

**MARNA diesel**

TYPE L2. 2-SYL.

**MAINTENANCE MANUAL AND ILLUSTRATED SPARE PARTS LIST**

**INSTRUKSJONSBOK OG ILLUSTR. RESERVEDELSLISTE**

***MANDALS MOTORFABRIK***  
**MANDAL**

**NORWAY**



Fuel, lubricating oil and adjustment data for

MARNA DIESEL ENGINE, TYPE L2

Fuel oil: Gas oil

Lubricating oils: For MARNA diesel engine type L2 use lubricating oil according to API specifications for "Service DS".

Summer: Viscosity SAE 20.

Winter: SAE 20 - SAE 10 may be used if the motor becomes too heavy to crank.

For engines equipped with reduction gear, use one of the following gear oils in the gear box:

Esso gear oil SAE 90

Caltex Thuban 90

BP Energol Gear oil SAE 90

Mobilube Gx80-90

Shell Dentax.

For greasing the stern bearings and the reversing gear we recommend the following special grease:

Mobilplex 47 (Mobil Oil A/S)

CaZar K2 (Esso)

If this becomes too thick in the winter, use grease no. 1. Never use the common consistent or cup grease.

The above-mentioned specifications are kept in stock by all leading dealers.

TIMING DATA AND CLEARANCES:

Valve-rocker arm clearance: 0,4 mm

Opening pressure of the fuel injector:

Exact pressure adjustment: 2055 LBS/sq.in. (145 kg/cm<sup>2</sup>)

Lowest pressure allowed: 1920 LBS/sq.in.

Clearance above top of piston: 1,2 - 1,5 mm

Minimum clearance: 1 mm

Recommended torque tensions:

Con. rod bolts: 60 LBS/Ft.

Cylinder head nuts: 75 LBS/Ft.

Flywheel bolts: 75 LBS/Ft.

DESCRIPTION OF MARNA 2 CYL. DIESEL ENGINE, TYPE L2.

Type: 4 stroke, vertical, water-cooled  
Bore: 95 mm  
Stroke: 105 mm  
Piston displacement: 1,488 ltr.  
Compression ratio: 17,5:1  
Output: 20BHP at 2000 RPM

Fuel system: Direct injection.

Fuel pump: Bosch type PFRIK 70/2  
Fuel injector: Bosch type KBL 9783/4  
Fuel nozzle: Bosch type DLLA 150 S 298  
Fuel filter: Hengst H2KI  
Fuel filter cartridge: Hengst E2K

Opening pressure for the fuel injector: 145 kg/cm<sup>2</sup>. - 2060 lbs/sq. in.

The fuel pump starts to deliver: 25° TOC

Lubricating system: The lubricating oil is pressure fed to all moving parts in the engine and the clutch by a gear pump. A full-flow filter is part of the system.  
Normal oil pressure: 21-35 lbs/sq.in. -  
min. 14 - (1 kg/cm<sup>2</sup>), max. 43 lbs./sq.in.  
(3 kg/cm<sup>2</sup>).

Lubricating oil filter cartridge: Fram CH 813 PL.

Oil in the sump up to the highest mark on the dipstick: 5 liter. - 1,1 imp. gal.

Cooling system: Fresh water system with thermostat, expansion tank and keel cooler. Water quantity 1 imp. gall.

Thermostat: Mekano, type T26.  
Pipes for keel cooler: 5/8" in. x 3 m (4 yards).  
Starting: Starting handle with chain drive to camshaft and automatic decompression release.

Engine rotation: Clock-wise facing front end of engine.

Propeller rotation with reduction gear: Anti-clockwise facing front end of engine.

Weight: The engine equipped with starting handle, flywheel, clutch and reversing unit: 750 lbs.

Engine equipped with rearstart, flywheel, clutch, reduction gear and reversing apparatus: 770 lbs.

Stationary engine with starting handle and flywheel: 640 lbs.

Fuel tank, standard size 6,6 imp. gallons.

Electrical equipment: Dyna/starter (in one unit): Bosch type  
LA/E7 90/12/2900+1, 0R2.  
Accumulator: 75 Ah - max. 90 Ah.  
Dynamo belt: Poly V-36, 0" J16

Provision is made for mounting a bilge pump and also for a front power take off.

V belt or a flat belt pulley may be used.

#### INSTALLATION OF MARINE ENGINE:

The maximum operating angle of which the engine can be installed is 8°.

Correct installation is the first requirement for the satisfactory performance of a marine engine, as faulty and inefficient mounting can cause overheating, excessive wear, loss of power, vibration etc.

THE WOODEN FOUNDATION must be of first class material, preferably of oak. The foundation consists of two beams 3 1/2" x 5" placed edge up. These beams should be firmly fastened longitudinally in the boat so as to avoid undue vibration while engine is running. Careful attention to fitting the foundation is of great importance and will pay good dividends. Before the engine is bolted down,

It is essential to ensure that the axis of the engine and propeller shaft are in alignment. To check this, the correct way is to place the coupling on the propeller shaft into the coupling on the engine. Then turn the propeller shaft by hand and if the alignment is correct there will be no visible opening between the coupling flanges. When this is precisely done, the engine may be bolted to the foundation. Finally check the two coupling flanges once more before tightening the bolts connecting the two flanges.

Standard lengths: Propeller shaft 2,5 m (8 ft. 1 1/2 ins.)

Tube between stern bearings 0,65 m (approx. 2 ft.).

#### CHECKING THE FOUNDATION.

The foundation timbers have a tendency to warp then they are water-logged, and the bolts in the couplings must therefore be slackened after a time, so that the alignment of the propeller shaft and the engine can be checked, and if necessary, readjusted.

It is important that there is a reasonable clearance between propeller blades and stern.

#### THE FUEL TANK.

It is important to mount the fuel tank as high up as possible. The outlet of the tank must be at least 8 in. (20 cm) above the engine fuel filter inlet (corresponding to 1 ft. 8 ins. (50 cm) above the engine foundation) in order to attain the necessary pressure for the fuel pump. The fuel pipe from the tank to the fuel filter must be placed in such a way that no air may be trapped in the pipe and thus keep the fuel oil from flowing into the fuel filter. The fuel tank must be securely fastened, if not, it may loosen in heavy sea. Never use galvanized material in the fuel tank.

#### THE EXHAUST PIPE.

The exhaust pipe must have an internal diameter of 1 1/2" and should be laid as straight as possible, with the minimum of bends, and make sure water from outside cannot run into the outlet.

Galvanized pipes and fittings are recommend.

It is not advisable to use copper pipe, it may cause electrolytic action. If the engine is supplied with a combined bilge pump to drive the water into the exhaust pipe, plastic pipe may be used, provided that the pipe is cooled by cooling water.

The inlet on the exhaust pipe must be about 200 mm (8") lower than the exhaust outlet on the cylinder head, otherwise it may cause damage to the valves. A drain cock is placed on the lowest point of the exhaust pipe. It is essential to insulate the connection - with asbestos - running from engine to inlet on the exhaust pipe. If watercooled exhaust is not used, the entire exhaust-silencer included - should be insulated by asbestos.

#### COOLING SYSTEM.

The keel cooler of the standard fresh water cooling system should be mounted underneath the boat as close to the keel as possible to obtain the best protection. Do not paint the copper tubes of the keel cooler. All connections to the keel cooler must be silver soldered.

#### MANUAL REAR START.

Make it a custom to check the oil level on the dip stick, the fuel oil and the cooling water. Push in the cold start button. The starting handle is pushed forward in position to engage the engine for turning. The decompression arm is lifted up to allow the decompression barrel to jump into position. Continue to turn, until the engine has had a few firing strokes and is able to increase its speed.

To obtain a perfect start it is very important to turn the engine as quickly as possible.

When the engine is running, check that the cold start button has been released and the oil pressure increasing.

In very cold weather it may be helpful to use starting fluid. The fluid in the spray container is highly inflammable.

#### ELECTRIC STARTING.

The decompression handle is lifted up as the starting button is engaged. Release the handle when the engine is increasing speed. The starting button is held in position until the engine has started. It is not advisable to keep the button in contact more than 6 - 8 sec. if the engine does not fire. Release the button and wait a few seconds before the next attempt. The cold start button and starting fluid may also be used before the electric starter is engaged.

#### STOPPING THE ENGINE.

Run the engine at medium speed and push the stop button in until the engine has stopped.

#### PREPARATIONS FOR STARTING:

When the installation is completed, and the engine is connected in every way, do observe the following:

Let the fuel oil flow through the pipes connecting to the filter and let it "bleed" to make sure that the air is out of the pipe. Tighten all connections and be sure there is no leaking. The thermometer on top of the thermostat housing should indicate about 65-80°C when the engine has reached working temperature.

The engine has the correct quantity of lubricating oil in the sump when delivered from factory. Nevertheless check the dip stick. The oil level should reach between the two marks, for refilling with oil, unscrew the plug on top of cylinder cover. If the engine is equipped with reduction gear, check the oil level in the gearbox. Unscrew the plug on top of gearbox for refilling. It is essential to keep the reversing and stern tube bearings well greased. A turn of the grease cup before each trip is advisable, and always keep a container of non-acid grease in the boat.

If the engine is equipped with clutch and variable pitch propeller, full pitch is usually too heavy for the engine. Adjust the pitch on the propeller blades and let the engine run at 1000 - 1150 rpm, which is full speed for engines without reduction gear. For engines equipped with reduction gear, 1500-2000 rpm is normal for full speed. The revolutions for full speed depend on several factors.

If vibration occurs at a certain rpm, though the foundation is firm, run the engine at a higher or lower speed in order to reduce this vibration. If the boat is heavy compared to the engine's output, the speed will not increase even though the engine speed is raised by reducing the propeller pitch. If for example the engine without reduction gear is run at 1000 rpm the boat's speed may increase very little by running the engine at 1150 rpm despite the fact that the engine's power is increased.

It is essential to understand that before leaving the factory a limit is set on the fuel pump to give the correct quantity of fuel when the engine is running at full speed.

The governor is adjusted to give the engine an idling speed approx. 450 rpm when the regulating screw is turned right out, and with the screw downward the engine will run at the correct full speed rpm depending on whether the engine has reduction gear or direct drive.

After the first 10 hours running of the engine the oil in the sump must be changed, as the oil in the sump - when engine is delivered from factory - is of a special kind of "running-in oil". It is not advisable to run the engine more than 3/4 of full load in the first 50 operating hours.

#### NORMAL RUNNING.

Marine engine.

After 50 operating hours the engine will usually be sufficiently run in, and may be run with full load for any period of time. It is important that the fuel tank is not emptied completely, as air may enter the fuel system. As it takes some time to remove the air by bleeding the fuel system, it may cause an inconvenient stop.



When in shallow water, and in the vicinity of driftwood, rocks etc. extreme care should be taken with regard to the propeller blades as they can be easily bent, or broken, when in contact with such obstructions. It is advisable to have full control of the clutch lever in the above circumstances, so that if necessary, the propeller can be disengaged immediately.

When the engine has to run for quite some time at slow speed, it is advantageous not to run the engine at minimum revolutions, but to increase the revolutions, and instead let the propeller have less pitch. The fuel consumption will be about the same.

#### RUNNING IN COLD WEATHER.

Marine engine.

Frosty weather is in no way detrimental to the normal running of the engine, providing the following precautions are carried out:

Fill the cooling system with anti-freeze. If the engine is not in use and there is no anti-freeze in the cooling system, the water will freeze and expand and thereby crack the cylinder block and cylinder head. If there is no anti-freeze available, drain all water from engine, but remember the keel cooler which is still filled with water and is liable to freeze and thereby cause difficulties when engine is to be started up again. A fifty-fifty anti-freeze fluid and water should give sufficient protection.

We recommend the following anti-freeze fluids:

Atlas Perma Guard (Esso)  
Glyco Shell (Shell)  
BP Anti-Freeze (BP)  
Mobil Permazone (Mobil Oil)

#### CARE AND MAINTENANCE OF THE ENGINE.

It will pay to check the running of the engine and keep it in good condition. Check the fuel regularly - the lubricating oil - the cooling water and temperature. Lubricating oil must be changed according to instructions and use the recommended oils only. Never use cheaper oils which will cause sticking valves and piston rings - shorten the life of engine and finally it will lead to unnecessary expense. Clean the engine at frequent intervals. Prevent rust on the iron parts. Some time after the engine is installed in the boat - check the foundation, as the bolts or nuts holding the engine may have loosened. Vibration may be the cause. Only a skilled mechanic should repair the engine. Either go to a recognised workshop or send the engine to the factory.

The MARNA agents will quickly supply any spare parts from the factory. Use only original spare parts.



When the engine is in daily use, the control and maintenance should follow the routine listed below:

Check the fuel oil level - open the draincock on tank in case there should be some water.

Check the lubricating oil level.

Check the cooling water level.

Check the lubricating oil pressure.

Make a turn on the reversing and stern bearing grease cups.

Every 100 hours: Fuel consumption 26 imp. gallons (120 l).

Change the lubricating oil in sump.

Check the valve clearance.

Every 200 hours: Fuel consumption 52 imp. gallons (240 l).

Change the cartridge in the lubricating oil filter.

Check the valve clearance.

Check the fuel injectors nozzle pressure and spraying.

Every 400 hours: Fuel consumption 104 imp. gallons (480 l)

Check the cooling water thermostat.

Check the cartridge in the fuel oil filter.

(Renew if necessary).

If the compression of the engine is not satisfactory, find the cause and have it corrected.

If the consumption of the lubricating oil is unusually high check the wear of the piston rings and cylinder liners. When the piston rings have to be replaced with new ones, it is advisable to hone the cylinder liners, as the new rings will not function satisfactorily on a polished liner.

The fuel consumptions given above correspond to operating hours with normal use of boat. With special operating conditions observe the following:

If the engine is run at a low rpm for long periods (low fuel consumption) change the lubricating oil after 100 hours, even if the fuel consumed is less than listed above. If the engine is run with a steady load, there is no need to change the oil more often than every 100 hours.

It is essential to note that heavy loading of the engine requires more frequent attention to the lubricating oil filter and the fuel filter, and a high rpm requires more frequent attention to valves, fuel injectors, nozzles and the chain for rear start etc.

Checking the lubricating oil level.

The checking is done before the engine is started. Unscrew the dip stick, wipe it clean and insert it again without screwing it down. If the oil is below the lower mark, fill with oil to the top mark.

#### CHECKING THE COOLING WATER LEVEL.

The expansion tank is filled up, the lowest water level is about 2 1/2" (6 cm) below the top of tank. If the suggested anti-freeze fluid is used it is only the water that evaporates. To refill use water. If a leakage should occur in the cooling system, it is essential to refill also with anti-freeze fluid.

### CHANGING OIL IN THE SUMP.

The sump is emptied of oil by the hand pump. It is essential to do this immediately after the engine has been running, otherwise the sludge dissolved in the oil will sink to the bottom in the sump. The hand pump is inserted through the hole for the dipstick. Refill with new oil in front of top cover.

### CONTROL AND ADJUSTMENT OF VALVE CLEARANCE.

The valve clearance is measured when the engine is cold. The clearance should be 0,4 mm. A feeler gauge is inserted between the valve and the rocker arm and the engine is cranked a few times. The feeler gauge should barely be loose when the valve is closed. If the clearance has to be adjusted, loosen the nut on the rocker arm adjusting screw and turn the screw until the correct clearance is obtained. Tighten the lock nut and check the clearance again.

### REPLACING THE OIL FILTER CARTRIDGE.

Unscrew the center bolt on top and lift the cover off. Replace the new cartridge as the used one cannot be cleaned.

### CHECKING THE INJECTORS OPENING PRESSURE AND THE ATOMISER.

The injection pressure is adjusted to 2055 lbs/sq.in. ( $145 \text{ kg/cm}^2$ ) and after a long period of time it will decrease as the spring is weakened. The lowest pressure allowed is 1922 lbs/sq.in. ( $135 \text{ kg/cm}^2$ ). It is essential to test and adjust the pressure on a testing apparatus at a recognized diesel engine workshop. If the engine is not running properly the cause may be due to the atomiser and it may be tested on the engine. Unscrew the injector and connect it to the fuel pipe. Crank the engine and see if all three holes give a perfect atomising. If the holes are blocked - try to open them with a nozzle cleaning needle. It is dangerous to point the fuel spray toward a person.

### CHECKING THE COOLING THERMOSTAT.

The cover on the thermostat housing is unscrewed and the thermostat is lifted up. The thermostat is in working order if it is in closed position when it is cold. However, if it is open when it is cold due to leakage in the bellows, it must be replaced.

### CHECKING THE FUEL FILTER CARTRIDGE AND FUEL TANK:

Disconnect fuel pipe connecting filter and fuel pump. If the fuel flows too slowly through the filter, replace the cartridge. The duration of effectiveness depends on the cleanliness of the fuel in the tank. (It is essential to use a strainerfunnel for filling the fuel tank). Never try to wash or clean a well used cartridge, simply throw it away, and replace with a new one.

NOTE: Never remove the cartridge and run the engine without replacing, as the fuel pump will be worn out in a short time with unfiltered fuel.

To replace the cartridge, unscrew the center bolt on top of the cover. The filter housing may then be lowered and the cartridge removed. Pay attention to the rubber seals at bottom and top cover to ensure these are properly set and undamaged in their grooves. Open the drain cock in bottom of tank as there may be some water due to condensation. Otherwise the water will pass into the fuel filter. In frosty weather it may freeze in the fuel pipe. The fuel pumps and atomisers are spoiled if water passes through.

## ADJUSTING THE CHAIN FOR STARTING HANDLE.

The top cover is taken off to check the tightness of the chain. If it is too slack, it is tightened by lifting the sprocket wheel upward after the flange behind is loosened. When top cover is replaced, unscrew the plugs on top of the cover. Turn the adjusting screws to get the correct valve opening, 1 mm decompressed. 1 mm is equivalent to one full turn on the adjusting screw.

## THE CLUTCH.

The connection between engine and propellershaft is attained by pressing the handle into forward position. A tapered cylinder is forced to the rear, which allows two arms in the friction spring to bend outwards. If the clutch becomes slack the adjustable hardened screws situated on these arms must be tightened. This is done by loosening the lock nuts, and the screws are turned in clockwise direction until a suitable adjustment has been attained. Always ensure that both arms are equally readjusted if their position is altered. In the rear of the clutch assembly are a ball bearing and two sealing rings situated for the purpose of preventing the penetration of sea water if the deck becomes awash and the shaft is covered. A 1/4 turn on the grease cup daily is suggested.

## ENGINES WITH REDUCTION GEAR.

Check the oil level in the reduction gear now and then and change the oil every 1000 operating hours. If the engine is not used regularly never use the same oil in the reduction gear for more than half a year. When the engine is new, change the oil in the reduction gear after 50 operating hours. The oil change should be done right after the engine has been running, and the oil is sucked up by the hand pump through the dip-stick hole in the gearbox.

Unscrew the plug on top of gearbox and fill with oil to the top mark on the dip-stick, approx. 0,5 ltr or 7/8 of a pint.

If the engine is running for some time with the rear outlet from the gearbox under water, it is advisable to change the oil now and then, and to ensure that no water has entered. This way it is checked that the sealing rings are not damaged or leaking. If the engine has been under water find out if water has entered through the air pipe into the reduction gear. If this should happen the oil must be changed immediately.

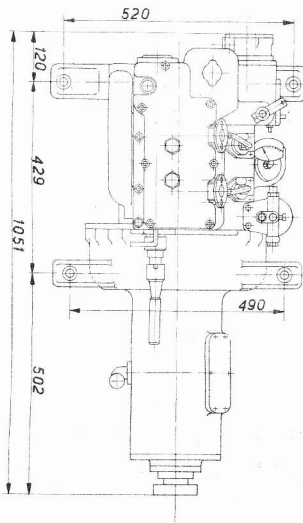
## VARIABLE PITCH PROPELLER ASSEMBLY.

The L2 engine is equipped with a 1" diam. propellershaft and a 1 1/4" diam. draw tube. In view of the fact that the stern post, and also the foundation members for the engine and reversing assembly are generally constructed of wood, which has a natural tendency to warp when in contact with water, it is important to ensure that the propeller shaft is not affected by the warping action of the timbers. A bent shaft will be subjected to rapid and excessive wear, and therefore a regular examination should be made to ensure that the shaft retains its original rigidity, and revolves evenly. (Refer to the section: Installation).

The stern tube is externally and internally sealed with a tallow packing and this should be examined yearly to ensure that tightness is retained, as otherwise water can penetrate inboard through the defective joint. It is important that, (not only during initial installation, but also during any subsequent replacement of the packing) neither of the joints are too compact. The propeller head is filled with grease. A small plug in the propeller head is unscrewed for refilling of grease.

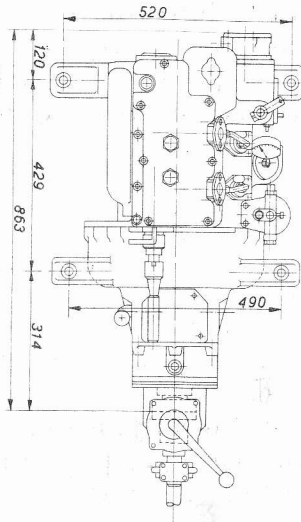
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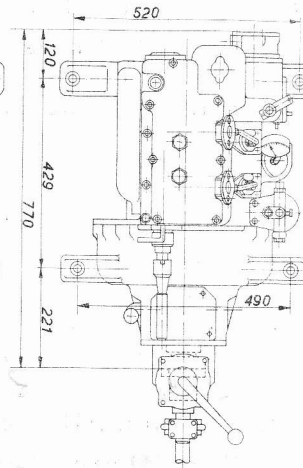
FRIKOBLING  
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CLUTCH  
REDUCTION GEAR  
VARIABLE PITCH PROPELLER



FRIKOBLING  
REVERSERING

CLUTCH  
VARIABLE PITCH PROPELLER



### MÅLSKISSE

MOTOR OG PROPELLERANLEGG

HVIS STANDARD MÅL FOR PROPELLERAKSEL  
IKKE PASSER-OPPGI DA LENGDE A.  
FOR HYLSERØR-OPPGI LENGDE B.

### FOUNDATION SKETCH ENGINE AND PROPELLER

IF OTHER DIMENSIONS OF PROPELLER SHAFT  
ARE REQUIRED-SPECIFY THE LENGTH A.  
FOR STERN TUBE-SPECIFY LENGTH B.

