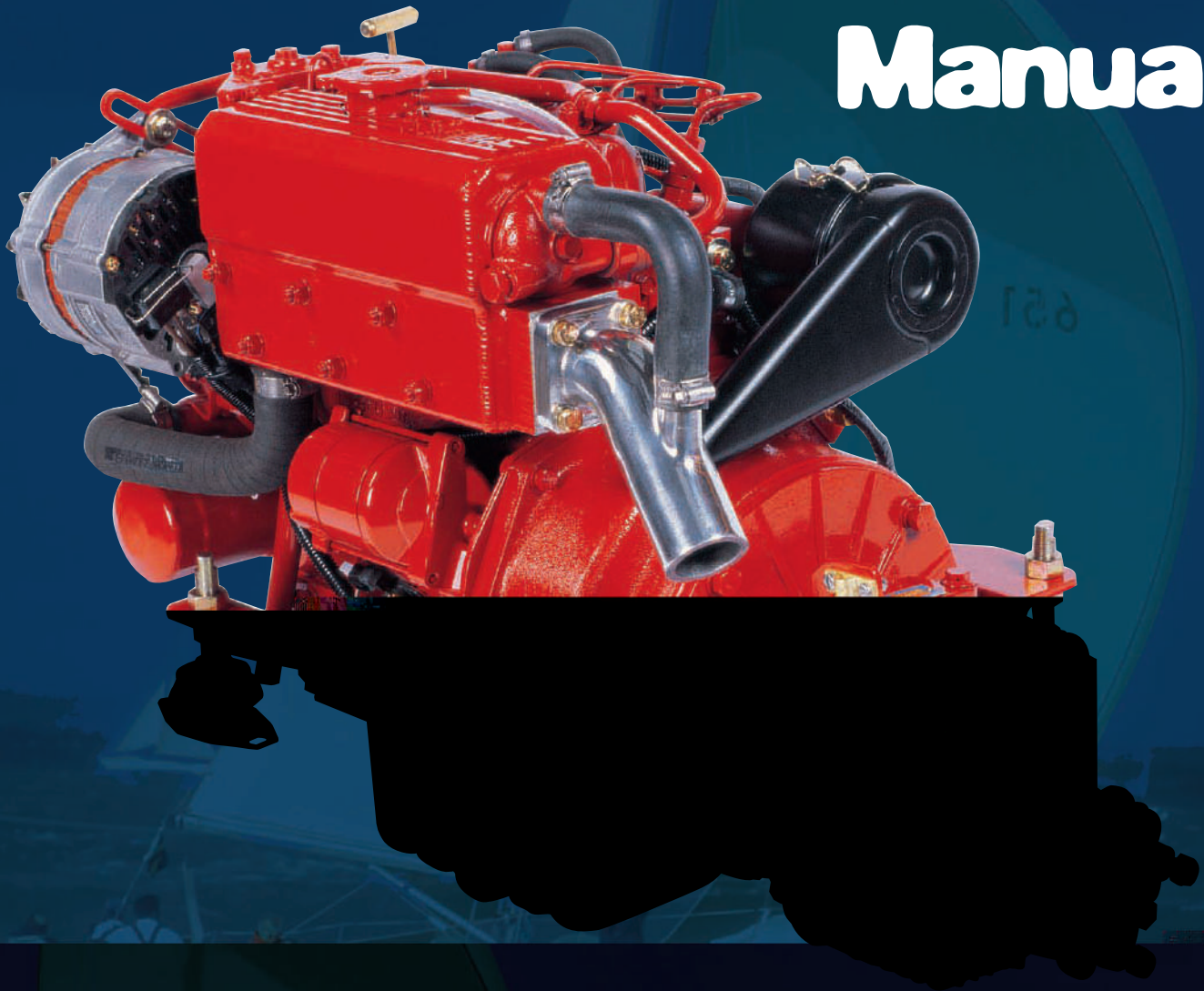


# **BETA** MARINE

## **Operator's Maintenance Manual**



### **Heat Exchanger Cooled Small Diesel Engine Range BD1005, BV1305 and BV1505**

CALIFORNIA — Proposition 65 Warning: Diesel engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects and other reproductive harm.

# Engine Details

**IMPORTANT** – Please fill in details at moment of purchase – it really will help you! (and it will really help us specify the correct spare parts for you).

Engine Type:	Power:	bhp	Speed:	rpm
BETA WOC NO: K				
Gearbox Type:				
Purchased from:				
Invoice No:				
Date Commissioned:				
Specification / Special Details				

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# OPERATION AND MAINTENANCE MANUAL FOR THE FOLLOWING BETA MARINE ENGINES BASED ON KUBOTA SUPER 5 SERIES

## BD1005, BV1305, BV1505

This manual has been compiled to provide the user with important information and recommendations to ensure a trouble free and economical operation of the engine.

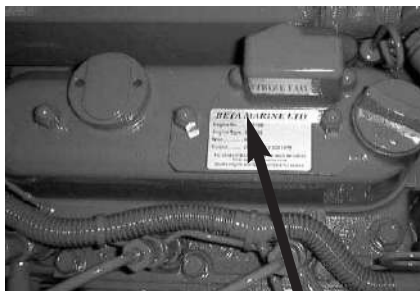
For further advice or technical assistance, application should be made to BETA MARINE LIMITED or its distributors.

All information and recommendations given in this publication are based on the latest information available at the time of publication, and are subject to alteration at any time. The information given is subject to the company's current conditions of Tender and Sale, is for the assistance of users, and is based upon results obtained from tests

carried out at the place of manufacture and in vessels used for development purposes. We do not guarantee the same results will be obtained elsewhere under different conditions.

### ENGINE IDENTIFICATION

**NOTE:** In all communications with the distributor or Beta Marine, **the engine number, type, and W.O.C. number must be quoted.**



<b>BETA MARINE LTD</b>	
Engine No.....	XE5567
Engine Type...	BV 1505
Woc.....	K 2345
Output.....	37.5bhp @ 3000RPM
Tel No: UK (44) 01453 835282	
Fax No: UK (44) 01453 835284	
Quote engine and WOC numbers for spares	

### BD1005, BV1305, BV1505

The engine serial number is stamped above starter motor on the port side of the engine, and is shown on the rocker cover label.

### INITIAL RECEIPT OF THE ENGINE

A full inspection of the engine must be made **immediately on delivery** to confirm that there is no damage. If there is any damage then write this clearly on the delivery note and inform your dealer or Beta Marine within 24 hours.

### ENGINE STORAGE

The engine must be stored in a dry, frost free area and this is best done in its packing case. If storage is to be more than six months then the engine must be inhibited (contact your dealer or Beta Marine). Failure to inhibit the engine may result in the formation of rust in the injection system and the engine bores, this could invalidate the warranty.

# SAFETY PRECAUTIONS!

**A Keep the engine, gearbox and surrounding area clean, including the area immediately below the engine**

## **B DRIVES - Power Take Off Areas**

### **i) Gearbox Output Flange**

The purpose of a marine diesel propulsion engine is to provide motive power to propel a vessel. Accordingly the gearbox output shaft rotates at between 280 and 2400 rev/min. This flange is designed to be coupled to a propeller shaft by the installer and steps must be taken to ensure adequate guarding.

### **ii) Forward End Drive**

Engines are supplied with unguarded vee belt drives to power the fresh water pump and battery charging alternator. The installer must ensure that it is not possible for injury to occur by allowing accessibility to this area of the engine. The three pulleys run at high speed and can cause injury if personnel or clothing come in contact with the belts or pulleys, when the engine is running.

### **iii) Power Take Off Shaft (Engine Mounted Option)**

Shaft extensions are available as an option and rotate at between 850 and 3600 rev/min. If contact is made with this shaft when the engine is running, injury can occur.

## **C EXHAUST OUTLET**

Diesel marine propulsion engines emit exhaust gases at very high temperatures - around 400-500°C. Engines are supplied with either wet exhaust outlet (water injection bend) or dry outlet (dry exhaust stub) - see option list. At

the outlet next to the heat exchanger/header tank, the exhaust outlet can become very hot and if touched, can injure. This must be lagged or avoided by ensuring adequate guarding. It is the responsibility of the installer to lag the exhaust system if a dry system is used. Exhaust gases are harmful if ingested, the installer must therefore ensure that exhaust lines are lead overboard and that leakage in the vessel does not occur.

## **D FUEL**

### **i) Fuel Lines**

Diesel engines are equipped with high pressure fuel injection pumps, if leakages occur, or if pipes fracture, fuel at a high pressure can harm personnel. Skin must be thoroughly cleaned in the event of contact with diesel fuel.

### **ii) Fuel Supply Connections**

Engines are supplied with 8 mm compression fittings. The installer must ensure that when connections are made, they are clean and free of leaks.

## **E OIL**

The Beta propulsion is supplied with 2 dipsticks, one for the engine and one for the gearbox. Ensure dipsticks are returned and secure after checking, if not oil leaks can cause infection when touched. All oil must be removed from the skin to prevent infection.

## **F SCALDING**

An engine running under load will have a closed circuit fresh water temperature of 85° to 95°C. **The pressure cap on the top of the heat exchanger must not be removed when the engine is running.** It can only be removed when the engine is stopped and has cooled down.

## **G TRANSPORTATION/ LIFTING**

Engines are supplied on transportable pallets. Lifting eyes on engines are used for lifting engine and gearbox assembly only, not the pallet and associated kit.

## **GENERAL DECLARATION**

This machinery is not intended to be put into service until it has been incorporated into or with other machinery. It is the responsibility of the purchaser/installer/owner, to ensure that the machinery is properly guarded and that all necessary health and safety requirements, in accordance with the laws of the relevant country, are met before it is put into service.

Signed:



J A Growcoot, C.E.O,  
Beta Marine Limited

## **NOTE: Recreational Craft**

Where applicable, the purchaser/installer/owner and operator must be responsible for making sure that the Recreational Craft Directive 94/25/EC is complied with.

# TECHNICAL SPECIFICATIONS

Standard Engines	BD1005	BV1305	BV 1505
Cylinder	3	4	4
Bore (mm)	76	76	78
Stroke (mm)	73.6	73.6	74.8
Displacement (cc)	1001	1335	1498
Combustion	3 Vortex		
Cooling	Water		
Starter voltage (V)	12		
Starter output (kW)	1.2		
Starter alternator output (Amps)	65 (standard)		
Glow plug resistance (each)	1Ω		
Engine speed (RPM)	3,600	3,600	3,000
Power output to ISO3046 (BHP)	28.0	35.0	37.5
Declared power ISO8665 (kW)	19.2	25.7	27.1
Compression Ratio	22:1		
Fuel timing BTDC	21°		
Capacity of standard sump approx (litres)	6	7.5	7.5
Capacity of shallow sump approx (litres)	5	6.5	6.5
Nett dry weight with gearbox (kg)	150	170	170
Fuel	Diesel fuel oil No.2D		
Coolant	33%-50% maximum antifreeze / water		
Coolant capacity approx (H/E litres)	5.5	7	7
Min. recommended battery capacity	12V 80Ah (400CCA Min)		

**Maximum Angle of Installation:** Trim 15°, Roll 30° (intermittent), 20° continuous

**Rotation:** ANTI CLOCK ON FLYWHEEL, CLOCKWISE ON OUTPUT GEARBOX FLANGE FOR USE **WITH RIGHT HAND PROP IN AHEAD**, on mechanical gearboxes. Hydraulic gearboxes can be left or right handed.

Diesel fuel must conform to BS2869-1970 class A1 or A2. The fuel must be a distillate and not a residual oil or blend.

**Lubricant:** Engine - Engine oil must meet MIL-L-2104C (see section 2 for details)

Gearbox - see operator's manual for the gearbox oil type and capacity

Oil pressure - minimum (tickover) 0.5 bar

**Power outputs:** These comply with BS EN ISO 8665:1996 crankshaft power

**Note: Declared Powers to ISO8665:1995**

1. The declared powers are at the same engine speed as the ISO 3046 figures. This speed is the speed related to the outputs / powers shown.
2. Declared powers are at the gearbox coupling (coupling to the propeller shaft) as per clause 3.2.1 with standard specifications as per our current price lists. Additional accessories or alternative gearboxes may affect the declared powers.
3. Operation at parameters outside the test parameters may affect the outputs / powers which in any case are subject to the ISO tolerance bands.



# SECTION 1

## GUIDELINES FOR OPERATION OF ENGINE

### IMPORTANT CHECKS PRIOR TO INITIAL USE

1. Generally, a new engine has the oil and anti-freeze removed after the works test. Fill the engine with the correct oil and anti-freeze (see sections on ENGINE OIL and COOLING). Check gearbox oil level - see separate operator's hand book.
2. Ensure the engine is free to turn without obstructions.
3. Ensure battery is fully charged and connected (the isolator is in the 'ON' position).

4. Ensure Morse speed and gearbox cables are fitted correctly and that cable travel lengths are correct.

**Gear selection lever –all mechanical gearboxes: care must be taken to ensure that the remote control cable is adjusted** so that the selector lever on the gearbox moves FULL travel and brought “hard up” against its end stop in both directions. Failure to achieve the correct adjustment will reduce efficiency of the clutch and may cause slippage at low revs.

**Warranty will not be accepted**

***on gearboxes returned in the warranty period for failure due to incorrect adjustment.***

5. Ensure engine is out of gear with 1/3 throttle - see single lever control instruction manual.
6. Open the fuel stopcock and bleed the fuel water separator of air as shown in manufacturers literature.
7. Fuel should now be at the fuel lift pump, see diagram 1a. Open the sea cock

### INITIAL STARTUP AND BLEEDING THE SYSTEM

- (a) Open fuel bleed screw on fuel filter assembly by 1½ turns. See diagrams 1a & 1b.
- (b) Move hand priming lever on fuel lift pump up and down until fuel with no bubbles comes out of the bleed screw.
- (c) Shut/tighten the bleed screw. Clean area thoroughly with tissue paper.
- (d) Continue to hand prime for 30 seconds to push fuel through the fuel pump.

- (e) Start engine (see normal starting).

Note the engine may have to be turned over with the starter for a few seconds before it fires. Do not run the starter for more than 20 seconds. If the engine has not started after 20 seconds then disengage the starter and continue to hand prime for a further 30 seconds, then repeat.

- (f) If engine does not start after 3 attempts then allow 5 minutes for the starter to cool down before repeating (a) to (e).

**Note:** The starter windings can be burnt out with continuous cranking

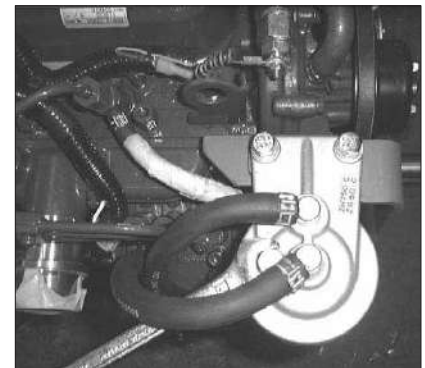


Diagram 1a



Diagram 1b

### CAUTION

To avoid personal injury:

- Do not bleed a hot engine as this could cause fuel to spill onto a hot exhaust manifold creating a danger of fire.
- Do not mix gasoline or alcohol with diesel fuel. This mixture can cause an explosion.
- Do not get diesel on the flexible mounts – they will deteriorate rapidly if soaked in diesel.
- All fuel must be removed from skin to prevent infection.

## NORMAL STARTING (BETA PANELS WITH SILVER KEYSWITCH, FOR KEYLESS SEE PAGE 23)

With the engine out of gear, set speed control lever to 1/3 throttle. Turn key anti-clockwise to HEAT\* (A) position and hold for ten seconds, turn key clockwise to RUN (C) position. At this stage the instrument panel should illuminate, an alarm buzzer will sound and two (or three\*) red warning lights will illuminate:

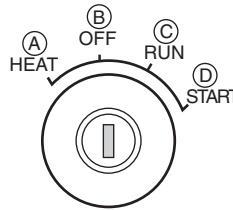
STARTER BATTERY CHARGE  
DOMESTIC BATTERY CHARGE (D in battery symbol - AB & C Deluxe panels only)

\*(Note: this will only illuminate if 2nd alternator is fitted)

OIL PRESSURE  
and green POWER ON / RUN LIGHT  
(this will stay on)

Turn to START (D) position and engine will motor, hold in position until engine fires (see initial start-up section for maximum time starter can be used).

Release key (when engine has started) to RUN position. Ensure alarm buzzer is not sounding and that warning lights are extinguished. If one or both of the alternator warning lights



are still on, then increase engine speed to excite the alternator - then return to idle. The battery charge lights should then go out. The run light will remain on (green lamp).

Check for sea water flow. If no flow then SWITCH OFF IMMEDIATELY AND CHECK SEA WATER SYSTEM.

**Note:** for some deluxe panel with the black keyswitch, they operate clockwise as legend on panel (OFF – RUN – HEAT – START). Operation for engine start procedure is the same as standard apart from this.

## STOPPING

Every propulsion engine is fitted with a stop solenoid which is energised to stop. To stop engine simply press stop push button, hold in until engine stops, then turn key from 'RUN' to 'OFF' position.

When leaving the boat for an extended period,

- Turn off sea-cock (heat exchanger cooled engines).
- Turn off battery isolator.

**Do not turn the key to the off position when the engine is running. This will damage the alternator.**

### \*WARNING ⚠

**Do not leave the key in 'HEAT' position for more than 15 seconds - this will damage the heater plugs and eventually lead to poor starting.**

**Do not depress stop button for more than 10 seconds as this will lead to overheating and failure of the solenoid.**

The Super 5 range of engines are equipped with a mechanical stop lever in the event of electrical system failure. This lever is located on the starboard side of the engine above the speed control lever. See Fig 2e:

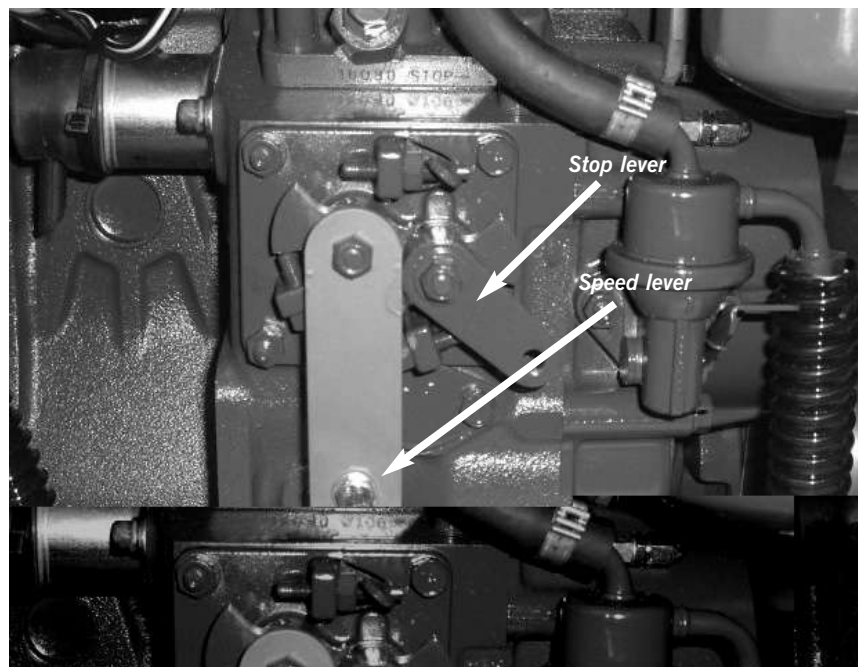


Fig. 2e



# SECTION 2

## MAINTENANCE SCHEDULE

### **DAILY OR EVERY 8 HOURS RUNNING**

- Check engine oil level.
- Check gearbox oil level.
- Check coolant level.
- Check battery fluid.
- Check drive belt tension
- Ensure raw water inlet strainer is clear.
- Check stern gland lubrication.
- Drain off any water in fuel water separator.

### **AFTER THE FIRST 25 HOURS RUNNING**

- Change gearbox lubricant (See separate gearbox manual).
- Check that all external nuts, bolts and fastenings are tight. See table for torque values. Special attention should be paid to the flexible mount lock nuts, these should be checked for tightness, starting with lower nut first in each case. If the lower nuts are found to be very loose, then the alignment of the shaft to the gearbox half coupling should be re-checked. Poor alignment due to loose flexible mount nuts will cause excessive vibration and knocking.
- Check the belt tension on any second alternators fitted and adjust –see page 12.
- Check ball joint nyloc nuts for tightness on both gearbox and speed control levers. Grease both fittings all over.

### **AFTER FIRST 50 HOURS**

- Change engine lubricating oil.
- Change oil filter.
- Check for leaks on header tank tubestack. Tighten end cap bolt if required.
- Drain off any water in fuel/water separator.

### **EVERY 150 HOURS**

- If shallow sump (option) is fitted, change engine lubricating oil and filter.

### **EVERY YEAR – OR EVERY 250 HOURS IF SOONER**

- Change engine lubricating oil (standard sump)
- Change lubricating oil filter
- Check air cleaner element
- Check sea water pump impeller and change if worn.
- Check wasting anode condition, replace when necessary. In some environments this may be 6 montly or less.
- Remove heat exchanger tube stack, by undoing the bolt each end of the tube stack. Remove end cover, pull out tube stack and clean. Replace rubber 'O' rings and re-assemble. Immediately engine is started check for leaks.
- Spray the key switch with WD40 or equivalent to lubricate the barrel.
- Check that all external nuts, bolts and fastenings are tight. See table for torque values.
- Check ball joint nyloc nuts for tightness on both gearbox and speed control levers. Grease both fittings all over.

### **EVERY 750 HOURS – As every 250 hours plus the following:-**

- Change air cleaner element.
- Change fuel filter.
- Change antifreeze.
- Change gearbox oil.
- Check electrical equipment, condition of hoses and belts, replace as necessary.

## LUBRICATION

**Engine oil:** Engine oil should be MIL-L-2104C or have properties of API classification CC/CD/CE grades. The following table gives grades of oil required for various ambient temperatures.

**Note:** A good quality 15W/40 mineral or multigrade oil as used in most diesel car engines will meet these requirements. Do not use 'Turbo Diesel Oil' or additives.

### CHECKING ENGINE OIL LEVEL

For quantities of oil required see section marked 'Technical Specification', Page 4

When checking the engine oil level, do so before starting, or more than five minutes after stopping.

1. To check the oil level, draw out the dipstick, wipe it clean, re-insert it, and draw it out again. Check to see that the oil level lies between the two notches.
2. If the level is too low, add new oil to the specified level - Do not overfill.

### IMPORTANT

When using an oil of different make or viscosity from the previous one, drain old oil. Never mix two different types of oil. Engine oil should be changed after first 50 hours running time and then every year or every 250 hours if sooner. Oil filter is a cartridge type mounted on the port side of the engine.

AMBIENT TEMP	SINGLE GRADE	MULTI GRADE
-30°C TO 0°C	SAE 10W	SAE 10W/30
-15°C TO +15°C	SAE 20W	SAE 15W/40
0°C TO +30°C	SAE 30	SAE 15W/40
25°C AND ABOVE	SAE 30	SAE 15W/40

## CHANGING ENGINE OIL

- (1) Run the engine for 10 minutes to warm up the oil.

- (2) Your engine is provided with a sump drain pump. Unscrew the end cap on the end of the pump, turn the tap to 'on'. Use the hand pump as shown to pump out the oil into a bucket. Turn the tap to off position and replace end cap. See diagram 2c.

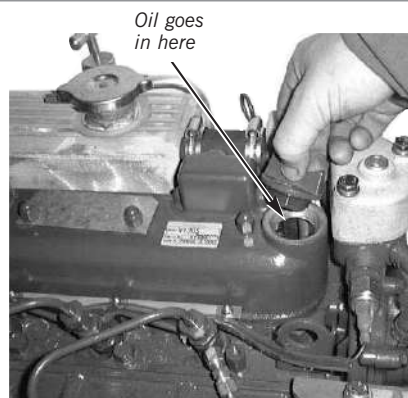


Fig. 2a

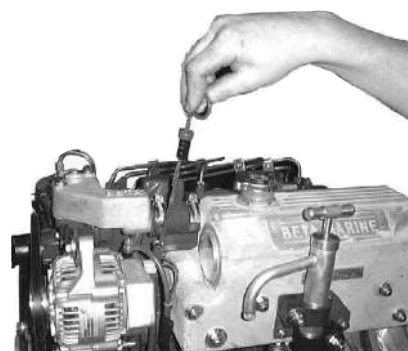


Fig. 2b. Dip stick

- (3) Unscrew the oil filter and replace with a new one. See diagram 2d.

**Note:** It is best to have a plastic bag wrapped round the filter to catch any oil left in the system. (Always keep your bilges clean!) Before screwing in the new filter spread a thin film of oil round the rubber gasket to ensure a good seal and screw in – hand tight.

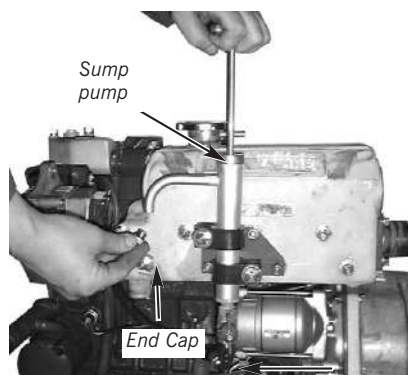


Fig. 2c

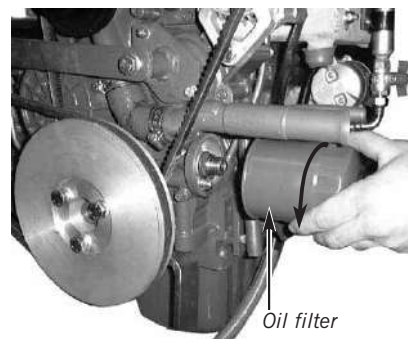


Fig. 2d

- (4) Fill the engine with new oil as described above.

- (5) Run the engine and check for oil leaks

## CHECKING GEARBOX OIL LEVEL

- (1) The gearbox is fitted with a dipstick and oil filler plug, see fig 2e.
- (2) Each engine is supplied with a gearbox operators manual which specifies the type of lubricating oil to be used, the capacity and frequency of changing of the oil.
- (3) New engines are normally supplied with the gearbox topped up with lubricant but **Check the level before starting the engine for the first time.**
- (4) The oil can be changed via the drain plug at the bottom of the

box or sucked out with a hand pump via the filler plug.

- (5) A guide to the type of oil to be used is as follows:

Gearbox	Lubricant	Capacity (approx)
TMC40M	Use ATF Oil	0.2 litres
TMC60M	Use ATF Oil	0.8 litres
PRM 80	Use Engine Oil 15W40	0.6 litres
PRM 120	Use Engine Oil 15W40	0.8 litres
PRM 150	Use Engine Oil 15W40	1.4 litres
PRM 260	Use Engine Oil 15W40	1.5 litres
ZF10M	Use ATF Oil	0.35 litres
ZF15M	Use ATF Oil	0.55 litres
TTMC 35A-2	Use Engine Oil 15W40	0.65 litres

**Note:** ATF is Automatic Transmission Fluid

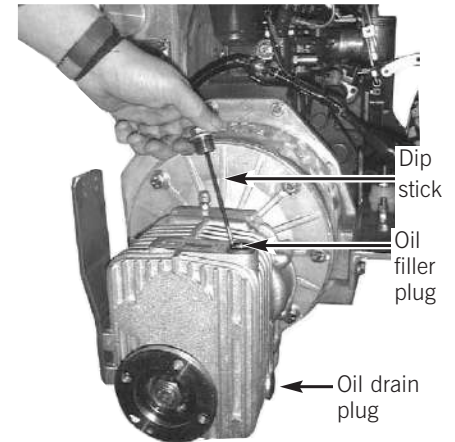


Fig 2e

## FUEL SYSTEM (see page 28 for a typical installation)

### IMPORTANT ⚠

- Always fit a fuel/water separator in the fuel supply system. **Water in the fuel can seriously damage the injection system.**
- If a fuel supply shutoff valve is fitted do not use a taper tap, only use a ball valve tap. The ball valve type are more reliable and less likely to let air into the fuel system.
- Be sure to use a strainer when filling the fuel tank. Dirt or sand in the fuel may cause trouble in the fuel injection pump.
- Always use diesel fuel.
- **Do not use kerosene**, which is very low in cetane rating, and adversely affects the engine.
- Be careful not to let the fuel tank become empty, or air can enter the fuel system, necessitating bleeding before next engine start.

- The fuel lift pump will only lift fuel through 0.25 metres. If this is insufficient then an electric fuel lift pump must be fitted. Drawing 202-06421, illustrating the wiring of a typical electric fuel lift pump with ignition switched relay can be supplied upon request..

### FUEL FILTER REPLACEMENT

1. The fuel filter is a spin on type. Remove by turning anti-clockwise when viewed from below.
2. Replace the fuel filter cartridge every 750 hours. See fig. 2g.
3. Apply fuel oil thinly over the gasket and tighten into position - hand tight.
4. Bleed as detailed - see initial start up.

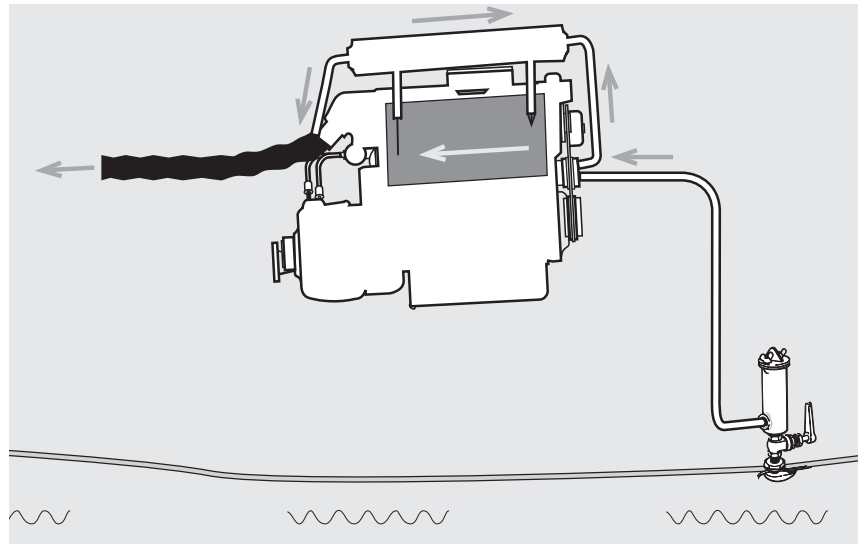
5. Check for leaks.
6. **Do not get fuel on the flexible mounts.**



Fig. 2g

## COOLING

BD1005, BV1305 and BV1505 engines are normally fresh water cooled. This water circulates through the engine and on to a heat exchanger where it is cooled by sea water which is pumped through the cooling tubes. The sea water is then injected into the exhaust system (see diagram).



## FILLING THE FRESHWATER SYSTEM

New engines are supplied with the freshwater drained off. The following instructions must be followed to fill the system.

- (a) Mix up in a clean bucket a 33 to 50% antifreeze to fresh water solution. For the volume required see technical specification page 4.
- (b) Check that the drain tap or plug is turned off. (see fig 2l)
- (c) Fill engine with freshwater/antifreeze solution through the top of the heat exchanger or header tank with the filler cap removed. (see fig 2m).
- (d) Fill header tank to the top of the filler neck and replace cap. Press down firmly on filler cap and hand tighten in a clockwise direction.
- (e) Run the engine for 5 minutes on no load (out of gear) and check coolant level. Top up as necessary.
- (f) Check system for leaks.
- (g) If a calorifier is fitted care must be taken to see that this is also full of coolant and all the air is expelled. (See calorifier fitting notes under Section 3).
- (h) Run the engine on one third load for 15 minutes, preferably with the boat tied up. As the system warms up coolant may be expelled from the overflow pipe into the bilge. Stop the engine and allow the engine to cool down before removing the pressure cap and top up the coolant to one inch below the filler neck.

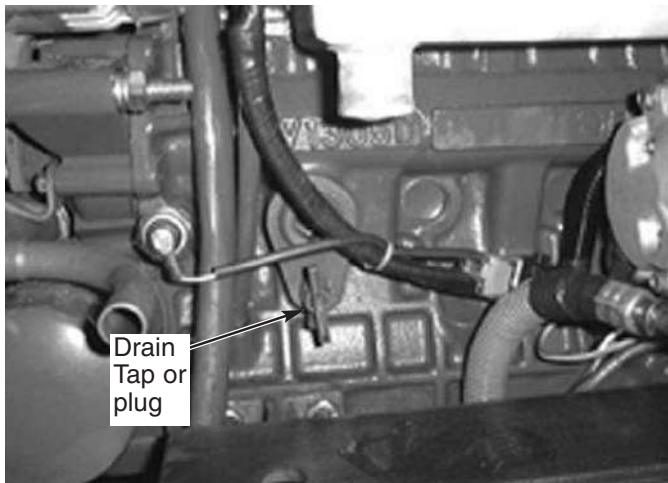


Fig. 2l



Fig. 2m



## IMPORTANT

Removal of the pressure cap when the engine is hot can cause severe injury from scalding hot water under pressure. Always allow the engine to cool and then use a large cloth when turning the cap anti-clockwise to the stop. This allows the pressure to be released. Press firmly down on the cap and continue to turn anticlockwise to release the cap.

- (i) Repeat (h) if coolant level is more than one inch below the base of the filler neck when the engine has cooled down.
- (j) Run engine on  $\frac{2}{3}$  full load for 20 minutes, check for leaks and repeat (i).
- (k) Anti-freeze solutions should be drained off every 2 years and replaced with a new solution.

**Note:** When draining fresh water system, ensure the engine has cooled sufficiently to prevent scalding from hot pressurised water. Prior to draining a cold engine, remove the filler cap from the header tank and then open the water drain tap. This allows the water to drain freely from the system.

## YACHTS AND LAUNCHES WITH HEAT EXCHANGER COOLING

It is essential that a 33% to 50% anti-freeze/water mixture is used. This not only stops freezing up in winter, but it prevents overheating and corrosion.

**The warranty is invalid unless the correct ratio is used.**

Concentration of ethylene should not exceed 50%.

The anti-freeze in the fresh water system enables the boiling point of water to rise to 124°C with a 13 psi pressure cap fitted. The water

temperature alarm switch will however be activated at 95° to 100°C. If no anti-freeze or a very weak solution is used, then the water temperature switch may not be activated before coolant is lost.

## SEA WATER PUMP AND COOLING SYSTEM

### (HEAT EXCHANGER-COOLED ENGINES)

#### CAUTION

Before working on the sea water system ensure that the **sea cock is in the off position**.

- (1) It is very important that the correct sea water flow is maintained to cool the closed circuit system of the engine. The key component in this system is the sea water pump impeller. This should be checked every year by removing the circular plate (see fig. 2h).

- (2) Withdraw the rubber impeller from its drive shaft as shown. See diagram 2i.

- (3) Check impeller for cracks in the rubber, excessive wear or lost vanes. Replace with a new impeller as necessary.

**Note:** If any pieces of rubber impeller are missing then they must be found as they are most likely to be trapped in the entrance to the heat exchanger cooling stack. See 'Cleaning Tube Stack'.

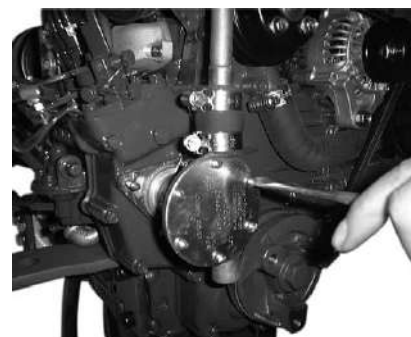


Fig. 2h

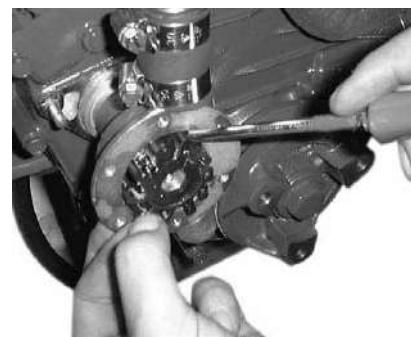


Fig. 2i



## CLEANING THE HEAT EXCHANGER TUBE STACK AND REPLACING WASTING ZINC ANODE

- (1) The wasting zinc anode should be checked every six months and replaced every year or as necessary. The anode is attached to the bolt inserted in the aft end cap of the heat exchanger. See fig. 2j.
- (2) Unscrew the bolt and replace the complete unit with a new one.
- (3) Check for leaks.
- (4) It is possible for fine sea weed and other debris to get past the inlet filter and into the tube stack. This should be removed and cleaned. See fig. 2k.
- (5) Drain off coolant into a bucket.
- (6) Unscrew the 2 end cap retaining bolts (one each end of the tube stack). Remove the 'O' rings and pull out tube stack. Clean tube stack and end caps.
- (7) Re-assemble using new 'O' rings. Do not overtighten end cap bolts and **make sure the tube stack is the right way round.**
- (8) Re-fill engine with water/anti-freeze solution and run engine up to temperature to check for leaks.

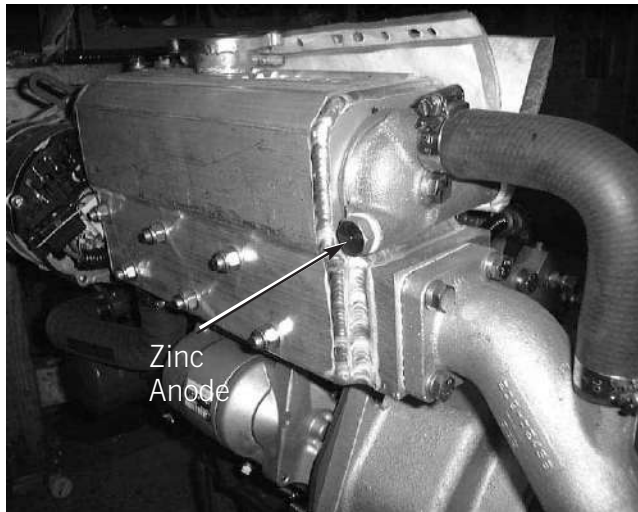


Fig. 2j

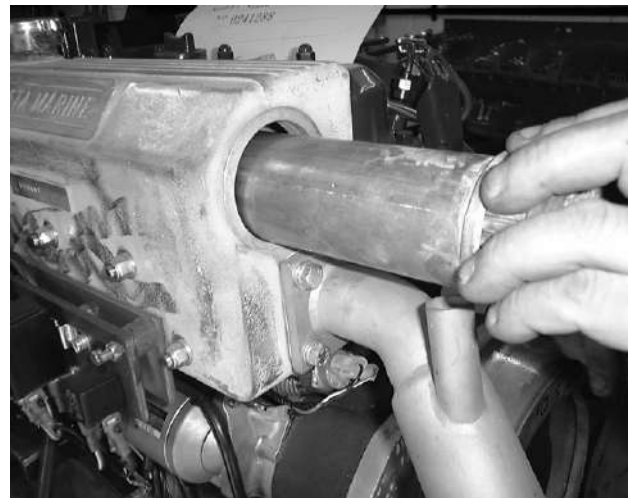


Fig. 2k

## BELT TENSION

### 65 AMP ALTERNATOR (HEAT EXCHANGER COOLED)

#### WARNING

Belt tension must only be checked with the engine switched off.

- (1) On heat exchanger cooled engines a single 65 amp is fitted as standard. These alternators are adjusted as follows.
- (2) The belt tension is adjusted by swinging the alternator outboard as it pivots on its power support bolt.
- (3) With the engine stopped, loosen the support bolts and the link adjusting bolt.
- (4) Push alternator outboard to tension and tighten link bolt. Check that the depression of the belt at position shown is approximately  $\frac{1}{2}$ " or 12 mm when pushed down firmly by thumb. Tighten support bolts.
- (5) Belt tension should be regularly checked especially during the first 20 hours of running in a new belt, as stretching occurs. Belt tension must only be checked with the engine switched off.



Support bolts

### 100 AMP ALTERNATOR (OPTION)

The same method, as outlined above applies, but final tensioning must be by hand only. Over tensioning will

cause premature failure of components.

## AIR INTAKE FILTER

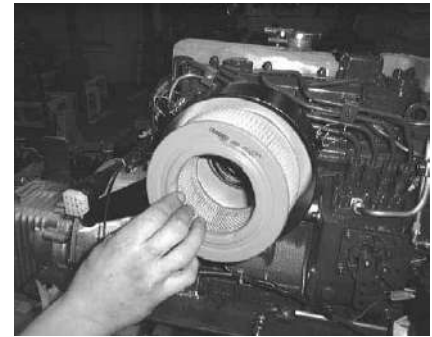
These engines are fitted with an air intake filter which should be checked every season and changed every 2 years or sooner if badly clogged. If badly clogged, check more often.



1



2



3

## MAINTENANCE - ELECTRICAL

### WARNING

Under no circumstances should the battery be disconnected or switched off when the engine is running. This will seriously damage the alternator

### PANELS AND WIRING

See installation notes, page 31.

### GENERAL MAINTENANCE

- (1) The panel must be protected from rain and sea water, see installation. Sea water entering the key switch will eventually cause corrosion and could result in the starter motor being permanently energised and burning out. Spray key switch every month with WD 40 or equivalent.

- (2) Check batteries for acid level and top up if required. For low maintenance and 'gel' batteries see manufacturers instructions.
- (3) Loose spade terminal connections are the most common cause for electrical faults - check on a regular bases (see maintenance instructions).

## WINTERISING AND LAYING UP

### HEAT EXCHANGER COOLED ENGINES LEFT AFLOAT AND ASHORE

- (a) The engine oil and oil filter should be changed at the end of the season rather than in the spring. See section 2.
- (b) The closed circuit system should contain a 50/50 solution of anti-freeze (this also applies to warm and tropical climates).
- (c) For cold climates where the air or water temperatures can fall below 3°C, the sea water circuit must be protected in addition to the fresh water system. This is best achieved as follows:
  - (i) Close the inlet seacock to the engine (engine stopped).
  - (ii) Disconnect the sea water inlet pipe and dip it into a small bucket containing 50/50 anti-freeze solution.
  - (iii) Start the engine (out of gear) and run for 5 to 10 seconds until the anti-freeze is used up and can be seen coming out of the exhaust outlet.
  - (iv) Shut engine off and reconnect the inlet pipe to the seacock.

The sea water or raw water circuit is now protected by anti-freeze.
- (d) Ensure instrument panel is well protected and give the key switch a spray of WD 40 or equivalent.
- (e) With the engine stopped, disconnect the battery (always disconnect the negative cable first and re-connect the negative cable last) and take it ashore for trickle charging and top up as necessary. If AC power is available then this can be done on the boat.
- (f) Fuel tanks should be kept full during the lay up period to eliminate water condensation in the tank. Water entering the fuel injection system can cause considerable damage.

### LAYING UP ASHORE

- (a) Change the engine oil before the boat is taken out of the water.

Warm engine oil is much easier to pump than cold!
- (b) to (f) should be followed as above.

# TROUBLE SHOOTING

Beta diesels are very reliable if installed and serviced correctly, but problems can occur and the following list gives the most common ones and their solution.

## **PROBLEM ENGINE DOES NOT START BUT STARTER MOTOR TURNS OVER OK**

Possible Cause	Solution
No fuel:	Turn fuel cock on and fill tank.
Air in fuel system:	Vent air (see initial start-up)
Water in fuel:	Change fuel filter and bleed system.
Blocked fuel pipe:	Clean out and bleed system.
Fuel filter clogged:	Change filter and bleed system.
Fuel lift pump blocked:	Remove and replace.
Blocked injector:	Remove and clean.
Fuel return not fed back to the tank:	Re-route fuel return pipe.
Heater plugs not working:	Check wiring to the plugs, and replace plugs if they are burnt out.
Stop solenoid stuck in off position.	Check solenoid is free to return to run position.

## **PROBLEM: STARTER MOTOR WILL NOT TURN OR TURNS OVER VERY SLOWLY**

Possible Cause	Solution
Battery discharged:	Charge battery or replace. Check alternator belt tension.
Starter motor flooded with sea water:	Remove and clean or replace.
Wiring disconnected or loose:	Check circuit for loose connections.
Water in cylinders:	Incorrect installation. <b>This is serious</b> - check engine oil for signs of water (creamy-coloured oil). Ring your dealer.
Engine harness fuse blown:	Replace fuse (located by starter motor or above flywheel housing) and check for wiring faults



*FUSE (If located by starter motor, usually it is positioned above flywheel housing at rear of engine)*

**Note:** For convenience, some engines are supplied with a spare fuse and holder attached onto the main engine fuse holder.

## **PROBLEM: ERRATIC RUNNING**

<b>Possible Cause</b>	<b>Solution</b>
Air in fuel supply:	Check supply system for leaks and fix.
Fuel lift pump faulty:	Replace.
Clogged fuel filter:	Replace.
Fuel return not fed back to the fuel tank, or blocked pipe:	Re-route pipe or clean.
Air filter blocked:	Replace.
Worn or blocked injector:	Service injectors.
Engine rpm in gear is too low, this must be 850 min:	Increase engine tick over speed.
Faulty stop solenoid:	Disconnect wiring to solenoid. If running improves check for a wiring fault.
Broken fuel injection pump spring:	Replace.

## **PROBLEM: WHITE OR BLUE EXHAUST GAS**

<b>Possible Cause</b>	<b>Solution</b>
Engine oil level too high:	Reduce the level.
Blocked injector:	Service injectors.
Piston ring and bore worn, giving a low compression:	Get compression checked by your dealer or Kubota service agent. He will advise action to be taken.
Check that the breather pipe is clear and not obstructed:	Remove and clean out.

## **PROBLEM: BLACK EXHAUST GAS**

<b>Possible Cause</b>	<b>Solution</b>
Blocked air filter element:	Inspect and replace
Over pitched propeller - engine will not reach its full rpm:	Get the propeller re-pitched if necessary.
Accumulated debris on hull:	Inspect and clean if required

## **PROBLEM: LOW POWER OUTPUT**

<b>Possible Cause</b>	<b>Solution</b>
Propeller is too big:	Change or depitch.
Check gearbox reduction ratio relative to propeller size:	Change.

## **PROBLEM: LOW POWER OUTPUT**

Possible Cause	Solution
Blocked fuel filter:	Replace.
Blocked air filter:	Replace.
Air in fuel system:	Check system.
Governor spring incorrectly mounted:	Dealer to adjust.
Single lever control not operating correctly:	Disconnect speed control cable and move the lever by hand. Adjust cable.
The electrical load is too large on start up.	Disconnect or reduce the load.

## **PROBLEM: HIGH OIL CONSUMPTION**

Possible Cause	Solution
Oil leaks:	Check for leaks.
Piston rings worn:	Overhaul required.
Valve stem and guide worn:	Overhaul required.
Piston rings gap facing the same direction:	Shift ring gap position.

## **PROBLEM: WATER IN LUBRICATING OIL - (Heat exchanger cooled)**

Possible Cause	Solution
Oil goes "milky" due to sea water entering exhaust manifold:	Check installation - has anti-siphon valve been fitted? Change engine oil and run engine for 10 minutes each time to eliminate any water. Get fuel injection pump and compression checked by Service Agent.

## **PROBLEM: WATER IN LUBRICATING OIL - (General)**

Possible Cause	Solution
Core plug pushed out due to frozen block:	Service Agent to check and replace.
Water pump seal damaged:	Service Agent to check and replace.

## **PROBLEM: WATER IN LUBRICATING OIL - (Keel cooled)**

Possible Cause	Solution
Oil goes "milky" due to water entering exhaust manifold and then into the sump:	Check installation – has dry exhaust system been fitted correctly, ensuring rain water cannot enter the exhaust port and run back? (See DRY EXHAUST SYSTEM) Change engine oil and run engine for 10 minutes each time to eliminate any water. Get fuel injection pump checked by Service Agent.



**PROBLEM: LOW OIL PRESSURE WARNING LIGHT COMES ON WHEN ENGINE SPEED REDUCED TO TICK OVER:**

Possible Cause	Solution
Faulty switch sender:	Replace.
Engine running too hot:	Check cooling water flow (see section 2 Cooling).
Oil relief valve stuck partially open with dirt:	Remove and clean.
Blocked oil filter:	Change.
Wiring fault:	Check circuit.
Insufficient oil:	Top up and check for leaks.

**PROBLEM: PANEL REV COUNTER NOT WORKING (WHEN FITTED)**

Possible Cause	Solution
No W connection to alternator.	Check power output from 'W' connection. Should be about 9V AC.
Wiring fault:	Check circuit.

**PROBLEM: ENGINE OVERHEATS**

Possible Cause	Solution
Check coolant level:	Top up.
Insufficient sea water flow:	Clear blocked intake or filter.
Damaged or worn pump impeller:	Replace.
Blocked tube stack in heat exchanger:	Remove tube stack and clean - replace 'O' rings.
Zinc anode flakes blocking tube stack:	Remove and clean tube stack as above.
Pressure cap loose:	Replace.
Switch sender faulty:	Replace.
Inlet sea cock is too small:	Replace (see heat exchanger cooled seawater inlet system in section 3).
High exhaust back pressure:	Must not exceed 3.1" of Hg.
Air locks in cooling pipe work to keel cooler:	Vent the system and top up coolant.
Keel cooler of insufficient size:	Contact boat builder.

## GENERAL -HEAT EXCHANGE ONLY:

The most common cause of overheating is insufficient seawater flow due to a blocked intake (weed or a plastic bag!). If this happens then clear the blockage. If the problem is not cured then check the system for sea water flow which should be 6.5 litres / minute minimum at 1,000 rpm as follows:

(a) With the boat tied up and out of gear run the engine up to 1000 rpm.  
\*Hold a plastic bucket over the

exhaust outlet for 10 seconds and measure the amount of water collected. Multiply this value by 6 to give the flow in litres/min. Repeat twice and take an average. If the flow rate is noticeably less than the 6.5 litre per minute minimum, then:

(b) Check impeller in sea water pump - if worn replace.

(c) If impeller has a vane missing then this will be lodged either in the

pipe to the heat exchanger or in the end of the exchanger. This must be removed.

(d) Check flow again as in (a).

**\*Note:** This operation must only be done in safe conditions, in port and with two assistants.

Working from a rubber dinghy is best. The person holding the bucket should take precautions against breathing in the exhaust gasses.

## PROBLEM: KNOCKING NOISE

Possible Cause	Solution
Propshaft touching gearbox output coupling through split boss or Type 16 coupling:	Adjust, giving correct clearance (10mm) between gearbox and propeller shaft.
Flexible mount stud touching engine bed:	Adjust stud to clear.
Drive plate broken:	Replace / repair.
Engine touching engine bed:	Re-align engine / modify bed.

## PROBLEM: BATTERY QUICKLY DISCHARGES

Possible Cause	Solution
High load and insufficient running:	Reduce load or increase charging time. Large domestic battery banks subject to high electrical loads will take a considerable time to recharge from a single alternator.
Low electrolyte level:	Top up.
Fan belt slipping - black dust in engine compartment: Engine compartment temperature too high:	Adjust tension / replace belt with a high temperature and/or improve engine compartment ventilation.
Alternator defective:	Check with Agent.
Battery defective:	Replace.
Poor wiring connection:	Check wiring system.

## **PROBLEM: TRANSMISSION NOISE**

Possible Cause	Solution
Check gearbox oil level:	Top up.
“Singing” propeller:	Check with supplier.
Drive plate rattle at tickover:	Check engine rpm (must be 850 rpm minimum in gear).
Worn drive plate:	Change.
Propellor shaft hitting the gearbox half coupling:	Move shaft back to give at least 5mm clearance (type 12/16 couplings only)

## **PROBLEM: VIBRATION**

Possible Cause	Solution
Poor alignment to shaft:	The alignment must be accurate even if a flexible coupling is used (see section 3 ALIGNMENT).
Flexible mounts not adjusted correctly to take even weight:	Check relative compression of each mount.
Flexible mount rubber perished:	Replace. (Diesel or oil will eventually perish most rubbers.)
Loose securing nut on flexible mount:	Check alignment and then tighten the nuts.
Insufficient clearance between the propeller tip and the bottom of the boat:	There must be at least 10% tip clearance between propeller and bottom of the boat (ie 10% of the propeller diameter as clearance). Refer to boatbuilder.
Loose zinc anode on the shaft:	Tighten or replace.
Worn cutless bearing or shaft:	Replace.
Weak engine support/bearers:	Check for cracked or broken feet.

## **PROBLEM: MORSE CONTROL CABLE WILL NOT FIT**

Possible Cause	Solution
Fitting incorrectly	Cables are being fitted the wrong way around, switch over and fit the opposite way.

# ELECTRICAL FAULT FINDING & TROUBLE SHOOTING – ENGINES BUILT AFTER JULY 2005 ONLY

The following chart is compiled to aid diagnosis of electrical faults, based on the Beta 10-90hp range of engines. If your engine was built before July 2005, contact Beta Marine for the relevant electrical trouble shooting guide.

Standard sea specification engines (heat exchanger cooled) are supplied with a single alternator, mounted port side, supplying power to starter battery and control panel.

Standard canal specification engines (keel cooled) are supplied with twin alternators:

- 1st alternator, mounted port side, supplying power to starter battery and control panel
- 2nd alternator, the standard mounting position for this is above the engine on the starboard side (or below 1st alternator on 75 & 90hp), supplying power to the domestic battery system.

Both of these alternators work independently, if the domestic battery system is disconnected, the engine will still run correctly but:

- Domestic charge warning lamp will not function
- Warning buzzer will remain on at all times

Standard control panels are supplied with four or five lamps:

Four lamp panels:

A, ABV, ABVW, B, these panels utilise bulbs inside sealed lamp holders

Five lamp panels:

AB or Deluxe C, these panels also utilise bulbs inside sealed lamp holders, having an additional lamp for domestic battery charge

With keyswitch\* in run position & engine off:

- Red lamp for no starter battery charge should function
- Red lamp for no domestic battery charge should function (**Note: this will only function if a second alternator is fitted to the engine and connected to a charged battery**)

All Beta panels have the following warning lamps:

(A, AB, ABV, ABVW, B and C Deluxe)

Starter battery charge warning lamp



Red

- High engine temperature warning lamp



Red

- Low engine oil pressure warning lamp



Red



All panels also have:

- Panel power on (this is not a warning lamp)



Green

In addition to above the domestic AB, C Deluxe panels also have a:

- Domestic battery charge warning lamp



Red

- Red lamp for high engine temperature should not function (when engine is cold / cool / warm). This lamp will only ever function if the engine is over temperature.
- Red lamp for low oil pressure should function
- Green lamp for panel power on should function
- Buzzer should sound

*\* For operation of engines controlled with keyless panels refer to 'correct operation of keyless panels' later in this section*

When the engine is started, all the red warning lamps should switch off leaving just the green power on indication lamp illuminated. The oil pressure lamp may take a few seconds to switch off and the charge fail lamp may remain on until engine rpm is increased to approximately 1,000rpm (if the engine was started at tickover).

Before investigating any specific electrical problem, always check:

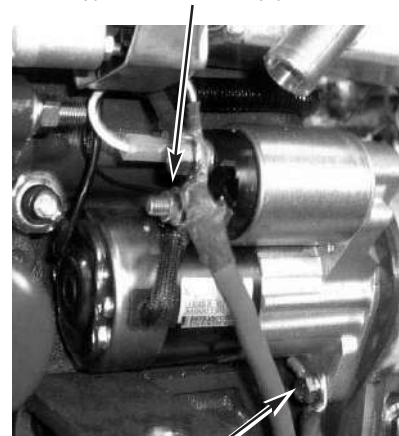
- Connection between panel harness and panel loom. It must be clean, dry and secured with a cable tie.
- Check the start battery is connected to the correct terminal on the starter motor.
- Check the domestic battery is

switched on and connected to the correct terminals for the 2nd alternator.

- Battery connections, inspecting condition of cables from battery to engine. If in doubt measure the voltage at the engine.
- If alternator charge problem, measure battery voltage with engine off and again with engine running, if there is an increase alternator is functioning correctly, if not refer to check list.

**Note:** The two way plug on panel loom will only have a corresponding socket to connect into from the engine if a 2nd alternator is fitted which requires this connection. Engines with only one alternator do not utilise this connection.

Typical start battery positive



Typical start battery negative

## ELECTRICAL FAULT FINDING – ALL LAMP PANELS

### PROBLEM

### POSSIBLE CAUSE & SOLUTION

No warning lamps or buzzer functioning, engine will not start or stop

- Battery isolation switch in off position –switch on
- Starter battery discharged – charge
- Engine fuse blown –check fuse (above starter motor or flywheel housing) & replace if necessary.
- Check for wiring faults.

Non function of warning lamp

**THE WATER TEMPERATURE LAMP WILL NOT FUNCTION UNLESS ENGINE IS OVERHEATING OR THERE IS A WIRING FAULT**

- Disconnect switch wire to non-functioning lamp: green/blue –water temperature, white/brown – oil pressure, brown/yellow –alternator charge. Reconnect wire temporarily to another warning lamp that is functioning; if wire switches lamp on replace faulty lamp.
- Disconnect positive feed to non-functioning lamp. Reconnect temporarily with wire from another warning lamp that is functioning, if wire switches lamp on rewire with new connection.
- If none of the above, check continuity of connections from panel to engine.

Water temperature warning lamp on when engine is not over temperature

**If engine is cold:**

- Faulty wiring, check connection & continuity (small green / blue) from switch to panel lamp. Ensure this connection is not shorting to earth (ground).
- Faulty temperature switch –if lamp switches off on removal of connection to switch unit, replace.

**(Not B or Deluxe C panel see table on following page)**

**If engine is warm:**

- Switch wire connected to large sender terminal of switch / sender unit. Remove and refit to smaller (switch) terminal

Buzzer not functioning

**THE BUZZER WILL NOT SOUND FOR GREEN POWER ON LAMP**

- - If lamp is functioning but buzzer not sounding, check connection & continuity from illuminated warning lamp (red not green) to buzzer board.
- - Faulty warning panel buzzer board –replace.

Starter battery charge lamp not functioning

**If tacho not functioning:**

- Alternator not connected properly, check continuity of small brown wire from rear of alternator to 'AC' position on keyswitch.
- alternator connected properly, faulty alternator –replace

**If tacho functioning correctly:**

- Check continuity of small brown/yellow wire from rear of alternator to no charge warning lamp on rear of panel.
- If alternator connected properly, faulty panel warning lamp –replace

Tacho not functioning

- -Check connections on rear of tacho, especially black/blue wire, terminal '4'
- -Check connection of black/blue wire on rear of 1st alternator (W connection, usually a bullet on flying lead, or lowest connection on alternators with 3 pin coupler)
- -Check continuity of black/blue wire from alternator to tacho
- -Measure voltage from alternator W connection to earth (ground), should be approx. 7.5 – 9.0 volts AC

Domestic charge lamp not functioning, buzzer remains on with engine running

- Domestic battery not connected
- Domestic battery not connected correctly:  
B+ to domestic isolation block on starboard rail (port on 75 & 95hp)  
B- to engine earth (ground)
- Domestic battery flat
- Panel relay faulty / incorrectly wired:  
Check voltage at relay terminal 86, white wire is positive feed for warning lamp from AC position of keyswitch.

Domestic charge lamp not functioning, buzzer switching off with engine running

**THIS LAMP WILL NOT FUNCTION IF A SINGLE ALTERNATOR IS FITTED**

- No second alternator fitted to engine, domestic lamp not used
- D+ (charge indication) lamp connection at rear of alternator not connected
- Two way plug & socket disconnected between engine harness & panel loom



## ELECTRICAL FAULT FINDING – DELUXE C & WATER TEMPERATURE FUNCTION ON B PANELS

In addition to the fault finding detailed on the previous table, the following is specific for the C deluxe panel (Also applicable for the B panel with Murphy water temperature gauge)

PROBLEM	POSSIBLE CAUSE & SOLUTION
Oil pressure warning lamp not functioning, oil pressure gauge showing maximum deflection. Engine off and keyswitch in run position	<ul style="list-style-type: none"> <li>Faulty wiring –check wire connection &amp; continuity (small white/brown) from sender to panel lamp. Ensure this connection is not shorting to earth (ground).</li> </ul>
Oil pressure gauge showing no movement - even when engine is started. Warning lamp functioning correctly	<ul style="list-style-type: none"> <li>Faulty wiring –check oil pressure sender wire (small white / brown) is connected.</li> </ul>
Oil pressure showing no movement, Warning lamp not functioning correctly	<ul style="list-style-type: none"> <li>Check connection to oil pressure gauge, if plug is not connected to socket on rear of gauge reconnect.</li> <li>If all connections are correctly made, possible faulty sender unit –check resistance to earth (ground) approx. 50Ω. Replace if no reading or short-circuited.</li> <li>If adjusted correctly &amp; buzzer still sounding, possible faulty switch gauge unit – replace.</li> </ul>
Oil pressure showing normal operating pressure (0.75–5 bar). Buzzer sounding & lamp illuminated.	<p><b>Engine warm:</b></p> <ul style="list-style-type: none"> <li>Incorrectly calibrated switching point for warning lamp, adjust on rear of gauge to 0.5 bar (minimum adjustment on gauge).</li> <li>If adjusted correctly &amp; buzzer still sounding, faulty switch gauge unit – replace.</li> </ul>
Water temperature gauge showing 120°C / 250°F	<p><b>Engine cold / cool:</b></p> <ul style="list-style-type: none"> <li>Faulty wiring, check water temperature sender wire is not shorting to earth (ground)</li> <li>Faulty sender unit, –check resistance to earth, approx. 3.5kΩ (cold) – 0.5kΩ (warm). Replace if notably less.</li> </ul>
Water temperature gauge showing normal operating temperature (85°C). Buzzer sounding & lamp illuminated.	<p><b>Engine warm:</b></p> <ul style="list-style-type: none"> <li>Incorrectly calibrated switching point for warning lamp, adjust on rear of gauge to 100°C/210°F.</li> <li>If adjusted correctly &amp; buzzer still sounding, faulty switch gauge unit – replace.</li> </ul>
Water temperature gauge showing no movement, lamp not illuminated, engine warm.	<ul style="list-style-type: none"> <li>Check connection to sender, if disconnected gauge will not function.</li> <li>Check connection to temperature gauge, if plug is not connected to socket on rear of gauge reconnect.</li> <li>If all connections are correctly made, faulty sender unit –check resistance to earth, approx. 3.5kΩ (cold) – 0.5kΩ (warm). Replace if no reading.</li> </ul>

**THIS ALSO APPLIES TO THE B PANEL WITH MURPHY GAUGE**

**THIS ALSO APPLIES TO THE B PANEL WITH MURPHY GAUGE**

**THIS ALSO APPLIES TO THE B PANEL WITH MURPHY GAUGE**

# ELECTRICAL – CORRECT OPERATION OF KEYLESS PANELS

These panels control the engine with three water resistant push buttons instead of a keyswitch, which are less prone to damage and corrosion from sea water spray than a keyswitch.

To operate the engine:

- 1. Press and hold 'HEAT' button for ten seconds maximum
- Red lamp for no starter battery charge should function
- Red lamp for high engine temperature should not function (when engine is cold / cool / warm). This lamp will only ever function if the engine is over temperature.
- Red lamp for low oil pressure should function

- Green lamp for panel power on should function
- Buzzer should sound
- 2. Press 'START' button and hold in position until engine fires (see initial start-up section for maximum time starter can be operated). Release button (when engine has started)
- All red warning lamps should extinguish and buzzer should stop sounding. The oil pressure lamp may take a few seconds to switch off and the charge fail lamp may remain on until engine rpm is increased to approximately 1,000rpm if the engine was started at tickover.

- Green lamp for panel power on should still function
- 3. To stop the engine press the 'STOP' push button, hold in until engine stops. This button also switches the power off to the gauges, engine and power on lamp.
- 4. To re-start the engine, simply repeat steps from '1' above, there is not need to switch battery isolators off **whilst remaining on board.**
- 5. If leaving the boat, isolate start battery from engine and panel, to prevent accidental start up of engine.

# ELECTRICAL FAULT FINDING –NON BETA PANELS

Engines can be supplied wired up to suit VDO switch senders, usually fitted to a non-Beta control panel.

If so refer to our wiring diagram 200-60971/01 (also part number for replacement harness)

- Loom is configured differently in the 11-way plug to accommodate the extra wiring.
- Small brown wire (battery sensed alternator feed) fitted with bullet connection beside harness plug.
- Oil pressure & water temperature switch / senders fitted to engine, requiring individual connections for driving gauges & warning lamps.

**Note:** Water temperature switch / sender (Part number 200-01133)

- large spade is sender connection (green / blue)
- small spade is switch connection (blue / yellow)

Oil pressure switch / sender (Part number 200-62680)

- G Gauge wire (white / brown)
- M Earth (black)
- WK Warning lamp (green / yellow)

# ELECTRICAL FAULT FINDING –EXTENSION HARNESSSES

Some installations require one of the panel extensions 11 way connectors to be removed to allow the cable to be passed through bulkheads etc. If any panel problems are experienced after this may have been carried out, visually check all 11 way connections on engine harness to panel extension

(and panel extension to panel on **Deluxe C**) to ensure wire colours to each terminal match up to the correct colour in its corresponding terminal. Extra attention must be given to black (ground) and black/blue (tacho), also brown (switched positive to alternator) and brown/yellow (charge fail) as

these connections are harder to distinguish between in poorly lit areas. Whilst doing this check integrity of each connection to ensure terminals have not become damaged. Once checked, re-fit cable tie around each connection to keep them secure.

## BETA P/N'S FOR REPLACEMENT ITEMS:

Description	Part number
40 amp blade fuse (all panels)	200-00959
Alarm board –all panels from June 05	200-04655
Oil pressure switch 1/8" BSP (not C panels)	600-62670
Oil pressure sender (C panels only)	200-94350
Oil pressure switch gauge (C panels only)	200-96190
Temperature switch with single terminal (on some BZ602 & BD902)	600-62820
Temperature switch / sender 1/8"BSP (not B or C panels)	200-01133
Temperature sender (B & C panels only)	200-94360
Water temperature switch gauge (B & C panels only)	200-96200
Voltmeter (C panels only)	200-96210
28Ra relay 12V 40A (fitted to rear of domestic panels)	200-87020
Keyswitch, silver bezel	600-00057
Panel stop button (all panels) –Also heat and start on ABVW	200-00072
Tacho, 0-4000rpm with digital hour counter (all panels but A)	200-02373
Standard engine harness Mini Series	200-98380/01
Standard engine harness S5 Series	200-60973/05
Standard engine harness S3 series	200-05267
Iskra 65 amp sub loom	200-01196
1m panel extension loom	200-04588/01
2m panel extension loom	200-04588/02
3m panel extension loom	200-04588/03
4m panel extension loom	200-04588/04
Domestic charge engine sub loom (top mounted alternators)	200-01197
Green power on indicator lamp & retaining clip	200-04656
Red warning indicator lamp & retaining clip	200-04657

**Note:** the above part numbers are suitable for earth return installations only (where battery negative cable is connected directly to engine ground). For insulated earth (where battery negative cable is isolated from engine ground) different harnesses,

alternators, switches for oil pressure and engine temperature will be required. If your application is wired as insulated earth return and the engine will not operate correctly, always check starter battery negative is connected to the correct terminal

on the isolating solenoid. It should be connected to the terminal which is also used for all the small black wires, **NOT the terminal with the single black wire connected directly to engine ground.**

# Spanner torque settings

Tightening Torques for general use bolts and nuts

ITEM	Size x Pitch	kgf·m	ft·lbs	N·m
M6 (7T) : 6mm (0.24in)	–	1.0~1.15	7.2~8.3	9.8~11.3
M8 (7T) : 8mm (0.31)	–	2.4~2.8	17.4~20.3	23.5~27.5
M10 (7T) : 10mm (0.39in)	–	5.0~5.7	36.2~41.2	49.0~55.9
M12 (7T) : 12mm (0.47in)	–	7.9~9.2	57.1~66.5	77.5~90.5

Tightening Torques for special use bolts and nuts

ITEM	Size x Pitch	kgf.m	ft.lbs	N.m
Head Bolts	M10 x 1.25	6.5 ~7.0	47.0~50.6	63.7~68.6
Bolts, Connecting Bolts	M8 x 1.0	4.2~4.7	30.4~34.0	41.2~46.1
Bolts, Flywheel	M10 x 1.25	5.5~6.0	39.8~43.4	53.9~58.8
Bolts 1, Bearing Case	M8 x 1.0	3.0~3.5	21.7~25.3	29.4~34.3
Bolts 2, Bearing Case	M9 x 1.25	5.0~5.5	36.2~39.8	49.0~53.9
Nozzle Holder Assembly	M20 x 1.5	5.0~7.0	36.2~50.6	49.0~68.6
Caps Nuts, Head Cover	M7 x 1.0	0.7~0.9	5.1~6.5	6.9~8.8
Glow Plugs	M10~1.25	2.0~2.5	14.5~18.1	19.6~24.5
Oil Switch	PT 1/8	1.5~2.0	10.8~14.5	14.7~19.6
Nuts, Rocker Arm Bracket	M7 x 1.0	2.2~2.7	15.9~19.5	21.6~26.5
Bolts, Idle Gear Shaft	M6 x 1.0	1.0~1.15	7.2~8.3	9.8~11.3

# Section 3

## INSTALLATION RECOMMENDATIONS

The installation details contained herewith are basic guidelines to assist installation, due to great diversity of marine craft it is impossible to give definitive instructions. Therefore Beta Marine can accept no responsibility for any damage or injury incurred during the installation of a Beta Marine Engine whilst following these guidelines.

- All engines shall be placed within an enclosure separated from living quarters and installed so as to minimise the risk of fires or spread of fires as well as hazards from toxic fumes, heat, noise or vibrations in the living quarters.
- Unless the engine is protected by a cover or its own enclosure, exposed moving or hot parts of the engine that could cause personal injury shall be effectively shielded.
- Engine parts and accessories that require frequent inspection and / or servicing must be readily accessible.
- The insulating materials inside engine spaces shall be not combustible.

## ENGINE MOUNTING



To ensure vibration free operation, the engine must be installed on substantial beds, extending as far forward and aft as possible and well braced to form an integral part of the hull.

The engine must be installed as low as possible on the flexible mount pillar stud. This will limit vibration

and extend the life of the flexible mount. If necessary, fit spacer blocks below the mounts.

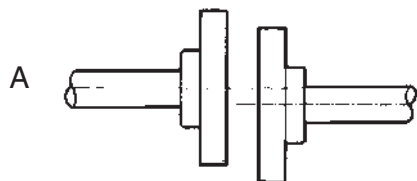
A flexible coupling should be fitted. Flexible couplings do not accommodate bad alignment. The mating faces of the gearbox and tailshaft must be checked for alignment, they must be parallel and concentric to within 0.005" (0.127mm).

### WARNING

1. Do not set the engine feet high up the flexible mount pillar stud. This will cause excessive engine movement and vibration. Pack under the flexible mount with steel shims securely bolted into the engine bearer.
2. The pillar stud on the flexible mount is secured into position by the lower locknut, do not forget to tighten this. **Also ensure that the stud is not screwed too far through the mounting body so that it can touch the bearer. This will cause vibration and knocking noises which are very hard to find!!**

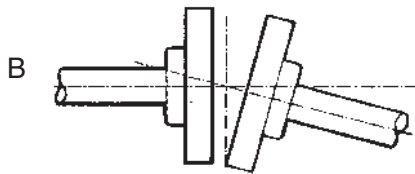
## ALIGNMENT

Alignment must be checked for parallel (A) and concentric (B) misalignment using a set of feeler gauges.



To obtain accurate alignment the flexible mountings must be adjusted until alignment is attained, and the mountings must be locked in position.

Once mounts are tightened, alignment must be re-checked. Coupling can now be fitted in accordance with instructions supplied with coupling.





# EXHAUSTS

(a) A correctly installed engine as described in this handbook will meet the exhaust emission requirements of Directive 2003/44/EC amending the Recreational Craft Directive 94/25/EC.

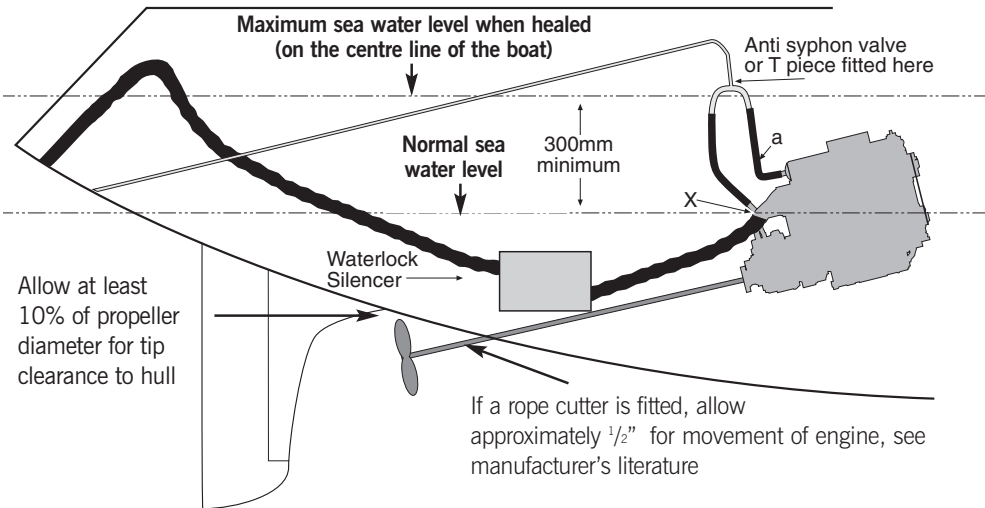
(b) For compliance with exhaust emissions requirements, engines must have correctly installed exhaust systems. To ensure exhaust emissions are kept within permissible limits it is most important to reduce exhaust back pressure to a minimum, whilst ensuring exhaust is adequately muffled. Back pressure increases as exhaust length increases and from bends in the exhaust system. The exhaust back pressure,

	BD1005	BV1305	BV1505
Standard	50mm	50mm	50mm
Option 1 5/8" is available in SS	1 5/8"	N/A	N/A
High rise water injection bend SS	50mm	50mm	50mm
Option high rise water injection bend SS	1 5/8"	N/A	N/A
Cross over injection bend SS to suit Volvo replacement engines.	50mm	50mm	50mm

measured with the exhaust system connected and the engine running at full speed, must not exceed 80mmHg (3.1 inches Hg / 42 inches WG). The correct measuring point is at the position where the exhaust connects to the exhaust manifold. That is

before the water injection elbow or dry exhaust bellows.  
Wet Exhaust hose should be matched to the injection bend sizes, see above.

## TYPICAL YACHT INSTALLATION



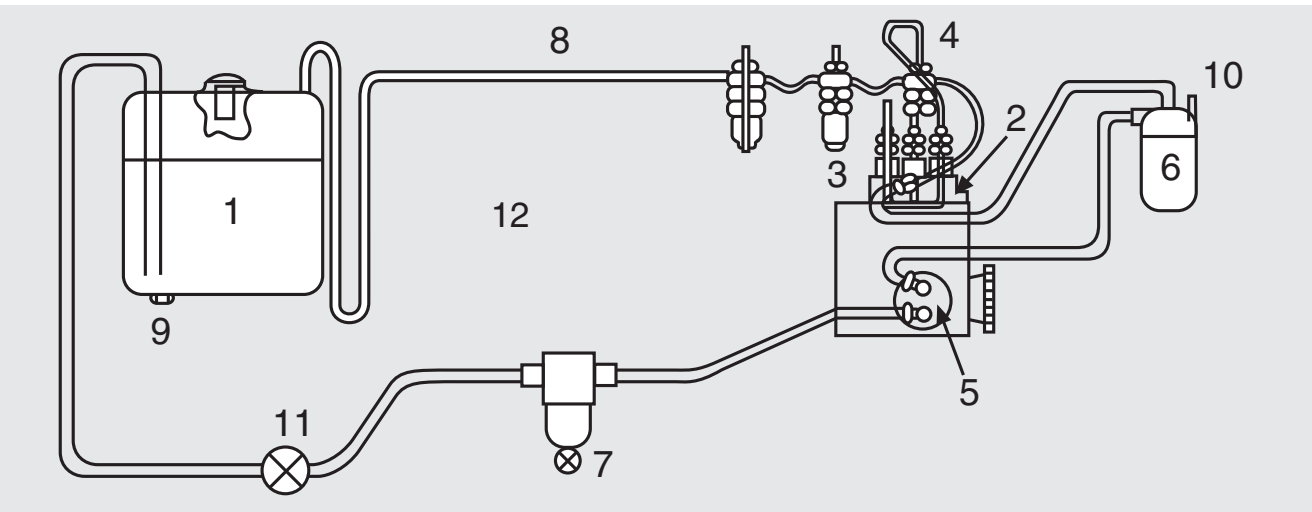
### WARNING:

(1) One of the most common problems with engine installation is water entering the exhaust manifold from the exhaust system by syphoning. This can occur when the point of water injection (X) on the engine is close to or below the water line. Water entering the pistons can cause bent con rods, emulsified

engine oil and a wrecked fuel pump! Its best avoided!  
(2) The diagram shows a typical installation. It is essential that the small black rubber hose connecting the heat exchanger with the injection bend is removed and replaced by a hose marked 'a'. This must be of sufficient length to

supply either a T piece or an anti syphon valve sited at least 300mm (12 inches) above the water line and on the centre line of the boat. The pipe then returns to the injection bend and the sea water is pumped down the exhaust pipe.  
(3) The exhaust back pressure should not exceed 3.1 inches of Hg.

**FUEL SUPPLY & LEAK OFF** - A typical system is shown below



- |                      |  |                          |                     |
|----------------------|--|--------------------------|---------------------|
| (1) Fuel tank        | (4) Injection pipe                               | (7) Fuel water separator | (10) Air vent       |
| (2) Injection pump   | (5) Mechanical fuel feed pump with priming lever | (8) Overflow/leak off    | (11) Stop cock      |
| (3) Injection nozzle | (6) Fuel filter                                  | (9) Drain plug           | (12) Fuel pipe loop |

**Notes:**

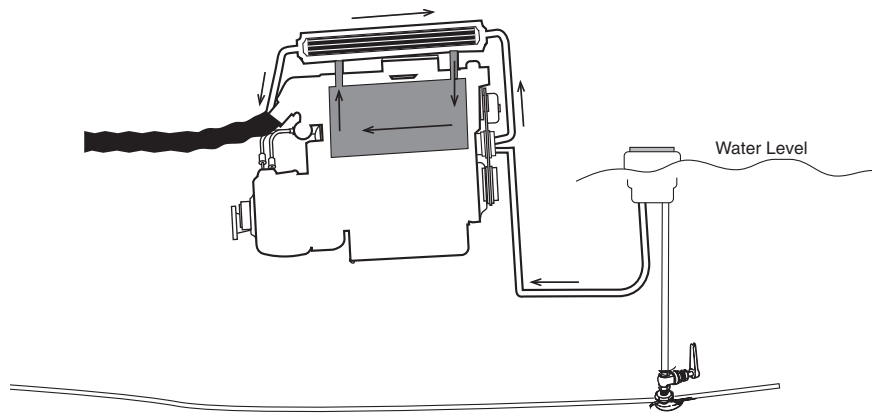
1. The mechanical fuel lift pump is fitted to all engines as standard, but if a suction head of 0.25m is required then an electric fuel lift pump must be fitted (ask your dealer or Beta Marine).
2. It is very important that the excess fuel from the injectors is fed back to the fuel tank and not back to any point on the supply line. This will help prevent air getting into the system.
3. Fuel pipe sizes are:

	Supply (mm)	Leak off (mm)
	8	8
4. Any fuel leaks in the system are likely to cause poor starting and erratic running and must be corrected immediately.
5. **A fuel/water separator must be installed.**
6. The fuel return (leak off) pipe must loop down to be level with the bottom of the tank before it enters the top of the tank - see 12. This prevents fuel 'drain down'.
7. Fuel lines and hoses must be secured and separated or protected from any source of significant heat. The filling, storage, venting and fuel supply arrangements and installations must be designed and installed so as to minimise the risk of fire and explosion. Flexible fuel hoses connecting the engine to fuel tank supply and return lines must meet the requirements set in standard ISO 7840:1995/A1:2000 and as required by your surveyor / authority.

## SEAWATER INLET SYSTEM (HEAT EXCHANGER COOLED ENGINES)

Your engine is fitted with a gear driven sea water pump which sucks in seawater or raw water to cool the closed circuit system via the heat exchanger.

1. It is very important that the seawater inlet should have a strainer system either built into the sea cock or a high level system with visual inspection glass, as shown, mounted just above the water line.
2. The inlet sea cock and pipe work to the sea water pump should be 22mm ID or 3/4" minimum.
3. Good access to the inlet sea cock is essential so that plastic bags or sea weed trapped in the intake can be poked out!
4. All pipe work should have approved marine grade stainless steel hose clips. Any loose clamps or bad connections can



- cause flooding and sinking of the vessel.
5. If water is required for stern tube lubrication then this should be taken from a 'T' piece in the pipe going from the heat exchanger outlet to the water injection bend.
  6. Scoop type water pickups should never be used, as water will be forced through the pump and into the exhaust system whilst

the vessel is in motion. This is very dangerous as the exhaust will eventually fill and raw water will back up into the engine through the exhaust valve. Catastrophic failure will result as soon as the engine is restarted.

**Note:** The maximum lift of the sea water pump is 2m

## CALORIFIER SYSTEM

All Beta engines can be fitted with the engine tappings to allow the hot water from the closed fresh water/antifreeze system to circulate through a calorifier tank which in turn heats up domestic water.

Calorifier tappings on this range of engine are shown.

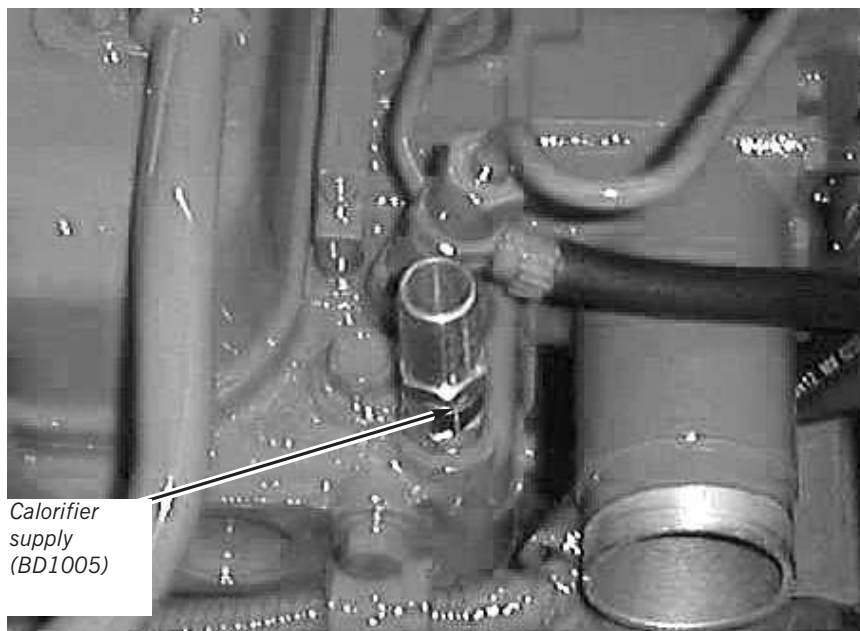
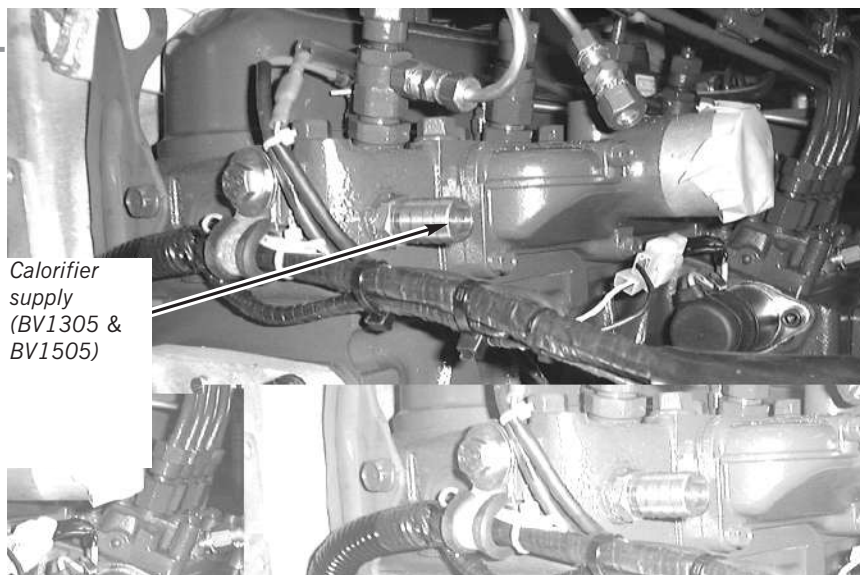
1. The big problem with a calorifier is to remove all the air from the system. If this is not achieved then they don't work!
2. Try and keep the supply and return pipes either horizontal or sloping down in a continuous fall towards the calorifier. This avoids air pockets being created.
3. Extra care must be taken when first filling the calorifier circuit system with 50% antifreeze to water solution as the engine may appear to be full but it soon disappears into the calorifier pipe work. Run the engine off load for 10 minutes then check the level as described in 'Filling The Fresh Water System'.

Also check to see if the pipe going to the calorifier is getting warm after 15 mins. Top up the water level as required and run for another 10 minutes then repeat.

4. If the water level is steady but no warm water is getting to the calorifier then very carefully open the calorifier bleed valve (see manufacturers instructions) or if none is provided then very carefully loosen the jubilee clip securing the supply pipe to the calorifier. Air should escape. Refasten securely when no further bubbles are seen.

### CAUTION

Do not do this when the engine is hot as scalding hot water may be forced out of the pipe under pressure.



## ELECTRICAL INSTALLATIONS

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Beta has 6 panels: A -standard  
AB or ABV  
or ABVW  
B  
C

The engine harness is common to all.

1. These panels must not be installed where sea water spray can get at them. A suitable flap or cover must be fitted.
2. Panels must be fitted in a location where the helmsman can either see or hear the alarm system.
3. For standard wiring diagrams see following pages.
4. Extension looms longer than 3m (10 feet): As an option, Beta can provide various lengths of extension looms for runs of over 3m, but this kit includes a start relay to overcome the voltage drop. (See drawing 300-58520)
5. All electrical equipment must be protected from sea water. Sea water or rust in the starter will invalidate the warranty. Care must be taken when pushing the two halves of the plug together to ensure that individual pins do not fall out. To prevent corrosion and assist in assembly we recommend that the plug is packed with petroleum jelly (Vaseline) and then carefully pushed together. The plastic boots should cover both halves and overlap. A cable tie is then put around to hold the two halves in position and help prevent any ingress of water.
6. All cables must be adequately clipped and protected from abrasion.
7. Electrical systems shall be designed and installed so as to ensure proper operation of the craft under normal conditions of use and shall be such as to minimise risk of fire and electric shock.
8. Attention shall be paid to the provision of overload and short-circuit protection of all circuits, except engine starting circuits, supplied from batteries.
9. Ventilation shall be provided to prevent the accumulation of gases, which might be emitted from batteries. Batteries shall be firmly secured and protected from ingress of water



## APPENDICES –WIRING DIAGRAMS & GENERAL ARRANGEMENTS

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1. Typical starter motor ratings		
2. Suggested engine starter battery size		Page 33
3. Keyswitch terminations		Page 33
4. Standard harness (65 Amp)	200-05452	Page 34
5. Standard harness (100 Amp)	200-06077	Page 35
6. Diagram of A panel & cut-out	200-06516	Page 36 & 37
7. Diagram of AB panel & cut-out	200-06517	Page 38 & 39
8. Diagram of ABV panel & cut-out	200-06519	Page 40 & 41
9. Diagram of ABVW panel & cut-out	100-06333	Page 42 & 43
10. Diagram of B panel & cut-out	200-06520	Page 44 & 45
11. Diagram of C Deluxe panel & cut-out	200-06518	Page 46 & 47
12. Split charge diagram –65 Amp alternator	300-62210	Page 48
13. Starter booster relay	300-58520	Page 49
14. GA of BD1005 H/E – PRM 80	100-99550	Page 50
15. GA of BD1005 H/E – TMC 40	100-01939	Page 51
16. GA of BD1005 H/E – PRM 80 Atomic	100-05009	Page 52
17. GA of BV13/1505 H/E – PRM 120	100-98915	Page 53
18. GA of BV13/1505 H/E – TTMC35A	100-06375	Page 54
19. GA of BV13/1505 H/E – PRM 150	100-99660	Page 55
20. 100 Amp alternator information	100-05471	Page 56
21. Beta Controller information		Page 57 & 58
22. Wiring 100 Amp & Beta Controller	100-05475	Page 59
23. Declaration of Conformity for Recreational Craft		Page 60 & 61
24. Maintenance record and service items		Page 65

## TYPICAL STARTER MOTOR RATINGS:-

Starters used in Kubota engines have the following standard capacities

Engine	Starter capacity (kW)
1000cc to 1500cc	1.2

## SUGGESTED MINIMUM ENGINE STARTER BATTERY SIZE:

Engine (cc)	Typical Battery Capacity (AH) at a 20hr Rate	Typical C.C.A. (A) Cold Cranking Amperage
BD1005	65 ~ 75	450 ~ 540
BV1305	70 ~ 75	450 ~ 540
BV1505	70 ~ 75	450 ~ 540

## KEYSWITCH TERMINATIONS

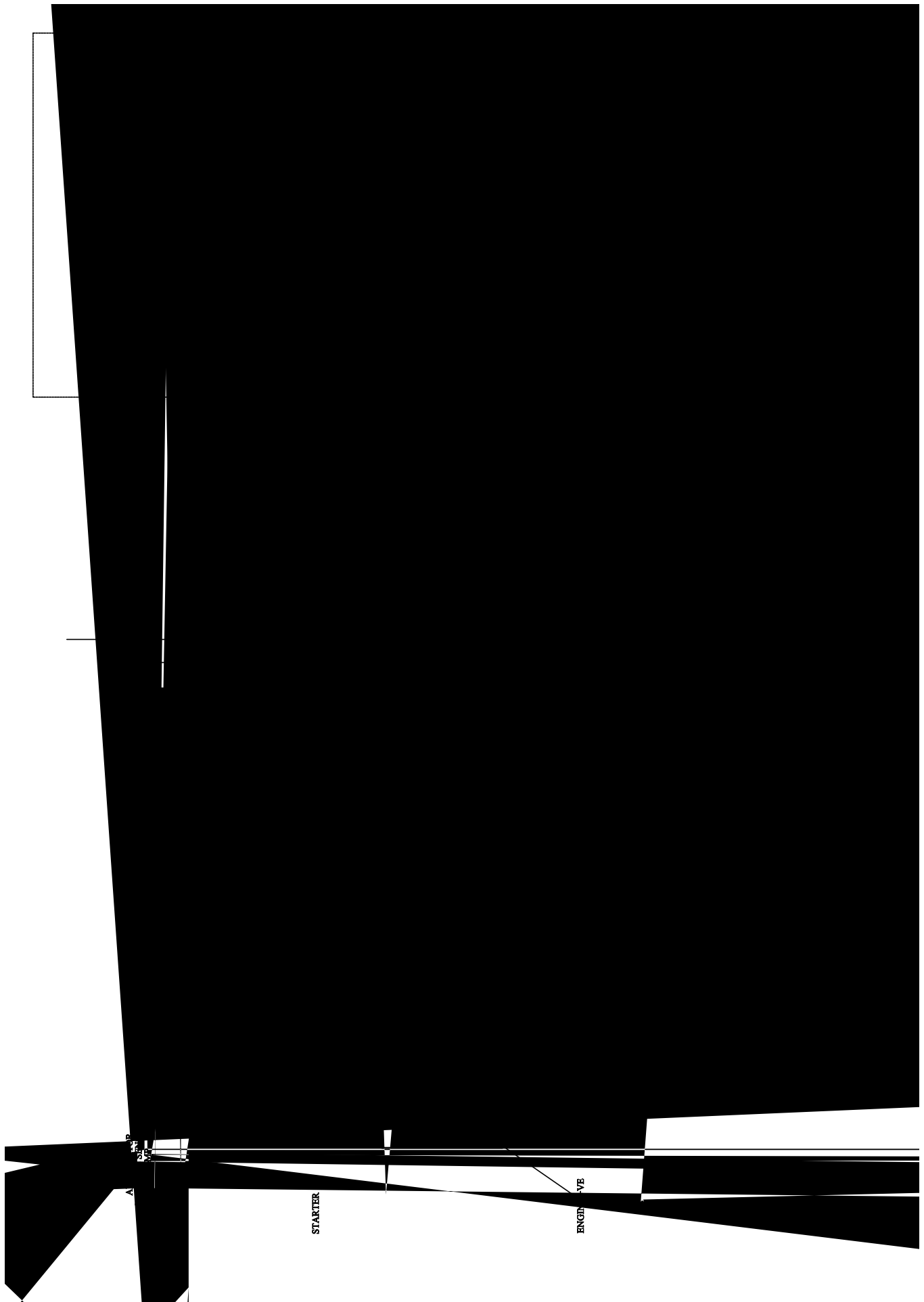
The standard panel keyswitch can be used to tap off a switched positive ignition feed to power additional gauges. In this way these gauges will only be live whilst the engine is running, the engine is starting or the heaters are being used.

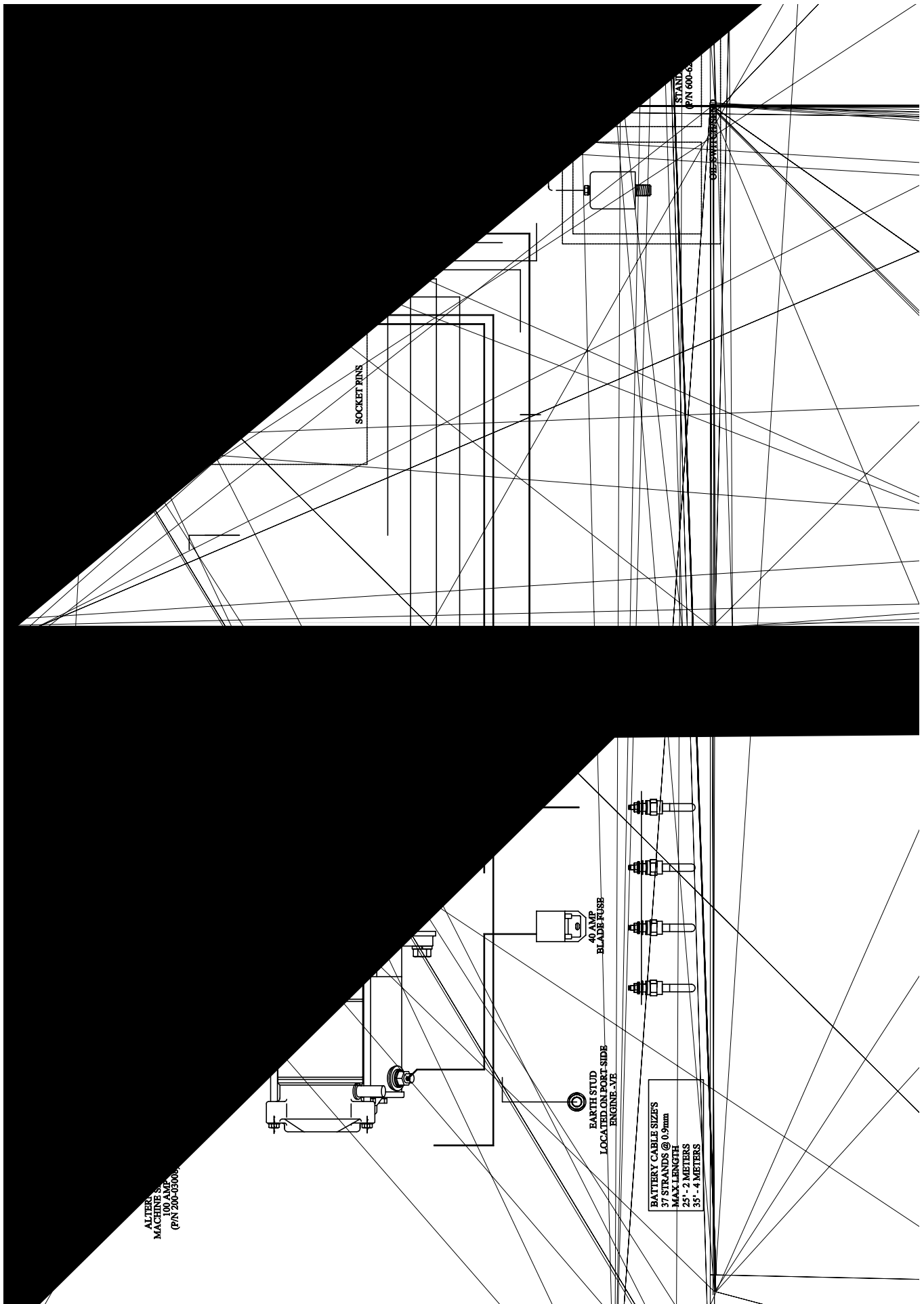
For silver keyswitches, the terminal to achieve this ignition switched positive is marked 'AC'.

For black keyswitches, the terminal to achieve this ignition switched positive is marked '15/54'.

For panels without any keyswitch, gauges can be driven from the 1mm<sup>2</sup> brown wire which terminates at 11 way connector terminal 4. This is a low power switched positive, any additional power required from this connection **must** be fed through a relay, as noted below.

**Note:** these terminals are rated at 10 amps maximum, since they are already utilised for panel and alternator feeds Beta Marine recommend any additional requirements from these terminals must be fed through a relay. This relay should then be connected to it's own fused positive supply directly from the engine battery. Beta drawing 202-06421 illustrating the wiring of a typical electric fuel lift pump with ignition switched relay can be supplied upon request.



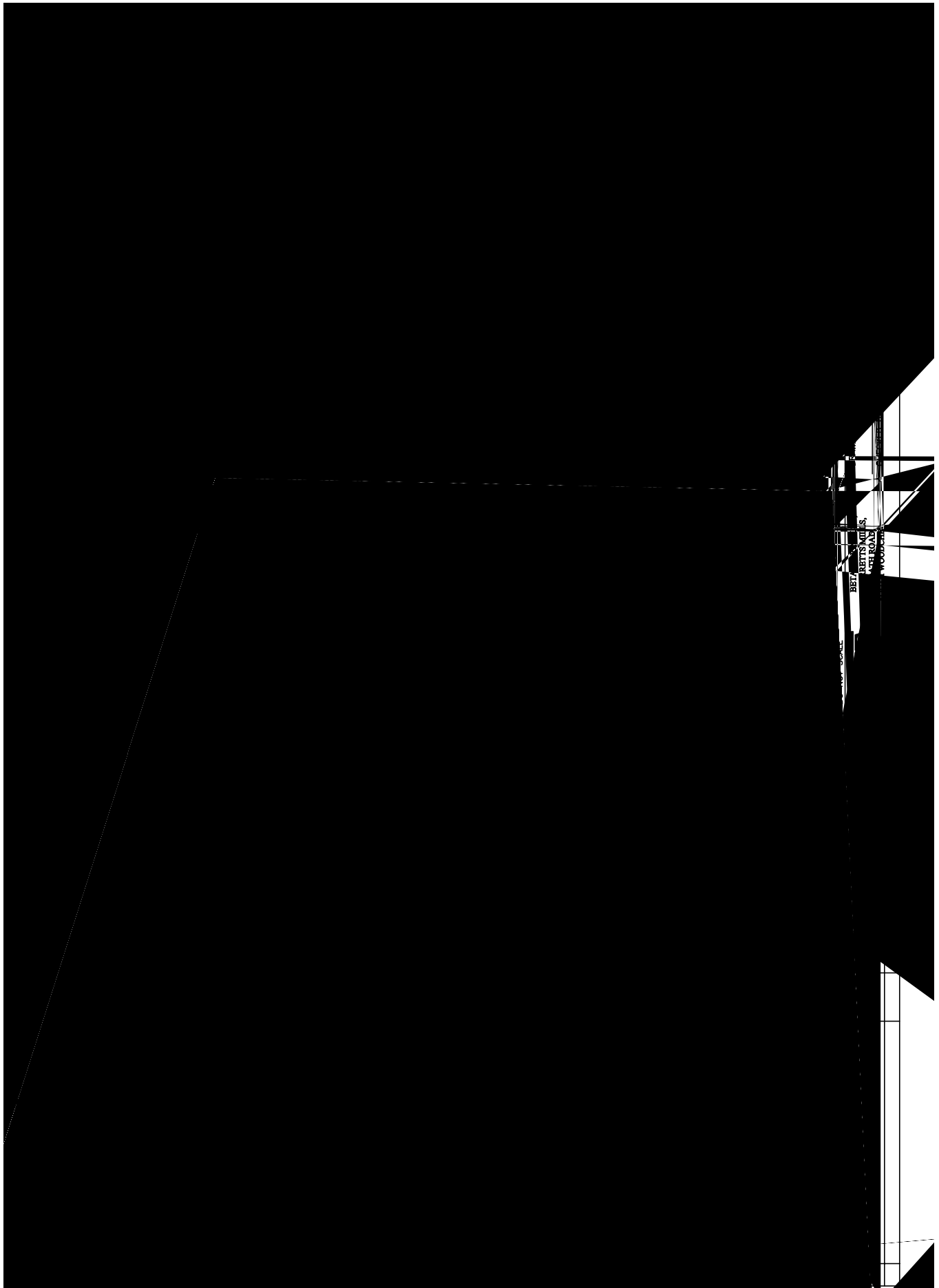








## 2A PANEL

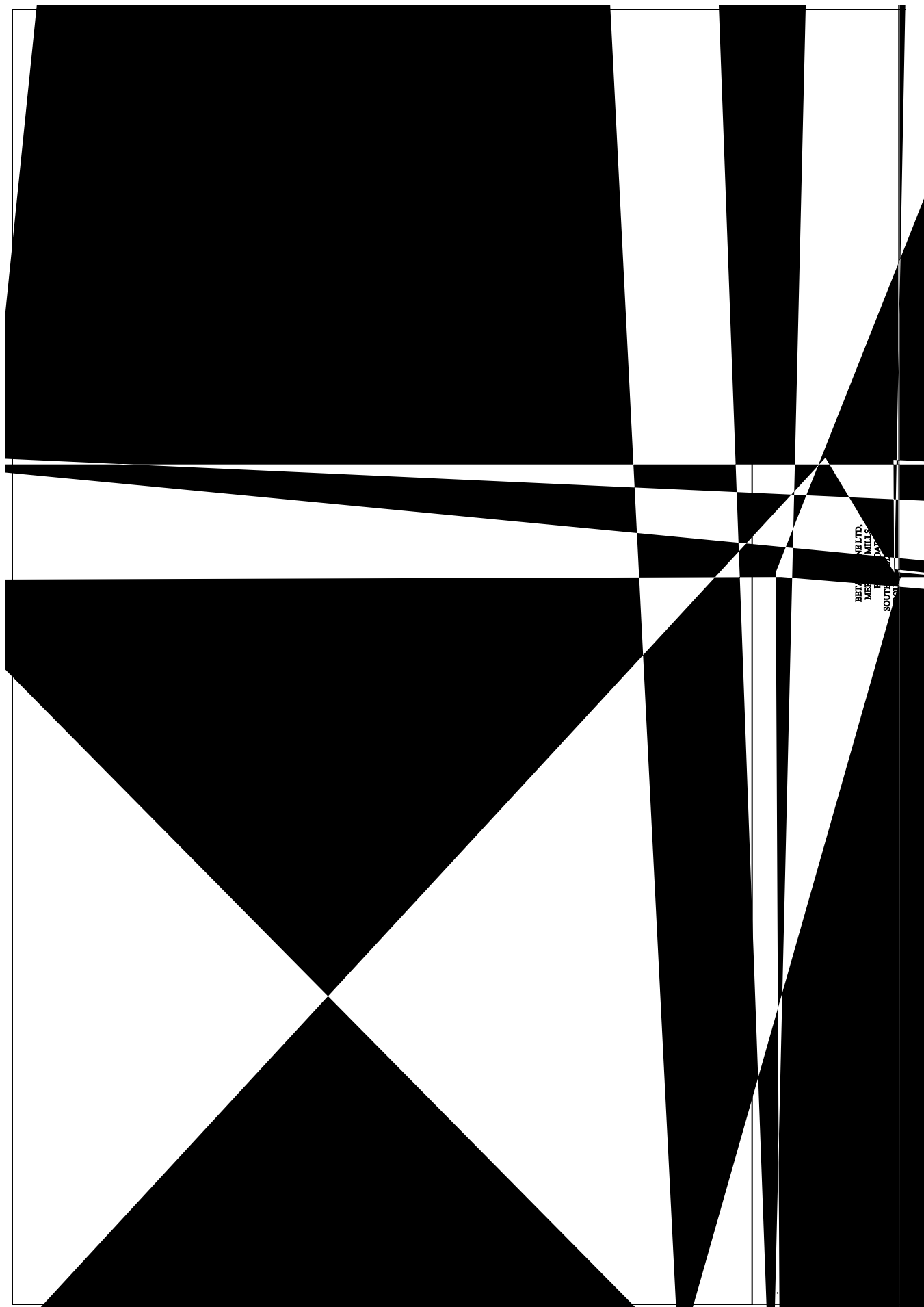






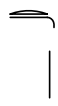




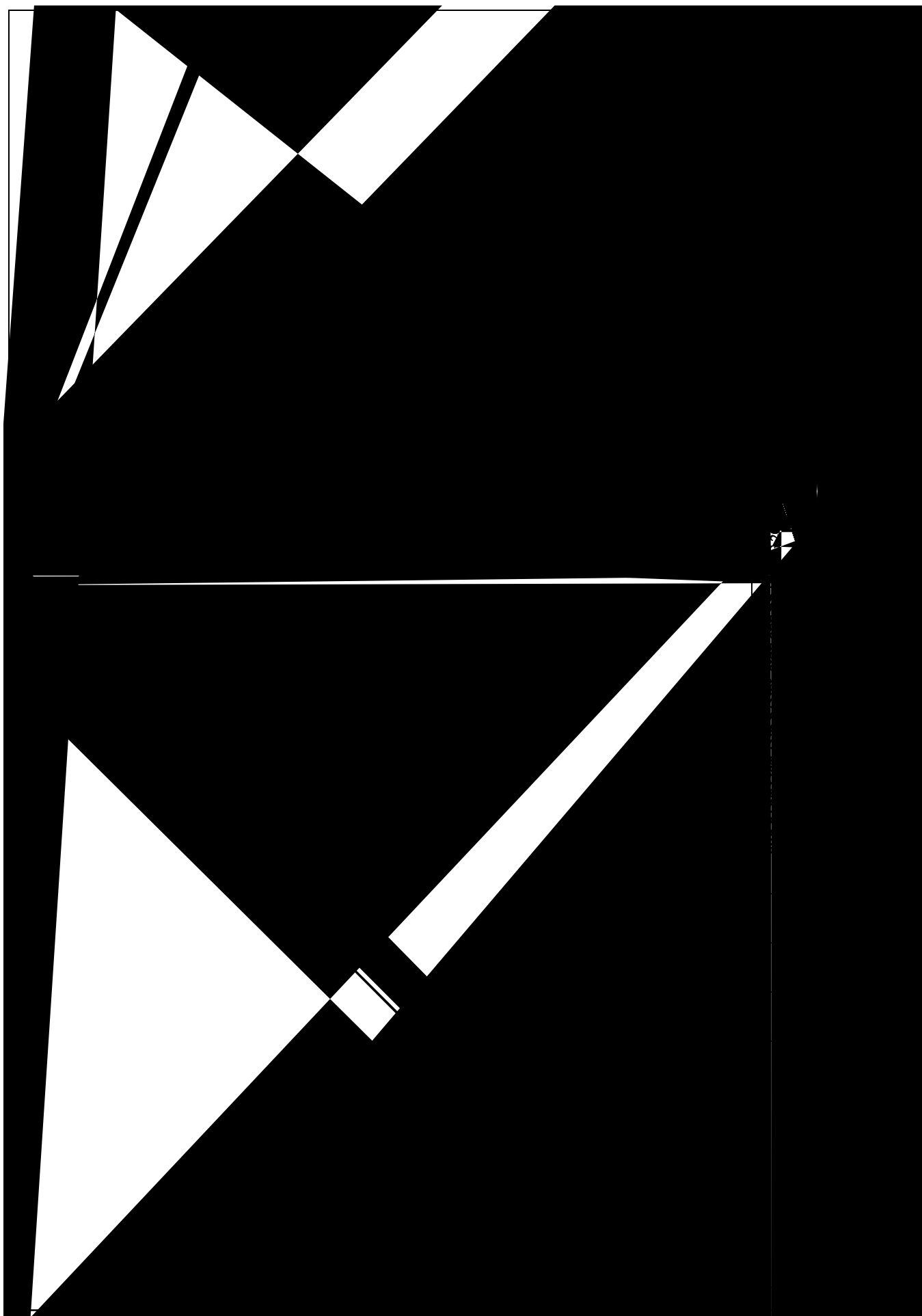


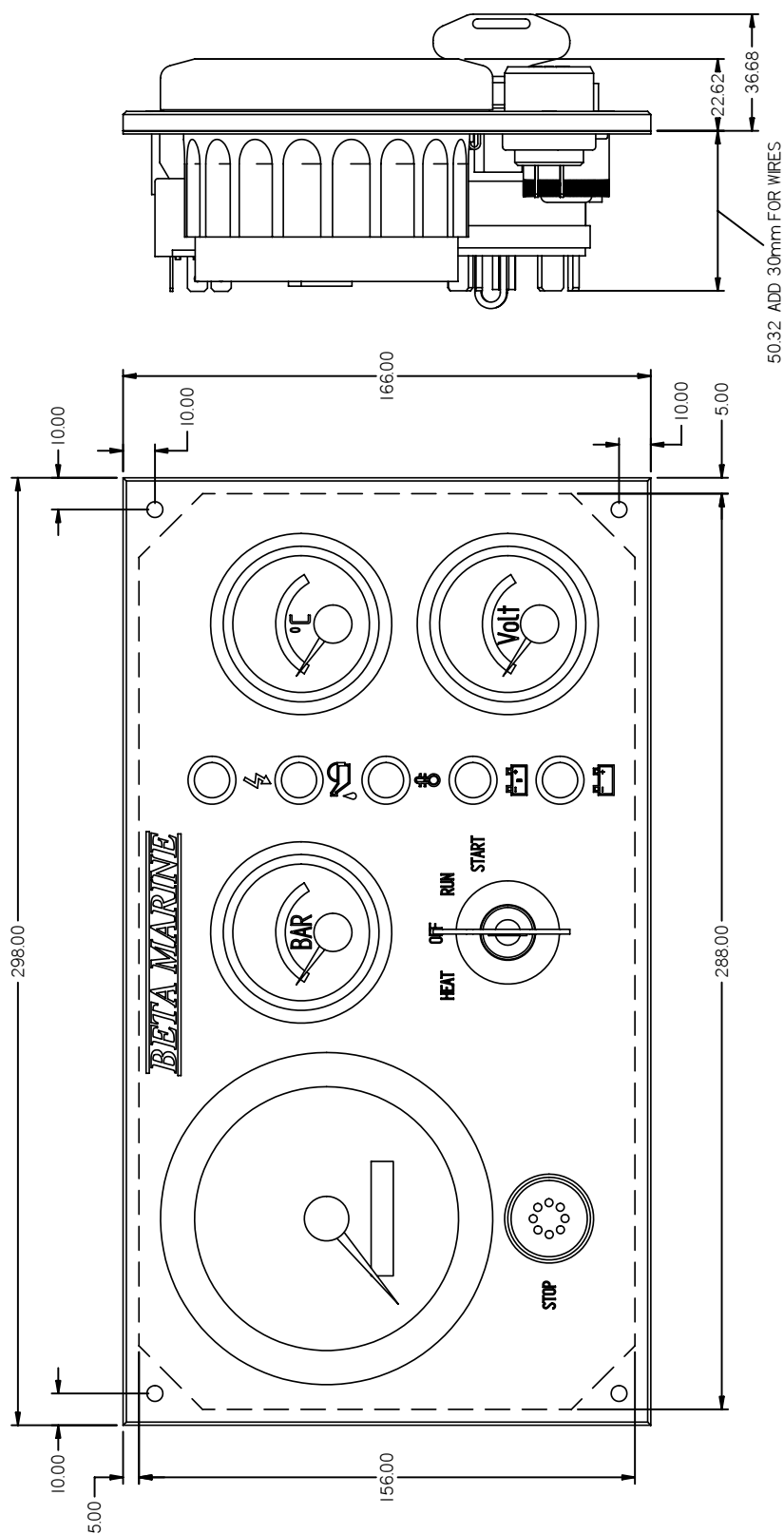




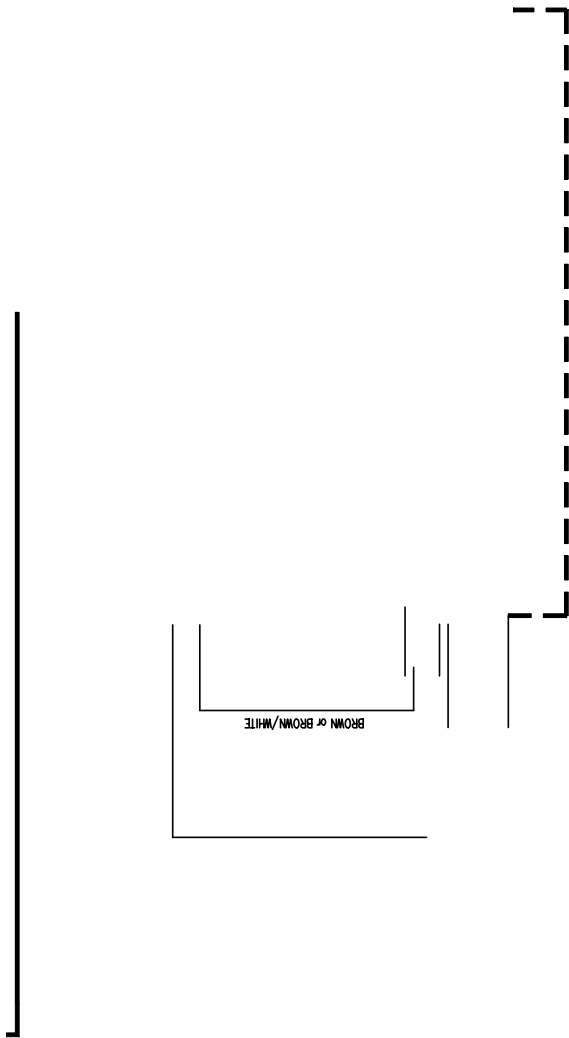


## 2B PANEL



[illegible]





#### NOTES\_

IF BATTERY ISOLATOR(S) ARE FITTED THEY MUST BE CLOSED WHEN ENGINE IS STARTED AND RUNNING. THEY MUST NOT BE OPERATED WHEN THE ENGINE IS RUNNING AS THIS WILL DAMAGE THE ALTERNATOR

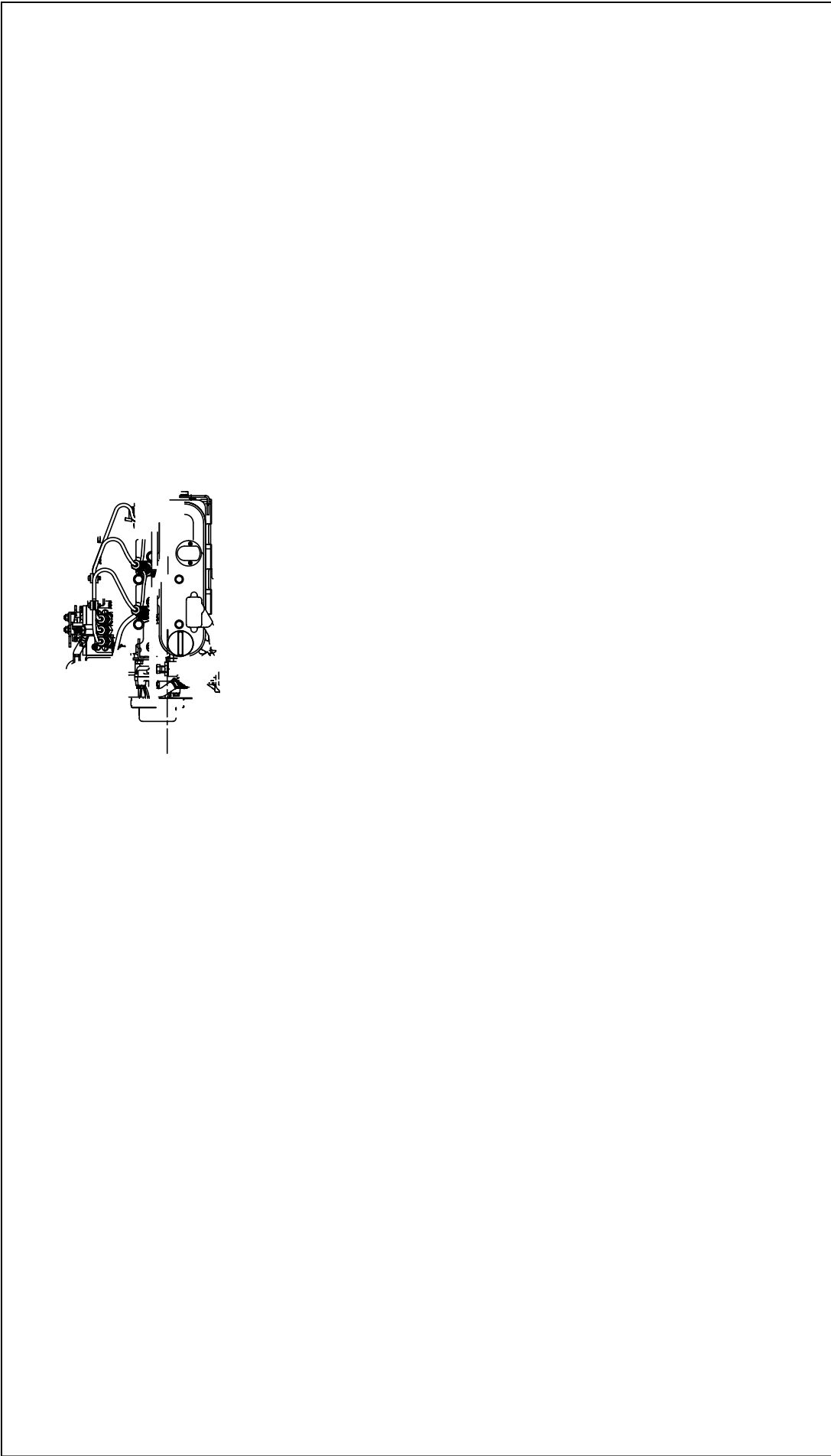


	REV	DESCRIPTION	DATE	APP'D	DRAWN	NOTES
	01	SHALLOW SUMP DIM ADDED	27/02/02	L.T	TW	

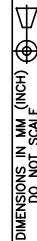
DIMENSIONS IN MM (INCH)  
 DO NOT SCALE

**BETA MARINE**  
 TEL: (01453) 835282    FAX: (01453) 835284

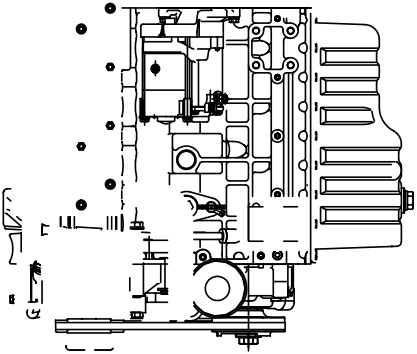
DRAWN BY: \_\_\_\_\_  
 CHECKED BY: \_\_\_\_\_

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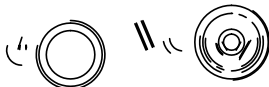




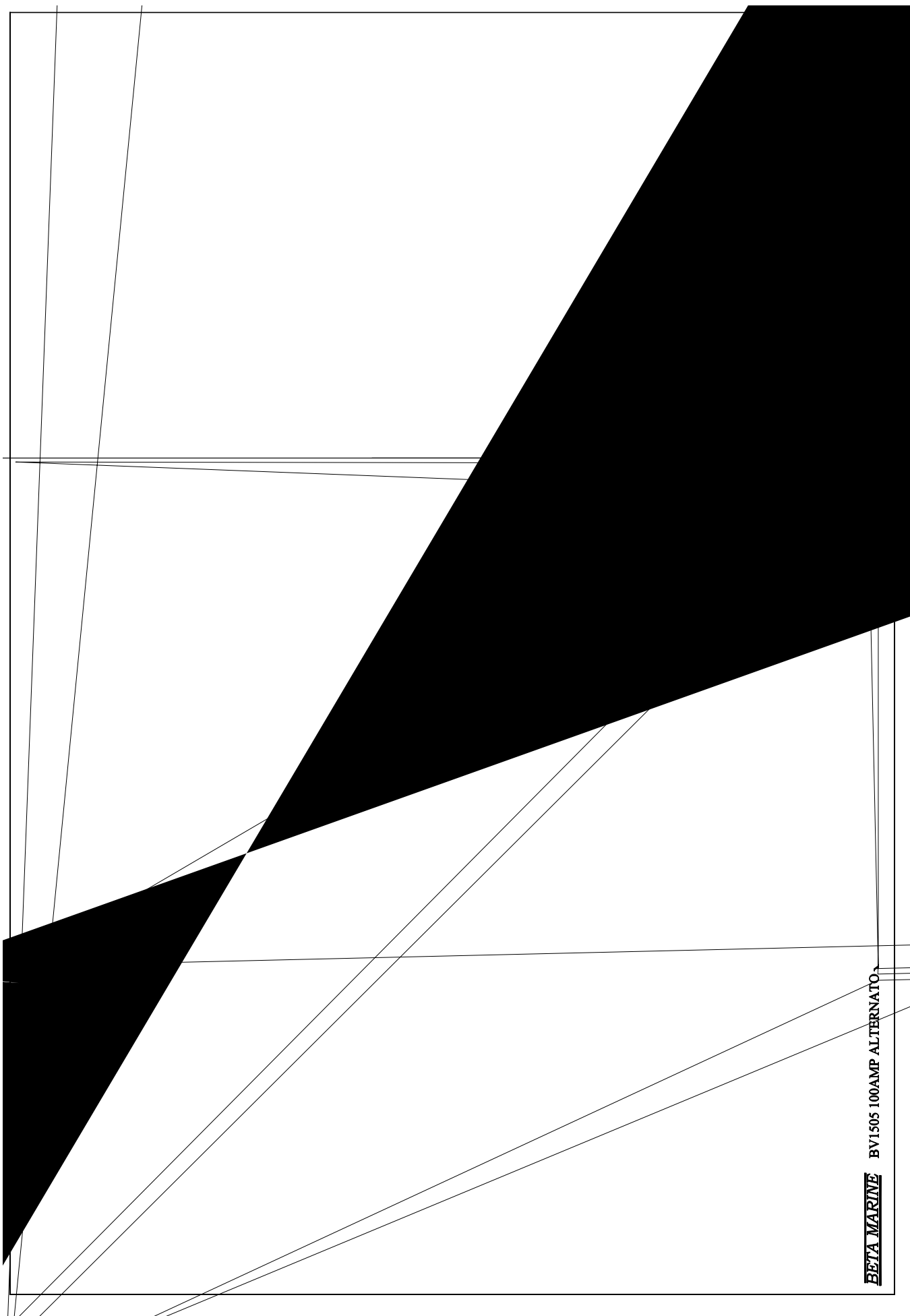
# BETA MARINE

REV	DESCRIPTION	DATE	APPD	DRAWN	NOTES	TITLE				REV					
00						BV1505 AND BV1305 HEAT EXCHANGE WITH TTMC35A GEARBOX AND 65 AMP ALTERNATOR				SIZE A4	DWG NO. 100-06375	REV 00			
										SCALE	NTS	PAGE	1 of 1	DATE	17/01/05
										DRAWN BY:- TW					
										CHECKED BY:- LT					
										BETA MARINE LTD, HERRINGWILLS, BATH ROAD, SOUTH WOODCHESTER, STROUD, GLOS. GL5 5EU					
										TEL: (01453) 835282 FAX: (01453) 835284					
										<b>BETA MARINE</b>					
										DIMENSIONS IN MM (INCH) DO NOT SCALE					
															

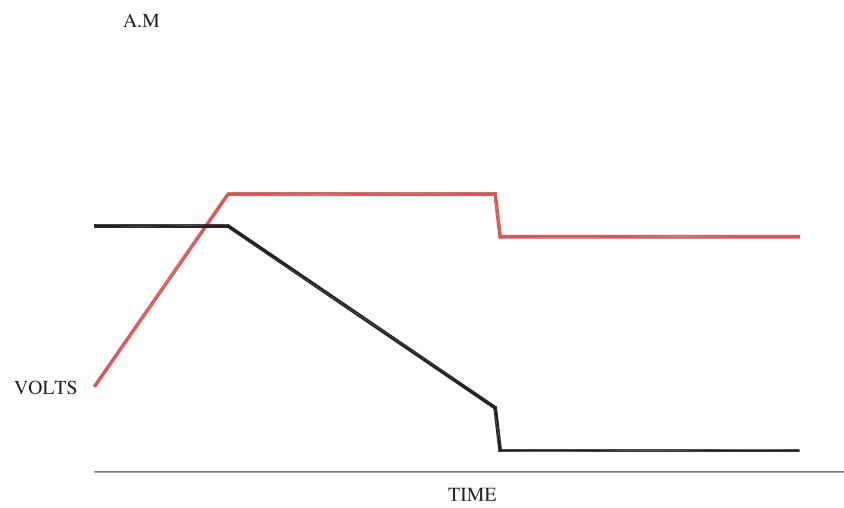




**BETA MARINE**



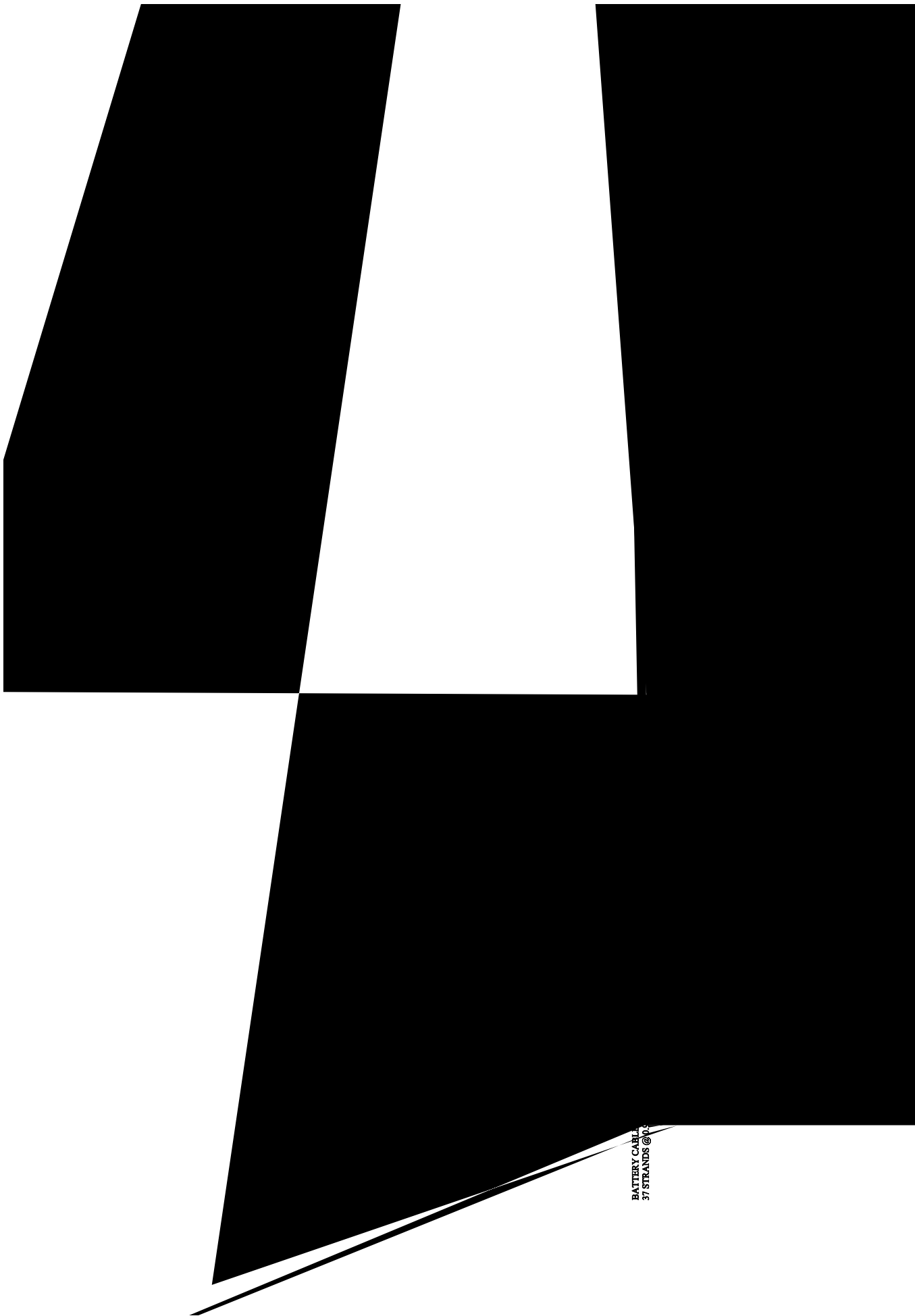
**BETA MARINE** BY1505 100AMP ALTERNATO



All goods are offered and supplied in accordance with our 'General Terms of Tender Sale'.

1

All goods are offered and supplied in accordance with our 'General Terms of Ten



# Declaration of Conformity for Recreational Craft Propulsion Engine with the Exhaust

Engine type-approved according to: stage II of Directive 97/68/EC

## DESCRIPTION OF ENGINES AND ESSENTIAL REQUIREMENTS

Engine type: Inboard engine.

Fuel type: Diesel gas oil IIS K2204-1007 or equal

Combustion cycle: 4-stroke.

### ENGINE(S) COVERED BY THIS DECLARATION

Engine models and engine family names:	EC Type certificate number (exhaust)
BZ602 Beta 16 BD902 Beta 25 5KBXL898KCB	e1*97/68DA*2002/88*0266*00
BD1005 Beta 28 BV1305 Beta 35 3KBXL01.3BCD	e1*97/68DA*2001/63*0157*00
BD1105 BV1505 Beta 38 3KBXL01.5BAD	e1*97/68DA*2001/63*0160*00
BD1703 Beta 39 BV1903 Beta 43 BV2203 Beta 50 YKBXL02.2FCD	e1*97/68DA*2001/63*0072*05
BV3300 BV3300T 3KBXL03.3BCD	e1*97/68GA*2001/63*0145*00
BV3800 3KBXL03.8ACD	e1*97/68GA*2001/63*0155*00

Essential requirements	Standards Used	Other normative document used	See technical file
<b>Annex I.B – Exhaust Emissions</b>			
engine identification	N/A	2033/44 annex 1B para 1.	QA025
exhaust emission requirements	N/A	2003/44 para 16, L214/19	Each EC type certificate has its own technical file.
durability	N/A	2033/44 annex 1B para 3.	QA033
owner's manual	BS EN ISO 10240	2033/44 annex 1B para 4.	N/A
<b>Annex I.C – Noise Emissions</b>	see craft manufacturer's Declaration of Conformity		

I declare on behalf of the engine manufacturer that the engine(s) will meet the exhaust emission requirements of Directive 94/25/EC as amended by Directive 2003/44/EC when installed in a recreational craft, in accordance with the engine manufacturer's supplied instructions and that this (these) engine(s) must not be put into service until the recreational craft into which it is (they are) to be installed has been declared in conformity with the relevant provisions of the above mentioned Directive.

*Handwritten signature: J. K. Koot*

# Emission durability.

## **IN RESPECT TO THE RECREATIONAL CRAFT DIRECTIVE 94/25/EC AND AMENDMENT 2003/44/EC ANNEX 1, B3.**

The engine must be installed, maintained and operated within the parameters detailed in the Operator's Maintenance Manual. Maintenance must use approved materials, parts and consumables. Should the engine lie unused for a period in excess of 6 months it must be inhibited otherwise it will deteriorate with resulting decrease in performance. See also the Winterising and Laying Up procedures in the Operator's Maintenance Manual.

The fuel settings of the diesel injection system must not be tampered with otherwise the guarantee will be invalid and the performance may fall outside prescribed limit. Such adjustment cannot be allowed under the terms of the emission certification.

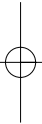
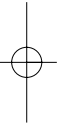
Performance of the engine depends upon the use of correct fuels, lubricants and inhibitors. These are fully detailed in the Operator's Maintenance Manual.

Particular attention must be paid to the installation with respect to the exhaust system. The system must be designed so that water cannot back feed into the engine. The run must be such that the back pressure at the engine manifold does not exceed the level detailed in the Operator's Maintenance Manual. Wet, water injected, exhaust systems must be at least the bore mentioned in the Operator's Maintenance Manual and should the run be excessive this bore must be increased accordingly. Back pressure is measured at the outlet of the engine manifold before the water injection bend or dry bellows.

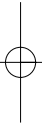
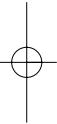
Our experience over 14 years has shown that properly installed and maintained engines hold their performance without major mishap even when running hours exceed those mentioned in the Recreational Craft Directive. It is the owners / users responsibility to ensure that the engine continues to function properly and any malfunction must be immediately investigated. The Trouble Shooting section as detailed in the Operator's Maintenance Manual is particularly helpful in this respect. Engine performance, especially with respect to erratic running, exhaust condition, low power output and high oil consumption are indications of engine conditions that may result in emissions outside the prescribed limits and must therefore be investigated and rectified immediately.



## NOTES



## NOTES



# Quick Reference Parts Listing

## HEAT EXCHANGER COOLED BD1005, BV1305 AND BV1505

In all cases please quote the Beta Marine WOC "K" number and engine number.

Description	Part Number	Qty per Engine
Heat Exchanger <b>"O" Ring</b>	209-80110	2
Wasting <b>Zinc Anode</b>	209-61840	1
Lubricating Oil <b>Filter</b>	211-60390	1
Fuel <b>Filter</b> – Heat Exchanger cooling	211-60210	1
<b>Fuel Lift Pump</b>	600-67830	1
Fuel Lift Pump <b>Gasket</b>	600-00065	1
Air Filter <b>Element</b> – BD1005 only	211-62950	1
Air Filter <b>Element</b> – BV1305 & BV1505 only	211-61831	1
Sea Water Pump <b>Service Kit</b> (includes *)	207-61470	1
Sea Water Pump <b>Impellor</b> *	207-79630	1
Sea Water Pump Cover Plate <b>"O" Ring</b> *	207-04206	1
Sea Water Pump <b>Cover Plate</b>	207-05305	1
Sea Water Pump Cover Plate <b>Bolt</b>	207-04207	3
Sea Water Pump <b>Seal</b> *	207-02239	1
<b>Thermostat</b>	600-72450	1
Thermostat <b>Gasket</b>	600-80490	1
<b>40 Amp Blade Fuse</b> - engine wiring harness	200-00959	1
Control Panel <b>Key Switch</b>	600-00057	1
Control Panel standard <b>Key</b>	600-00058	1
<b>Water Temperature Switch</b> (Panel A, ABV, ABVW)	200-01133	1
<b>Water Temperature Sender</b> (Panel C & B)	200-94360	1
<b>Oil Pressure Switch</b> (Panel A, ABV, ABVW)	600-62670	1
<b>Oil Pressure Sender</b> (Panel C & B)	200-94350	1
<b>Vee Belt</b> – standard 65 Amp alternator	214-63090/Q	1
Optional <b>Polyvee Belt</b> – 100 Amp alternator	214-00493	1

# Service Record

	Service	Date	Responsible	
1	Commissioned			
2	First 25 hours			
3	First 50 hours			
4	Every 150 hours with Shallow sump			
5	Every Year / Every 250 hours if sooner			
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

