Installation Manual

BMW D7-D12
D35-D50

V12 ENGINEERING

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BMW Marine Engines

Introduction

This manual deals with the installation of BMW D7, D12, D35 and D50 Marine Diesel engines.

We can, for natural reasons, not give detailed instructions for every single combination of boat and engine. But, although the instructions because of this only can be generalized, certain requirements must all the same be met with, in order for you to experience a maximum of pleasure and a minimum of problems with your BMW Marine Engine.

Careful planning will not only facilitate the installation itself, but also future maintenance work.

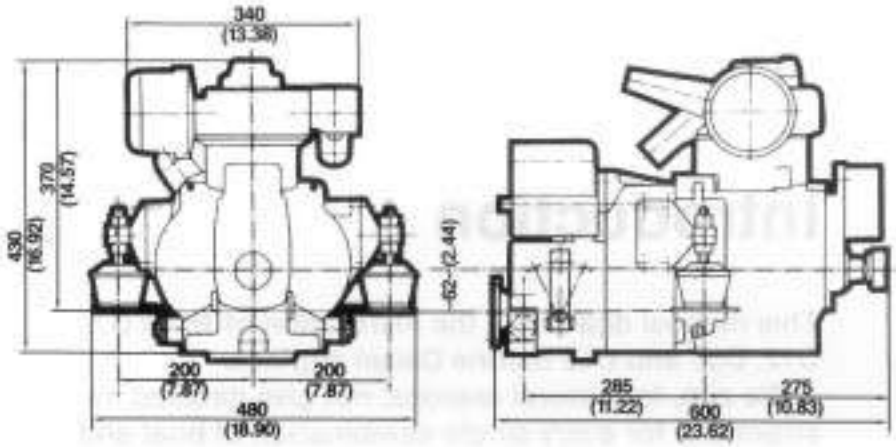
A few extra hours spent planning the installation and the engine room, will be well worth the time. Also, remember that your engine will require service, and that oil dip stick, water pump and generator must be easily accessible for inspection.

In all descriptions to follow, we assume that genuine BMW Marine accessories and parts are used. We also want to point out, that these instructions have only been written to meet with BMW Marine's own requirements regarding engine installations. If requirements by classifying association, sea rescue service or similar are more exacting, then these, of course, will have to be complied with. Being that such rules and regulations differ from one country to another, we are, unfortunately, unable to take them into consideration in this manual.

Should you be in doubt on any point in this respect, your BMW Marine Dealer will be at your service with necessary advise.

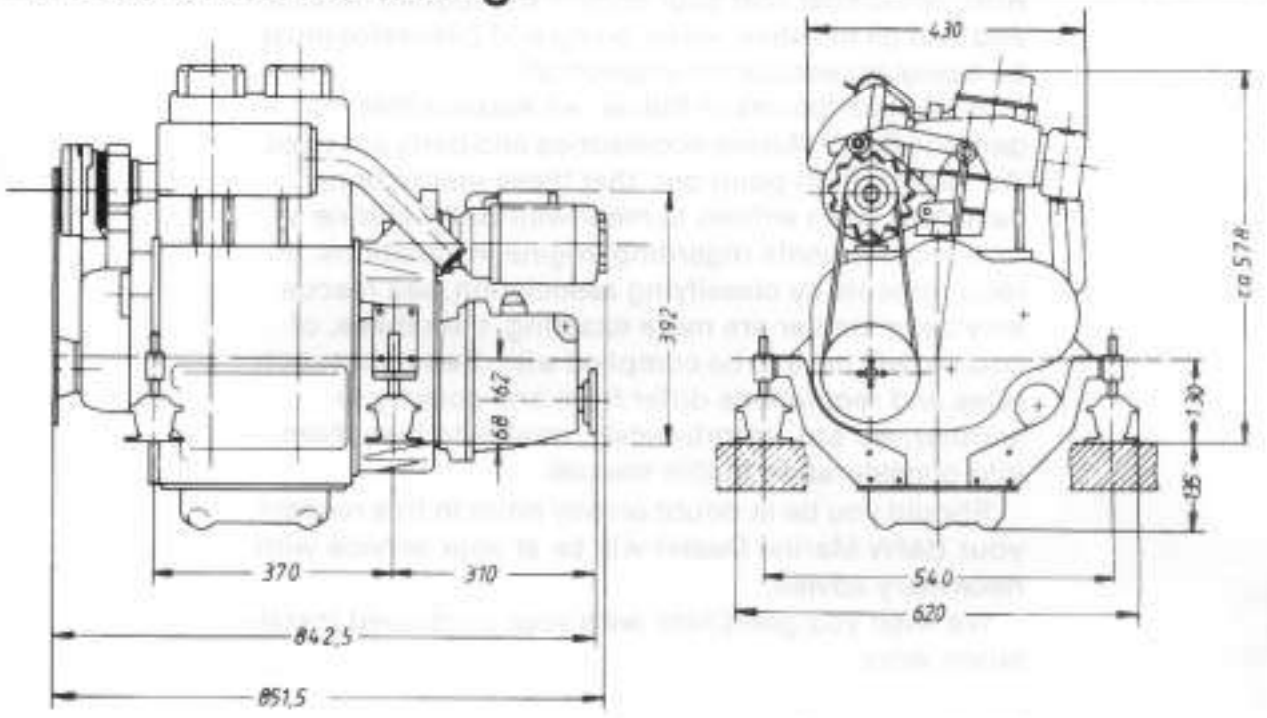
We wish you good luck with your continued installation work.

BMW Marine GmbH
Service Division



D7

Installation drawing



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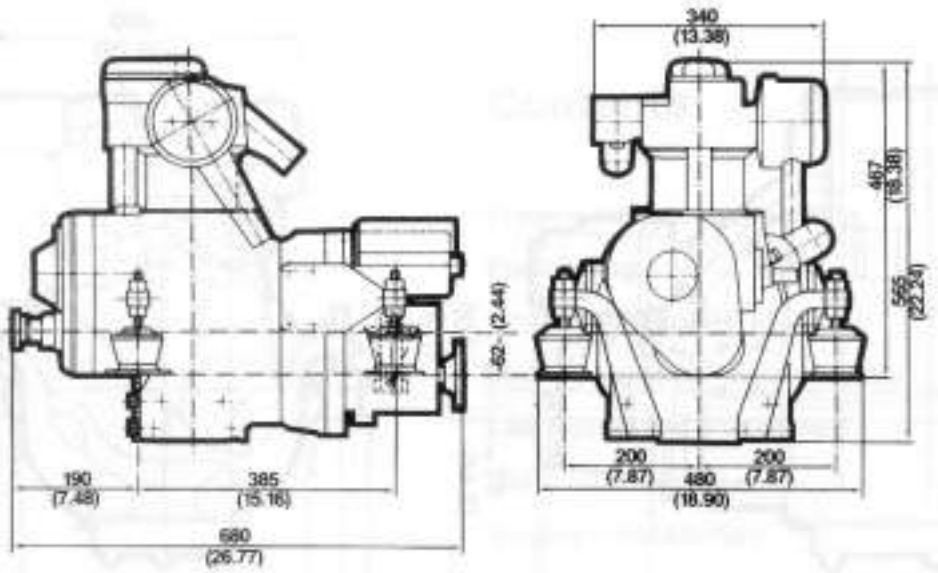

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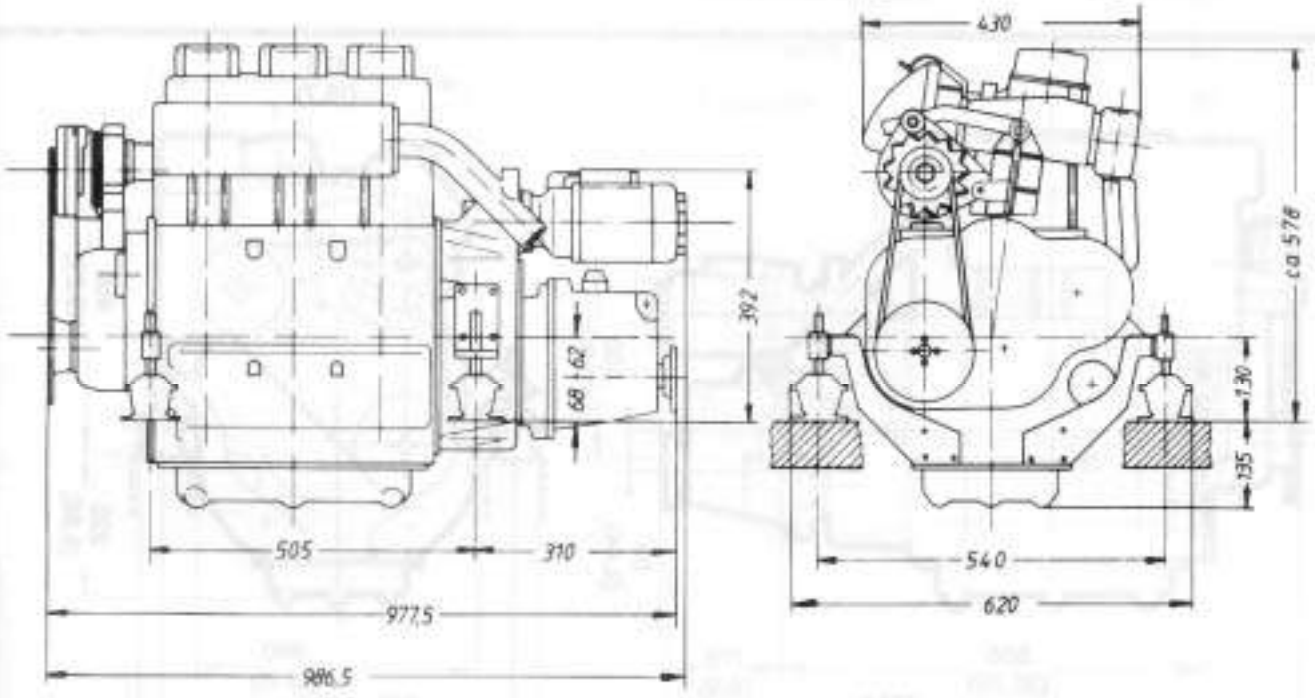

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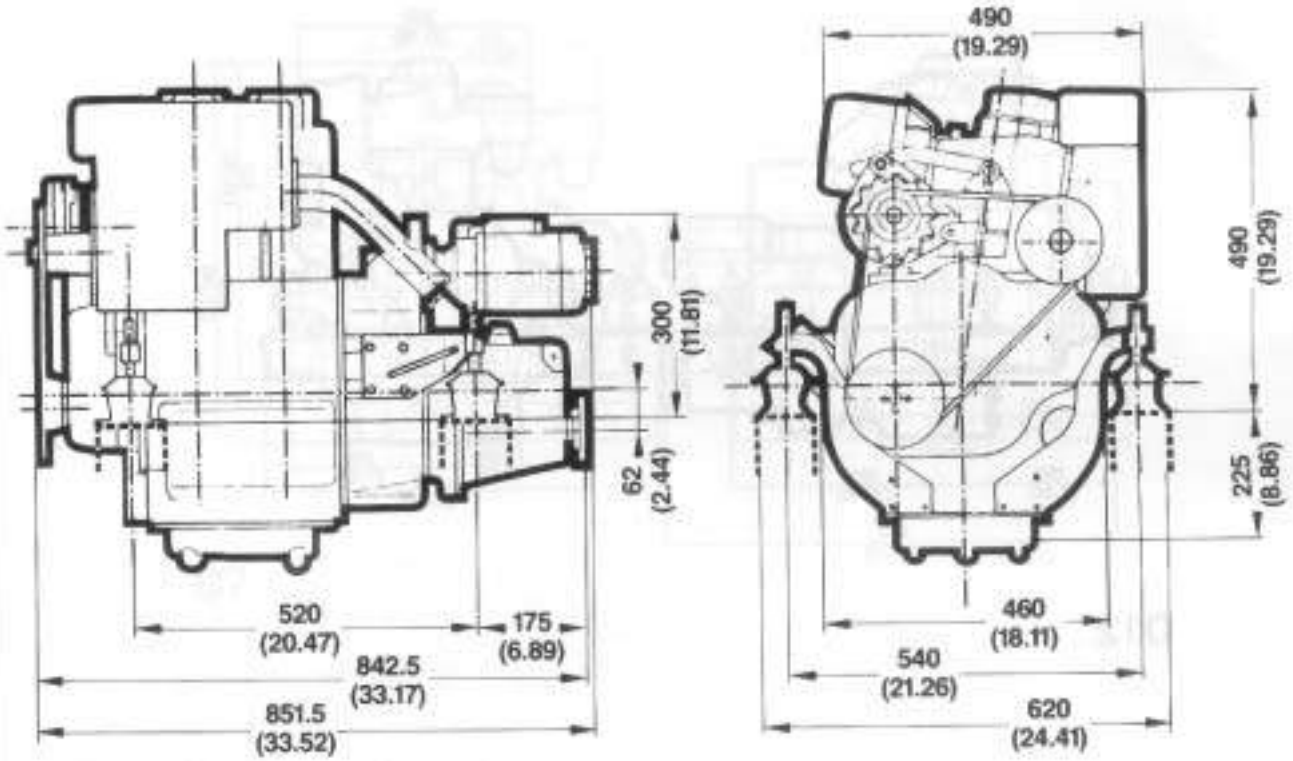

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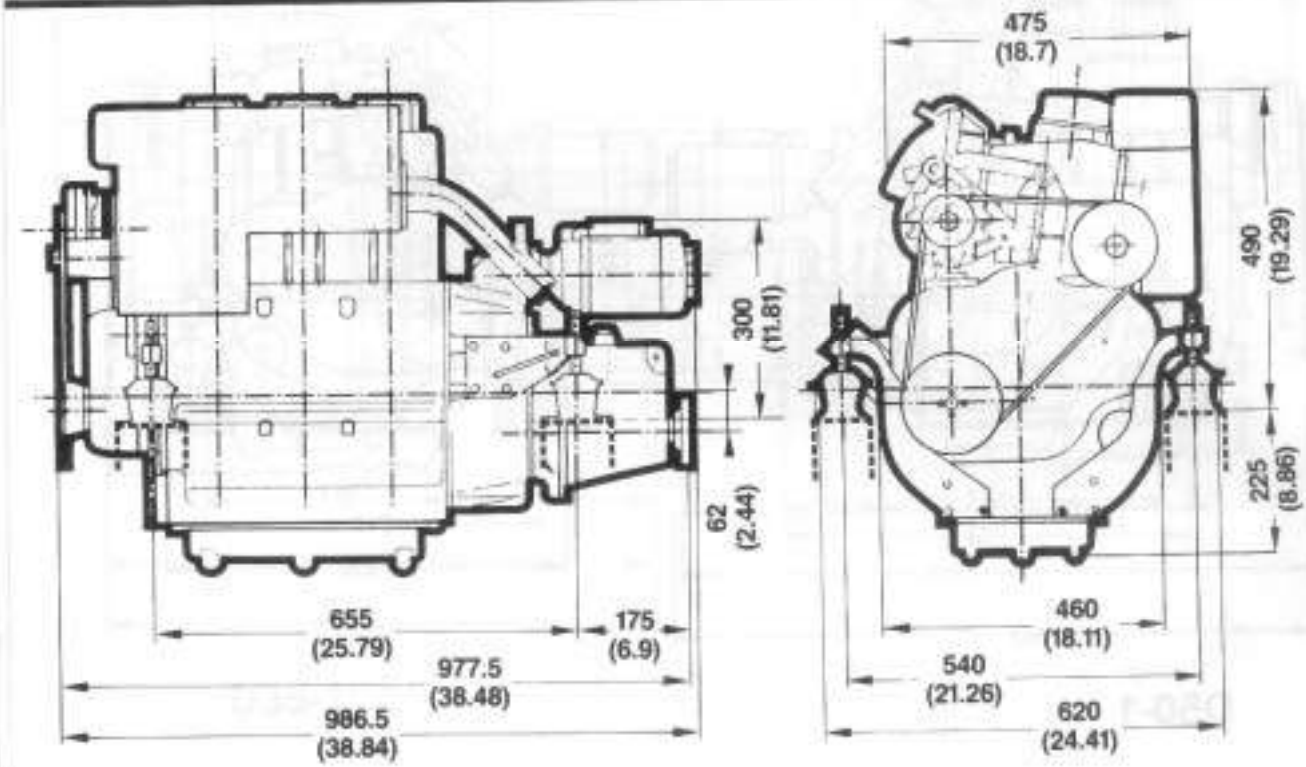
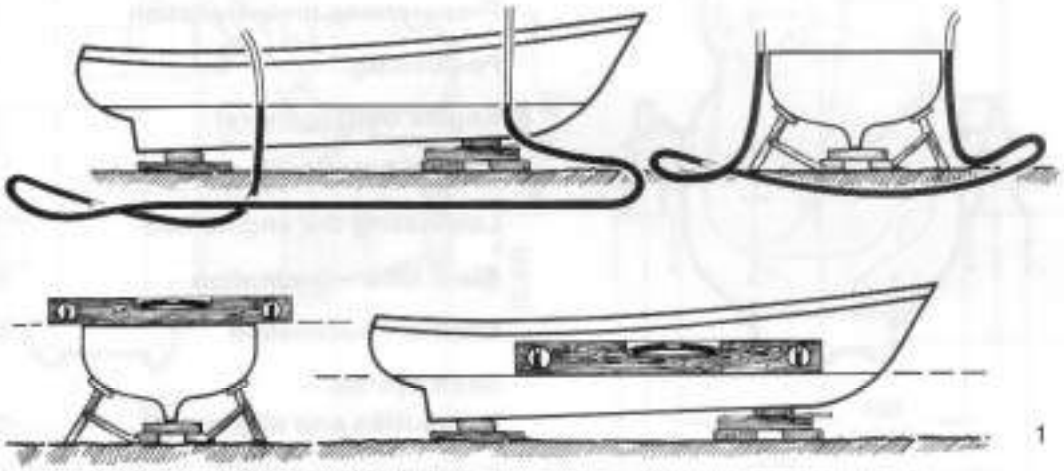


D50-2

Contents

Preparations for installation



1

One condition in order to succeed with the installation is, that the boat is rigidly and accurately blocked up in the horizontal plane, fore and aft and athwart. In most cases the water line is marked off on the hull, which facilitates the positioning of the boat. If such markings are missing, the boat builder or designer will have to be consulted to obtain information on the position of the water line, fore and aft. The easiest way to check the position of the boat is with the aid of a transparent, flexible hose filled with water, or with the aid of a spirit level, fig. 1.

Next you should check the shipment of engine and accessories. Make sure that all parts ordered are there, and take the opportunity to familiarize yourself with the details. Compare them with the illustrations in this manual in order to learn where and how they are to be installed.

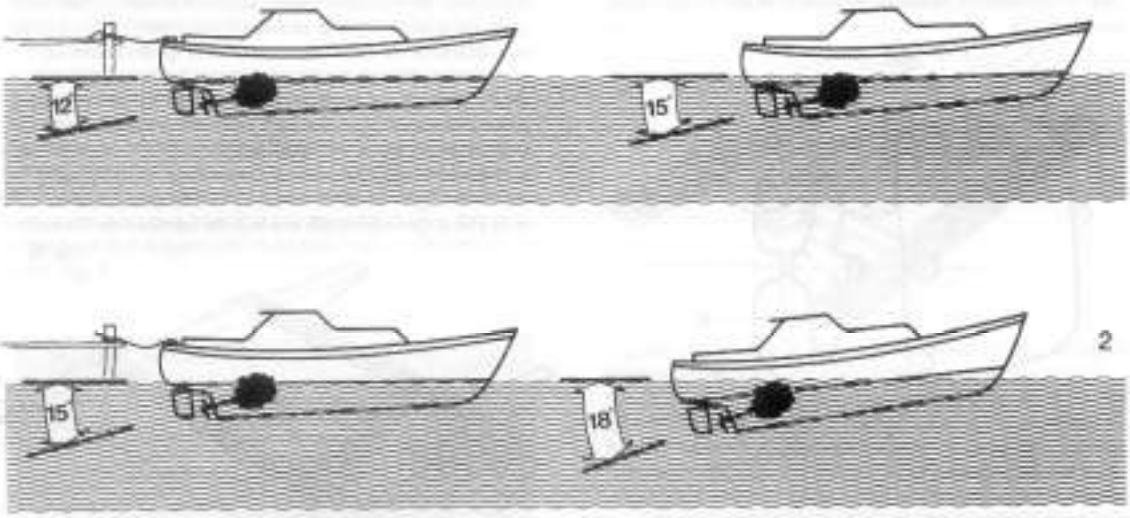
Engine compartment – General

When doing the layout of the engine compartment the following items should be considered:

- To facilitate the installation and removal of the engine components such as rubber mounts, propeller shaft assy, cooling water hoses, fuel lines, exhaust system and electrical system must be easily accessible. The engine compartment aperture must be big enough, to allow installation and removal of engine.
- Engine room covers must be removable or have a positive lock in open position.
- Items such as fuel filter, air filter, oil filter and water-strainer must be easily accessible to facilitate future services.
- Dipstick of engine and reverse gear must also be easily accessible.
- There must also be sufficient space for replacement of sacrificial anodes of the cooling system and for removal of water pump impeller.
- The water level in the fresh water cooling system must be easily checked.
- There must be sufficient space above the engine for valve adjustment if the engine is only accessible from the front.

Positioning

Positioning of engine bed, stern tube and possible support bearing



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The following description assumes that you have a hull where the engine bed and stern tube are missing, i.e. you are confronted with a complete installation. If engine bed and/or sleeve tube already are built in, the procedure will of course be different. In such a case you need only look up the applicable sections.

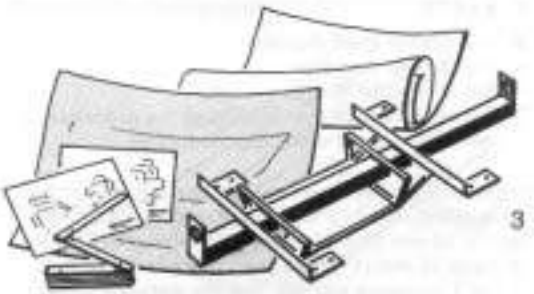
Location and height of the engine bed and the position, type and length of the stern tube will be influenced by a number of factors, more or less well known.

1. Maximum inclination of the engine. Maximum permitted angle of installation for engines described here is 15° longitudinal backward inclination. Bear in mind that the boat has a trimming angle of about 3° during operation, for which reason the practical angle of installation will be limited to 12°, fig. 2.
b. The space requirement of the propeller (this will be dealt with later).
c. Installations in finkeeled sailing boats, where bearing support need to be used, will mean further complications since stern tube and stern bearing (support bearing), in this case, will be two separate components.

The installation work will, however, be aided by two facilities that have been worked out for all models of BMW Marine diesel engines.

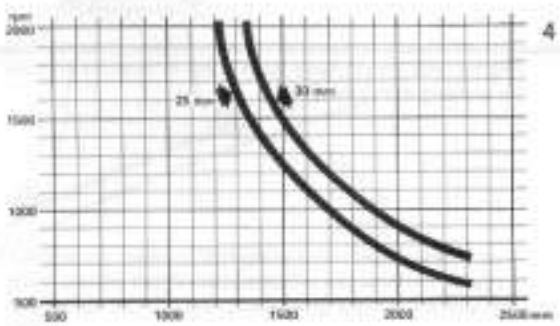
a. transparent engine drawings on the scale of 1:10 which you may obtain from the nearest BMW Marine retailer.

b. Engine jig which can be made according to the engine's measurements. See fig. 3.



3

Place the transparent engine drawing on top of the hull drawing and mark out the center line of the propeller shaft and the outline of the propeller. You will then be able to measure up the spot where the hole for the stern tube is to be made, possible holes for bearing support, the position of the engine bed as well as engine inclination. Check in the diagram, fig. 4, that the shaft length and distance between shaft bearings will be within limits. If in doubt consult BMW technician.



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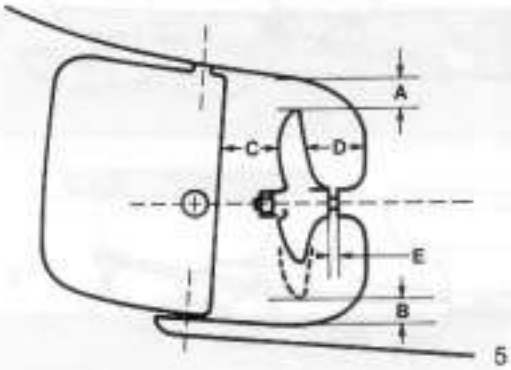
Propeller space requirements will be evident from fig. 5. Note that the clearance between propeller blades and hull should not be less than 50 mm, 2", as risk of cavitation noise otherwise will exist, see table under fig. 5.



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A d x 0,1 or more*
B d x 0,06 or more
C d x 0,1 or more**
D d x 0,13 or more
E a x 0,75

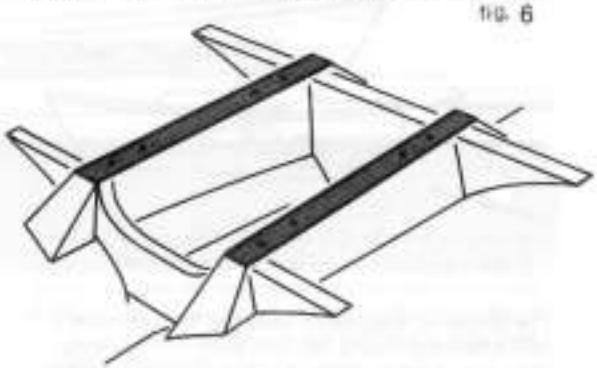
a = propeller shaft diameter
d = propeller diameter
* But at least 50 mm, 2"
** But not less than that permitting the propeller be removed without removing the rudder.

The distance between cutless bearing and propeller hub should be 75% of the propeller shaft diameter, i.e. 20 mm (3/4") for a shaft diameter of 25 mm (1") and 25 mm (1") for a shaft diameter of 30 mm (1 1/4"), compare with fig. 5. If the distance is less there is a risk of the bearing not being surrounded by sufficient amounts of water to provide adequate cooling and lubrication. Should the distance be greater, chances of annoying propeller vibrations will increase. This will require special attention if you intend to use a folding propeller, since the long hub of this type of propeller will increase the risk of vibrations substantially.

Engine bed – general

The stability of the engine bed is of great importance, since it not only must carry the weight of the engine, but also take up the compressive forces from the propeller as well as the acceleration forces, when the boat rolls and pitches at sea. A solid engine bed is a prerequisite for maximum deadening of noises and vibrations. The engine bed should therefore be provided with cross members in order to obtain greatest possible stability. If the bed is made a little longer than the engine, it will also function as a drip pan that will prevent spilled oil and diesel fuel from flowing into the bilge. This, of course, on the assumption that the engine bearers are tightly bonded to the hull.

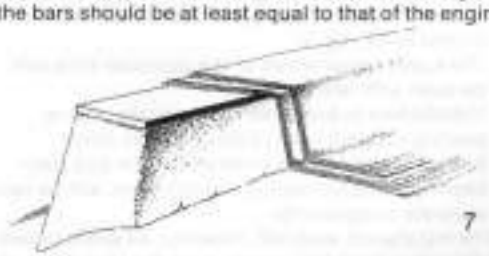
fig. 6



Avoid forming the bed in the shape of a cavity since this can give rise to annoying vibrations and noise. Depending on method of fabrication the bed can be filled with polyurethane foam or a mixture of polyester and sand. Wood should be avoided since there is a risk that it will rot or expand.

Iron flat bars should be laminated into the bed, partly as stiffeners and partly to function as "nuts" when the engine is to be bolted down to the bed. fig. 7.

The flat bars should be made of galvanized iron or of stainless steel, 50×10 mm, 2"×3/8". The length of the bars should be at least equal to that of the engine.



7

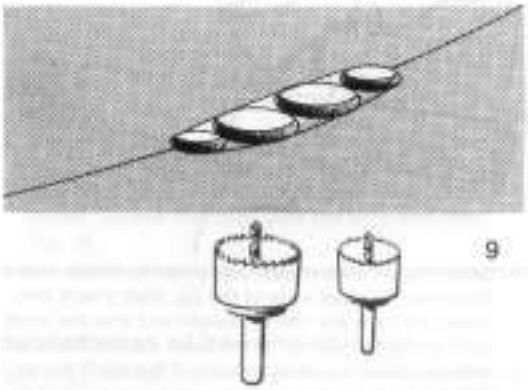
The flat bars should have large holes in them, to improve the bedding in into the GRP.

Note! In this connection we definitely want to warn against the, unfortunately, often employed method of using hexagon headed wood screws for fastening the engine to the bed. Machine screws of stainless steel are the only kind that can be recommended, nothing else, fig. 8.

The thickness of the laminate in the engine bed should be at least 8 mm, 5/16" for D7/D12 and at least 10 mm, 3/8" for D35/50.

Making holes for the stern tube

From the hull drawing measure up the position where the stern tube is to be mounted and cut the hole out with a crown saw. This will be no problem as far as long-keeled sailing boats and double-enders are concerned, but will be a little more problematic in finkeeled sailing boats where bearing supports must be used. In this case the stern tube will pass through the hull at a narrow angle and the hole will, because of this, have to be shaped to the form of an ellipse. The easiest way of making this kind of a hole is by using crown saws of different diameters and thereafter trim the edges with a coarse file or a keyhole saw, fig. 9.



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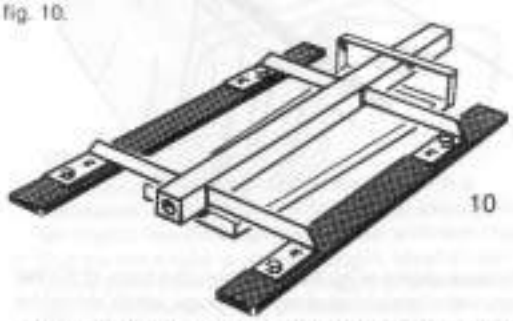
Laminating the engine bed

Mount the flat bars mentioned in the section "engine bed general" to the underside of the drilling jig or engine, fig. 10.



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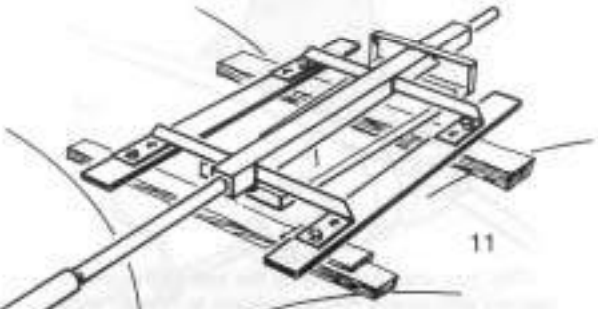
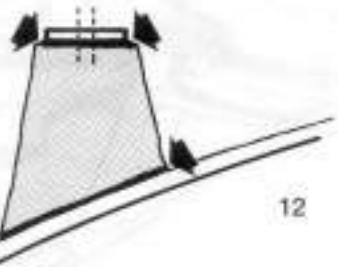
Block the engine or jig up to the spot where the engine is to be seated, install the stern tube temporarily and slide the propeller shaft through stern tube and jig, fig. 11. If the tube isn't equipped with a cutless bearing the shaft will have to be centered at both ends of the tube. This can be accomplished with the aid of masking tape wrapped around the shaft. In stern tubes having cutless bearings it is, of course, only necessary to center the shaft at the front end. Check with a spirit level that the jig is set up to the horizontal plane athwart.



11

Now cut to shape pieces of polyurethane foam or similar, and fit them in between the flat bars and the hull. Make sure that there is at least 15 mm, 5/8" clearance between jig and hull. Form the filler-pieces such that the bed will be tapered. This will increase rigidity and also facilitate the lamination work, fig. 12.



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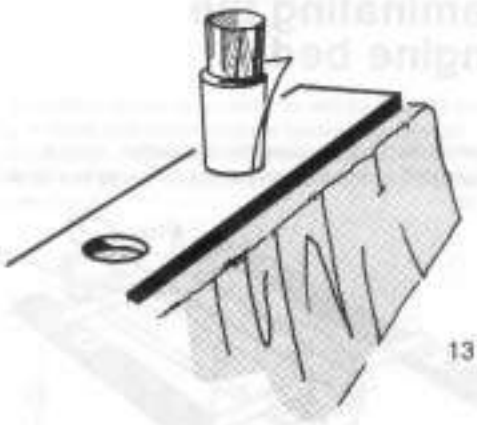
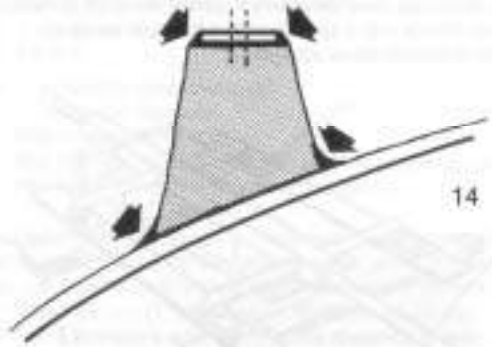
Laminate 2 layers of fibre glass over the polyurethane foam and lay the flat bars onto the wet laminate. Blend the flat bar into the fibre glass using filler for the final lamination.



13

Remove engine or jig. Plug the threaded holes of the flat bars with slightly conical wooden plugs, which should be wrapped up with a few turns in grease-proof paper. The plugs should stick out approx. 15 mm at the top, see fig. 13. The points at which the polyurethane foam meets the hull should be filled to a smooth curve to avoid air pockets and cavities when laminated.



14

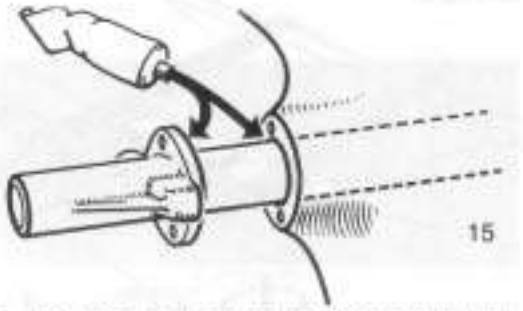
After that, start building up the bed and engine bearers with strand mat and plastic to correct thickness. See section "Engine bed-general". As a rule of thumb, one layer of 450 gram, —16 oz type of strand mat will build 1 mm, 3/64". Note: Max 4 layers at the time, with 8 hours curing intervals in between.

Allow the bed a final curing period of about 24 hrs. After that pull the plugs out with a pair of tongs, and grind the bed smooth. Clean up the threads with a thread tap. Apply top-coat to all bare plastic surfaces and let cure.

Stern tube – Lamination

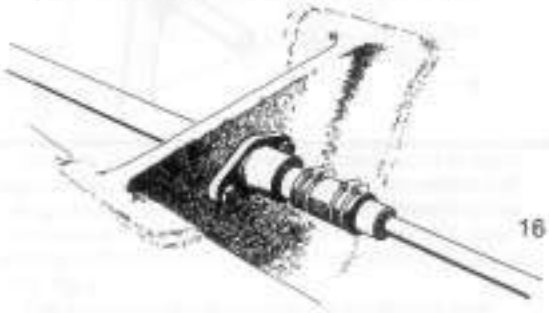
Long-keeled boats (without bearing supports)

1. Slide the stern tube into the hole in the stem post and mark off where the holes for the bolts securing the stern tube are to be drilled.
2. Remove the stern tube and drill the two 11 mm, 3/8" holes at the markings.
3. Bevel the edges of the holes as well as the end of the tube 45°.
4. Degrease the stern tube and spread silicon rubber or similar over the faying surfaces between the stern tube and the hull, see fig. 15. Secure the tube to the hull with stainless steel bolts and nuts with an stainless steel washer between nut and hull.



15

5. Slide the propeller shaft into place to check that it matches the shaft hole of the jig. Also check that shaft and tube are 100% straight and that the shaft runs along the center of the tube. Center the shaft with the aid of wooden wedges. If the shaft doesn't fit the jig, the rubber pads can be adjusted slightly. If, however, the angle error is considerable, the tube must be refitted. An easy and simple way of doing this is by applying plastic putty between the stern tube's mounting flange and the hull.
6. Cut the stern tube to correct length if necessary and if this is possible. The ideal tube length will put the inner bearing in the middle of the shaft.
7. Build up a plastic bulkhead perpendicular to the stern tube about 200 mm, 8" from its fore end and fit the bearing flange. Check for sufficient radial clearance between tube and bulkhead and secure the flange without exposing the tube to any undue forces, vertical nor horizontal, fig. 16.

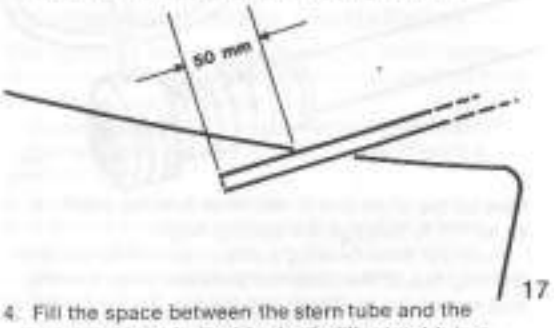


16

8. Final installation of the shaft system is carried out only after the engine has been installed.

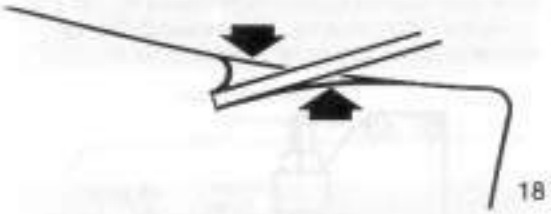
Finkeeled boats (with support bearings)

1. Degrease the stern tube with trichlorethylene or acetone and slide it through the hole in the hull. Build up 5 "O-rings" with silicon rubber around the knurled part of the tube to avoid leakage.
2. Insert the propeller shaft into the sleeve tube and into the shaft hole of the jig.
3. Center the shaft with the aid of masking tape, wrapped around the shaft at both ends of the tube. At the same time check the sleeve tube to protrude about 50 mm, 2" from the bottom of the hull (measured along the top of the tube) fig. 17.



17

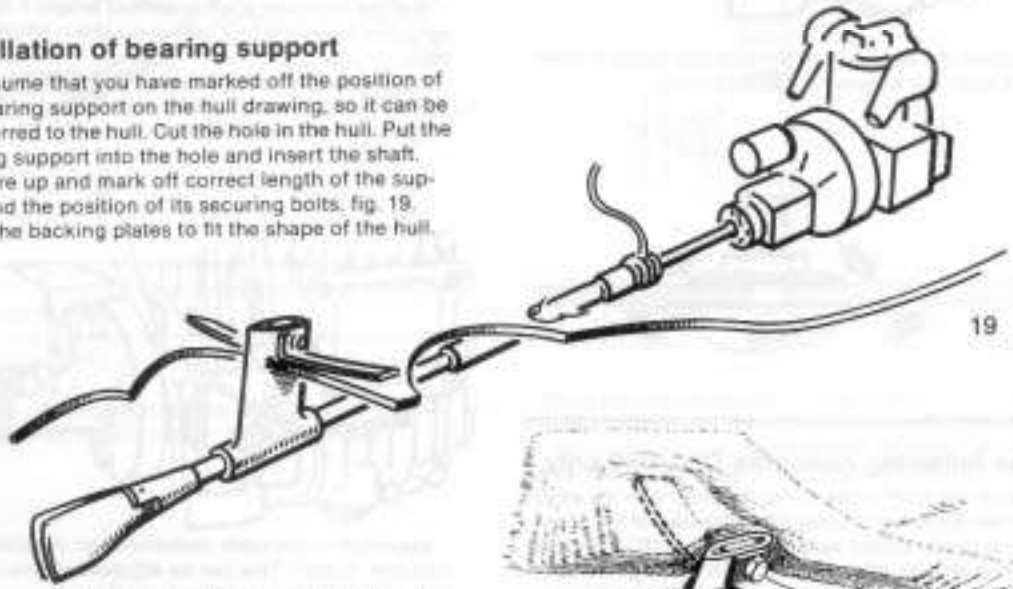
4. Fill the space between the stern tube and the outside of the hull with plastic filler to obtain a smooth transition to the hull. When the filler has cured, spread top-coat over the tube and filler, fig. 18.
5. Now fill up the space between stern tube and inside of the hull. About 200 mm, 8" measured along the bottom side of the tube should be sufficient to give necessary support, fig. 18.


18

6. Next, secure the stern tube to the hull with a laminated layer of 5 mm, 3/16". Grind smooth after plastic has cured and paint over with top-coat.
7. Cut the stern tube to correct length. Ideal length of the stern tube is when it brings the inner bearing to the middle of the propeller shaft.
8. If the forward, free end of the stern tube is longer than 200 mm, 8" a bulkhead should be built up 200 mm, 8" from the fore end of the tube. Fit a bearing flange to the bulkhead, fig. 16. Check for sufficient radial clearance between tube and bulkhead and secure the flange without exposing the tube to any undue forces.
9. Final installation of the shaft system is not to be carried out until the engine has been installed.

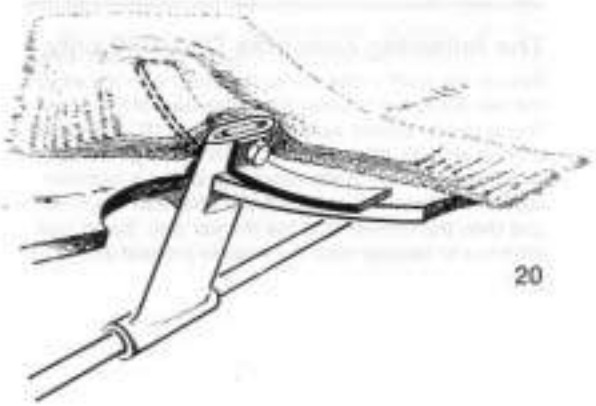
Installation of bearing support

We assume that you have marked off the position of the bearing support on the hull drawing, so it can be transferred to the hull. Cut the hole in the hull. Put the bearing support into the hole and insert the shaft. Measure up and mark off correct length of the support and the position of its securing bolts, fig. 19. Form the backing plates to fit the shape of the hull.


19

Remove and cut the support to correct length and drill the hole for the bolt. Slide the small piece of flat iron into the column of the support, until the holes are opposite each other and then press the upper end of the column flat in a vice.

Install the bearing support in the boat, insert the shaft and bolt the backing plates to the support column. Now secure the support column and the backing plates to the hull with eight layers of laminate, 4 layers at the time, in two stages, fig. 20.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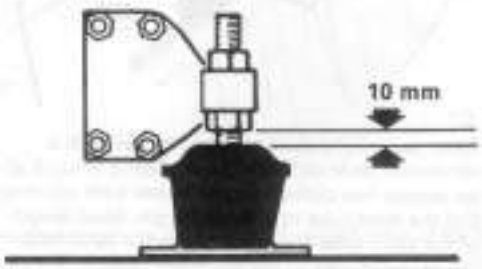
Engine – installation

Fit the rubber-mounted engine supports and adjust them such, that the bottom nut is spaced 10 mm, 3/8" above the rubber pad, fig. 21. D7's and D12's rear engine supports should be fitted as in fig. 21.



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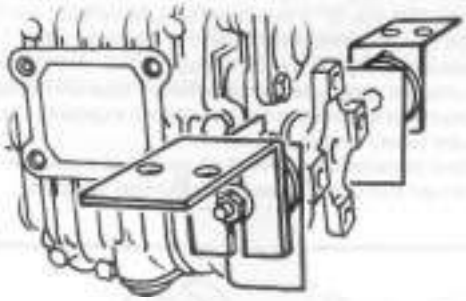


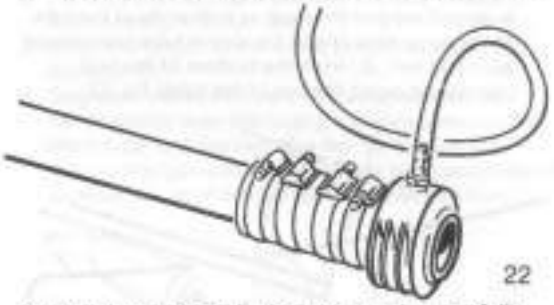
Lower the engine onto the bed and fasten it down with machine screws of stainless steel.

The following concerns D35/D50 only

Secure the shaft in the clamp coupling with the aid of the two enclosed tubular pins. One half of the coupling is center drilled with an Ø8 mm, 5/16". Continue drilling with an Ø8 mm, 5/16" right through the shaft and the other half of the coupling. Using a hammer, tap the thicker of the two tubular pins into the hole and then the thinner into the thicker one. Spray rust inhibitor or lacquer over the ends to prevent action of rust.

Shaft system – installation and alignment

Insert the shaft into the stern tube and then press the inner bearing's rubber tube onto the stern tube, together with the four hose clips, turned as illustrated in fig. 22. Make sure that the shaft has no sharp edges or scratches. If so, they will have to be removed first.



22

Now oil the shaft and fit the inner bearing carefully, so as not to damage the sealing rings.

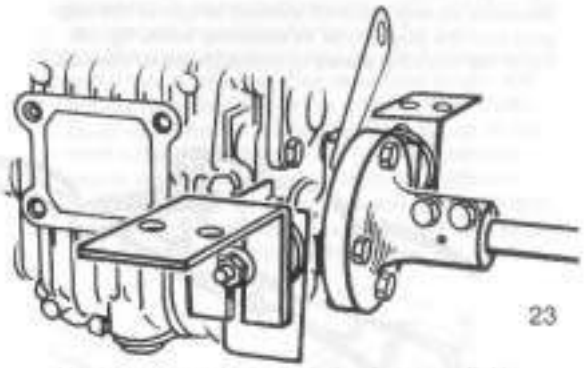
Push the inner bearing's rubber tube onto the inner bearing. Adjust the distance between inner bearing and stern tube to 20mm and tighten the hose clamps.

Degrease the shaft carefully, secure the clamp coupling and push the shaft up against the coupling flange of the reversing gear.

Fit the propeller and check that space, in accordance with fig. 5, is available.

Cut the propeller shaft to correct length if necessary, and bevel the end so that no sharp edges remain.

Push the clamp coupling up against the flange of the reversing gear and check the alignment of the engine with the aid of a feeler gauge, fig. 23.



23

Maximum acceptable deviation from parallel is 0,05 mm, 0,002". This can be adjusted vertically by means of the adjustment nuts on the rubber pads, if required. Engine alignment can also be adjusted laterally by loosening the screws in the engine bed. Don't forget that the shaft must be centered in the stern tube.

Finally fill the inner bearing box with oil. Engine oil or transmission oil for outboard engines can be recommended. Attach the nipple and fasten the hose as high as possible on a bulkhead. The hose functions as an expansion tank when temperature variations occur.

Cooling system

In short, the cooling system is built up such, that sea water is drawn into the engine by the sea water pump and, in the exhaust collector, mixed with the exhaust gases and discharged overboard through the exhaust system.

As for installation work, it only amounts to installation of a cooling water intake and, in certain cases, a vacuum valve. The design of the exhaust system will be described in a special section.

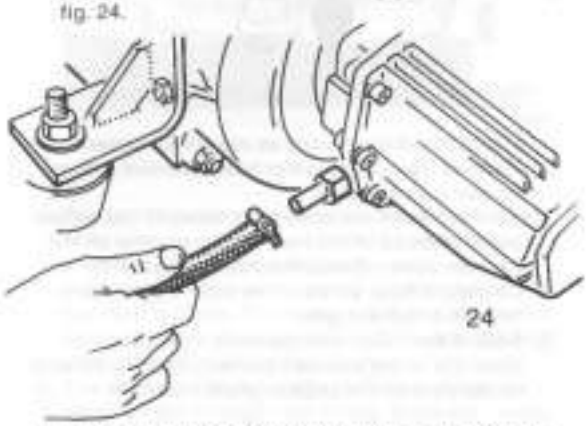
Cooling water intake – installation

The cooling water intake provided by BMW Marine, consists of a water intake with strainer, shut-off cock and hose-coupling nipple.

Begin by installing the water intake with strainer.

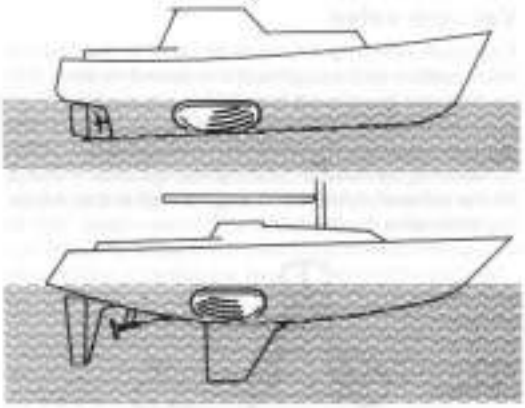
Remember to locate the water intake in such a position that

- it will be easily accessable.
- it will be located as close to the engine's hose connection as possible, i.e. D7/D12 the water pump and D35/D50 the reversing gear's oil cooler, fig. 24.



24

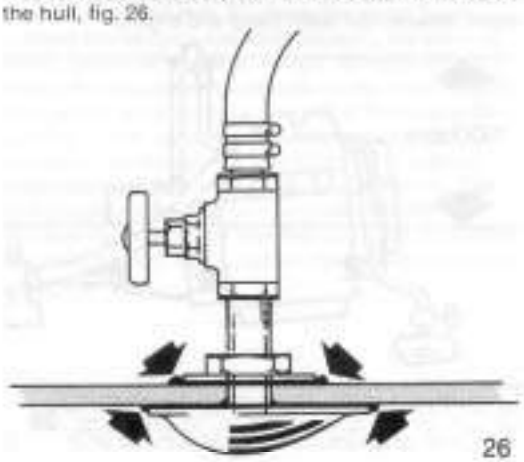
- it is located so deep below the water line that the cooling water supply is guaranteed even when the boat heels over.
- the hose between the engine and water intake has sufficient bight, so it won't be strained by engine vibrations.
- the hose used is sufficiently rigid to resist compression by the vacuum in the suction tube.



25

The water intake strainer shall be turned differently for different types of boats. In motor boats the openings in the strainer should face forward, while they in a sailing boat should be facing aft, fig. 25. This prevents water from being forced into the engine while sailing.

Bevel the hole in the outer skin so that the sealing compound, which must be used, can creep in and form an "O-ring", which improves on the sealing. Secure the water intake with the nut on the inside of the hull, fig. 26.



26

Wrap teflon tape around the top 20 mm, 3/4" of the threads, fit and secure the shut-off cock. The threads of the hose-coupling nipple should be sealed in the same way before fitted to the shut-off cock.

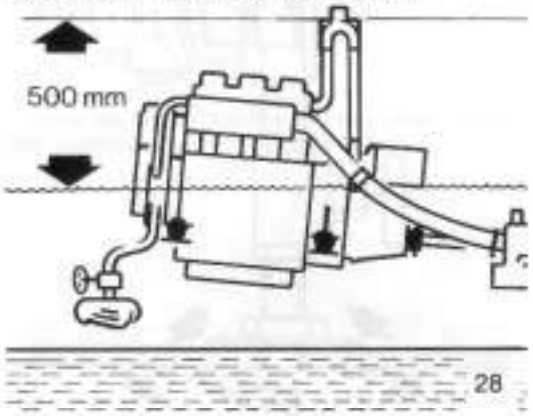
Vacuum valve

A vacuum valve, fig. 27, must be fitted to the cooling water system of the engine, if it is seated so deep into the hull that its exhaust manifold is situated less than 200 mm, 8'' above the water line. The purpose of the vacuum valve is to prevent the cooling system from functioning as communicating vessels, which could fill the exhaust system and engine with water, causing expensive damage.

27

The vacuum valve should be connected between exhaust manifold and exhaust elbow, at a height of at least 500 mm (20") above the waterline, see fig. 28.

Note: At D7 and D12 the vacuum valve should be connected between raw water pump and engine.



28

Furthermore the following must be observed, namely

- that it is installed as close to the fore and aft line of the boat as possible, in order not to affect its function when the boat heels over.
- that it must not be installed directly on the engine as the engines vibrations can affect its function
- that it is not located above components or interior fittings that are sensitive to water, since water leakage can occur at low engine RPM´s or when shutting the engine down
- that the valve housing must face straight up, fig. 29.

29

The installation is carried out in the following manner:

1. Mount the vacuum valve as described above.
2. Remove the cooling water hose between sea-water pump and engine.
3. Connect an oil-resistant hose between the water pump and one of the t-piece connections on the vacuum valve (choose the most convenient).
4. Connect a hose between the other t-piece connection and the engine.
5. Secure the hoses with stainless hose clips.
   Note! the hoses should be loosely fitted to be able to vibrate with the engine, under no strain.

Waterstrainer

To prevent the heat exchanger becoming plugged with debris, all fresh water cooled engines should be equiped with a waterstrainer. It should be connected between the raw water intakde and the reverse gear cooler. Install it slightly above the waterline in a vibration-free place. It should never be installed directly onto the engine. Make sure the hoses are long enough so as not to get strechted by engine movements.

Raw water cooled engines could also be equipped with waterstrainer. In areas with polluted water it is highly recommended. The above installation instructions also apply to raw-water cooled engines.

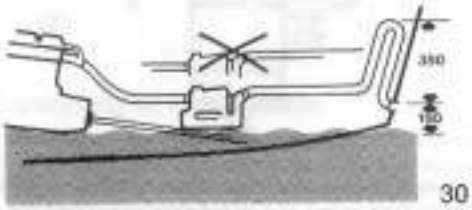
Exhaust system

The majority of all modern pleasure boats today use wet exhaust lines i.e. the outgoing cooling water from the engine is mixed in the exhaust bend with the exhaust gases, and transported out through the exhaust line.

An exhaust system of this type has several advantages, such as e.g.

a. simple installation, since rubber hose can be used
b. an excellent noise-suppression
c. exhaust hose is corrosion-proof, i.e. maintenance cost are low
d. system has no hot spots, which reduces fire hazards.

During installation there are, however, a few points that must be paid attention to, in order to prevent water from penetrating into the engine and causing corrosion damages.



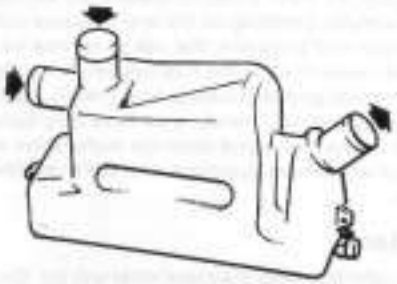
30

a. The cooling system must be equipped with a vacuum valve mounted in accordance with the instructions in the previous section.
b. A water trap must be mounted in accordance with the sketch above, to prevent residual water in the exhaust line from being sucked back into the engine, when it is being shut down.
c. The exhaust line should be formed to a "swan-neck" at the through-hull fitting, to prevent wave-splash from filling the exhaust line. (Applies to dry or wet-jacketed exhaust lines as well).

The inner diameter of the exhaust hose should be in accordance with the following:

D7/D12	Ø 40 mm, 1 1/2"
D35/D50	Ø 50 mm, 2"

The location of the water trap will be evident from fig. 30, as will the position of the through-hull fitting, and the recommended dimensions for the "swan-neck". Also important is the fact that the part of the exhaust running horizontally, including the water trap, has a larger volume, than that in the rising part of the "swan-neck". The water trap has two alternative inlets, to allow the hoses to be positioned as ideal as possible. Cut out the hole in the inlet to be used, fig. 31.


31

The exhaust system's through-hull fitting should be placed about 150 mm, 6" above the water line to prevent the hedge wave from blocking the exhaust outlet, which produces a "rough" exhaust sound. Mount the angled part upwards on the inside of the hull, which automatically provides a favourable beginning to the "swan-neck". Apply silicon rubber or similar to the threadings and drip ring to prevent water leakage. The male threaded connection has two shoulders built up on the inside. Therefore a suitable flat bar can be inserted and used to secure the through-hull fitting, rather than using a polygrip or pipe wrench.

Fuel system

Great care should be taken, when planning and installing the fuel system. Faulty installations will inevitably will lead to service interruptions. Although diesel fuel is less explosive than gasoline, the requirements on safety and system tightness should be set just as high in the case of diesel engine installations because, among other things, diesel oil has a very penetrating and unpleasant smell.

Since the engine's fuel system (injection pump and injectors) is very sensitive to water and impurities, the fuel must be filtered very carefully before it reaches the engine. All BMW's marine diesels are equipped with automatic bleeding on the low pressure side of the fuel system and therefore, the risk of service interruptions, because of air in the fuel system, is negligible.

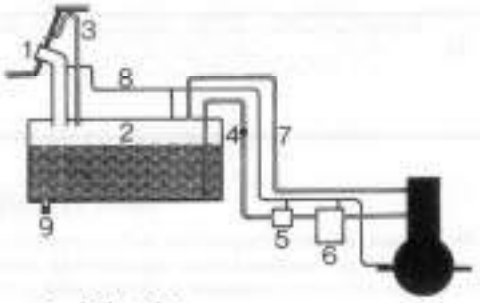
Safety rules and regulations vary greatly from one country to another. Therefore we here only furnish general instructions, and describe installation of standard equipment, supplied with BMW marine diesels.

Fuel tank

As for materials, only stainless steel will do. Since diesel fuel contains sulphur, galvanized steel tanks are definitely unsuitable. Other materials can be used, but don't forget

- polyester, resistant to chemicals, must be used for plastic tanks
- that galvanic corrosion can set in, in fuel tanks of aluminium
- that no tank, independent of material, may be lacquered inside.

All connection fittings should be placed on the top of the tank. The tank should however, also be equipped with a hand hole for inspections, and fittings for a fuel gauge on the top side. In addition the tank should be equipped with a drain plug located at its lowest point, to allow efficient removal of water and impurities, fig. 32.



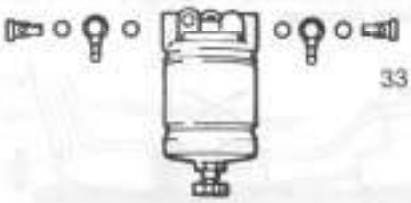
32

1 – Filler pipe
2 – Fuel tank
3 – Tank ventilation
4 – Tank shut off valve
5 – Fuel pump
6 – Filter (water trap)
7 – Fuel return line
8 – Ground connection
9 – Drain plug

The tank filling pipe should be designed for connection to a hose with an inner diameter of 50 mm, Ø2".
The ventilation hose should have an inner diameter of at least 13 mm, Ø1/2". The hose must be shaped to the form of a lyre or a loop, to prevent water from being able to make its way to the tank when heeling over.

The ventilator on the outside of the hull may not be mounted in the vicinity of an exhaust outlet from engine, refrigerator or heater due to the risk of fire.

The fuel feed line between the fuel tank and the engine's feed pump must be equipped with a shut-off cock. The inner diameter of the fuel line may not be less than 6 mm, 1/4".



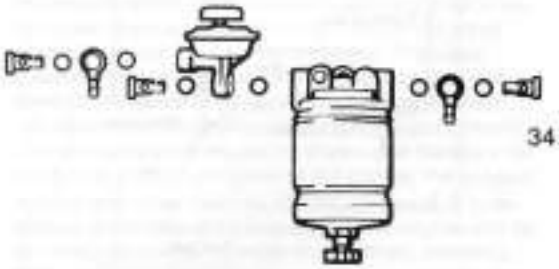
33

The fuel filter (water separator) fig. 33, is mounted between feed pump and injection pump. The filter may not be mounted on the engine, but in a place easily accessible and as free from vibrations as possible. The accessibility is important, bearing in mind that the filter must be drained and also changed, at regular intervals.

The return line between engine and tank should have an inner diameter of minimum 6 mm, 1/4".

The hand pump (D12 only) should be mounted on the fuel filter's inlet side, fig. 34. The arrow on the side of the hand pump shall point in the direction of the flow.

The feed pump's maximum suction height is limited to 1.0 m, 39 1/2'' measured between the bottom of the tank and the feed pump. If the height exceeds the above limit, an electric feed pump will have to be mounted as close to the tank as possible, in order to avoid service interruptions.



34

Grounding of fuel system

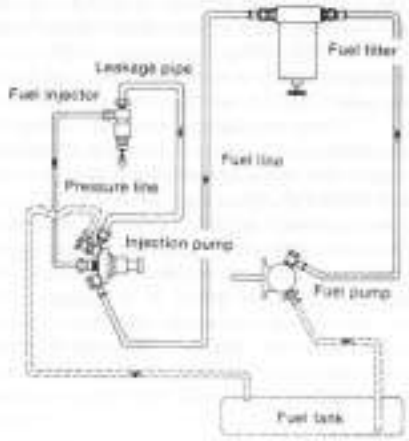
In order to prevent static electricity from accruing between the various components of the fuel system, all integrated parts must be connected to the engine in the following manner:

Ground wire tank – deck fittings/filling pipe
Ground wire tank – tank ventilator
Ground wire tank – engine
Ground wire fuel filter – engine

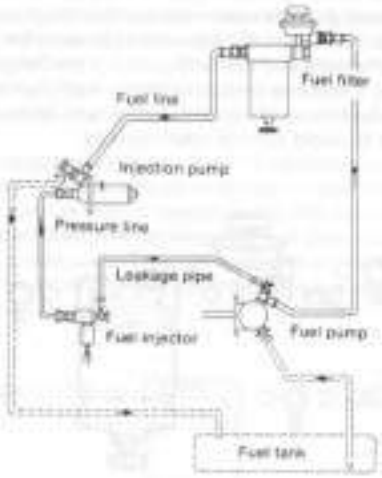
Finally:

a. All hose connections in the fuel system should be secured with double stainless steel hose clips.
b. All components in the fuel system should be pressure-tested to a pressure of 0.2 bar before installation.
c. cramp all lines and wires neatly with rubber-lined clips and bevell all lead-throughs (through holes) in order to avoid chafing.
d. Keep in mind that all lines must be easily accessible for inspection and repair.

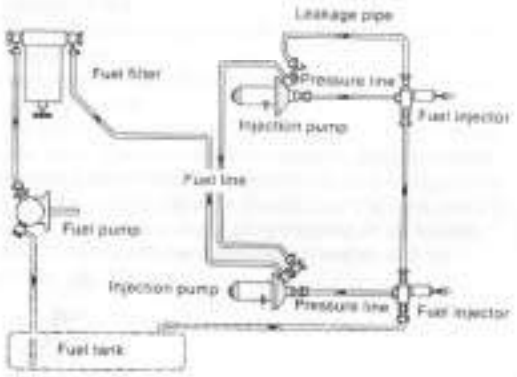
Fuel system



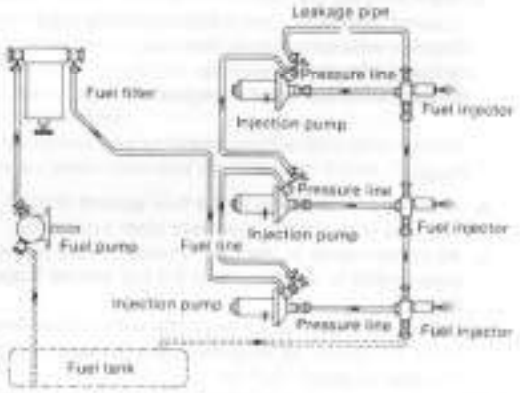
D7



D12



D35



D50

Electrical system

The engine's electrical system is installed at the factory and no further installation work is necessary except for connecting the battery leads.

The cable system is equipped with non-interchangeable connection plugs and need only be inserted into their corresponding sockets at the engine respectively at the instrument panel.

Always fasten up the cable system with suitable rubber-lined clips to avoid chafing damage to the insulation, which otherwise inevitably will lead to cable breakdown or short circuits. This can, if worst comes to worst, lead to fire on board. The cable system should not, under any circumstances, be allowed to lie in the bilge, since possible water there can severely affect the connectors through corrosion. The wiring harness should be drawn and fastened up such, that it stays well clear of the engine, the exhaust system and other sources of heat on board. It is designed to withstand the amperages the engine and its accessories consume while in operation, meaning that additional electrical equipment may not be connected to the cable system, since risk of overloading then will exist. This will be dealt with, in more detail, later in this section.

Battery, battery leads and battery main switch

The battery should be placed in a well ventilated compartment, separated from the engine room. Ventilation is important, since the battery gives off explosive gases while being charged (oxyhydrogen gas). Also, the battery box should be acid-proof, considering the possibilities of battery acid being spilled. After connecting the battery leads, the cable clips and battery terminals should be coated with vaseline or special terminal lubricant.

Recommended starter cable length/area ratios will be evident from the table below.

D7/D12/D35/D50

Cable length meter	Cable area mm^2
Max. 1.5	25
Max 3.0	35
Max 4.5	50
Max 6.0	70

The battery main switch, fig. 39, is a vital part of every electrical system. It should be mounted in a place where it is easily accessible, but still hidden in order to render theft a little more difficult. It should be placed such, that there is no risk of acoidentally setting it to off position, while the engine is in operation, which without fail, will lead to generator breakdowns.

Wiring diagrams

See page 22-24

Instrument panel

The instrument panel is connected to the cable system with a non-interchangeable connector plug. To facilitate the cutting of holes in the instrument panel a template is supplied with each engine.

The instrument panel must not be mounted in such a manner, that it will be exposed to rain or in other ways be sprayed or flushed with water. You should also avoid mounting the panel such, that it will be exposed to sunlight. Sunlight is not harmful in itself, but can result in you not observing that a warning light suddenly has lit up. Installation of the instrument panel can, especially in sailing boats, be quite a problem. Should the case be such, that the instruments and warning lights are difficult to read, we recommend an alarm system for monitoring of the most vital engine functions. Your BMW Marine dealer will be able to advice you in these matters.

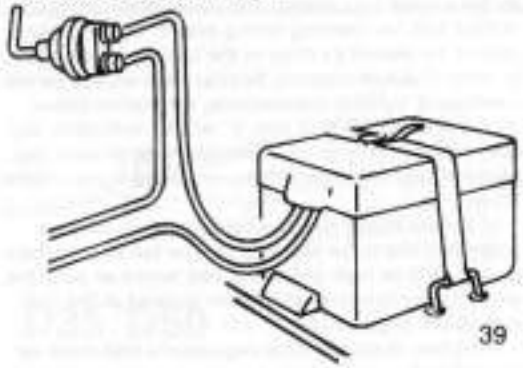
The boat's electrical system, battery separator and extra battery

As mentioned earlier, the engine's cable system must not be burdened with the boat's electrical equipment, since this, if worst comes to worst, can result in a cable fire. Concerning the installation of the boat's electrical system, we would like to refer you to the special branch handbooks available on this subject.

Electrical equipment on board has increased in pace with the rising demands on comfort. It is therefore more and more common, that a second battery is installed in the boat. This second battery should then be separated from the engine's electrical system by a battery separator, the purpose of which, it is to prevent that current from the starter battery is used for consumers. There are two different types of battery separators

a. with diodes
b. with relays

As usual both types have their advantages and their disadvantages. We, however, recommend type b, i.e the relay type, since it will not cause voltage drop in the charging circuit and will therefore offer a more efficient charging of the battery. As the installation of these battery separations vary from one manufacturer to another, we would like to refer to the respective manufacturer's instructions.



39

Ventilation

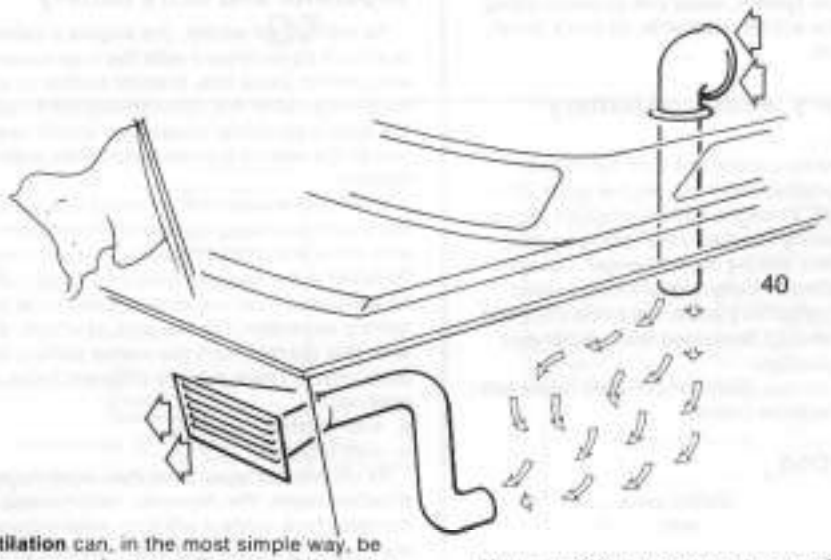
The ventilation of the engine room has three purposes:

a. to secure the supply of combustion air
b. to maintain the temperature in the engine room at an acceptable level
c. to remove, by ventilation, possible fuel vapours and exhaust fumes from the engine room.

Excessive temperature of the combustion air will reduce power and increase the load to pistons, pistons rings and electrical equipment. The oil temperature and consumption will also increase. The temperature in the engine compartment should therefore not exceed the ambient air temperature of more than 20 °C. Should the combustion air be taken from the engine compartment the difference between ambient air temperature and engine compartment temperature should not exceed 10 °C.

Ventilation can be arranged in two different ways

a. self-ventilation
b. mechanical ventilation



Self-ventilation can, in the most simple way, be arranged by means of two ventilators and their respective hoses, fig. 40. One ventilator is installed with its opening facing forward and its hose should, in this case, end relatively high in the engine room and close to the engine's air intake. The other ventilator is installed with its opening facing astern, and its hose should be placed as deep in the keelson as possible, in order that fuel vapours, heavier than air, can be led overboard. In most installations, ventilation hoses with a diameter of Ø75 mm, 3'' will be sufficient, but also here considerations must be taken to local regulations, and to temperatures measured in the engine room.

In certain cases mechanical ventilation (engine room fan) has to be resorted to. The fan should then be installed as high under the free board as possible, while its suction hose should be located at the bottom of the engine room.

Here too, there are local regulations that must be considered.

As there are many factors influencing the engine compartment temperature, measurements should always be carried out to achieve a optimum installation. For this reason the above given instruction can only serve as a guide to curing temperature problems. If temperature problems should arise, it is recommended to lead the combustion air from a seperate air duct. This air duct must however be designed to prevent spray water from being induced into the engine.

The total amount of air necessary for combustion and ventilation can easily be calculated with the following formula:

$$V_{tot} = N \times V_s + \frac{V_d \times n}{2000}$$

V_{tot} = necessary amount of air in m^3/min.
N = max. engine output in kW
V_s = specific air volume (is found in table below)
n = engine speed at max. output $min.^{-1}$
V_d = engine displacement (liter)

Specific air volume V_s

	Air temperature at air filter			
	10 °C	20 °C	30 °C	40 °C
Indirect injection engines	0,25	0,35	0,50	1,0
Direct injection engines	0,15	0,20	0,35	0,70

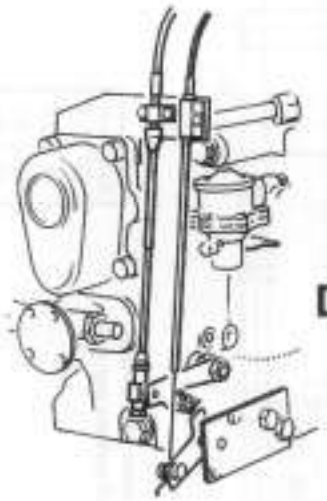
Controls

We highly recommend that you use original BMW controls, since these are thoroughly tested and trimmed to fit the BMW engines, with reference to cable connections and lengths of stroke.

Detailed installation instructions and templets for making holes etc. are enclosed with each control box, and will therefore not be dealt with in this manual.

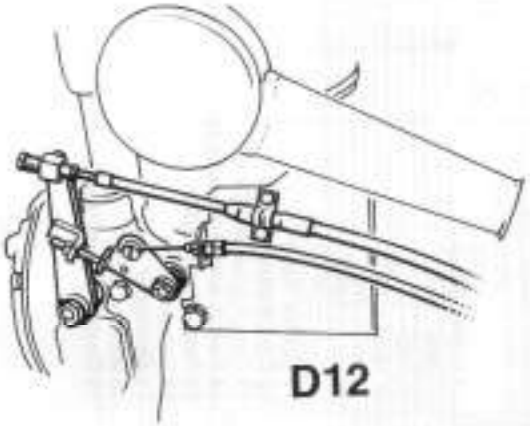
In accordance with standard specifications, the controls are delivered with pull movement for the throttles, and push movement for the shift. They can therefore have to be modified in accordance with page 6 in controls instruction.

The control cables are to be connected to respective engines according to sketches below.

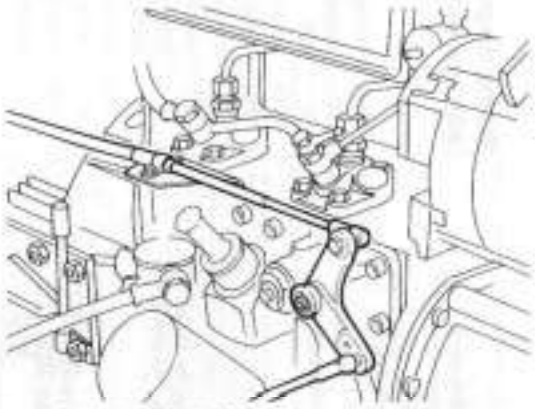


D7

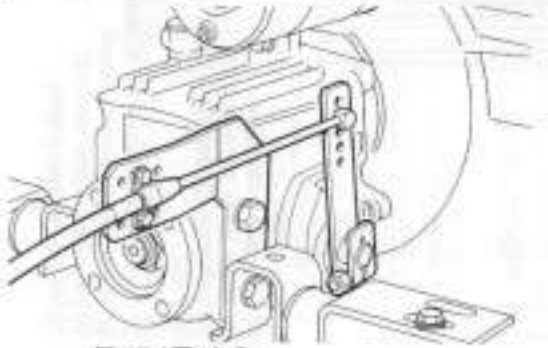
D35/D50-1



D12



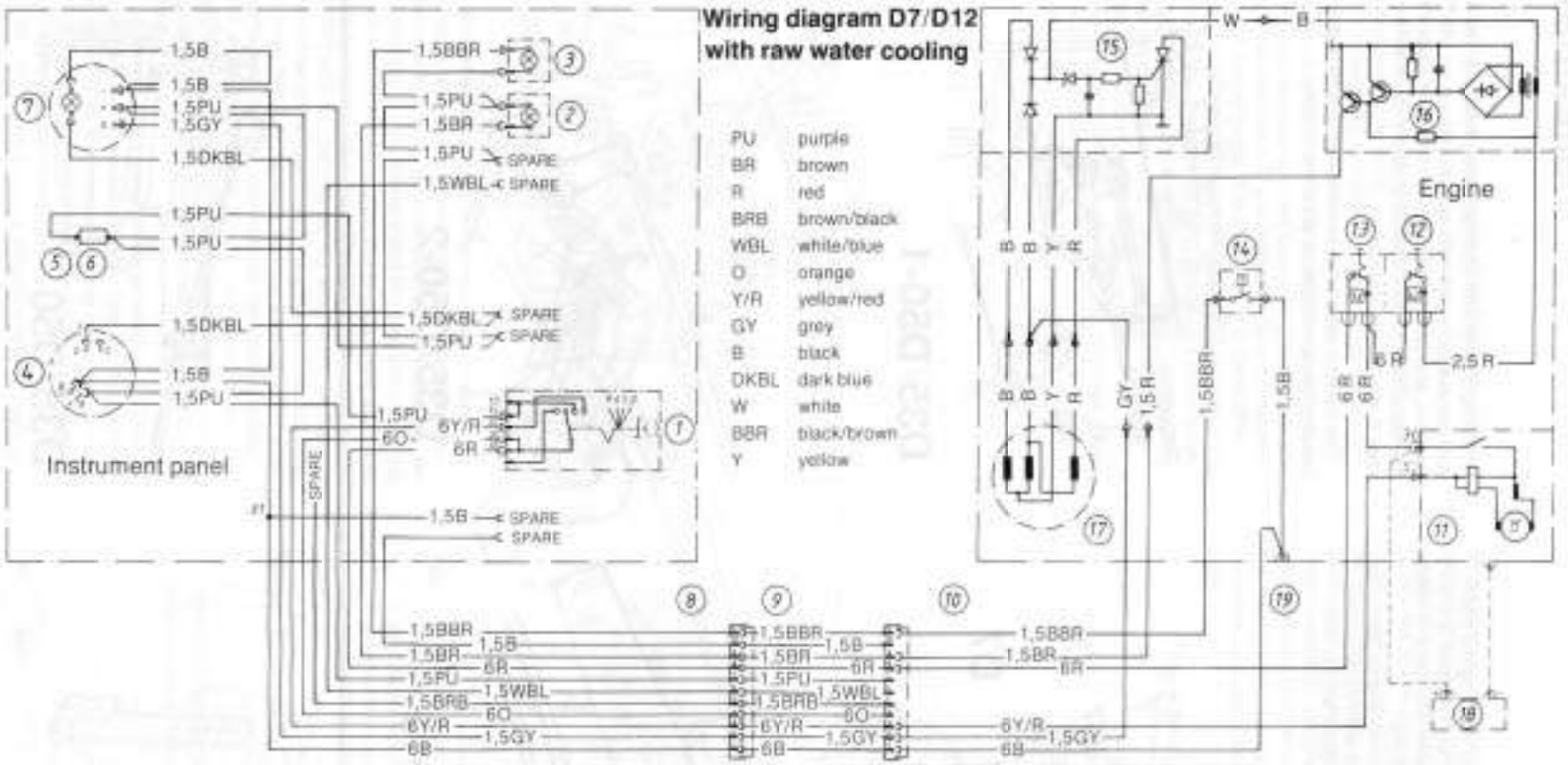
D35/D50-2



D7/D12

D35/D50

Wiring diagram D7/D12 with raw water cooling

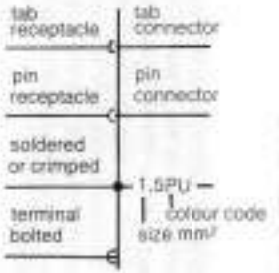


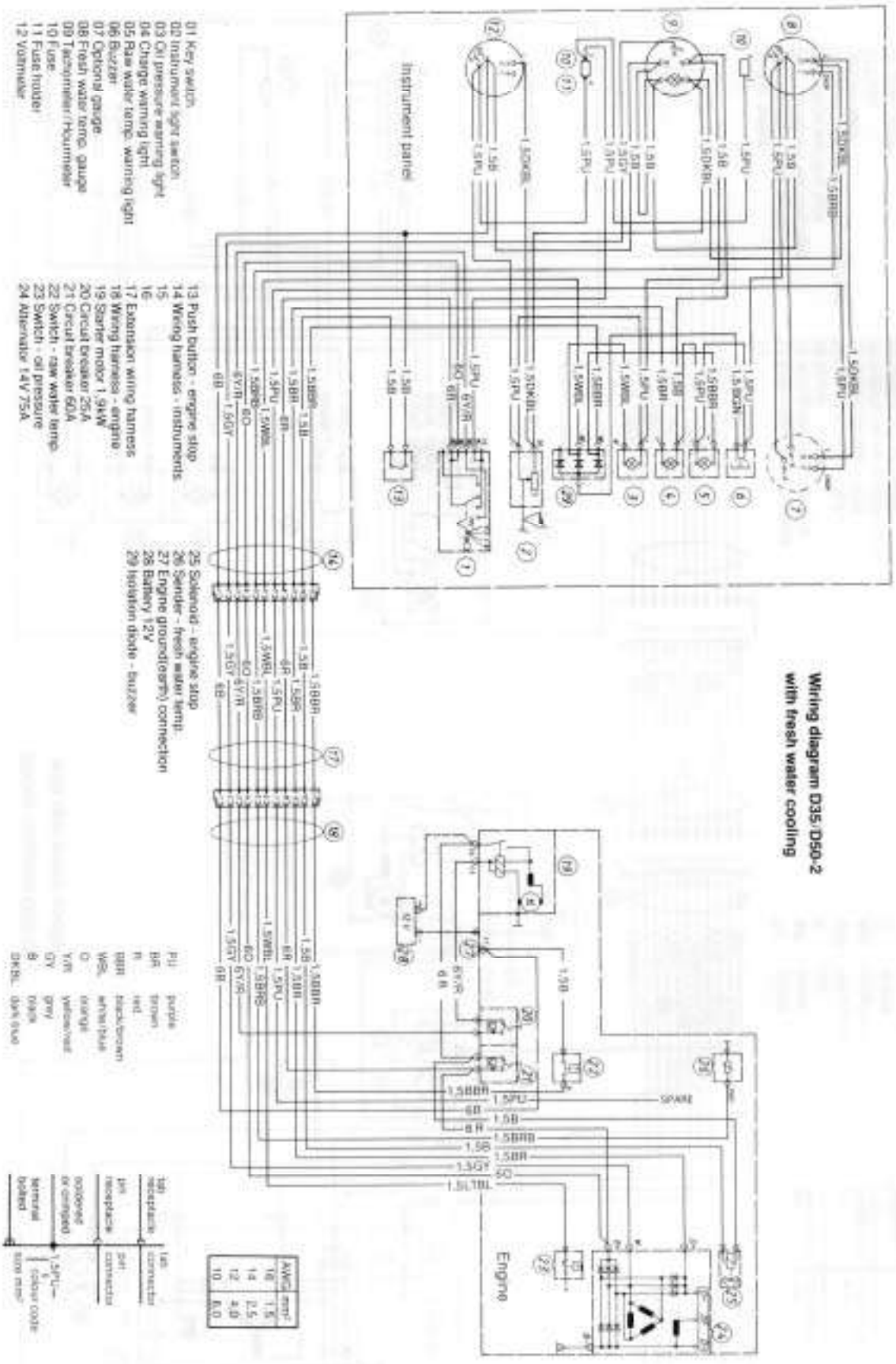
PU	purple
BR	brown
R	red
BRB	brown/black
WBL	white/blue
O	orange
Y/R	yellow/red
GY	grey
B	black
DKBL	dark blue
W	white
BBR	black/brown
Y	yellow

01 Key switch
02 Charge warning light
03 Water temp. warning light
04 Voltmeter (Optional)
05 Fuse
06 Fuse holder
07 Tachometer/Hourmeter (Optional)
08 Wiring harness-instruments
09 Extension wiring harness
10 Wiring harness-engine

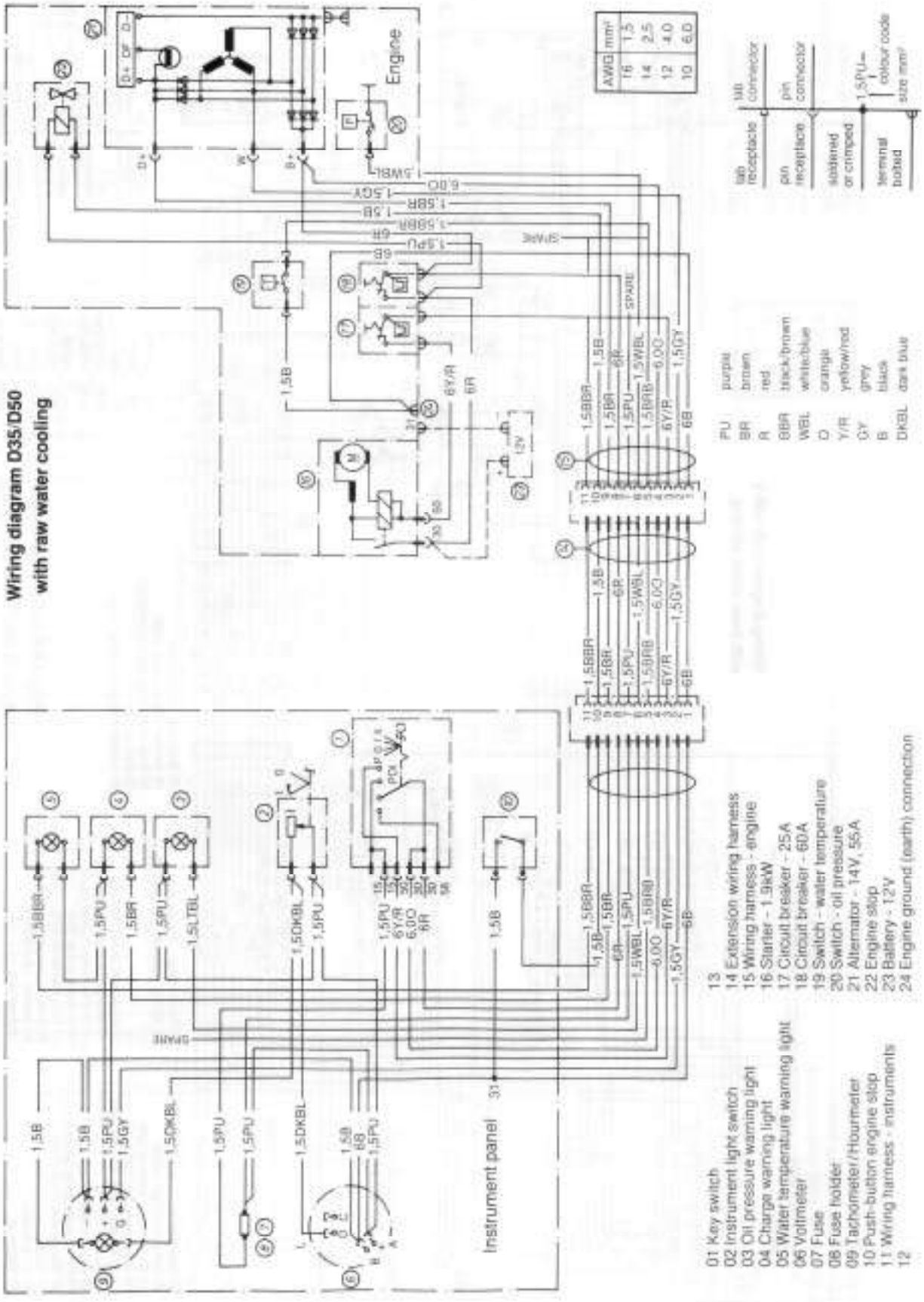
11 Starter motor
12 Circuit breaker 25A
13 Circuit breaker 25A
14 Switch water temperature
15 Regulator/rectifier
16 Sender unit
17 Alternator
18 Battery 12V
19 Engine ground (earth connection)

AWG	mm²
16	1,5
14	2,5
12	4,0
10	6,0





Wiring diagram D35/D50-2
with fresh water cooling



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