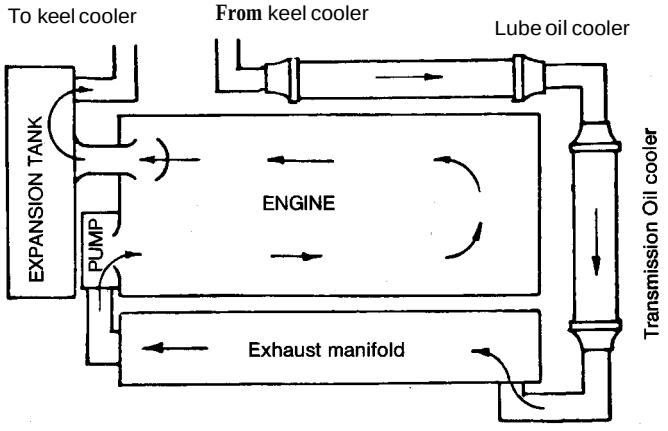


FIG. 11. WATER CIRCULATION SYSTEM (Keel Cooler Type) WITH LUBE AND TRANSMISSION OIL COOLERS IN FRESH WATER FLOW.

Tachometer Adapter

A tachometer "take–off is provided on the starboard side of all naturally aspirated engines as an extra cost option. There is no provision for mechanical tachometer hook–up on turbocharged engines. This adapter accommodates a standard marine tachometer cable with 7/8" – 18 adaptor nut. Tip of cable core should be .187" diameter. Cable turns on–half engine speed in counter–clockwise direction.

If mechanical tachometer is not used or if cable is disconnected with engine to be operated for any lengthy period, the take–off should be capped to prevent oil leakage. Suitable cap (or plug to close aperature if take–off assembly is removed) is listed in the parts section of this manual.

It is recommended that a mechanical type tachometer be used only if located relatively close to engine. If cable length exceeds 12 to 14 feet or if many bends are required, an electrical tachometer system should be considered as much less strain is placed upon the take–off assembly. Installations requiring two tachometers should always use electric instruments.

Electrics

The standard electrical system for Lehman engines is 12 volt, NEGATIVE GROUND. Under no circumstances should polarity be reversed even for an instant for serious damage to alternator may result.

For special applications, optional electrical systems are available in 12 volt insulated return, 24 volt negative ground and 24 volt insulated return configurations.

A vee belt drives the alternator from crankshaft pulley. (Note: maintain belt at proper tension see "minor Repairs, Maintenance and Adjustments").Alternator has been corrosion–treated and has built–in silicon rectifier and enclosed slip– ring design for safe, sparkless, trouble–free operation. Transistor type, sealed voltage regulator has no moving parts and requires no adjustments. Alternator is lubricant packed for life at time of assembly and therefore requires no external lubrication. All alternators are equipped with a tapping for connection to operate a matching electric tachometer. (see Fig. 13)

A special actuating switch located on side of engine block behind alternator automatically energizes the alternator from the battery when engine is started and oil pressure reaches 7 lbs. Battery is disconnected by this switch when the engine is stopped. This switch initiates operation of the alternator system without the need of a separate switch and precludes the possibility of the operator neglecting to turn the charging system on or off. If desired, electrical instruments such as oil gauge, temperature gauge, etc. may be wired to be autmoatically energized when engine is started.

The starter motor is located on the left side (rear) of engine and requires no attention beyond, maintaining the electric cable connections clean and tight, the commutator clean and brushes renewed when necessary.

The standard solenoid mounted on the starting motor is a heavy–duty type. It must mechanically engage the starter pinion with the ring gear on flywheel then it must actuate an electric switch to energize the starting motor. As the solenoid is normally energized by a simple push–button located at some distance from the starter, relatively heavy gauge wire is required to transmit the needed amperage. Using small gauge wire can result in insufficient current reaching the starter solenoid, overheating of wires, insufficient travel of starter pinion and failure of engine to start.

To assure adequate amperage reaching starter solenoid a "piggy-back" solenoid is provided with short, heavy–gauge wires connecting the two solenoids. The new solenoid requires comparatively little amperage so smaller gauge wiring is required for connection to pushbutton.

The accompanying diagram indicates basic wiring requirements. Make certain that all connections are clean and tight. Locate battery as close as practical to the starter. Gauge of battery cables will be dependent upon length, but should be NO. 0 minimum. Use No. 12 gauge or heavier wire for balance of system. Electrical gauges which require low current draw may be wired to oil pressure energizing switch indicated by " X on the diagram.

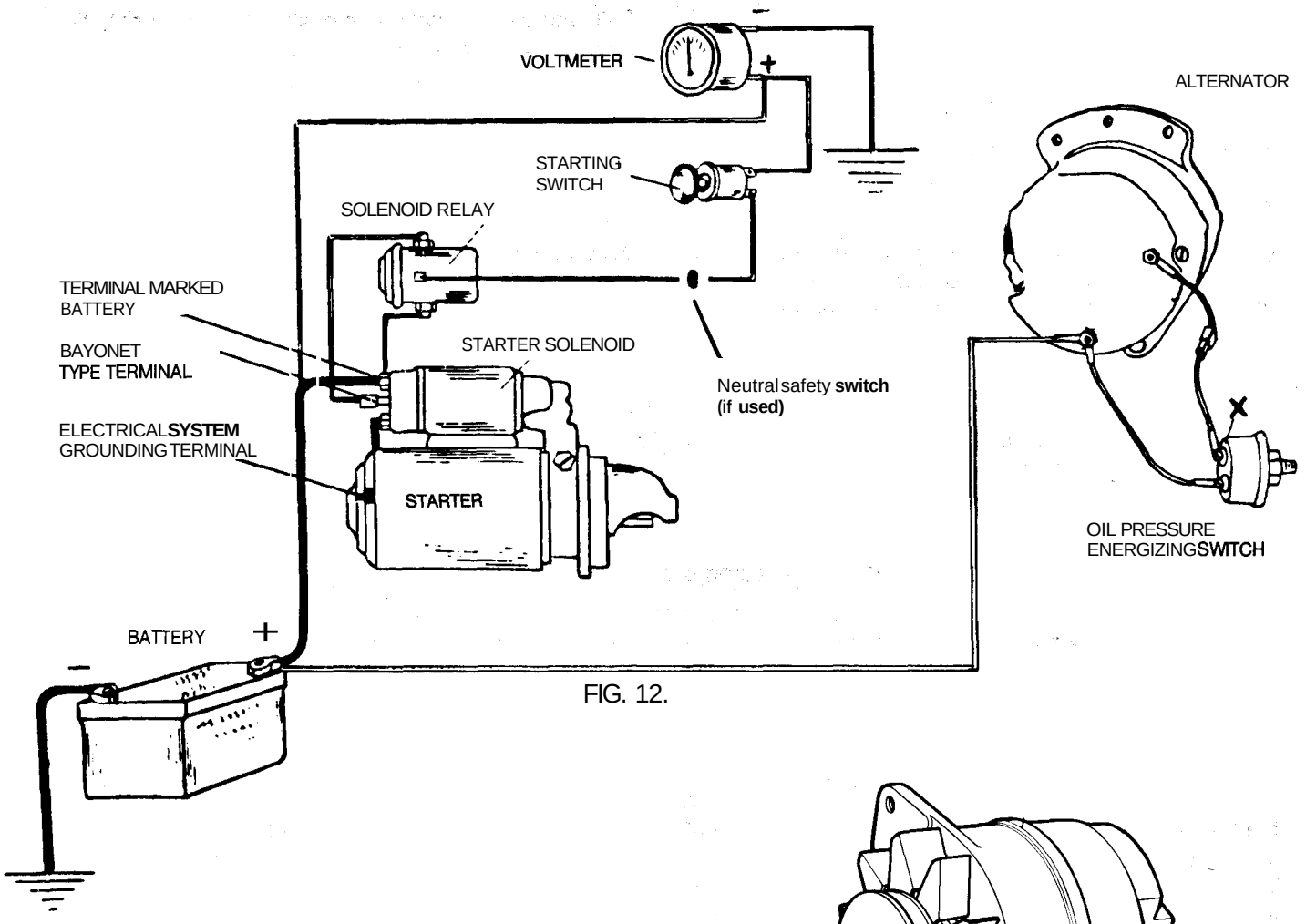


FIG. 12.

WIRING DIAGRAM

NOTE: Wiring diagrams of all standard applications are available from Lehman on request.

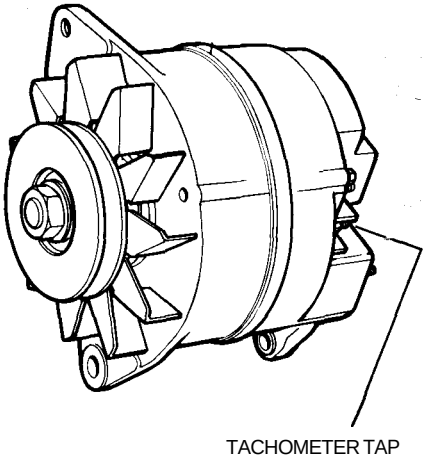


FIG. 13.

Lubrication System

The engine lubricating system is of the forced feed type, the oil being circulated by an oil pump mounted with the crankcase. The pump draws oil from the sump through a metal gauze screen and through an oil gallery on the port (left) side of engine which is tapped for installation of oil pressure gauge, low oil pressure alarm, or other such devices. Constant oil pressure is maintained by means of a relief valve situated in the pump. Oil under pressure passes through the oil filter where it is cleaned prior to being circulated inside the engine. The filter is a full-flow, disposable "spin-on" type. It should be replaced at each oil change, and is readily available from your Lehman dealer.

All marine installations should include an oil pressure gauge to register the lube system pressure and such gauge should be frequently checked to insure that system is functioning correctly. Normally the registered pressure should remain constant for a given engine speed. If pressure reading suddenly varies or fluctuates, the reason should be determined at once, otherwise severe damage may occur. As it is difficult to maintain a constant watch on engine gauges, the use of an audible warning system to sound a buzzer in case of low oil pressure (or high engine temperature) is strongly recommended – Lehman has kits EK31 and EK31A available now fitted as STD in Lehman panels, – contact your dealer for further details.

When engine is first installed, provide the proper quantity of oil as indicated under “specifications” section. The oil cap is located on top of engine rocker cover. After pouring in oil, it will be necessary to wait several minutes before the oil level is checked in order to allow time for oil to flow to sump. Another fill cap which leads directly to sump is located on sump near front of engine. Run engine for several moments, shut down and check level on dipstick (see Fig. 14.) If oil level measurement is different from the “full” mark on dipstick, a new mark should be scratched or filed at the correct level. Another method is to measure the distance between the new full level and the factory full mark on the dip stick, remove the dipstich tube from the sump, and cut that distance off the tube. After deburring and reinstalling the tube the dipstick will be lowered into the oil, thereby retaining the factory markings. Of course, the above procedure applies only to 6 cylinder N.A. and turbo units with disptick at front of sump. Four cylinder models with stick at rear of sump, require scratching the appropriate marks. These procedures are necessitated by differing installation angles.

When measuring oil level in regular usage in all naturally aspirated engines it is preferable to check after the engine has stopped for a period of time, such as overnight. This allows the oil in the overhead valve system to drain back to the oil sump, permitting a more accurate measurement.

On all turbocharged engines the oil should be checked prior to starting. After several minutes, shut engine down, wait for oil to drain back for several minutes, then check and add as required.

Add engine oil of the type and viscosity as follows. Oil should meet Ford specification 2M–2C–1017A, API classification CC or equivalent.

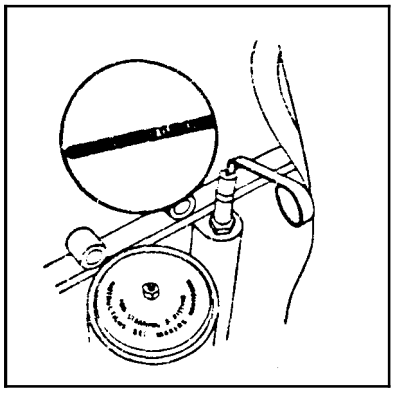


FIG. **14.**
ENGINE OIL DIPSTICK

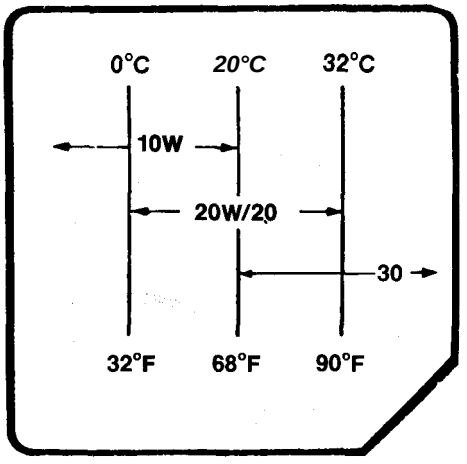


FIG. 15.
OIL VISCOSITY CHART

TURBO ENGINES: API classification CD oils only must be used in turbocharged engines. Use of other oil result in reduced engine life and invalidate engine warranty.

Serious damage to turbocharger may result from inadequate lubrication. Upon starting, engine should be allowed to idle (1000 rpm maximum) for 30 seconds or more before applying load. Also allow engine to idle for at least two minutes before shut–down to dissipate heat from turbocharger bearings.

Turbocharger must be oil–primed under any one of the following conditions;

After an oil change.
If oil supply tube to turbocharger has been disconnected.
If either the engine or turbocharger is newly installed.
If no oil pressure registers on gauge after a “dead crank” (cranking with stop control in operation) for 15 seconds.
This test must be performed if engine has not been started for 4 weeks or more.

To oil–prime turbocharger;

a) Check for sufficient oil in the engine sump but **do** not top–up at this time.
b) Remove plug on top of turbo oil feed block, inject ¼ pint of oil and replace plug.
c) Using suitable syringe, inject about 4 pints of oil (as used in engine sump) into oil gauge connection for engine. Refit oil gauge.
d) Start engine, allowing **1** minute to idle before increasing speed.
e) Stop engine and check sump oil level. Top–off if needed or drain off any surplus.

Engine oil should be changed after the initial 15 hours or operation and at each 200 hours of operation thereafter. Run the engine until normal operating temperature is reached. Shut down engine and allow oil to return to sump for five to ten minutes. In most installations it will not be possible to drain sump by removing plug which is located at bottom of oil pan, for clearance to bilge of hull will be limited. A low-cost, suction type, hand operated sump pump is required. Available as an extra cost option is a Lehman approved, permanently mounted hand pump. This can be connected to the sump lug – installation permitting or . . . Remove the dip–stick tube and insert suction hose of pump, working same towards lower portion of sump. (Some operators find it advantageous to use a length of copper tubing to assure reaching low section of sump. Pump oil into container and dispose of same ashore. Replace vent cap on sump. Refill crankcase to **"full"** mark on dipstick. Run engine for several minutes, shut down and recheck oil level. If required, add sufficient oil to bring up to full mark.

Lube oil filter element should be replaced at each oil change. the disposable element is simply unscrewed from its base by turning counter– clockwise on naturally aspirated engines it is possible to rotate the oil filter, or remove it from its bracket, thus minimizing the risk of oil spillage. Position a one–quart or larger container under filter before removal to catch oil from spilling into bilge. A new element is simply screwed onto the base with medium hand tightness. Under no circumstances should a wrench or excess pressure be used. When next starting engine, check filter for possible leaks or seepage, and tighten only sufficiently to prevent same.

Transmission

As there is such a wide variety of transmissions available with Lehman diesels, it is not practical to cover all installations in this manual. However, due to the popularity of the Borg Warner, PRM/Newage and Twin Disc transmissions, the following information is offered for those models.

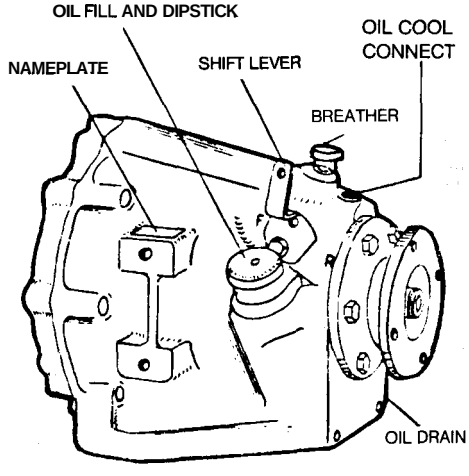
BORG WARNER

No attempt is made herein to instruct in the installation of engine in the boat. The prudent boat owner or operator will, before initially starting engine, check engine/shaft alignment, operate clutch control to make certain that lever fully travels to the full ahead or full reverse positions, that neutral position may easily and quickly be found and of course check oil level.

The transmission is a self–contained, sealed unit with independent lubrication system. No external adjustments of any kind are required. A built–in oil pump supplies the required hydraulic pressure to provide effortless shifting and assures an adequate supply of lubricant to all moving parts. An oil cooler is provided in order to maintain proper oil temperature which should not exceed 190 °F.

Automatic transmission fluid type A, suffix A is recommended for lubrication*. Or, if desired, "Dexron" type fluid maybe used. Before starting engine fill transmission to the full mark on the dipstick. Run engine for a minute or two at low speed (in order to fill oil lines, cooler, etc.) Then shut off engine and check oil level. Add sufficient oil to bring up to full mark. Transmission oil level should be checked each time the oil level in engine is checked. Change oil every 200 hours of operation or at least once each season under normal conditions however, number of hours may vary depending upon severity and conditions of service WARNER drain plug is a large "hex" plug located near bottom right side. Removal of this plug and a small plug on the bottom of the reduction housing will completely drain the transmission. On some models the cooler return hose may be fed into the plug at the bottom of the transmission, In these instances, remove the hose and rotate the brass elbow as required for draining.

*WARNER WILL NOW ALLOW USE OF SAE 30 OIL. ENSURE YOU CHECK THE STICKER ON THE COOLER WHICH INFORMS ON TYPE OF INITIAL FILL.



PRM/NEWAGE Operation

First time usage
Before starting the engine fill the gearbox with one of the recommended lubricants (SAE30W) to the maximum level indicated on the dipstick.

Ensure that the gearbox is in neutral, it is recommended that the optional neutral safety start switch (if fitted) should be wired in to the starter circuit to avoid uncontrolled boat movement on starting-up. Start up and run the engine and gearbox for a few minutes to allow the oil to circulate through the cooling circuit (and angle drive if fitted). Stop the engine, allow to settle, check the oil level and 'top-up' to the maximum level shown on the dipstick.

Operating temperature
Normal operating temperature should be between 50°C – 70°C with a maximum of 80°C. The oil coolers supplied for fitting to Newage PRM gearboxes have adequate capacity to ensure correct operating temperature under all conditions.

Gear shifting
Newage PRM marine gearboxes have been designed and tested to ensure rapid shifts from ahead and astern and vice versa can be operated at full horsepower ratings and speeds, and the transmission will respond rapidly in these circumstances. Full power shifts, however, do place abnormal, even if short lived, loads on the gearbox, and the operating life will be increased if they are reserved for emergency use only.

Trailing (free-wheeling) the propeller.
The bearings used in Newarge PRM gearboxes have been carefully selected to ensure that prolonged trailing (free-wheeling) of the propeller will not have any detrimental effect on the transmission. This allows the propeller to turn freely with the engine shut down and makes Newage PRM gearboxes particularly suited for use in auxilliary sailboats, motor sailers, or multi-engine installations where the boat may be operated with one or more engines shut down.

Emergency operation
Included as standard in every Newage PRM marine gearboxes is a 'Get-You-Home' device, allowing the gearbox to be mechanically locked in 'ahead' drive, in the unlikely event of hydraulic failure.

ROUTINE MAINTENANCE

After **25** hours running
Drain all oil from the gearbox and refill with one of the recommended lubricants. Operate the engine and gearbox, allowing the oil to circulate, then stop the engine and allow the oil to settle. Re-check the oil level and top up if necessary to the maximum mark on the dipstick.

Daily
Check oil level and make visual check for oil leaks especially at the output shaft oil seal and at gasket sealing surfaces.

Annually
Check oil cooler hoses and connections
Check propeller shaft alignment
Ensure that remote control operating linkage is adjusted to give the correct travel on the gearbox operating lever.

TWIN DISC MARINE TRANSMISSION

All moving parts of the transmission are lubricated by the oil within the sump as it travels throughout the hydraulic system. The oil used should be of the same quality and type recommended for use in the engine. Use SAE30 HD when the inlet water temperature to the heat exchanger is above 80°F, and SAE20 HD when this temperature is below 85°F.

Oil level in the transmission should be checked daily with the engine at idle speed and the marine transmission in "neutral". Oil level must be maintained at the "full" mark on the dipstick. The period between oil changes is 1000 hours of operation or 6 months, whichever occurs first. At each oil change the filter screen, installed at the bottom of the rear cover and extending into the sump, should be removed and cleaned. It should be re-installed using pipe sealant or pipe thread compound on the threads. The breather cap should also be removed and flushed in clean diesel fuel. Next, disconnect the heat exchanger hoses and drain all the oil from the heat exchanger. Finally, if an oil filter is used in the hydraulic system, drain the filter and connecting hoses, and replace the filter element.

To drain the transmission, remove the Hex-Head plug from the bottom of the main housing. When re-filling, use 1.2 US gallons (4.456 Its) of oil. Pour the oil into the breather cap opening. After filling, start the engine and shift the unit from "forward" to ''reverse" several times to fill the oil lube lines, heat exchanger etc. with oil. Set the engine at idle speed and the transmission in "neutral". The oil level must be to the "full" mark on the dipstick. Re-instal the breather cap when the correct level has been reached and run the transmission until the oil temperature has been raised to its operating range. Re-check the oil level and top up if necessary.

Periodically inspect hoses for signs of leak, damage or sponginess, replacing where necessary. Pressure and temperature gages should be regularly inspected and replaced if found to be damaged or of suspect accuracy.

If information on any other transmission is required, please contact Lehman and such information will be forwarded to you.

Maintenance

The importance of correct lubrication, periodic inspection and adjustment cannot be over–emphasized. On it will depend, to a very large extent, the service which your engine will deliver.

The heat exchanger of your engine is protected by a "zinc pencil" which should be inspected and replaced periodically as required. As the rate of electrolysis varies greatly in different areas, only experience will dictate how often inspections should be made.

For convenience lubrication and maintenance work has been divided into the following periods;

A Daily
B After every 50 hours running.
C After every 200 hours running.
D After every 1200 hours running.
E After every 1500 hours running.
F After every 3000 hours running.
G After every 3600 hours running.

Summary of Regular Maintenance

Daily.	Check engine and transmission oil levels. Check cooling water level. Check belt tension and adjust if required.
After first 50 hours of operation.	Change Engine Oil and filter. Check (exchanger) zinc pencil.* Check for fuel, lube oil or coolant leaks. Check all wiring connections, cables, etc. Check valve clearances, adjust if required.
Every 200 hours of operation.	Change Engine Oil & Filter. And Transmission Oil. Check idling speed, adjust if required. Check exhaust components for leaks. Check condition of all coolant and oil hoses. Check all engine mount bolts. Replace raw water pump impellor.
Every 1200 hours of operation.	Flush cooling system. Replace anti–freeze.
Every 1500 hours of operation.	Check end play of turbocharger rotating assembly.
Every 3000 hours of operation.	Remove and dismantle turbocharger – repair as required.
Every 3600 hours of operation.	Replace thermostats.

*Zinc pencil should be checked every 2 weeks, regardless of number of operating hours until owner determines how often zinc element must be replaced. Replace after 50% deterioration.

Injectors need not be serviced at regular intervals but rather, should be serviced after problem such as smoke, loss of power, hard starting, etc. develops and has been diagnosed.

Minor Repairs, Maintenance and Adjustments

DUE TO REVISED HEAD GASKET, HEAD GASKET AND HEAD BOLT DESIGN RETORQUING OF CYLINDER HEAD IS NOT REQUIRED. **AND MUST NOT BE ATTEMPTED.**

TO ADJUST VALVE CLEARANCES: (Note . . . Adjustments should be made while engine is at normal operating temperature). Following removal or rocker arm cover and tightening cylinder head bolts as described above, actuate the engine stop control lever so engine will not start and revolve crankshaft pulley, until numbers 1 and 6 valves (on **4** cylinder, see specification section) or number 1 and 4 (on 6 cylinder, see specification section) are opened by their respective rocker arms.

Insert the correct thickness feeler gauge (as shown in the following table) between the valve stem cap and rocker arm of No. 3 inlet valve (on 4 cylinder) or No 9 exhaust valve (on 6 cylinder) as shown in figure 25. Turn the valve clearance adjusting screw Fig. **18** until the feeler blade is lightly caught between the rocker arm and valve stem cap, but so that the blade can still be removed with light resistance.

Select the appropriate feeler blade and repeat the procedure for No. ***8*** exhaust valve (on **4** cylinder) or No. 12 exhaust valve (on 6 cylinder) models.

Rotate the engine and following the sequence in the following table, adjust each of the remaining valves. Replace rocker cover, making certain that gasket is unbroken and correctly positioned. After running engine for a short while, check rocker arm cover gasket for possible oil leaks.

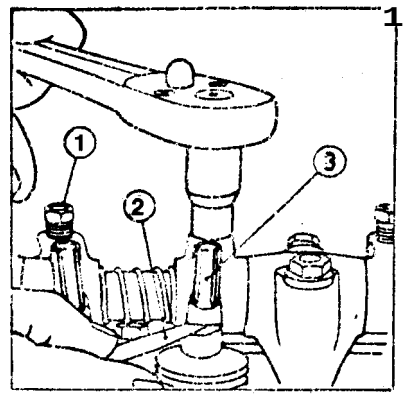


FIG. **18.**

ADJUSTING VALVE CLEARANCE

1. Adjusting screw
2. Feeler blade
3. Rocker arm

4 Cylinder engines

Valves Fully Open	Valves to Adjust
1 and 6	3 and 8
2 and 4	5 and 7
3 and 8	1 and 6
5 and 7	2 and 4

6 Cylinder engines

Valves Fully Open	Valves to Adjust
1 and 4	9 and 12
8 and 10	3 and 5
2 and 6	7 and 1
9 and 12	1 and 4
3 and 5	8 and 10
7 and 11	2 and 6

TO ADJUST VEE BELT TENSION: Loosen alternator mounting and adjusting strap bolts as per figure 19. **Move** alternator to adjust belt tension. Tension is correct when your thumb pressure on belt at a point between alternator or and water pump pulleys does not exceed ½". Tighten alternator mounting and adjustment strap bolts.

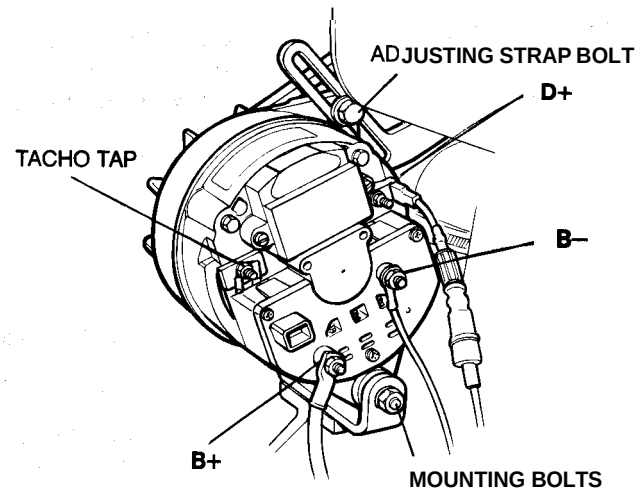


FIG. **19.**

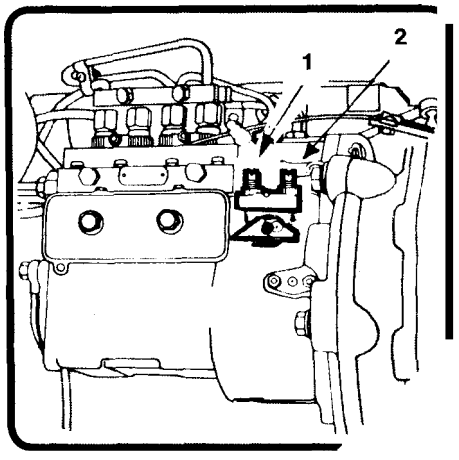
BELT ADJUSTMENT

INTAKE **AIR** FILTER: The air filtering element(s) on all naturally aspirated engines is polyurethane foam which traps and holds dust and foreign matter which could be drawn into the engine and cause severe damage. Turbo Charged and Turbo Intercooled engines only use a Mesh Screen.

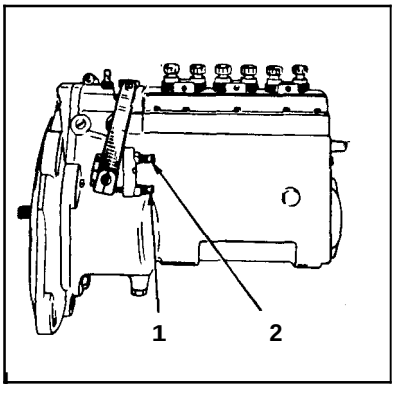
By reason of the efficiency of the filter in trapping contaminants it is difficult to effectively clean the element. It isusually best to replace this low–cost item as occasion demands. Simply slide old element off its retaining screen and carefully stretch a new element into position. If cleaning is desired, wash in a mild detergent mixed in clear, sweet water. DO NOT wash in mineral spirits, varsol, gasoline, or any petroleum product.

FIG. 20

INJECTION PUMP (All N.A. ENGINES)



INJECTION PUMP (TURBO ENGINES)



1. Max speed stop screw
2. Idling stop screw & locknut

TO ADJUST IDLING SPEED: When properly serviced and after the initial "break–in" period, your engine should idle as indicated on spec sheet.

Engine must be at normal operating temperature when making adjustments. With engine running, loosen the idle screw locknut which is on side of fuel injection pump. Adjust the idle speed screw until eingine is idling at correct speed and then tighten locknut. Operate the throttle lever to make certain that same returns to same setting.

Note: If engine is new or cold, it may idle unevenly. Do not increase the idle speed setting to compensate. ON NO ACCOUNT SHOULD THE MAXIMUM SPEED STOP BE CHANGED.

TO CLEAN FUEL LIFT PUMP Turn off fuel supply valve. Holding receptacle under pump to prevent spilling of fuel into bilge of boat, loosen the center bolt and remove cover and pulsator. Clean pump thoroughly and wash cover and pulsator in fuel oil. Replace parts carefully. It will be necessary to bleed fuel system. Check for possible leaks after starting engine.

TO CHANGE SECONDARY FUEL FILTERS (note–making certain that the filter element(s) you will use is an EXACT replacement for the element you will remove, otherwise, air leaks into the fuel system may result. Unscrew the securing bolts on top of filter housing and remove filter bowls and elements. Discard elements and upper and lower sealing rings. Wash out the bowls and clean fuel oil but do not use a cloth for remaining lint may clog the fuel system. Carefully fit new sealing rings to the filter heads and bowls, assemble to the filter heads and replace and tighten securing bolts. It will now be necessary to bleed the fuel system of air as described in separate section. After running engine for a short time, check filters for possible fuel leaks.

Winterizing

In preparation for freezing temperatures, anti–freeze should be provided in the fresh water system of your engine. Due to the high temperature of operation a high boiling point anti-freeze is demanded. Do not attempt to use alcohol or other non-permanent types and do not use any liquids containing "sealants". Zerex (produced by DuPont) is highly recommended. Consult the specification freeze to bring within the limits of expected temperatures. Inboard type heat exchangers and oil coolers must be drained of raw (sea) water when exposed to freezing temperatures. Drain plugs will be found on bottom of heat exchanger and oil coolers and should be removed until all water has been drained. Raw water pump may be drained by loosening screws holding rear cover in position. Please refer to "cooling system" section of this manual for alternate winterizing method.

If boat is to remain in water while draining engine, of course, the intake water seacock must be closed prior to draining. Do not neglect to open sea–cock prior to starting engine.

NOTE: TO DRAIN FRESH WATER, REMOVE WATER FILLER CAP FROM TOP OF EXPANSION TANK ON FRONT OF ENGINE. DRAIN BLOCK BY OPENING PETCOCK ON PORT (LEFT) SIDE OF ENGINE IN CENTER, LOWER SECTION. REMOVE PLUG ON UNDERSIDE OF HEAT EXCHANGER (THE ONE NEAREST CENTER OF EXCHANGER) TO DRAIN WATER FROM EXCHANGER, EXPANSION TANK AND EXHAUST MAINFOLD. REPLACE FILL CAP ON TANK AFTER CLOSING PETLOCK AND INSTALLING PLUG IN HEAT EXCHANGER.

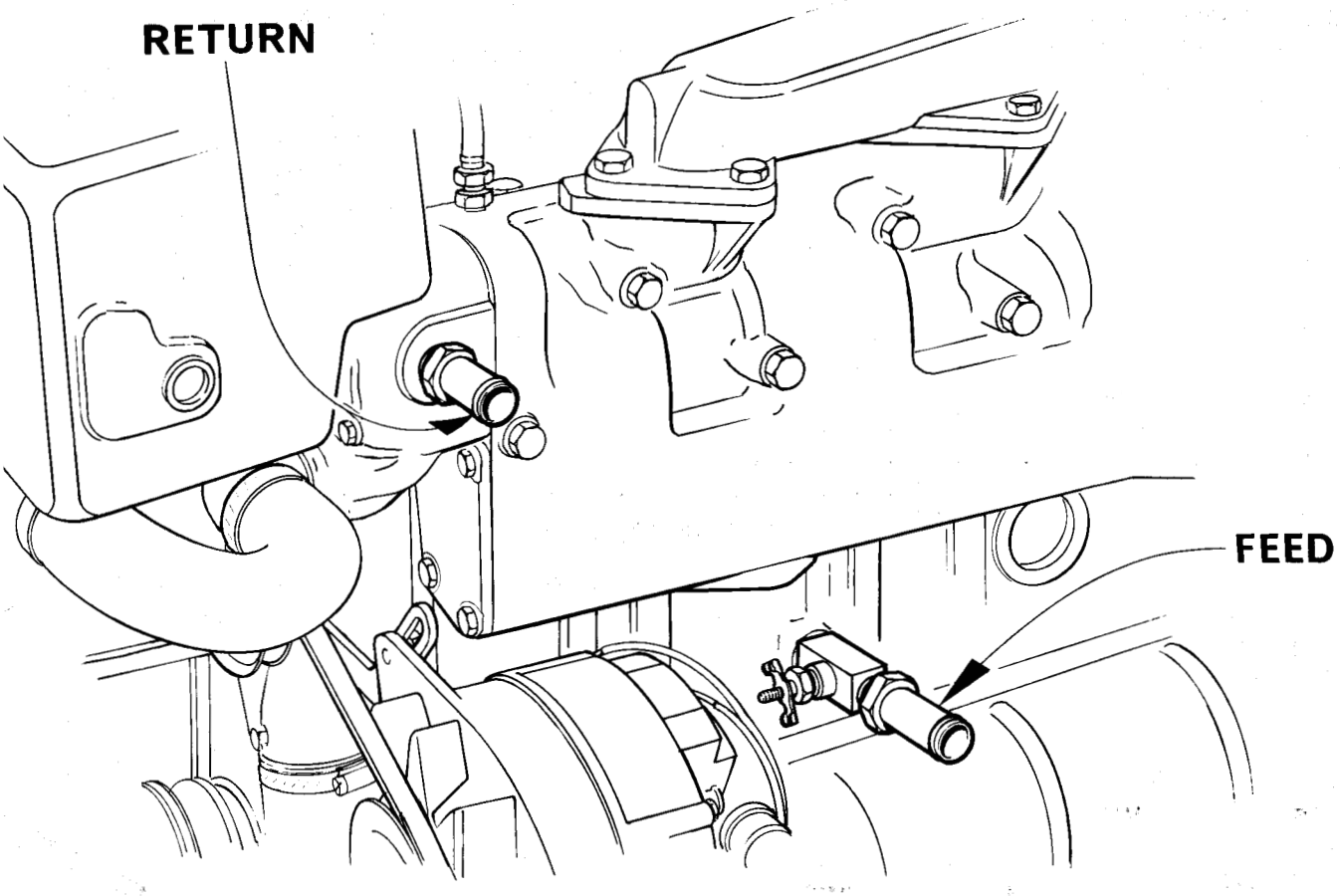
:emove air filter(s) and cover openings in manifold with plastic film held in place with masking tape. Seal off all ther openings . . . air vent on top of rocker arm cover, vent on front end of sump and overflow and vent hole on ıjection pump. Plug exhaust pipe to prevent entrance of moisture.

Make certain that all engine exterior surfaces are clean, dry and free of oil or grease; then spray complete engine with any good rust preventative compound.

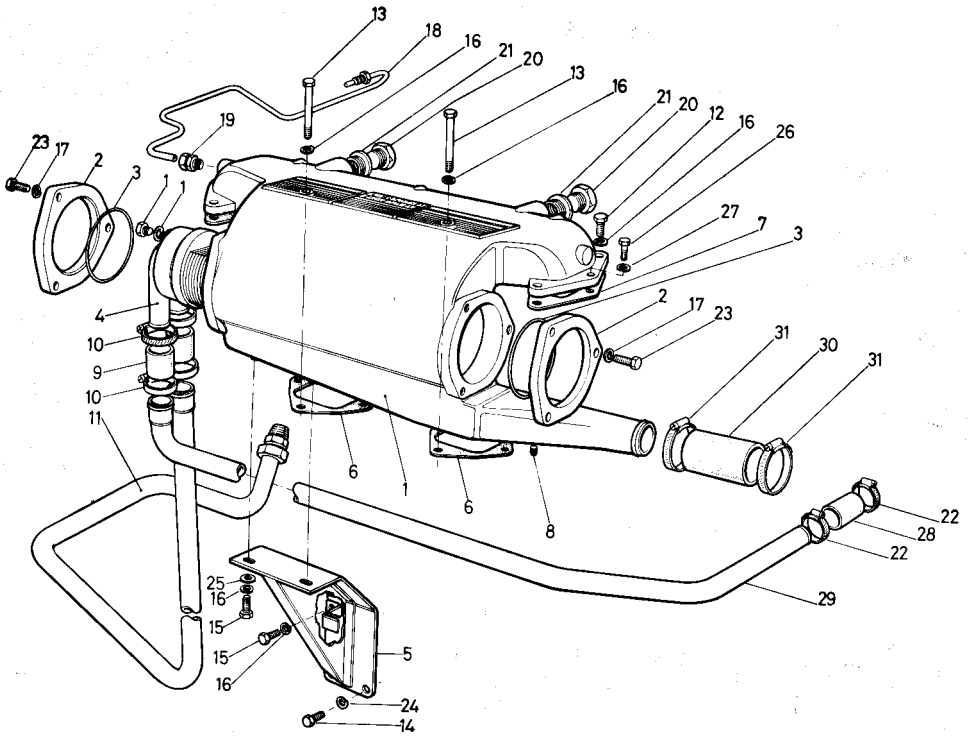
Before restarting engine, remove all plastic seals, covers, exhaust plug, etc., and refit air filter(s) in place. Do not eglect to replace all drain plugs, tighten rear cover of raw water pump, and turn on seacock.

Galley Hot Water Connections

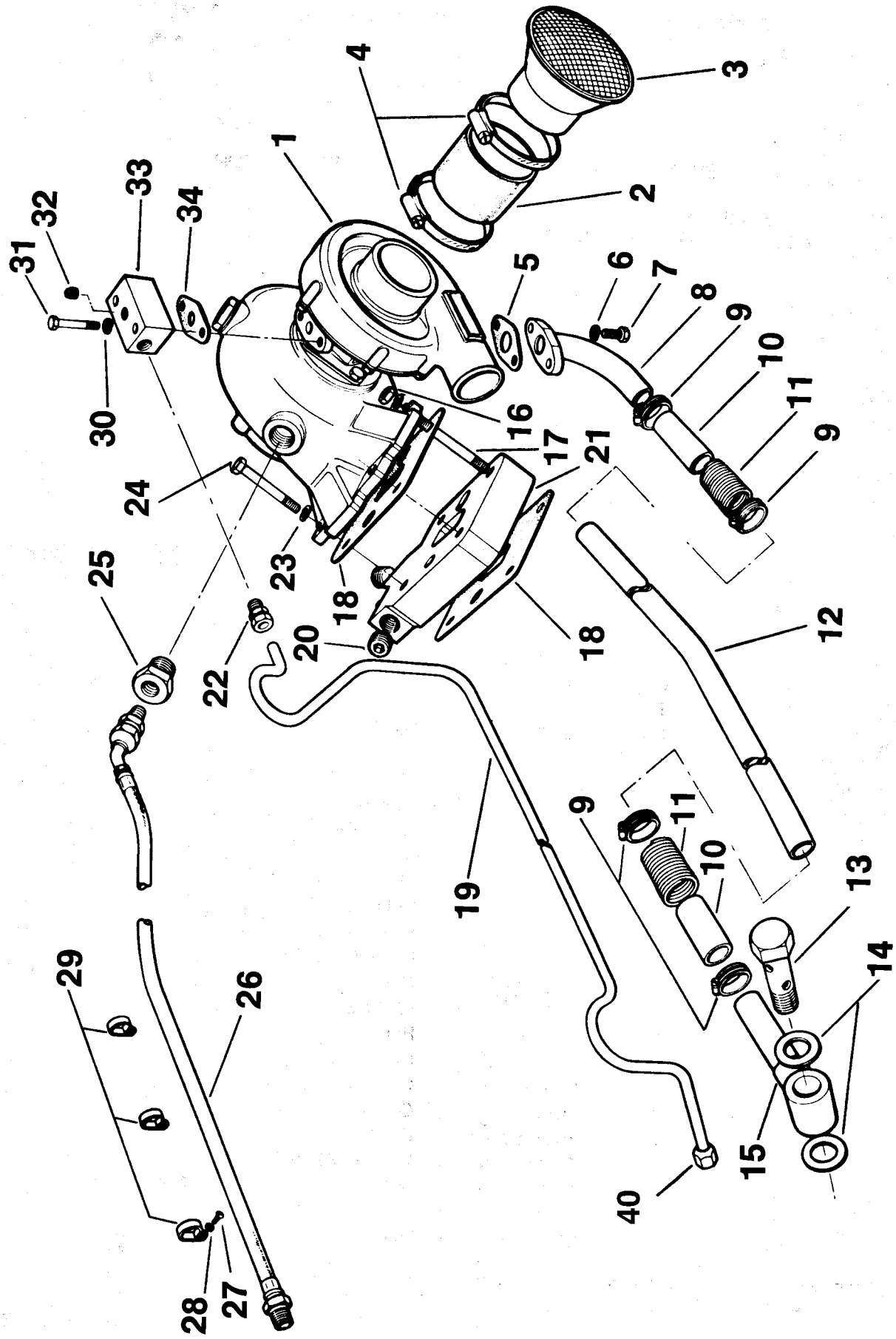
: is common marine practice to utilize engine coolant passed through a hot water heater to provide domestic hot vater. Connection to engine is made with Lehman Kit D1496. A coolant feed to the heater is made from the engine rain plug on the portside of block while the coolant return hose is attached to the forward, port side of the exhaust ıanifold. Always ensure that the max. height of the cooling hot water coil is 1" lower than the top angle of the xpansion tank.



Intercooler Assembly D I128T
Comprising Key 1–31 SP275



CODE	KEY	QTY	PART No.	DESCRIPTION
T	1	1	2J30	INTERCOOLER BODY
	2	2	2J32	END RING
	3	2	2D304	"O" RING
	4	1	2J33	INTERCOOLER CORE
	5	1	2J41	SUPPORT
	6	2	1c39	GASKET
	7	2	1C40	GASKET
	a	1	3L1	PLUG
	9	2	3K210	HOSE
	10	4	3K13	HOSE CLIP
	11	1	1G192	PIPE
	12	6	OE202C	BOLT
	13	2	OE208	BOLT
	14	2	OE401	BOLT
	15	3	OE201C	BOLT
	16	11	OC31	LOCK WASHER
	17	6	OC41	LOCK WASHER
	18	1	1D64	PIPE ASSEMBLY
	19	1	3L45	ADAPTOR
	20	2	3L50	PLUG
	21	2	3E40	ADAPTOR
	22	4	3K13	HOSE CLIP
	23	6	OE302	SETSCREW
	24	2	OC51	LOCK WASHER
	25	2	OC30	WASHER
	26	2	OE104	SET SCREW
	27	2	OC21	LOCK WASHER
	28	1	3K220/10CM	HOSE
	29	1	IG193	PIPE
	30	1	3K215	HOSE
	31	2	3K12	CLAMP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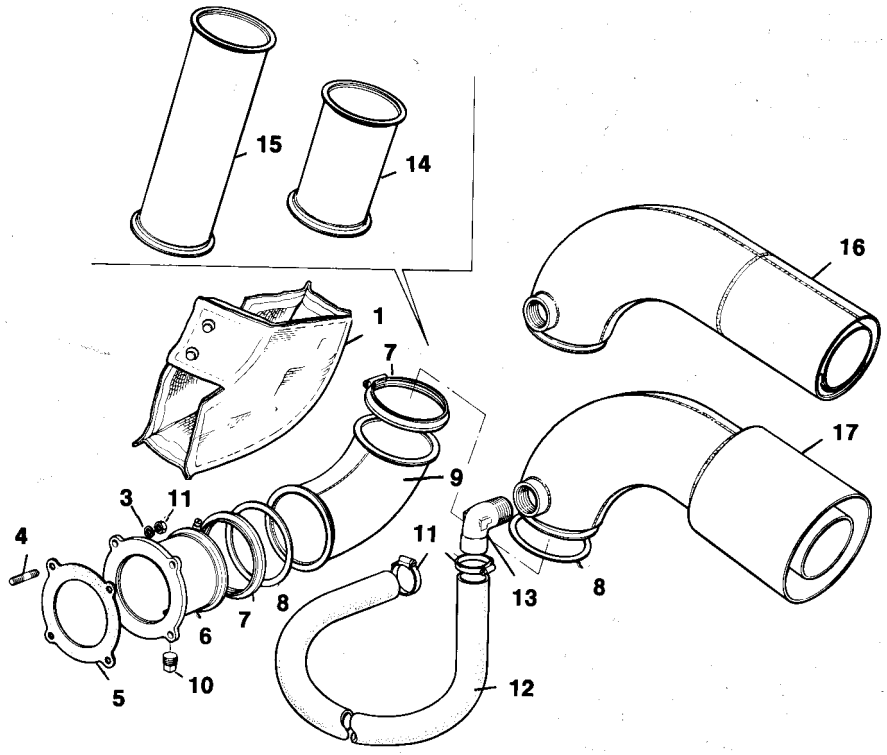
SEE OVER

Turbo Charger Assembly D1515
Comprising Key 1–39
SP185/SP225/SP275 Engine

CODE	KEY	QTY	PART No.	DESCRIPTION	
	1	1	2J45	TURBOCHARGER HOLSET	
	2	1	1456626	HOSE	
	3	1	1456620	**AIR** CLEANER – SEE ALSO PAGE C42	
	4	2	5007673	CLAMP	
	5	1	1C52	OIL RETURN GASKET	
	6	4	OC31	WASHER	
	7	2	OGE201C	SETSCREW	
	8	1	3E901	OIL RETURN ELBOW	
	9	4	5009881	CLAMP	
	10	2	6099199	HOSE	
	11	2	6065031	SLEEVE	
	12	1	6087966	TUBE	
	13	1	6097079	BANJO BOLT	
	14	2	1515382	WASHER	
	15	1	6087961	CONNECTOR OIL DRAIN	
	16	2	OB45	NUT	
	17	2	OD61	STUD	
	18	2	1c43	GASKET	
	19	1	3E903	OIL FEED PIPE	
	20	2	3E905	PLUG	
	21	1	3E910	ADAPTOR BLOCK	
	22	1	3E230	ADAPTOR	
	23	4	OC51	WASHER	
	24	2	OE408	BOLT	
	25	1	3E915	PLUG	
	26	1	3K790	VENT HOSE	
	27	2	OA3	SCREW	
	28	2	OC5	LOCK WASHER	
	29	2	2M6	CLIP	
	30	4	OC31	WASHER	
	31	2	OGE207	BOLT	
	32	1	3L1	PLUG	
	33	1	3E912	OIL FEED BLOCK	
	34	1	1c53	OIL FEED GASKET	
	35	2	6065050	CLIP	Not Shown on Drawing
	36	1	2M9A	PIPE SUPPORT	
	37	1	OB1	NUT	
	38	1	OC41	SPRING WASHER	
	40	1	1549952	ADAPTOR BLOCK	

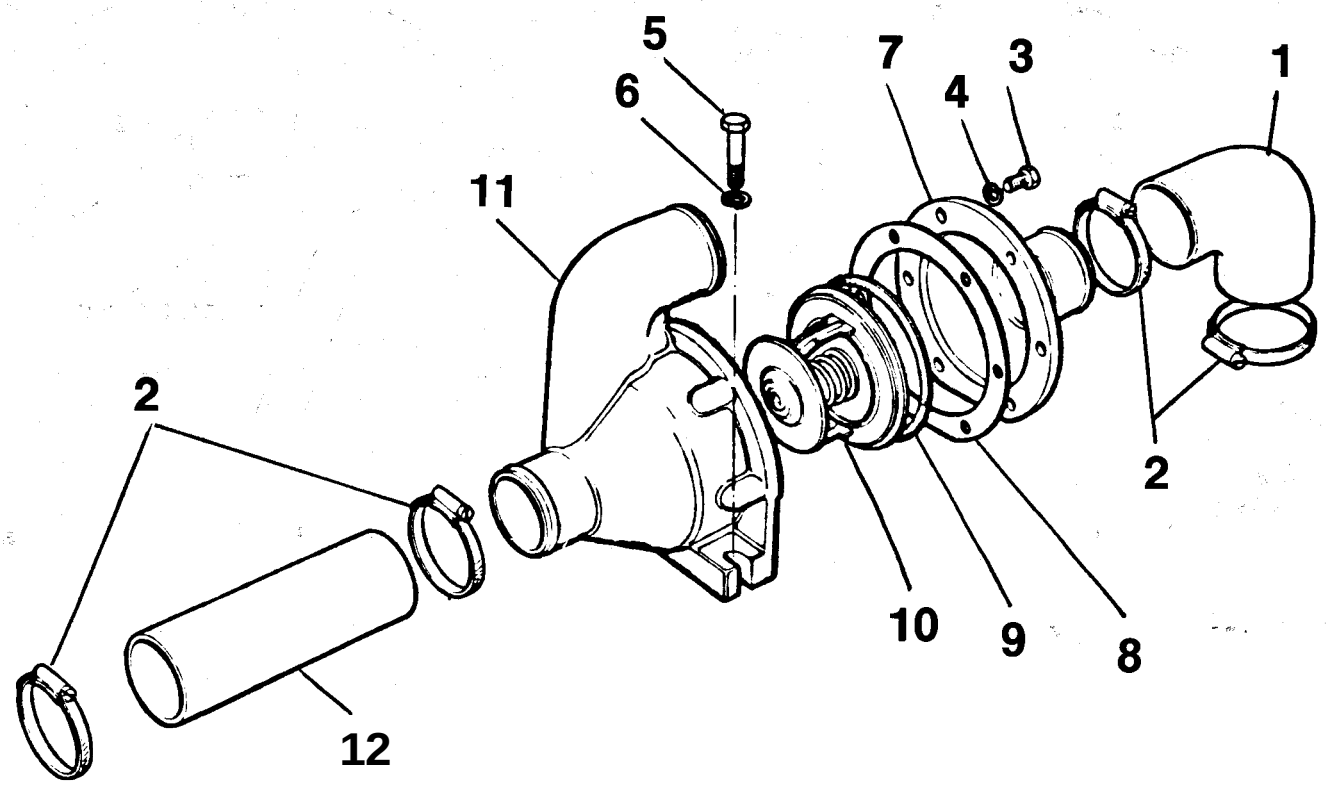
Turbo High Rise Exhaust Assembly
D1510 STD. Comp Key (1-17) Less 14115
D1511 - 150 EXT. Comp Key (1-17) Less 15
D1512 - 300 EXT. Comp Key (1-17) Less 14
SP185 / SP225 / SP275

NOTE:- ENGINE 'D' ASSEMBLY CODES AS FOLLOWS
SP185-S SP225-P SP275-T
USE THE APPROPRIATE SUFFIX WHEN ORDERING ASSEMBLIES.



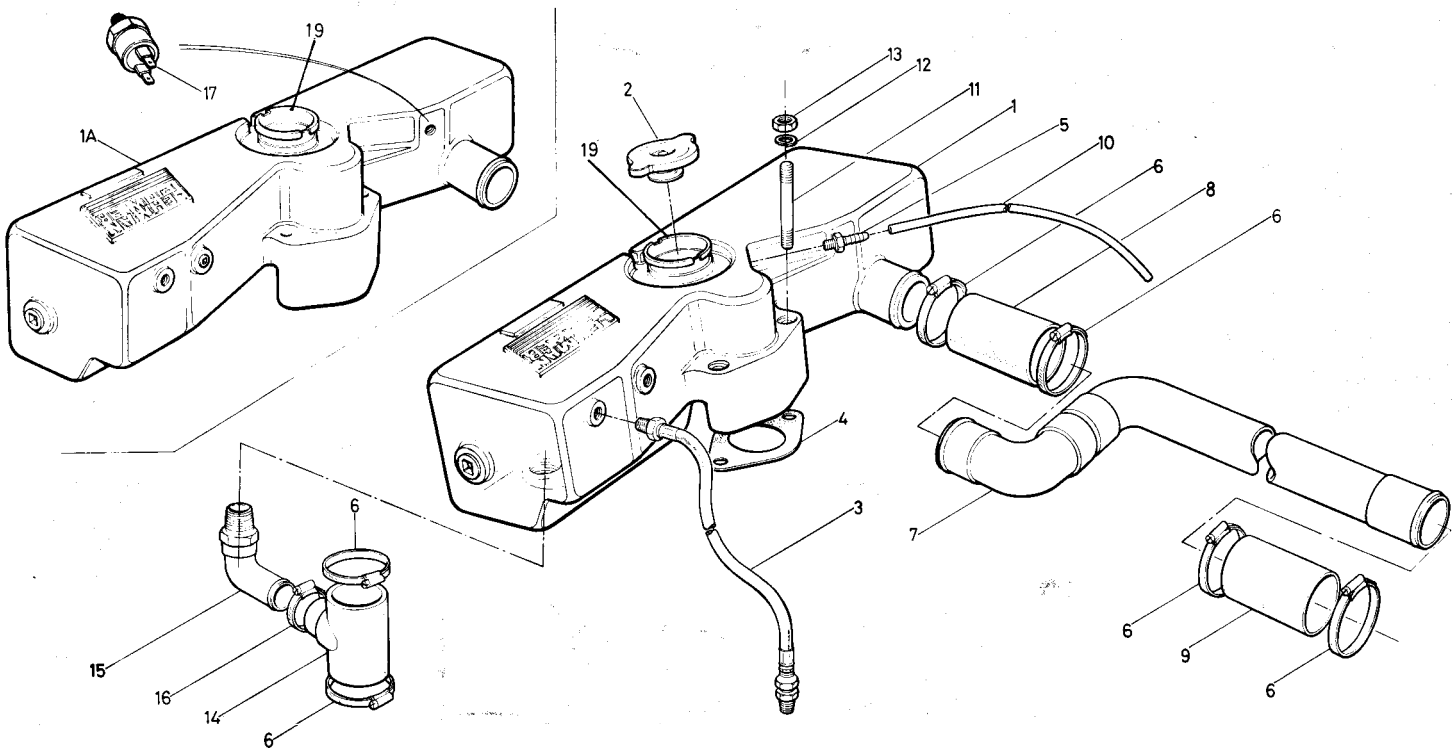
CODE	KEY	QTY	PART No.	DESCRIPTION	
P/S/T	1	1	2J134	HEAT SHIELD	
	2	1	OGB28	NUT	
	3	1	OGC31	LOCK WASHER	
	4	1	1500785	STUD	
	5	1	2J23	GASKET	
	6	1	2J20	ADAPTOR	
	7	3	2J21	CLAMP	)ALSO USED ON TOP OF
	8	3	2J22	STEEL GASKET	) RISER EXTENSION
	9	1	2J133	RISER	
	10	1	3L2	PLUG 1/8"	
	11	1	3K13	CLIP	
	12	1	EW64 24"	HOSE	
	13	1	3E859	ELBOW	
	14	1	2J131	RISER EXT (150mm) – Jacket not shown	2J136
	15	1	2J132	RISER EXT (300mm) – Jacket not shown	2J137
S	16	1	2J129	EXH ELBOW 4 O	
P K	17	1	2J130	EXH ELBOW 5" Ø	

Thermostat Assembly D885
Comprising Key 1–12
SP185 / SP225 / SP275



CODE	KEY	QTY	PART No.	DESCRIPTION
P/S/T	1	1	3K511	HOSE
	2	4	3K4	CLAMP
	3	6	OE101	BOLT
	4	6	OC21	LOCK WASHER
	5	2	OE202	BOLT
	6	2	OC21	LOCK WASHER
	7	1	1A409	THERMOSTAT COVER
	a	1	1c47	GASKET
	9	1	1C46	RUBBER SEAL
	10	1	2C250	THERMOSTAT, SP160/225/275
	11	1	1A410	THERMOSTAT HOUSING
	12	1	3K2135	HOSE

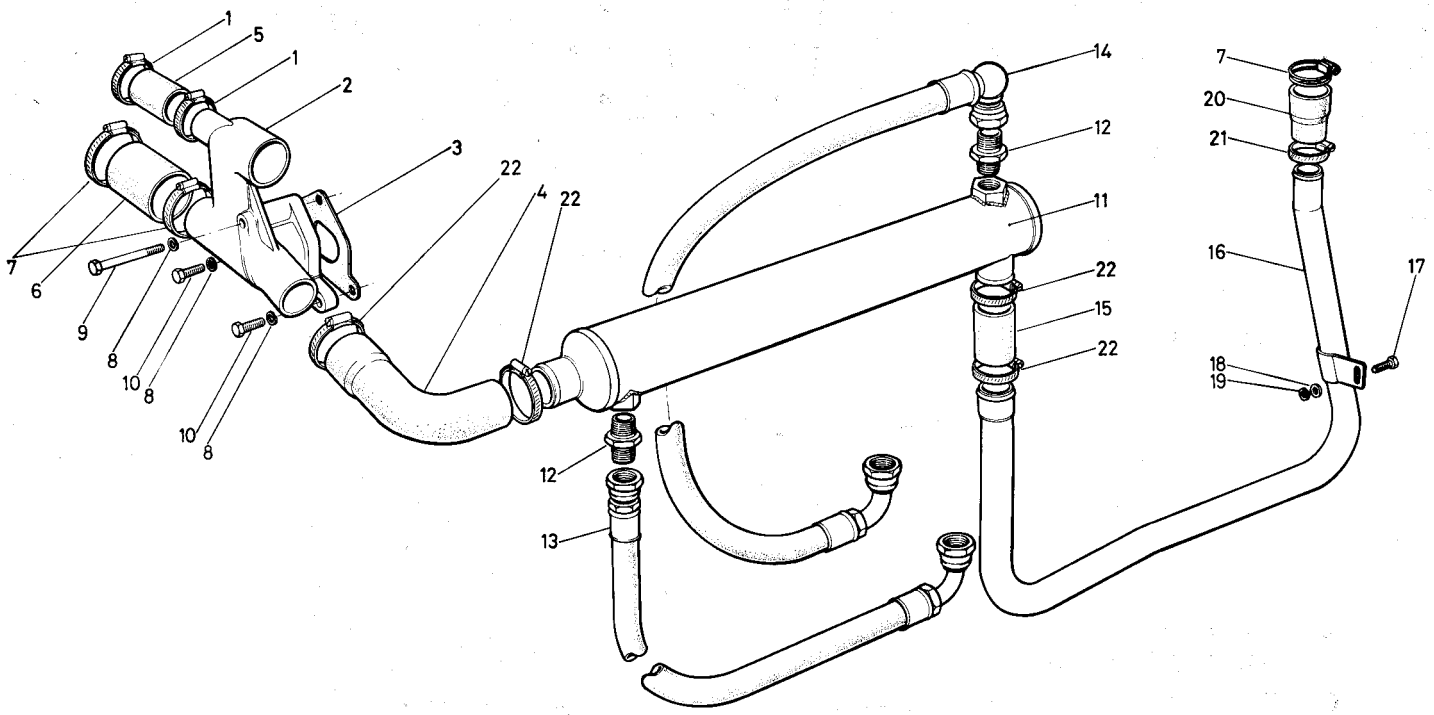
Header Tank Assembly D800 (Angled STD) Comp Key 1-17 Less (1A) D801 (Horizontal) Comp Key (1-17) Less (1) SP185 / SP225 / SP275



CODE	KEY	QTY	PART No.	DESCRIPTION
P/S/T	1	1	1A393	HEADER TANK (ANGLED)
	1A	1	1A465	HEADER TANK (HORIZONTAL)
	2	1	2C304	PRESSURE CAP
	3	1	3K860	VENT HOSE
	4	1	1541317	GASKET
	5	1	3C27	HOSE BARB
	6	6	3K4	CLAMP
	7	1	1D73	TUBE
	8	1	3K2133	HOSE
	9	1	3K2133	HOSE
	10	1	3K825	HOSE, OVER FLOW
	11	2	OD71	STUD
	12	2	OC31	WASHER
	13	2	OB26	NUT
	14	1	3K826	T-REDUCING HOSE
	15	1	3E860	ELBOW
	16	1	3K2	CLAMP
	17	1	1608027	COLD START SWITCH
	18	1	IF63	FILLER NECK

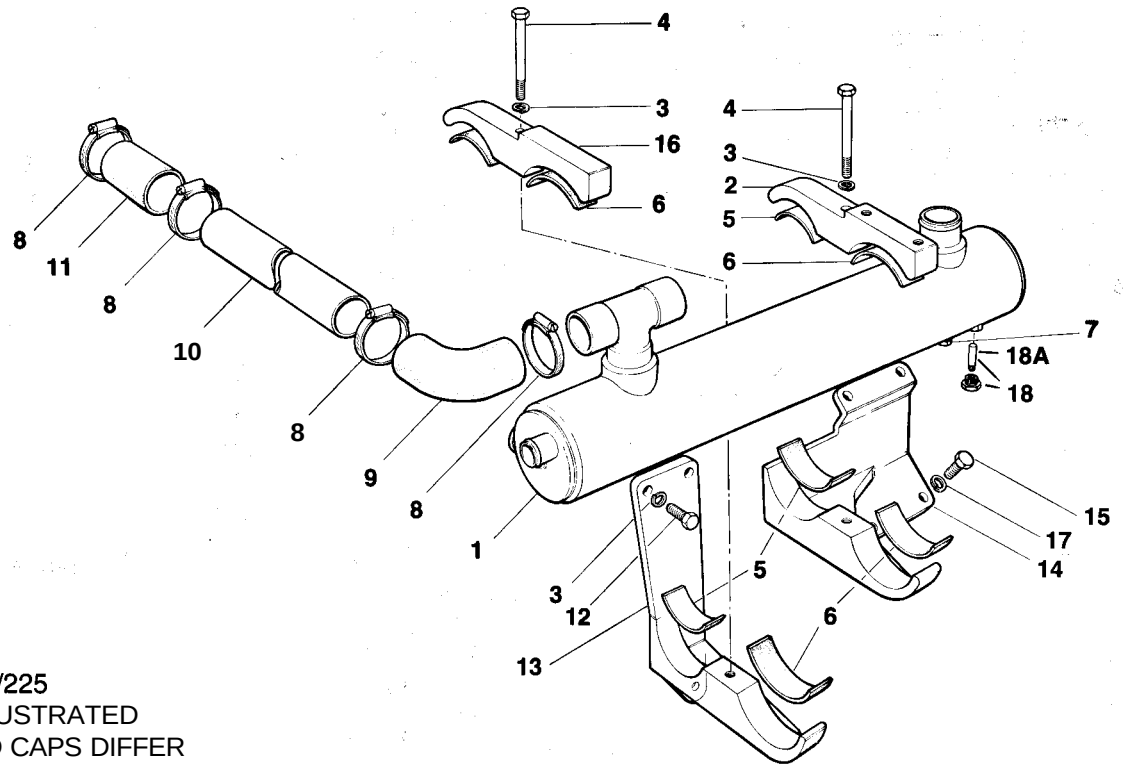
NOTE:- USE 'P' SUFFIX ON ALL

Engine Oil Cooler Assembly D197T
Comprising Key 1-22
SP275



CODE	KEY	QTY	PART No.	DESCRIPTION
T	1	2	3K14	HOSE CLIP
	2	1	1A413	SPLIT FLOW RETURN
	3	1	2D36	GASKET
	4	1	3K786	PIPE RUBBER
	5	1	3K353	WATER HOSE
	6	1	3K2133	RADIATOR HOSE
	7	3	3K12	HOSE CLIP
	8	3	OC41	LOCK WASHER
	9	1	OE307.5	SOCKET SCREW
	10	2	OE302	SETSCREW
	11	1	2C272	OIL COOLER ENGINE
	12	2	3G38	ADAPTOR
	13	1	3K801	OIL HOSE ASSEMBLY
	14	1	3K802	OIL HOSE ASSEMBLY
	15	1	3K209-2	HOSE
	16	1	IG191	PIPE
	17	1	OGE201	BOLT
	18	1	OC30	FLAT WASHER
	19	1	OGC32	LOCK WASHER
	20	1	6135883	HOSE
	21	2	3K3A	HOSE CLIP
	22	4	3K3A	HOSE CLAMP

Heat Exchanger Assembly
D882 (Cupro) – Comp Key (1A-18)
D883 (Copper STD) – Comp Key 1-18 (LESS 1A)
SP185 / 225 / 275



N.B. 185/225
ARE ILLUSTRATED
275 END CAPS DIFFER

CODE	KEY	QTY	PART No.	DESCRIPTION
P/S/T	1	1	2C246	HEAT EXCHANGER (COPPER) SP185/225 SPARES ONLY
	1A	1	2C269	HEAT EXCHANGER (CUPRO) SP185/225 ONLY
	1B	1	2C273	HEAT EXCHANGER (CUPRO) SP275 ONLY
	2	1	ID57	CLAMP
	3	5	OC41	LOCK WASHER
	4	2	OE310	BOLT
	5	4	1C54	RUBBER STRIP
	6	2	1c54	RUBBER STRIP
	7	1	3L1	PLUG
	8	4	3K12	HOSE CLIP
	9	1	3K503	RADIATOR HOSE
	10	18	1D56/18	PIPE
	11	1	3K2133	HOSE
	12	2	OE303	SETSCREW
	13	1	1D68	SUPPORT REAR
	14	1	1D58	SUPPORT FRONT
	15	4	OE403	SETSCREW
	16	1	1D67	CLAMP REAR
	17	4	OC51	LOCK WASHER
	18	1	EM21	ZINC ANODE ASSEMBLY
	18A	1	EM21A	ZINC ANODE
			NOT SHOWN SEPARATELY	
		1	2C269A	END PLATE SP185/225
		1	2D26	RUBBER GASKET SP185/225/275
		1	2C273A	END PLATE SP275
		1	2C211A	END PLATE ALL
		1	2D25	GASKET ALL

NOTE:- ENGINE 'D' ASSEMBLY CODES AS FOLLOWS SP185-S SP225-P SP275-T