KINGFISHER DIESELS LIMITED

MARINE ENGINE INSTALLATION INSTRUCTIONS

The reliability of your Kingfisher propulsion unit is dependant on the quality of the installation. Almost all marine engine problems are caused by poor installation.

These instructions must be followed strictly. Please read them through completely before starting any part of the installation. Disregard of any part of these instructions may void the warranty and incur call out charges.

If in doubt, our technical staff are available to help on:-

Phone +44 (0)202 875111
Fax 861144

20 HOUR SERVICE

All Kingfisher engines must be serviced after the first 20 hours and not later than 30 hours' running from new. **If a boat is still in the hands of its builder or his agent at this time, they are responsible for arranging the work in conjunction with the owner** (who is liable for the cost).

DELIVERY

All engines should be carefully inspected for damage on delivery and the carriers and ourselves notified immediately in there is any sign of possible damage. If we do not notify the carriers within 48 hours, no claim can be accepted.

GENERAL LAYOUT

Please give consideration to service engineers who will need access to the engine, in particular oil and fuel filters, oil removal points, rocker cover, injectors and Jabsco pump. Inadequate access is likely to cause delays and expense in future.

Engines are often enclosed whilst running. If this is not so, ensure that the engine is protected from the weather, and that all moving parts such as belts and the flywheel are properly guarded, especially if children are likely to be on board.

ENGINE BEARERS

Engine bearers must have sufficient stiffness and strength to withstand not only the engine running normally, but also the thrust from the propeller and, importantly, shock loads should the propeller become jammed by debris. Substantial

longitudinal and transverse support is therefore essential. This is equally important in flat bottomed hulls, such as narrowboats, where the vertical stiffness of flat steel sheet is not great and resonant bouncing may occur at certain speeds.

There are two recommended systems for mounting Kingfisher engines. The first is to bolt the engine directly to hardwood bearers, which in turn are fixed to the hull. There should be no metal contact between the engine and hull, so that the timber can act as a sound absorber. (Electrical and control cables etc. are permissible.) Any bolts or screws into or through a wooden hull should be in A4 stainless steel to withstand constant immersion.

The second system is to use flexible mounts supplied by Kingfisher which can be bolted directly to bearers which in turn are bonded, welded or bolted to the hull. In this case, the engine is free to move on the flexible mounts and provision must be made for this when arranging propeller shaft, control and electrical connections to the engine. This system is not presently recommended for the KD12, nor for the KD26 in narrowboats where engine speeds tend to be low. In such cases, the engine is best bolted down to as solid a mass as possible via timber bearers.

Where flexible mounts are used, some settlement will occur in addition to the initial deformation, particularly during the first two days. Alignment should therefore be checked at regular intervals.

Flexible mounts are not designed to be effective below 850 rev/min; furthermore, they have a natural vibration frequency of their own, and when engine vibrations coincide with this frequency, typically at very low speeds, excessive engine movement may result. If this should happen, avoid running the engine at the speed which triggers the movement.

VENTILATION

A diesel engine draws substantial amounts of air and there should also be a reasonable flow of air around the engine. We recommend at least a 75 mm. diameter duct from both sides of the vessel to the engine compartment as a minimum.

PROPELLER SHAFT

Accurate alignment of the propeller shaft to the gearbox is critical, unless a shaft system such as Aqauadrive or Centaflex CF-A-G is used. The propeller and gearbox shafts must be aligned to within 0.004" (0.1 mm.) at the periphery of

a 4 inch (100 mm.) circle and to zero offset. Even with a flexible coupling, accuracy to this level will be beneficial.

Ensure that the shaft is of suitable material and diameter for the transmitted power and shaft length. We strongly recommend that a flexible coupling be fitted to the output shaft of the gearbox to act as a shock absorber whether or not the engine is on flexible mounts. This will reduce sound passing down the shaft to the hull which then acts as an amplifier, and will also dampen torsional resonance which can damage a gearbox.

If the engine is flexibly mounted, the propeller shaft must be able to accommodate the engine movement. This can be achieved by using a Cutless bearing in an "A" or "P" bracket or in the aft end of the stern tube. A floating type stern gland (i.e. flexibly connected to the stern tube) is then essential. Alternatively, a flexible coupling with adequate movement, such as the Centaflex type, can be used at the gearbox output shaft.

If an offset arrangement is required, a specialist transmission unit such as Aquadrive or Centaflex and/or vee belts should be used. Offset engine installations using intermediate shafts and universal joints without flexible couplings are not recommended as they can be noisy at certain speeds and may damage a gearbox. We cannot accept responsibility on such occasions for any adverse consequences.

Ensure that there is adequate clearance between the propeller shaft coupling and the stern tube so that the shaft can be disconnected and slid out for maintenance if required.

Propeller

Correct propeller selection is critical to successful performance. We recommend the use of a specialist propeller supplier who will take into account all of the hull details, required speed, available power etc. in determining the optimum propeller. A questionnaire for this purpose from Crowther Marine is attached to these instructions and contact should be made direct if required.

Do not prop. a boat so that the engine runs too slowly at cruising speeds: minimum recommended speeds are 700 rev/min for larger engines, and 850 rev/min for the KD6 and KD8.

Running an engine consistently at very low speeds may result in smoky exhaust and sooting up of the injectors caused by low combustion chamber temperatures and incomplete combustion.

FUEL SYSTEM

Fuel tanks must be made of steel, approved rubber or plastic. Do not use galvanized tanks with diesel fuel.

The outlet should draw from a point at least 25 mm. above the bottom of the tank so as to avoid debris and condensation water. A means of removing these contaminants should be provided, either by a drain plug (if permitted) or by pump access through the top of the tank.

Deck fillers must be of an approved type that does not permit water to enter the fuel, and an air vent of adequate size, screened to prevent water entering, must also be provided.

If the tank is below the level of the injector pump, a fuel lift pump must be employed. These are standard on the KD26, KD36, KD16 and KD14-11 Special engines.

The fuel pump on the KD14-11 Special and KD16 is electric and must be kept upright for optimum efficiency.

The fuel line to the engine must be at least 6 mm. or 0.25" bore and comply with relevant regulations as to material, routing and fittings. All engines are supplied with one secondary filter unit, but the use of additional sedimenter and/or agglomerator filter units in the fuel line is strongly recommended. Fuel injection equipment is highly sensitive to dirt. The most damaging particle size is in the 10 to 30 micron range, and any one filter does not guarantee to remove more than a certain percentage of such particles: the more filters, the better.

Diagrams and notes from Lucas CAV on fuel conditioning are attached as an appendix.

The leak-off lines from the injectors must be led back to the fuel tank. The KD26 and KD36 engines have a one metre leak-off hose attached fitted with a 3/16" hosetail.

Separate fuel lines to other equipment or engines should be taken direct from the tank and not shared.

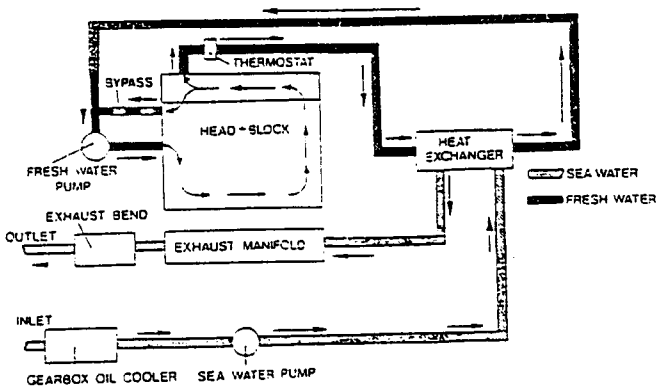
COOLING SYSTEMS

Cooling systems can be divided into direct and indirect, and with wet or dry exhausts (see following section).

Direct cooling systems use raw water from outside the vessel for circulation round the engine block before discharge through the hull, or injection into the exhaust system (wet exhaust).

Indirect systems use recirculated fresh water to cool the engine. This water in turn is cooled either via a heat exchanger through which external water is pumped separately, or via a skin cooling tank which disperses heat through the hull into the surrounding water. The latter is standard on narrow boats and other steel hulls where a tank can be formed as part of the hull inside and below the waterline. Ensure that the pipework layout will not permit air locks to form anywhere in the system.

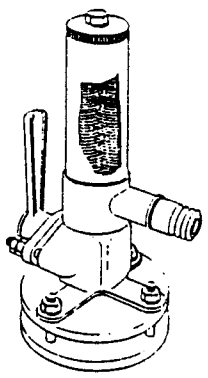
Indirect systems require a header tank at the highest point in the system to allow for water expansion and for air to be expelled. Generally, they are preferable to direct systems. A diagram of an indirect system is shown below.



Heat Exchanger Cooling Layout - KD26/36

All offshore and dual system engines employ a Jabsco pump in the cooling system which must not be run dry or severe damage will result.

All water intake seacocks should incorporate a strainer which can be accessed from inside the vessel for cleaning, and be capable of closure. The open area of the screen should be at least four times the area of the hose bore. Intake hose must be of the non collapsible variety (NOT car heater hose) and with a bore at least equal to that of the Jabsco pump inlet.



Seacock with Strainer

Use stainless steel Jubilee clips for securing hoses.

Cooling water outlets MUST be above the waterline if they do not inject into the exhaust. Make sure they will not be obstructed when alongside jetties or banks.

KD26 and KD36

These engines come in Inland or Offshore versions. The Inland versions are suitable for skin cooling or use with a remote heat exchanger, but are **NOT** suitable for direct (raw water) cooling. The systems can be pressurised if required but it is not essential to do so.

Offshore versions come with a combined heat exchanger and pressurised header tank built on to the engine. Fresh water must be used in the engine circulating water, combined with 50% antifreeze or other corrosion inhibitor such as Fernox, depending on climatic requirements. Connect one hose tail on the gearbox oil cooler via non collapsible suction hose to a seacock. The other oil cooler hose tail is connected to the lower, intake spigot on the Jabsco pump on the front of the engine, still using suction hose.

The water outlet from the exhaust manifold is fed into the exhaust system (wet exhaust) or through a hull fitting above the waterline (dry exhaust).

Calorifiers - KD26 & KD36

Calorifiers can be connected to both Offshore and Inland engines. On an Offshore engine, the bypass hose, which is 1/2 inch (13 mm.) bore and connects the thermostat housing to the water pump, is removed. The feed to the calorifier should then be connected to the thermostat housing, and the return connected to the water pump.

Calorifier connections for Inshore engines must be specified as a factory option. The flow to the calorifier is then connected to the thermostat housing and the return from it to the exhaust manifold. A short hose bridges the two connection points for test purposes and should be removed.

KD4, KD6, KD8, KD12, KD14, KD16.

These engines are suitable for either direct, or indirect cooling using a skin tank. Whichever is used, the cooled water must be routed through the gearbox oil cooler (hydraulic gearboxes only) and via the Jabsco pump to the engine block. With direct systems, the water from the block passes to the exhaust system (wet exhaust), or overboard separately above the waterline leaving the exhaust dry (and the pipe hot).

With indirect systems, the warmed water from the engine must be routed back to the skin tank for cooling and recirculation. Indirect systems for these engines must NOT be pressurised or the Jabsco pump will be damaged.

Calorifiers may be connected between the thermostat outlet and the return to the skin tank. A plumbing diagram is available for calorifier installations.

Bypass link adjustment KD4, KD6, KD8, KD12, KD14, KD16.

In all installations for these models, there is an engine bypass link in the cooling system, allowing some water from the pump to bypass the engine. However, the balance of flow between the engine and the bypass is critical and highly sensitive to the plumbing of any particular installation. The correct balance can only be achieved once the engine is installed, and an isolator valve is fitted to the bypass link for this purpose. The valve can be turned with a 1p piece or screwdriver, and a 90 deg. turn gives 100% valve movement.

If too much water bypasses the engine, it will overheat; if too little bypasses the engine, excessive pressure will develop between the pump and the engine. This will not only damage the pump seal, but will result in a surge of cold water into the engine when the thermostat opens, particularly at working engine speeds. This will shut the thermostat until the engine water heats up again and the cycle repeats itself. Such treatment is highly damaging to the engine castings and if a calorifier is fitted, it will not heat up properly.

Start the engine with the valve fully open, i.e. with the slot in line with the water flow, and watch the temperature gauge as the engine warms up at a brisk idling speed. If the temperature rises above 70 deg., partially close the bypass by rotating the valve about 30 deg. and noting the temperature behaviour. If it continues to climb, close the valve further until the temperature settles at around 60 deg. Check again when the engine is under load.

If the temperature rises to 60 - 70 deg. and then suddenly drops to 50 deg. or less before rising again, particularly with the engine under load, the valve is restricting the bypass too much and should be opened and adjusted until the correct setting is found.

With a little care, a position for the valve should be found where it can be left without further adjustment.

If the temperature indicator fails to move for a long time and then suddenly indicates 80 deg. or more, there is an airlock in the system and the engine water has boiled. Stop the

engine immediately and allow it to cool for at least 30 minutes before allowing any cold water into the engine block.

EXHAUST SYSTEMS

Wet

Wet exhaust systems inject cooling water drawn from outside the boat into the exhaust system just aft of the exhaust manifold. This cools and silences the gases so that marine rubber exhaust hose can be used for the remainder of the exhaust system.

With any wet system, there is a risk of water entering the engine up the exhaust pipe. **THIS MUST BE PREVENTED AND FAILURE TO DO SO WILL VOID THE WARRANTY.**

A suitable water trap MUST be fitted in the exhaust system. Ideally, the trap should be one metre from the water injection point, and at least 300 mm. (12") below it. Ensure that a lift type trap of adequate design and volume is fitted: if in doubt, consult manufacturers such as Halyard (0722 210922) or a Vetus stockist. If a standard trap is impracticable, a special trap will need to be made to suit the installation.

The outlet pipe from the trap must be led up in a gooseneck to at least 500 mm. (18") above the waterline before descending to a hull fitting. Do not use hose of smaller bore than the engine manifold outlet. The use of an anti surge combined gooseneck and hull fitting is recommended. Use a sealant such as Sicoflex for hull fittings.

In small boats or offshore sailing craft, the hull fitting should be capable of closure to prevent waves or wash from surging up the pipe.

If the water injection point is less that 300 mm. (12") above the waterline, a syphon breaker device or valve MUST be fitted between the engine block and the water injection point, according to the maker's instructions.

The need for these precautions is created by water lying in the exhaust pipe when the engine is not running. In the absence of a trap, the water will surge up and down the pipe as the boat tilts on waves or wash, and spill over into the engine. Exhaust water is highly corrosive.

Water can also seep in through the water inlet via the Jabsco pump and, over a period of time, fill up the exhaust system and flood the engine. This can be prevented by looping the pipe between the pump and the engine above the waterline and fitting the anti syphon device already referred to. The

seacock should be closed if the engine is not to be used for 24 hours or more.

If the seacock incorporates a scoop, it should point AFT in sailing vessels.

In sailing boats, the consequences of heel and even broaching (knock down) should be borne in mind. Water traps are not non return valves, and are designed to function more or less upright. The water injection hose should always be looped well above the maximum heel waterline and a syphon breaker incorporated. Closure of the exhaust outlet and water inlet is recommended in heavy weather or when racing.

Dry

A dry exhaust can be specified as an alternative and is standard practice in narrow boats. In this case the cooling water is not injected into the exhaust and lagged steel exhaust piping must be used. Ordinary water pipe is acceptable, but its weight must not be carried by the engine manifold: incorporate a length of flexible steel pipe next to the manifold, particularly if the engine is on flexible mounts. If the exhaust outlet is vertical, be sure to fit a self closing device to prevent rain running down and into the engine. CHECK THAT IT WORKS PROPERLY.

Various silencers are available on the market. Do not restrict gas flow by using small bore pipework, and ensure that all joints inside the boat are gas tight.

ELECTRICAL EQUIPMENT AND PANEL

Fit the instrument panel in a safe position within easy reach and sight of the steering position. Ensure no water can fall directly on to the panel: protection of the panel will prolong its service life and help to prevent water ingress. Fitting a perspex hinged cover over the panel is recommended.

To connect the wiring loom to the engine, follow the wiring diagram supplied. Ensure each connection is tight and cover with petroleum jelly or a suitable spray protective. Repeat applications during winter lay up.

Use a battery of adequate size, and of the sealed, maintenance free variety to avoid any explosive gas build up. Keep the terminals clean and tight, protected with petroleum jelly.

Connect the starter with adequate cable to carry 140 amps and keep the length as short as possible. If a length longer than one metre is essential, use heavier grades of cable to avoid voltage drop under load.

Battery connections are negative to the block. One of the flywheel housing bolts will have been replaced by a stud and Nyloc nut to facilitate this.

Do not carry out any arc welding on the boat unless the engine alternator is disconnected first: induced currents can destroy the diodes.

Keep all 240v. supplies completely separate from the engine electrics.

REMOTE CONTROLS

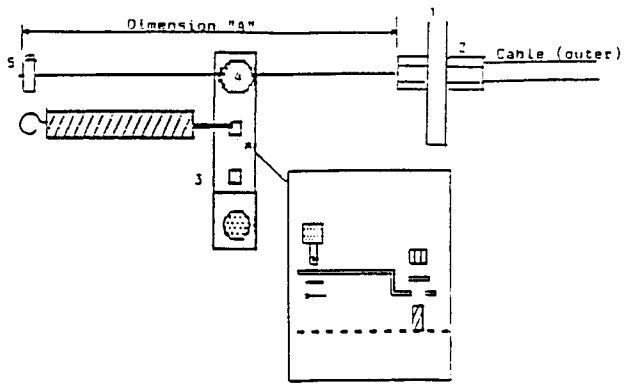
Fit remote controls according to the manufacturer's instructions and relevant regulations, keeping all lengths to a minimum and avoid tight curves.

Connect the gear linkage with the lever on the gearbox and the control lever in neutral. Check for smooth operation and that the correct throw is achieved in both ahead and astern positions. Then connect the throttle and stop controls and repeat the checks.

KD6, KD8 and KD14

The throttle and stop controls are interconnected and the following instructions must be followed exactly to achieve correct operation.

The following diagram shows the linkage on top of the engine timing cover.



1. Outer cable bracket
2. Stop control outer cable
3. Governor lever
4. Nipple
5. Cable clamp

As the engine speed varies with throttle lever movements, the governor lever 3 swings to the left or right on its spindle. The outer part of the stop cable 2 **must be clamped securely to the bracket 1** on the engine, and the inner part of the cable **must pass freely through the nipple 4** attached to the end of the governor lever. With the stop control pushed fully in, feed the inner cable through nipple 4 and measure off dimension A precisely. Attach a clamp 5 to the end of the inner stop cable and cut off any surplus cable. Dimension A is as follows:-

KD6	140 mm.
KD8	210 mm.
KD14	160 mm.

When the stop control is operated, the inner cable slides to the right in the diagram so that the clamp 5 engages against the nipple 4 and moves the governor lever also to the right, stopping the engine.

KD12

A similar arrangement applies to the KD12: the stop cable must be free to slide through the brass nipple attached to the governor control lever on the engine, so allowing the throttle to be operated without interference from the stop control system.

All other controls should be arranged as required.

STARTING THE ENGINE

When the installation is complete, prepare to start the engine as follows.

1. Make a final check of all the mounting and coupling bolts, and that all controls operate properly.

2. Check engine and gearbox oil levels.

3. Fill the fresh water cooling system (if applicable) with coolant, ensuring as far as possible that there are no air locks. Ensure that the engine block, in particular, is full of water.

4. Open sea cocks (if applicable).

5. Pour sufficient fuel into the fuel tank. If the pressure head to engines without a lift pump is marginal, fill the tank to provide maximum head. Use only clean, fresh

fuel. If in doubt as to its quality, use a fine mesh water trapping filter funnel.

6. On the KD26 and KD36 engines, there is a hand priming pump fitted to the side of the injector pump. Unscrew the large knurled knob on top of the pump to release the plunger. Slacken the bleed screw on top of the injector pump. This is a slotted 10 mm. A/F bolt adjacent to the hand priming pump. Operate the pump until bubble free fuel flows from the bleed screw. Push the plunger in whilst screwing up the bleed screw and then screw it home.

7. On other models, switch on the electric fuel pump if applicable. On the KD14 and KD16 models, slacken the plug on the injector pump opposite the fuel pipe banjo bolt; on the KD4,6 and 8 models, slacken the banjo bolt itself. In each case, wait until bubble free fuel flows and retighten the bolt.

8. Slacken the injector pipe nuts at the injector(s), open throttle fully (on the KD12, pull up excess fuel ring - see item 10 below), operate decompressor and crank the engine until fuel flows from the joint(s). Tighten the nut(s) and crank engine once more until a distinct "dink" or grunting sound is heard from the injector(s). The engine is now primed and ready to start. Should fuel fail to reach the injectors, slacken the injector pipes from the injectors and repeat the bleeding process.

   DO NOT ATTEMPT TO START AN ENGINE UNTIL THE FUEL SYSTEM IS PROPERLY PRIMED AND FREE OF AIR. Cranking an engine without fuel or with aerated fuel can damage the injector pump and injectors.

9. Before operating starter, ensure that any loose clothing, hair, ties etc. are well clear of moving parts such as the alternator belt or flywheel whilst these are unguarded.

10. On the **KD12**, pull up the excess fuel ring, located between the injector pump and the decompressor lever. It will return automatically when the engine has started, and is required only for cold starts.

11. Release decompressor and open throttle fully if engine is cold. Operate the starter and **immediately** the engine starts, reduce the throttle to give a brisk idling speed. Operate starter for a maximum of 10 seconds at a time. For hand start engines, operate decompressor, crank as vigorously as possible and release decompressor whilst continuing to crank until the engine is firing properly.

If the engine does not start at the third attempt, repeat the bleeding process. In cold weather, 5 - 10 ml. of engine oil may be added to each cylinder via the inlet manifold to increase the compression. Do not add excess oil or the engine will "hydraulic" when the decompressor is released with possible expensive damage.

12. Listen for any unusual noises, and check the instrument readings. Check the installation visually for any oil, water or fuel leaks. Check a wet exhaust system for water flow. If water has not appeared from the exhaust within 20 seconds, stop the engine and check the cause.

    Check indirect systems for coolant level as any air locks clear. Speed up the engine to facilitate this.

13. On KD4,6,8,12,14 and 16 engines, carefully observe the temperature gauge readings and follow the bypass adjustment procedure under "COOLING SYSTEMS".

14. Reduce engine speed to idling, and operate gear control ahead and astern. Speed up to half throttle in each case before casting off and proceeding on a test run.

15. During the first 20 hours, do not exceed two thirds throttle whilst the moving parts bed in.