
BETA MARINE

Operator's Maintenance Manual



**Heat Exchanger Cooled
Mid Diesel Engine Range
43 and 50 bhp**

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.

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OPERATION AND MAINTENANCE MANUAL FOR THE FOLLOWING BETA MARINE ENGINES BASED ON KUBOTA SUPER 3 SERIES

BV1903, BV2203

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.



BV1903, BV2203

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.

BETA MARINE LTD

Engine No.....	XE5567
Engine Type...	BV1903
Woc.....	K12345
Output.....	43bhp 2800rpm

Tel No: UK (44) 01453 835282
Fax No: UK (44) 01453 835284
Quote engine and WOC numbers for spares

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 led 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 8mm 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)

Standard Engines	BV1903	BV2203
Cylinder	4	4
Bore (mm)	80	87
Stroke (mm)	92.4	
Displacement (cc)	1857	2197
Combustion	3 Vortex	
Cooling	Water	
Starter voltage (V)	12	
Starter output (kW)	1.4	
Alternator output (Amps)	65 (standard)	
Glow plug resistance (each)	1 Ω	
Engine speed (RPM)	2,800	
Power output ISO3046 (BHP)	43	50
Declared power ISO8665 (kW)	31.0	36.1
Compression Ratio	23.0:1	
Fuel timing BTDC	18°	
Capacity of standard sump (litres)	9.5	
Capacity of shallow sump (litres)	7	
Nett dry weight with std gearbox (kg)	270	300
Fuel	Diesel fuel oil No.2D	
Coolant	33%-50% (max) antifreeze / water	
Approx Coolant capacity H/E (litres)	7.4	
Min. recommended battery capacity	12V, 120Ah (600CCA Min)	

Maximum Angle of Installation: Trim 15°, Roll 25° (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

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

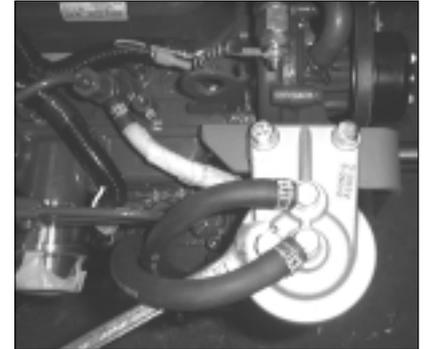


Diagram 1a

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 1b

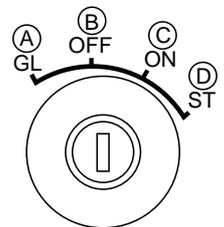
CAUTION

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 PAGE20)

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 -2AB'D' & 2C'D' 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.

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

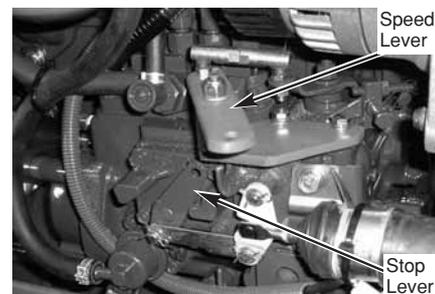
Do not leave the key in 'HEAT' position for more than 15 seconds - this will damage the heater plugs and eventually lead to poor starting.

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

Notes for all panel types:

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

This 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 illustration right:



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 11
- 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 six monthly 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

- 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.

AMBIENT TEMP	SINGLE GRADE	MULTI GRADE
-30°C TO 0°C	SAE 10W S	AE 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

Note: A good quality 15W/40 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



Fig. 2a

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 starboard side of the engine.

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

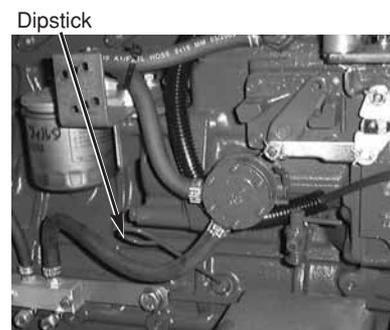


Fig. 2b

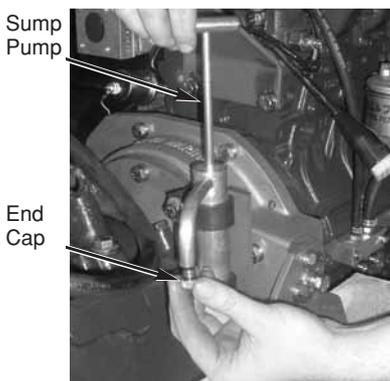


Fig. 2c

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.

- (4) Fill the engine with new oil as described on the previous page.
- (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)
ZF12M	Use ATF	0.55 litres
ZF15M	Use ATF	0.55 litres
ZF25M	Use ATF	0.75 litres
ZF25H	Use ATF	2.00 litres
ZF25H'A'	Use ATF	1.80 litres
TMC60M	Use ATF	0.80 litres
TMC260M	Use ATF	1.20 litres
PRM150	Use Engine Oil 15W40	1.4 litres
PRM260	Use Engine Oil 15W40	1.5 litres

Note: ATF is Automatic Transmission Fluid

FUEL SYSTEM (see page 24 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 recommended wiring for this pump 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 or every 2 years. 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.

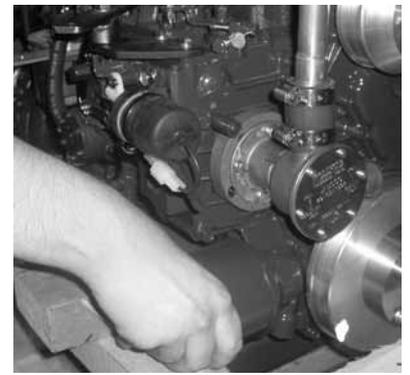


Fig 2d - oil filter removal



Fig 2e



Fig. 2g

HEATING EXCHANGER COOLED

Fresh 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% anti-freeze to freshwater solution (see page 10). 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/anti freeze 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 1" below the filler neck.

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 1 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.

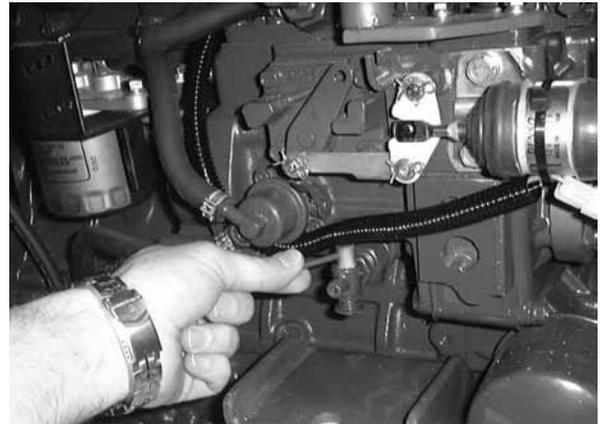
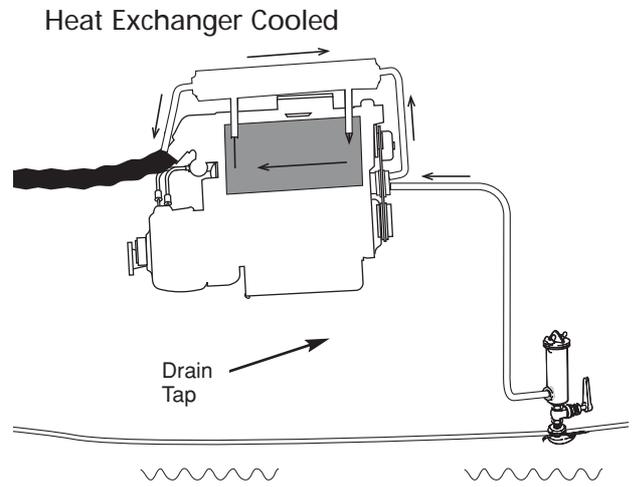


Fig. 2l

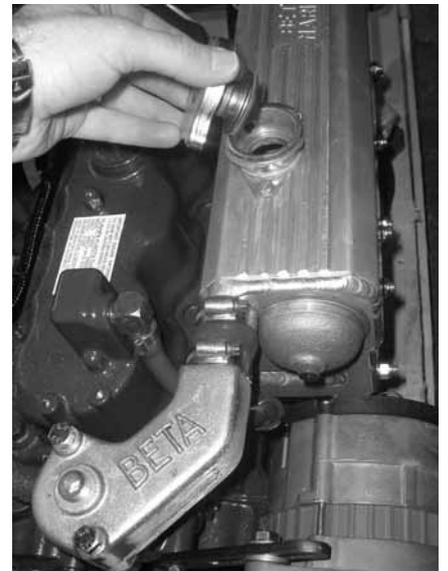


Fig. 2m

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.

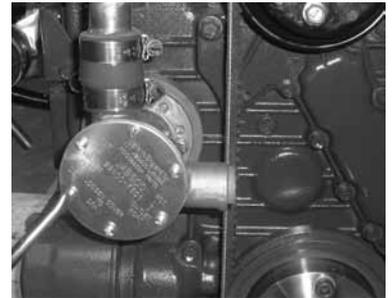


Fig. 2h

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'.

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 end cap of the heat exchanger. See Fig 2j. On most engines this is on the aft end.
- (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.

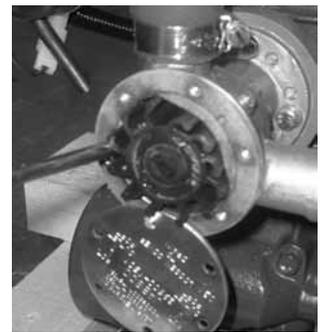
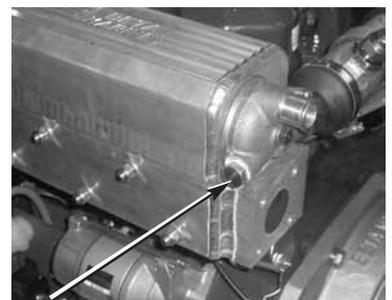


Fig. 2i



Zinc Anode

Fig. 2j



Fig. 2k

BELT TENSION

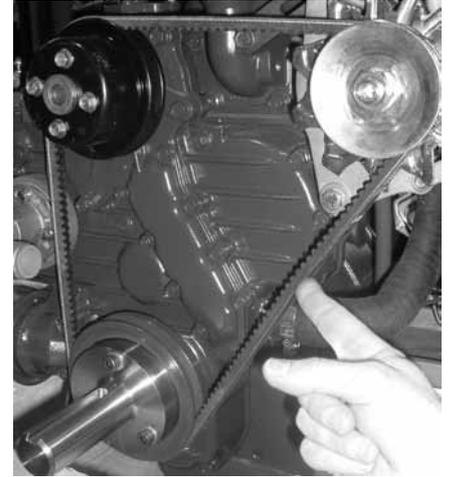
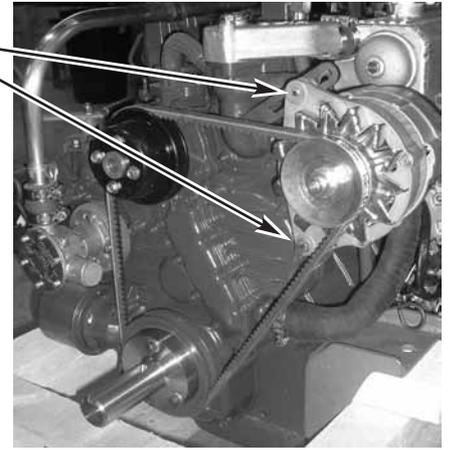
65 AMP ALTERNATOR (Heat Exchanger Cooled)

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. This alternator is adjusted as follows.
- (2) The belt tension is adjusted by swinging the alternator outboard as it pivots on its support bolts.
- (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.

ADJUSTING
BOLTS



100 Amp alternator (option):

The same method applies as outlined above, 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 27.

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 30 to 50% solution of anti-freeze to water (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

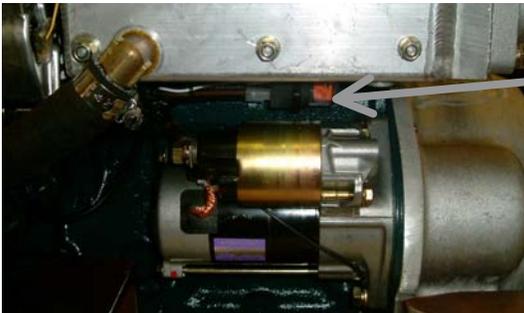
Beta diesels are very reliable if installed and serviced correctly, but problems can occur and the following list gives the most common ones and their solution.

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. <i>This is serious</i> – 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 to the main engine fuse holder.

Problem: Erratic running**Possible Cause**

Air in fuel supply:

Fuel lift pump faulty:

Clogged fuel filter:

Fuel return not fed back to the fuel tank, or blocked pipe:

Air filter blocked:

Worn or blocked injector:

Engine rpm in gear is too low, this must be 850 min:

Faulty stop solenoid:

Broken fuel injection pump spring:

Solution

Check supply system for leaks and fix.

Replace.

Replace.

Re-route pipe or clean.

Replace.

Service injectors.

Increase engine tick over speed.

Disconnect wiring to solenoid. If running improves check for a wiring fault.

Replace.

Problem: White or blue exhaust gas**Possible Cause**

Engine oil level too high:

Blocked injector:

Piston ring and bore worn, giving a low compression:

Check that the breather pipe is clear and not obstructed:

Solution

Reduce the level.

Service injectors.

Get compression checked by your dealer or Kubota service agent. He will advise action to be taken.

Remove and clean out

Problem: Black exhaust gas**Possible Cause**

Blocked air filter element

Over pitched propeller – engine will not reach its full rpm:

Accumulated debris on hull

Solution

Inspect and replace

Get the propeller re-pitched if necessary.

Inspect and clean if required

Problem: Low power output**Possible Cause**

Propeller is too big:

Check gearbox reduction ratio relative to propeller size:

Blocked fuel filter:

Blocked air filter:

Air in fuel system:

Governor spring incorrectly mounted:

Single lever control not operating correctly:

The electrical load is too large on start up:

Solution

Change or depitch.

Change.

Replace.

Replace.

Check system.

Dealer to adjust.

Disconnect speed control cable and move the lever by hand. Adjust cable.

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 seawater 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 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 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 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 15 litres / minute minimum at 1,500 rpm as follows:

- (a) With the boat tied up and out of gear run the engine up to 1500 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 15 litre per minute minimum at 1,500 rpm, 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 type 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.
Propeller 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: 2a, 2ab'V', 2ab'V'W and 2b, these panels utilise bulbs inside sealed lamp holders

Five lamp panels: 2ab'd' and 2c'd', these panels also utilise bulbs inside sealed lamp holders, having an additional lamp for domestic battery charge

All Beta panels have the following warning lamps: **(2a, 2ab'd', 2ab'V', 2ab'V'W, 2b, 2c'd')**

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 panels also have **(2ab'd', 2c'd' only)**

- Domestic battery charge warning lamp  Red

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**)
- 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.

Typical start battery positive

Typical start battery negative



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.

Electrical fault finding –all lamp panels

Problem	Possible cause & solution
No warning lamps or buzzer functioning, engine will not start or stop	<ul style="list-style-type: none"> - 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 <u>THE WATER TEMPERATURE LAMP WILL NOT FUNCTION UNLESS ENGINE IS OVERHEATING OR THERE IS A WIRING FAULT</u>	<ul style="list-style-type: none"> - 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 <i>(Not 2B or 2C deluxe panel see table on following page)</i>	<p>If engine is cold:</p> <ul style="list-style-type: none"> - 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. <p>If engine is warm:</p> <ul style="list-style-type: none"> - Switch wire connected to large sender terminal of switch / sender unit. Remove and refit to smaller (switch) terminal
Buzzer not functioning <u>THE BUZZER WILL NOT SOUND FOR GREEN POWER ON LAMP</u>	<ul style="list-style-type: none"> - 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	<p>If tacho not functioning:</p> <ul style="list-style-type: none"> - 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 <p>If tacho functioning correctly:</p> <ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - 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: <p>Check voltage at relay terminal 86, white wire is positive feed for warning lamp from AC position of keyswitch.</p>
Domestic charge lamp not functioning, buzzer switching off with engine running <u>THIS LAMP WILL NOT FUNCTION IF A SINGLE ALTERNATOR IS FITTED TO THE ENGINE</u>	<ul style="list-style-type: none"> - 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 –2c'd' & water temperature function on 2b panels

In addition to the fault finding detailed on the previous table, the following is specific for the 2c'd' type deluxe panel (Also applicable for the 2b 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	- Faulty wiring –check wire connection & continuity (small white/brown) from sender to panel lamp. Ensure this connection is not shorting to earth (ground).
Oil pressure gauge showing no movement -even when engine is started. Warning lamp functioning correctly	- Faulty wiring –check oil pressure sender wire (small white / brown) is connected.
Oil pressure showing no movement, Warning lamp not functioning correctly	- Check connection to oil pressure gauge, if plug is not connected to socket on rear of gauge, reconnect. - If all connections are correctly made, possible faulty sender unit –check resistance to earth (ground) approx. 50Ω. Replace if no reading or short-circuited. - If adjusted correctly & buzzer still sounding, possible faulty switch gauge unit – replace.
Oil pressure showing normal operating pressure (0.75–5 bar). Buzzer sounding & lamp illuminated.	Engine warm: - Incorrectly calibrated switching point for warning lamp, adjust on rear of gauge to 0.5 bar (minimum adjustment on gauge). - If adjusted correctly & buzzer still sounding, faulty switch gauge unit – replace.
Water temperature gauge showing 120°C / 250°F <u>THIS ALSO APPLIES TO THE 2b PANEL WITH MURPHY GAUGE</u>	Engine cold / cool: - Faulty wiring, check water temperature sender wire is not shorting to earth (ground). - Faulty sender unit, –check resistance to earth (ground), approx. 3.5kΩ (cold) – 0.5kΩ (warm). Replace if notably less.
Water temperature gauge showing normal operating temperature (85°C). Buzzer sounding & lamp illuminated. <u>THIS ALSO APPLIES TO THE 2b PANEL WITH MURPHY GAUGE</u>	Engine warm: - Incorrectly calibrated switching point for warning lamp, adjust on rear of gauge to 100°C / 210°F. - If adjusted correctly & buzzer still sounding, faulty switch gauge unit – replace.
Water temperature gauge showing no movement, lamp not illuminated, engine warm. <u>THIS ALSO APPLIES TO THE 2b PANEL WITH MURPHY GAUGE</u>	- Check connection to sender, if disconnected gauge will not function. - Check connection to temperature gauge, if plug is not connected to socket on rear of gauge reconnect. If all connections are correctly made, faulty sender unit – check resistance to earth (ground), approx. 3.5kΩ (cold) – 0.5kΩ (warm). Replace if no reading.

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:

- 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
- 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
- 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.
- To re-start the engine, simply repeat steps from '1' above, there is not need to switch battery isolators off ***whilst remaining on board.***
- 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 (ground) (black)
- WK Warning lamp (green/yellow)

Electrical fault finding –Extension harnesses

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 2c deluxe**) 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 2c panels)	600-62670
Oil pressure sender (2c panels only)	200-94350
Oil pressure switch gauge (2c panels only)	200-96190
Temperature switch with single terminal (on some BZ602 & BD902)	600-62820
Temperature switch / sender 1/8”BSP (not 2b or 2c panels)	200-01133
Temperature sender (2b & 2c panels only)	200-94360
Water temperature switch gauge (2b & 2c panels only)	200-96200
Voltmeter (2c 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 2ab”V”W	200-00072
Tacho, 0-4000rpm with digital hour counter (all panels but 2a)	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	M11 x 1.25	9.5 ~ 10.0	68.7~72.3	93.1~98.0
Bolts, Connecting Bolts	M8 x 1.0	4.5~5.0	32.5~36.2	44.1~49.0
Bolts, Flywheel	M12 x 1.25	10.0~11.0	72.3~79.5	98.0~107.8
Bolts 1, Bearing Case	M9 x 1.25	4.7~5.2	34.0~37.6	46.1~50.9
Bolts 2, Bearing Case	M10 x 1.25	7.0~7.5	50.6~54.2	68.6~73.5
Nozzle Holder Assembly	M20 x 1.5	5.0~7.0	36.2~50.6	49.0~68.6
Caps Nuts, Head Cover	M8 x 1.25	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	M8 x 1.25	2.4~2.8	17.4~20.3	23.5~27.5
Bolts, Idle Gear Shaft	M8 x 1.25	2.4~2.8	17.4~20.3	23.5~27.5
Nut, Crank Shaft	M30 x 1.5	14.0~16.0	101.2~115.7	137.3~156.9
Nut, Injection Pipe	M12 x 1.5	2.5~3.5	18.1~25.3	24.5~34.3

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).



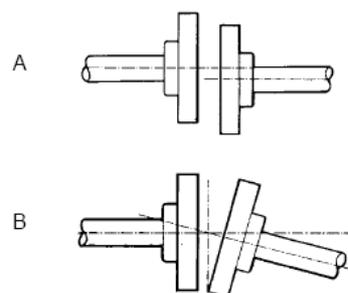
Flexible Mount

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.



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 mounting bearer. This will cause vibration and knocking noises which are very hard to find!**

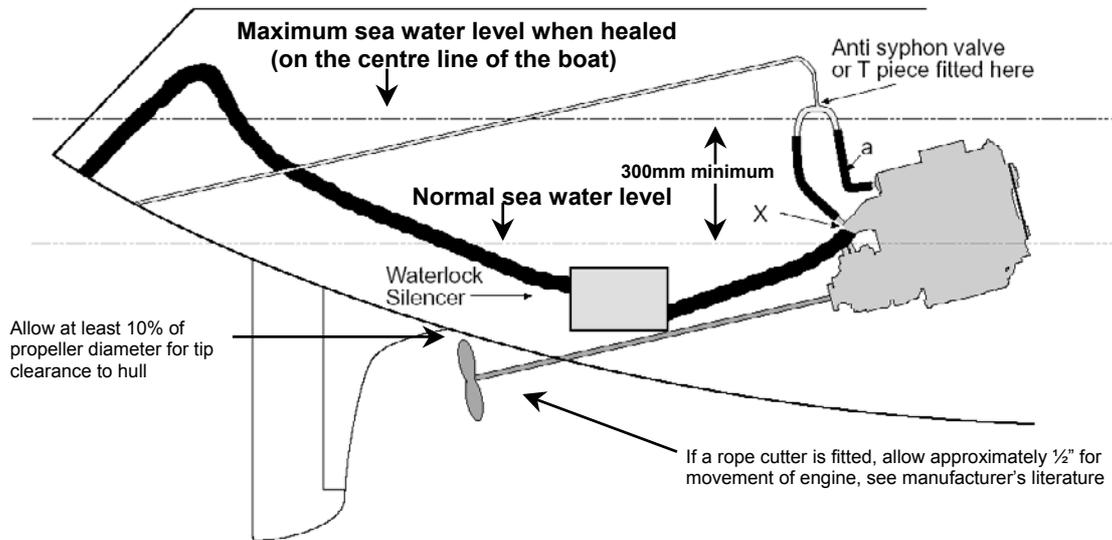
Exhausts

- 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.
- 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, measured with the exhaust system connected and the engine running at full speed, must not exceed 80mmHg (3.1inchesHg / 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 following injection bend sizes.

	BV1903	BV2203
Standard	50mm	50mm
High rise water injection bend SS	50mm	50mm

Typical Yacht Installation

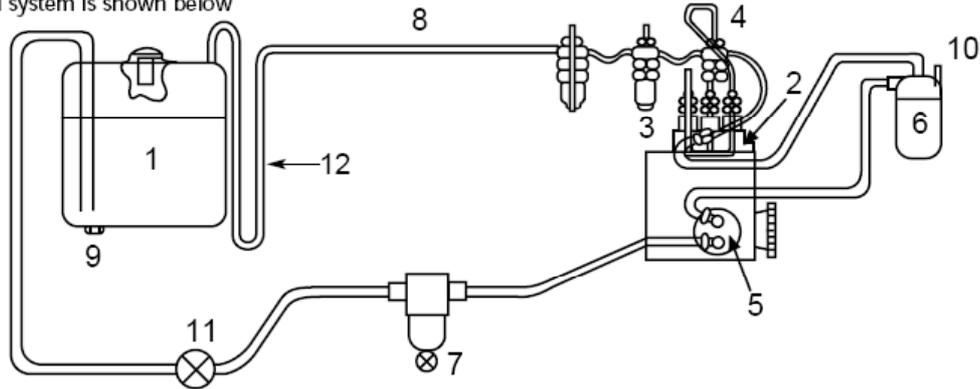


WARNING:

- (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
- (2) Injection pump
- (3) Injection nozzle
- (4) Injection pipe

- (5) Mechanical fuel feed pump with priming lever
- (6) Fuel filter
- (7) Fuel water separator

- (8) Overflow/leak off
- (9) Drain plug
- (10) Air vent
- (11) Stop cock
- (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:

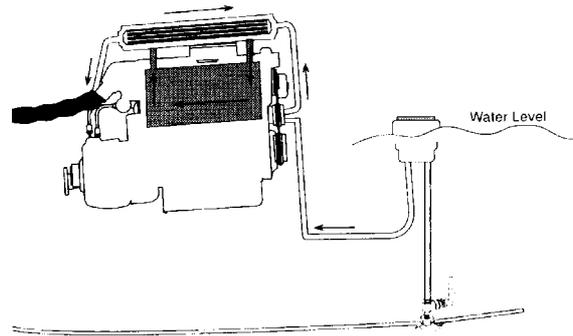
	Supply (mm)	Leak off (mm)
	8	8

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.** (See 7).
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'. This can cause poor starting. (See 12).
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 25mm ID or 1" minimum.
3. Good access to the inlet sea cock is essential so that plastic bags or seaweed 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 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. 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

Beta has 4 panel options: 2a
2ab'D' or 2ab'V' or 2ab'V'W
2b
& 2c'D'

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)

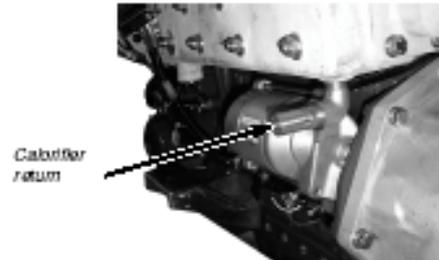
5. All electrical equipment must be protected from sea water. Sea water or rust in the starter will invalidate warranty. Care must be taken when pushing the two halves of the plug together to ensure that individual pins do not push out. To prevent corrosion and assist in assembly we recommend that the 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 round 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

1. Typical starter motor ratings		Page 27
2. Suggested engine starter battery size		Page 27
3. Keyswitch terminations		Page 27
4. Standard engine harness (65 Amp)	200-05451	Page 28
5. Standard engine harness (100 Amp)	200-06015	Page 29
6. Diagram of 2a panel & cut-out	200-06516	Page 30 & 31
7. Diagram of 2ab'd' panel & cut-out	200-06517	Page 32 & 33
8. Diagram of 2ab'V' panel & cut-out	200-06519	Page 34 & 35
9. Diagram of 2ab'V'W panel & cut-out	200-06333	Page 36 & 37
10. Diagram of 2b panel & cut-out	200-06520	Page 38 & 39
11. Diagram of 2c'd' deluxe panel & cut-out	200-06518	Page 40 & 41
12. Diagram of domestic extension harness	200-04588	Page 42
13. GA of BV19/2203 H/E –ZF12/15M	100-02011	Page 43
14. GA of BV19/2203 H/E –TMC60M	100-05154	Page 44
15. GA of BV19/2203 H/E –ZF25H	100-01333	Page 45
16. GA of BV19/2203 H/E –PRM260	100-01351	Page 46
17. Split charge relay wiring (65 Amp)	300-62210	Page 47
18. Starter booster relay diagram	300-58520	Page 48
19. 100 Amp alternator information	200-05466	Page 49
20. Beta Controller information		Page 50
21. Wiring 100 Amp & Controller	100-05470	Page 52
22. Declaration of Conformity for Recreational Craft		Page 53 & 54
23. Maintenance record and service items		Page 55

TYPICAL STARTER MOTOR RATINGS:-

Starters used in Kubota engines have the following standard capacities

Engine	Starter capacity (kW)
BV1903	1.4
BV2203	1.4

SUGGESTED ENGINE STARTER BATTERY SIZE:

Engine	Typical Battery Capacity (AH) at a 20hr Rate	Typical C.C.A. (A) Cold Cranking Amperage
BV1903	100 ~123	580 ~ 670
BV2203	100 ~123	580 ~ 670

1. Keyswitch terminations

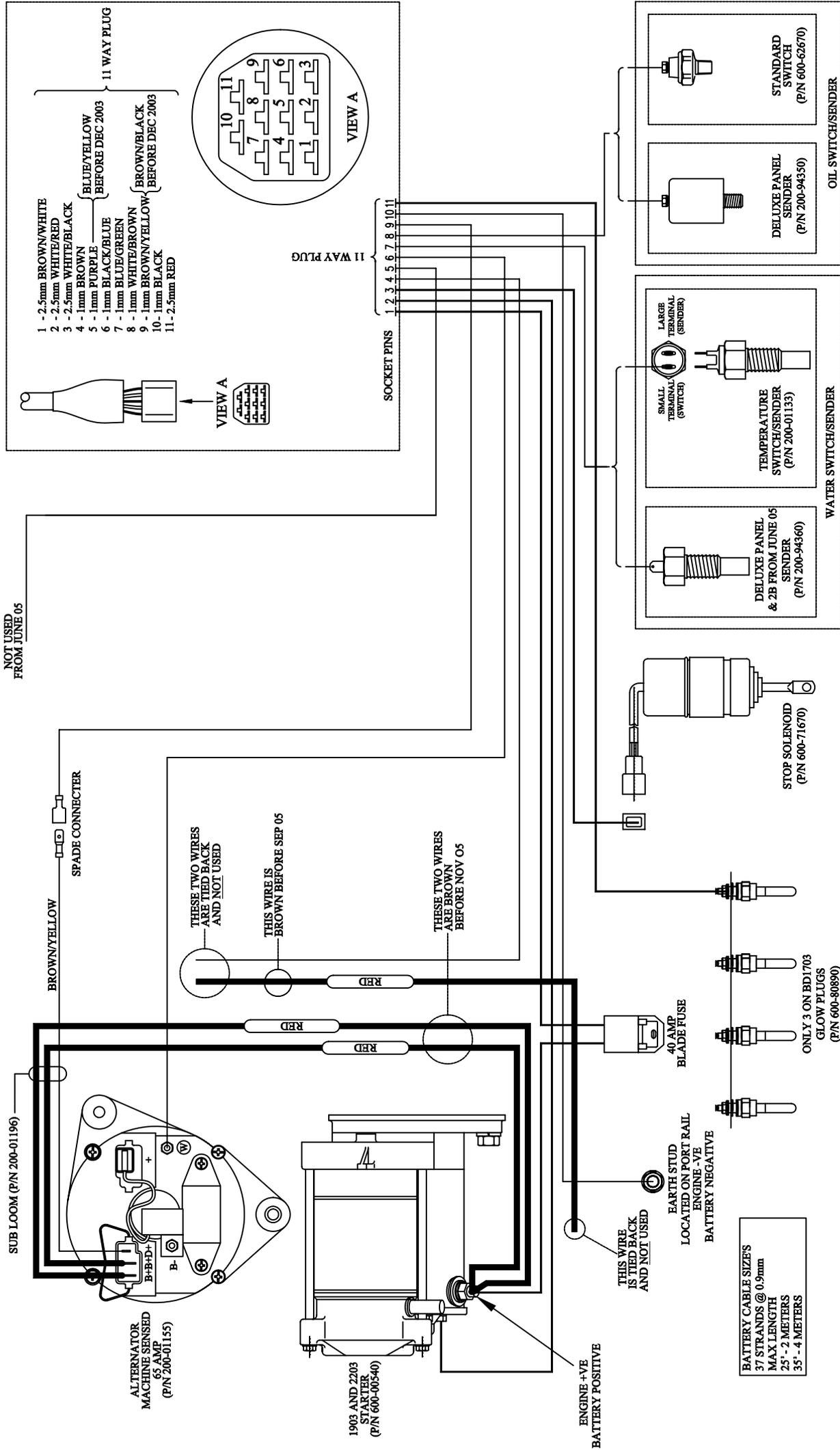
The standard panel keyswitch can be used to tap off a switched positive ignition feed to power additional gauges. In this way these gauges will only be live whilst the engine is running, the engine is starting or the heaters are being used.

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 1mm² brown wire, which terminates at the 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 keyswitch terminals are rated at 10 amps maximum, since they are already utilised for panel and alternator feeds Beta Marine recommends 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.

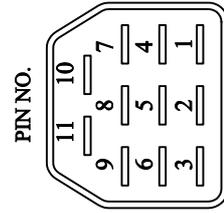
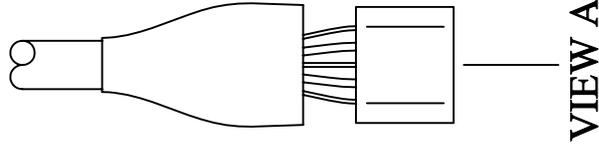
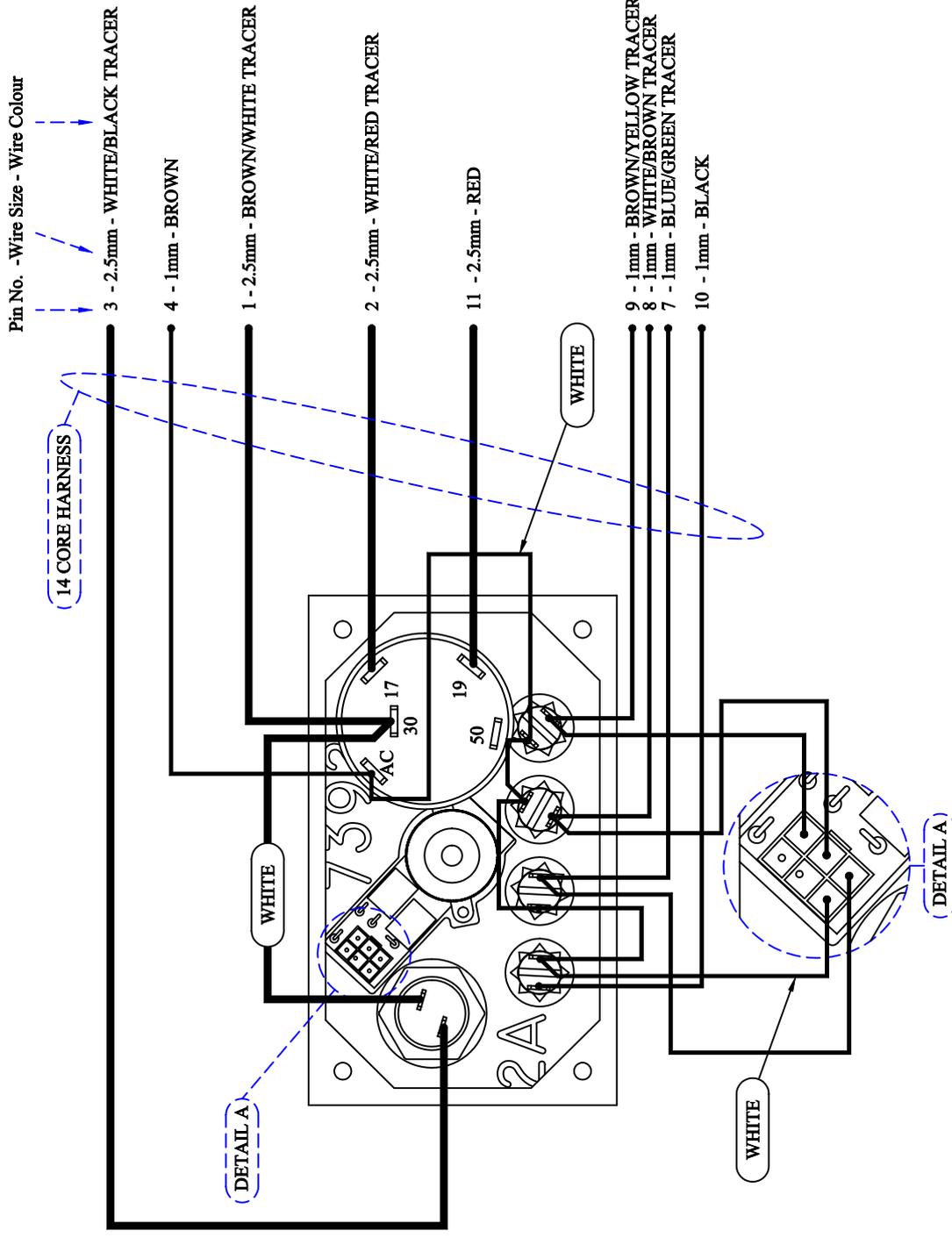


REV	DESCRIPTION	DATE	APP'D	DRAWN	NOTES
01	ADDED NOTES	29/05/03	DM	TW	
02	WIRE COLOURS	15/10/04	DM	TW	
03	ADDED NOTES	25/10/05	DM	TW	
04	ADDED NOTES	23/01/06	DM	TW	
05	REMOVED ISOLATION BLOCK	22/02/06	DM	TW	

TITLE		BETA MARINE LTD, MERRETT'S MILLS, BATH ROAD, SOUTH WOODCHESTER, STROUD, GLOS. GL5 5EU	
SCALE	N/A	PAGE	1 of 1
SIZE	A4	DWG NO.	200-05451
DRAWN BY:--	TW	CHECKED BY:--	
DIMENSIONS IN MM (INCH) DO NOT SCALE		DATE	
		11/09/02	

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PINS 5 AND 6 ARE NOT USED IN THIS ARRANGEMENT. THERE ARE SOME SPARE CORES UNUSED IN THE HARNESS.

WIRING SCHEMATIC FOR 2A PANEL (SIMPLE) AFTER MAY 2005

TITLE

FOR PART LIST AND PANEL SIZE SEE DRAWING 200-06305
PANEL PART NUMBER 200-00852

DIMENSIONS IN MM (INCH)
DO NOT SCALE

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DRAWN BY:--
CHECKED BY:--
TW
DM

SIZE A4
SCALE N/A

DWG NO. 200-06516
PAGE 1 of 1

DATE 15/05/05
REV

REV	DESCRIPTION	DATE	APP'D	DRAWN	NOTES

Pin No. - Wire Size - Wire Colour

- 12 - 1mm - YELLOW/GREEN TRACER
- 5 - 1mm - PURPLE
- 6 - 1mm - BLACK/BLUE TRACER
- 10 - 1mm - BLACK

- 1 - 2.5mm - BROWN/WHITE TRACER
- 2 - 2.5mm - WHITE/RED TRACER
- 3 - 2.5mm - WHITE/BLACK TRACER
- 11 - 2.5mm - RED
- 13 - 1mm - BLUE/YELLOW TRACER

- 8 - 1mm - WHITE/BROWN TRACER
- 7 - 1mm - BLUE/GREEN TRACER
- 4 - 1mm - BROWN

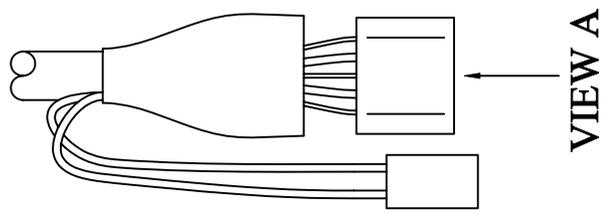
- 9 - 1mm - BROWN/YELLOW TRACER

14 CORE HARNESS

DETAIL A

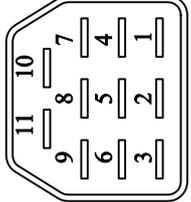
RESISTOR 5W 47R

28RA RELAY DETAILS
THIS RELAY MAY BE CLIPPED
ONTO HARNESS



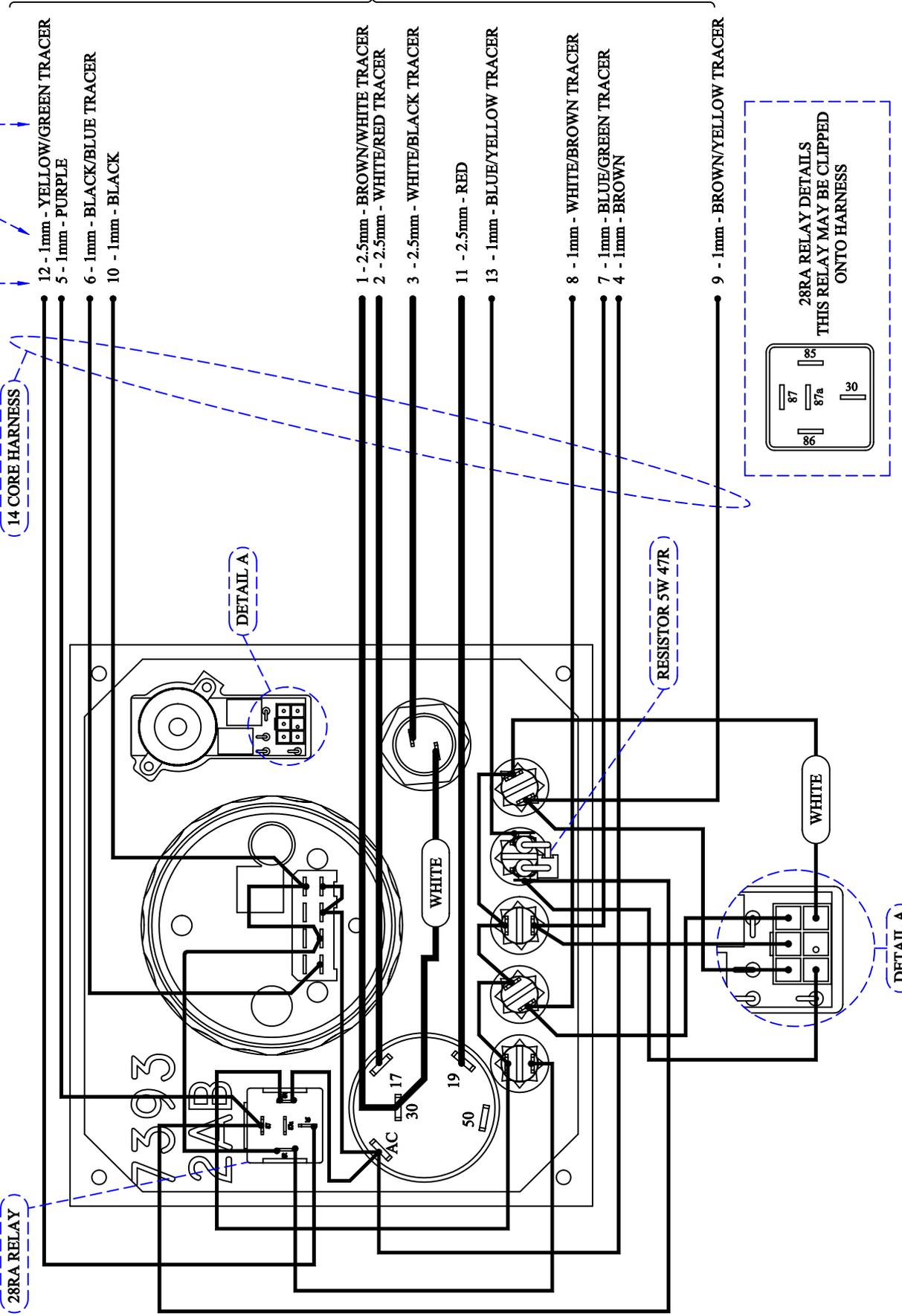
VIEW A

PIN NO.



VIEW A

THERE ARE SOME SPARE
CORES UNUSED IN THE
HARNESS.



WIRING SCHEMATIC FOR
2AB PANEL
AFTER MAY 2005

TITLE

FOR PART LIST AND PANEL SIZE SEE DRAWING 200-06304
PANEL PART NUMBER 200-00850
(THIS EXCLUDES TACHO)

NOTES

DRAWN

APP'D

DATE

DESCRIPTION

REV

DIMENSIONS IN MM (INCH)
DO NOT SCALE

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DRAWN BY:--
TW

CHECKED BY:--
DM

SCALE

N/A

PAGE

1 of 1

DATE

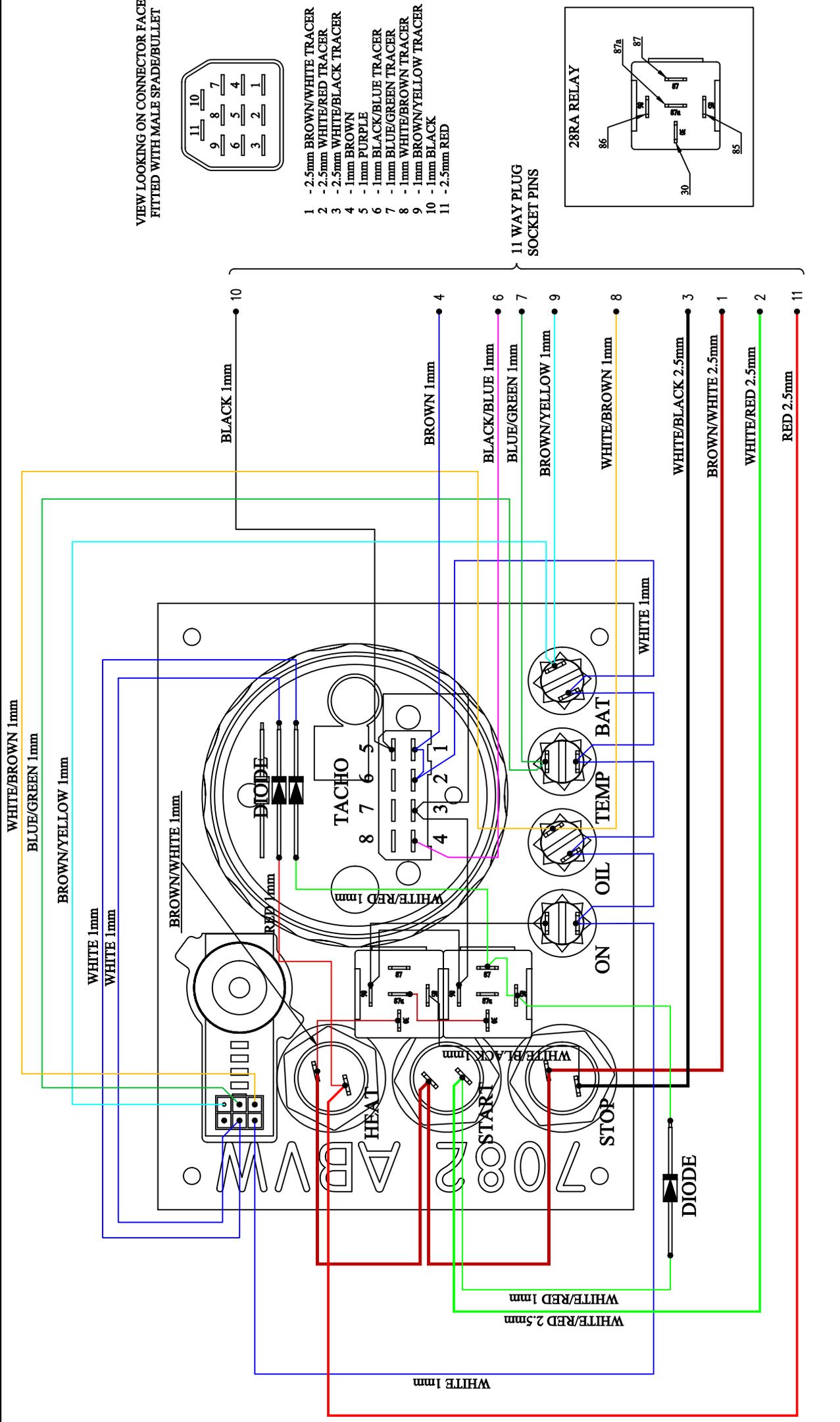
15/05/05

DWG NO.

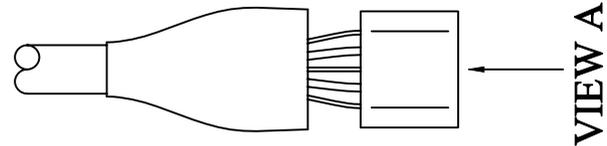
A4

200-06517

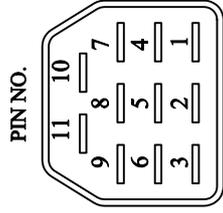
REV



REV	DESCRIPTION	DATE	APP'D	DRAWN	NOTES	TITLE
01	WIRE COLOURS	15/10/04	DM	TW		WIRING SCHEMATIC FOR ABVW PANEL AS USED ON K14744
02	MOVED BROWN/YELLOW WIRE	20/01/06	DM	TW		
DIMENSIONS IN MM (INCH) DO NOT SCALE						
BETA MARINE LTD, MERRETT'S MILLS, BATH ROAD, SOUTH WOODCHESTER, STROUD, GLOS. GL5 5EU TEL: (01453) 835282 FAX: (01453) 835284						
DRAWN BY: TW			SIZE: A4		DWG NO. 100-06333	
CHECKED BY: DM			SCALE: N/A		PAGE 1 of 1	
					DATE 03/12/04	
					REV 02	



VIEW A



VIEW A

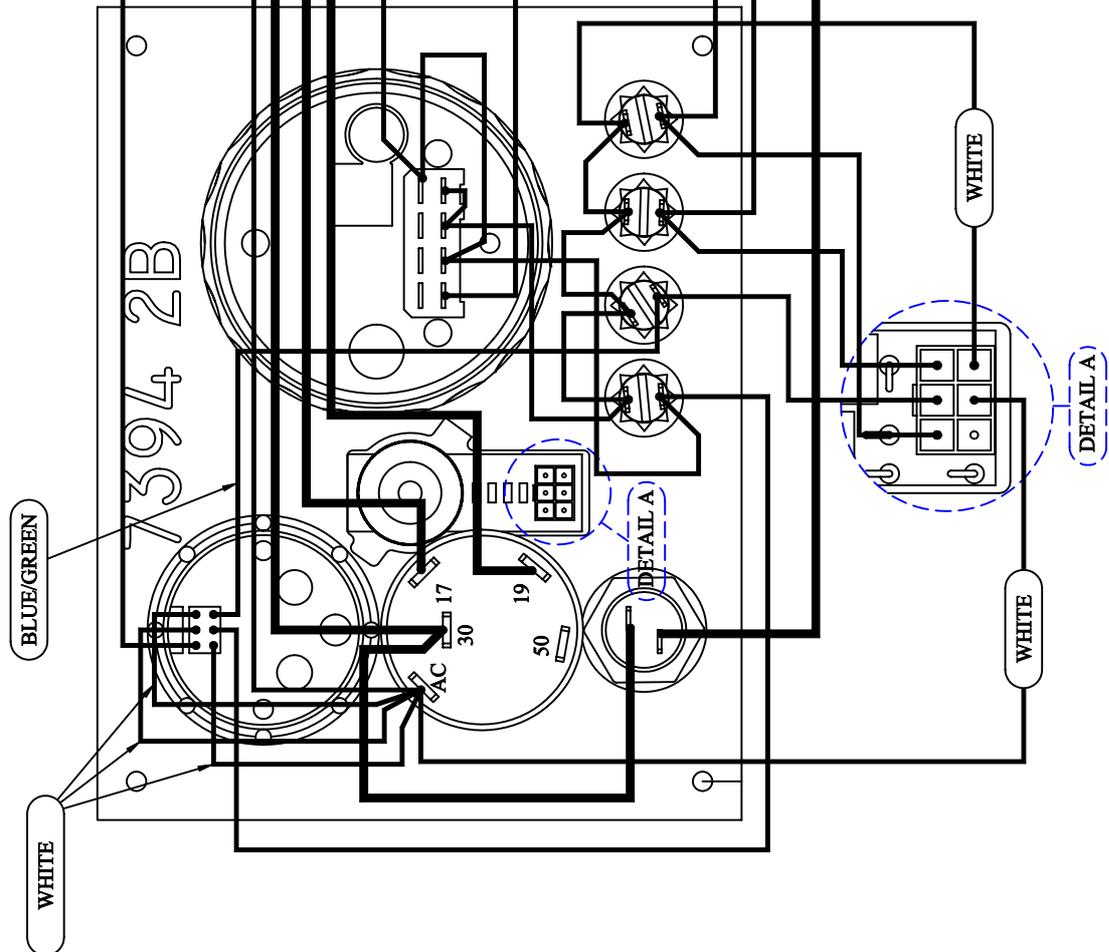
PIN 5 IS NOT USED IN THIS ARRANGEMENT. THERE ARE SOME SPARE CORES UNUSED IN THE HARNESS.

11 WAY PLUG

Pin No. - Wire Size - Wire Colour

- 7 - 1mm - BLUE/GREEN TRACER
- 4 - 1mm - BROWN
- 1 - 2.5mm - BROWN/WHITE TRACER
- 2 - 2.5mm - WHITE/RED TRACER
- 11 - 2.5mm - RED
- 10 - 1mm - BLACK
- 6 - 1mm - BLACK/BLUE TRACER
- 9 - 1mm - BROWN/YELLOW TRACER
- 8 - 1mm - WHITE/BROWN TRACER
- 3 - 2.5mm - WHITE/BLACK TRACER

14 CORE HARNESS



WIRING SCHEMATIC FOR
2B PANEL
AFTER MAY 2005

TITLE

FOR PART LIST AND PANEL SIZE SEE DRAWING 200-06303
PANEL PART NUMBER 200-05408
(THIS EXCLUDES TACHO & TEMPERATURE GAUGE)

DIMENSIONS IN MM (INCH)
DO NOT SCALE

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DRAWN BY: TW
CHECKED BY: DM

SIZE A4
SCALE N/A

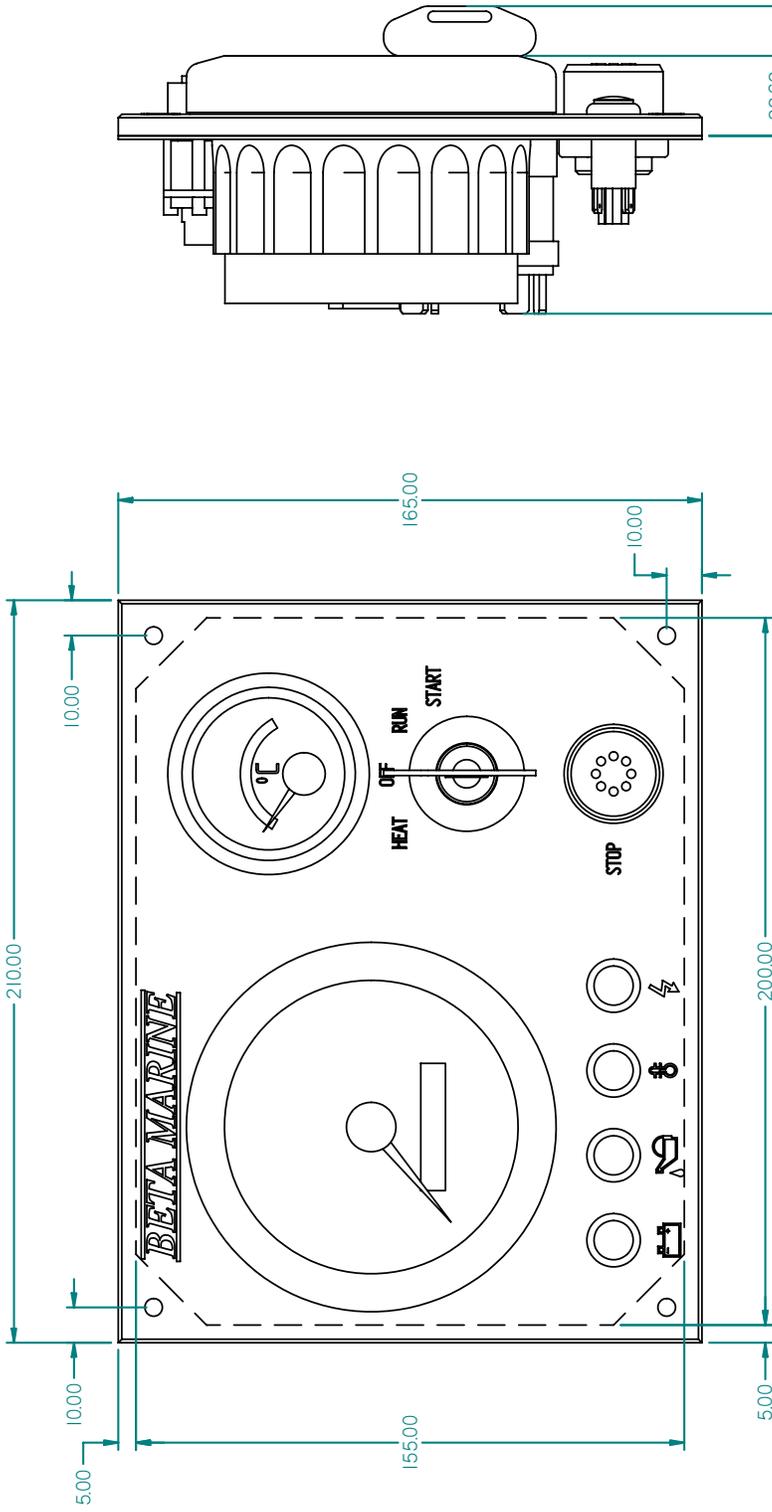
PAGE 1 of 1

DATE 16/05/05

REV

REV	DESCRIPTION	DATE	APP'D	DRAWN	NOTES

REV 01



50.32 ALLOW 30mm FOR WIRES

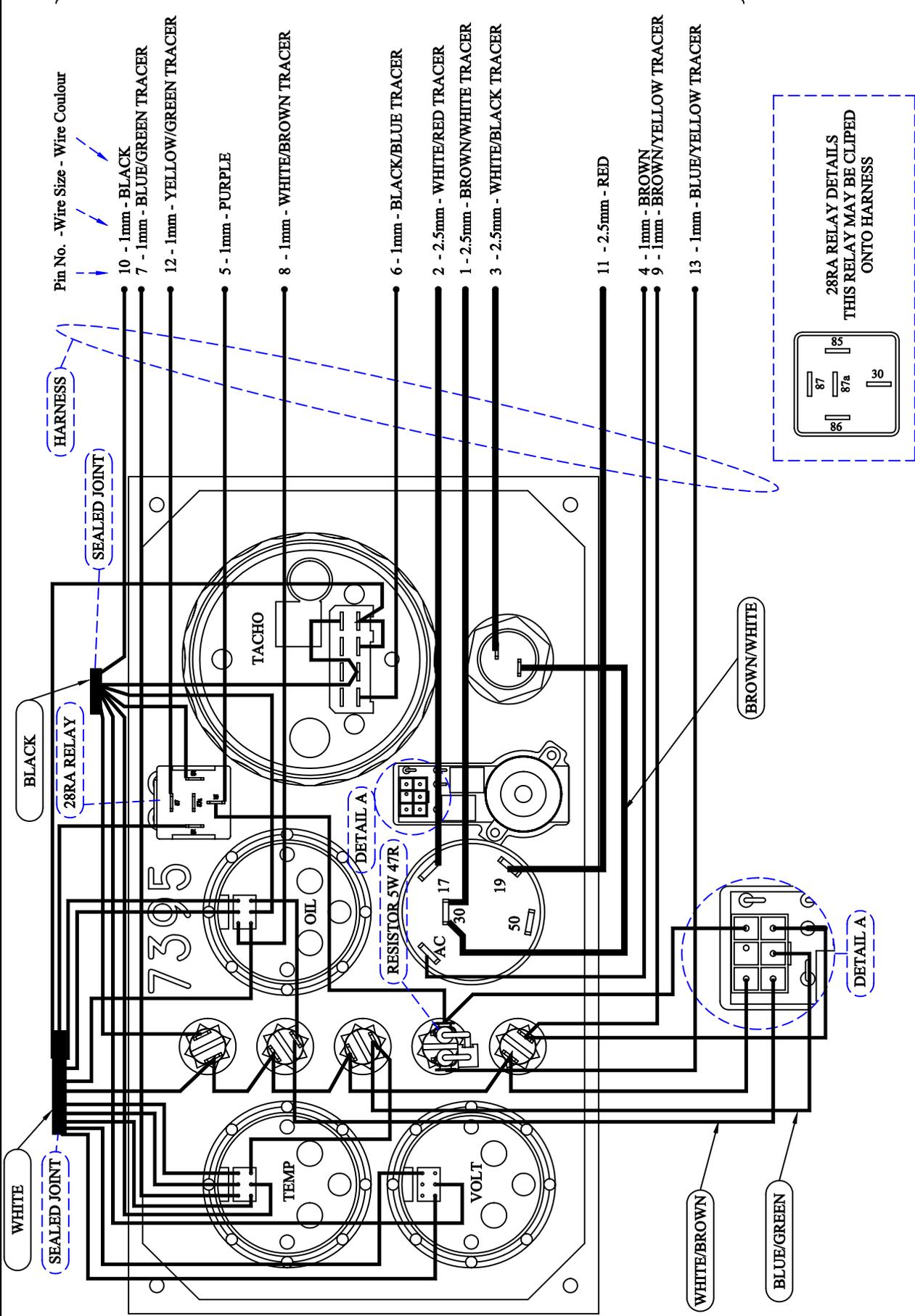
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						DRAWN BY:-	SIZE	DWG NO.	REV
						TW	A4	200-06303	00
						CHECKED BY:-	SCALE	NITS	PAGE
						LT	SCALE	2 of 2	DATE
									15/11/2004

DIMENSIONS IN MM (INCH)
 1:1 (1:1) SCALE

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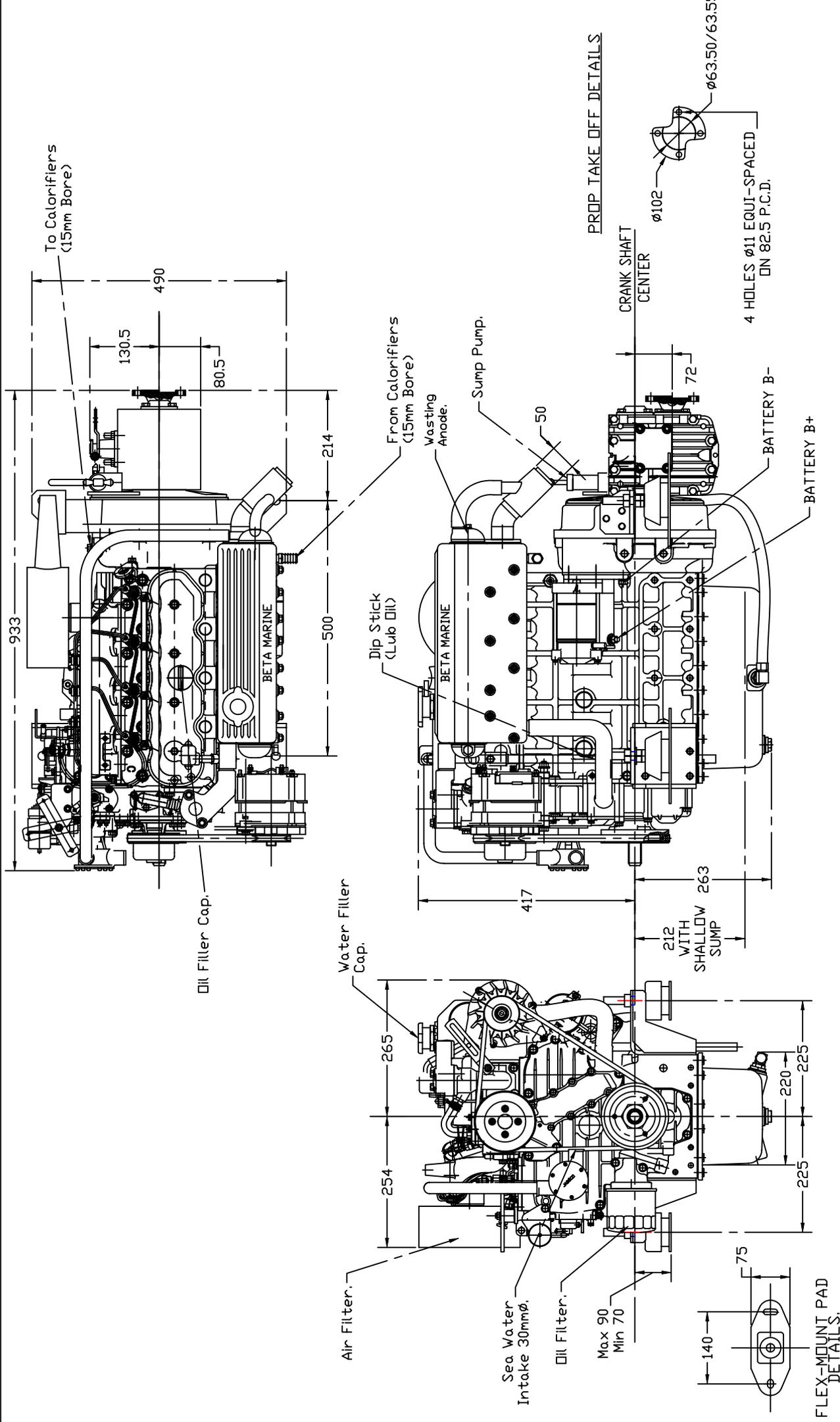


REV	DESCRIPTION	DATE	APP'D	DRAWN	NOTES	TITLE	SCALE	SIZE	DWG NO.	DRAWN BY:--	CHECKED BY:--	PAGE	DATE
01	CHANGED WHITE & BLACK AROUND	19/09/05	DM	TW	FOR PART LIST AND PANEL SIZE SEE DRAWING 200-06306 PANEL PART NUMBER 200-05445 (THIS EXCLUDES GAUGES)	WIRING SCHEMATIC FOR 2C PANEL (DELUXE) AFTER MAY 2005	N/A	A4	200-06518	TW	DM	1 of 1	15/05/05

DIMENSIONS IN MM (INCH)
DO NOT SCALE

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REV	DESCRIPTION	DATE	APP'D	NOTES	COMPLETE UNIT
01	NAME	29/11/05			
02	DIP STICK AND ANODE	22/02/06	DM		

TITLE		BV1903 H/E HURTH ZF12M (HBW 125) AND
SIZE		BV2203 H/E HURTH ZF15M (HBW 150)
DRAWN BY:--	T. WATTS	DWG NO. 100-02011
CHECKED BY:--		SCALE NTS
		DATE 06/02/01

ALL DIMENSIONS IN MM

COMPLETE UNIT

TITLE BV1903 H/E HURTH ZF12M (HBW 125)
AND
BV2203 H/E HURTH ZF15M (HBW 150)

DRAWN BY:-- T. WATTS
CHECKED BY:--
DWG NO. 100-02011
SCALE NTS
DATE 06/02/01
REV 02

BETA MARINE

FLEX-MOUNT PAD
DETAILS.

PROP TAKE OFF DETAILS

CRANK SHAFT
CENTER

4 HOLES ϕ 11 EQUI-SPACED
DN 82.5 P.C.D.

BATTERY B-
BATTERY B+

Air Filter.
Sea Water Intake 30mm ϕ .
Oil Filter.
Max 90
Min 70

Dip Stick (Lub Oil)
BETA MARINE
From Calorifiers (15mm Bore)
Wasting Anode.
Sump Pump.

To Calorifiers (15mm Bore)

Oil Filler Cap.

Water Filler Cap.

140
75

ϕ 102

212 WITH SHALLOW SUMP
263

214

500

254

265

140

75

417

50

72

80.5

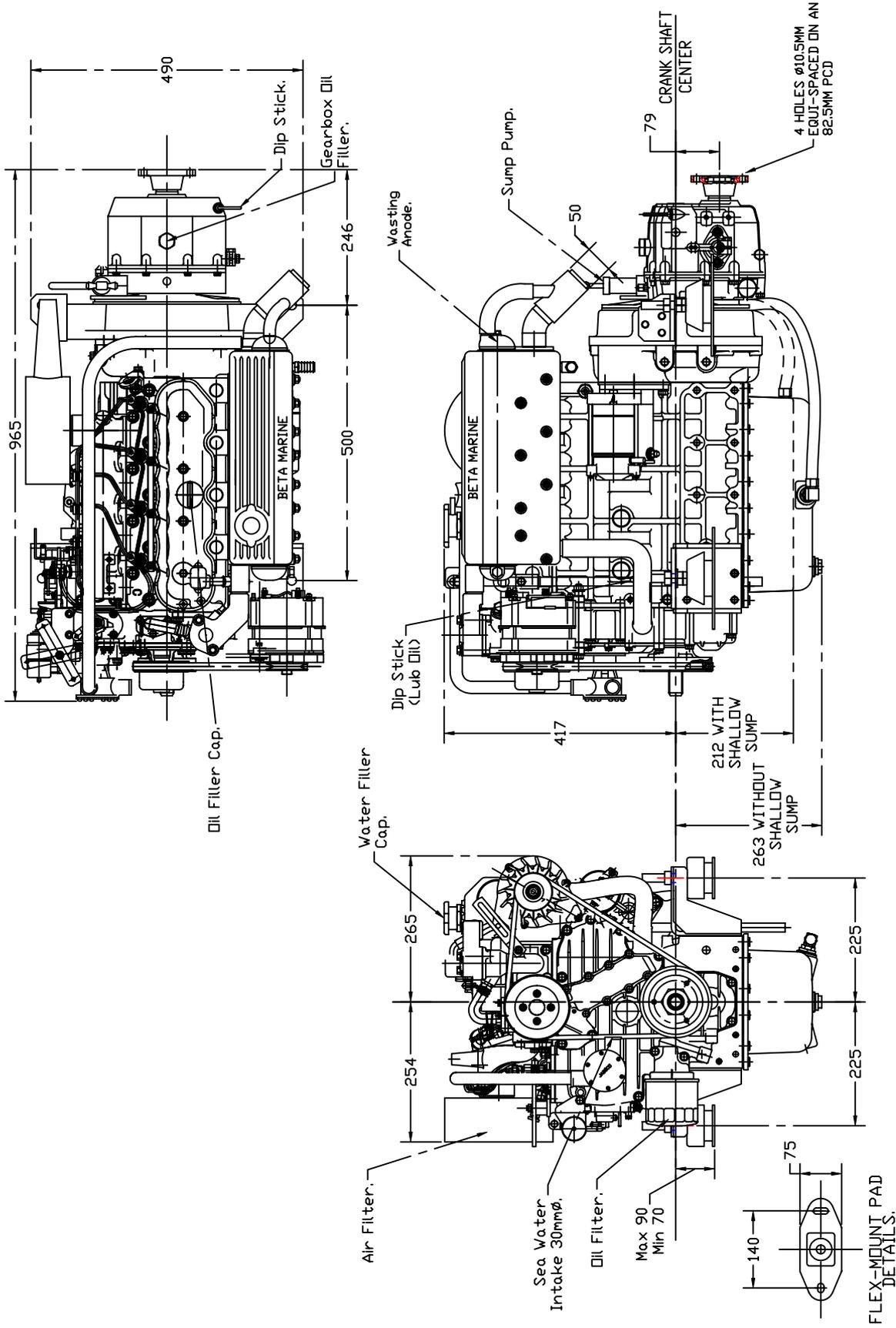
130.5

490

225

220

225



NOTES

COMPLETE UNIT

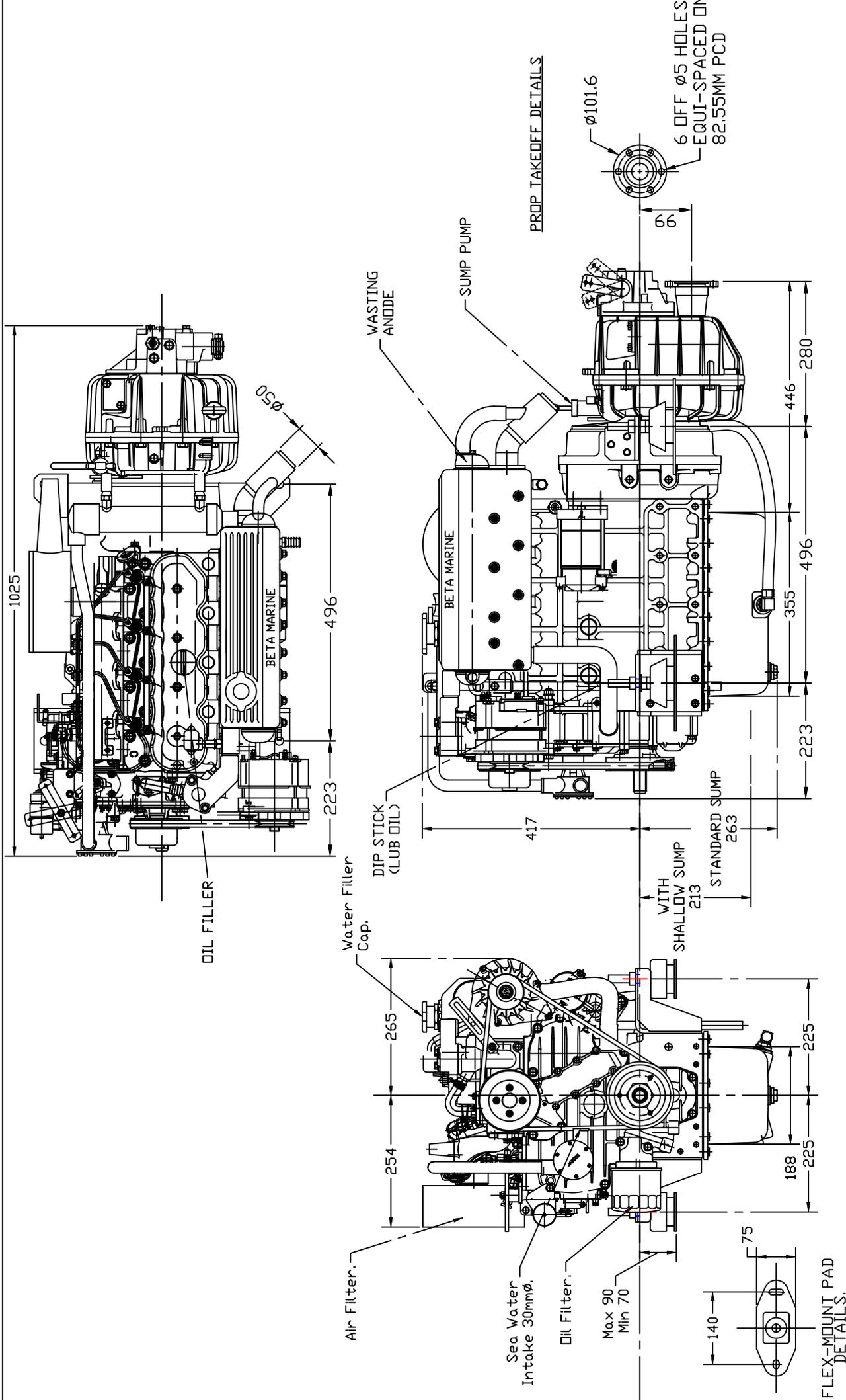
REV	DESCRIPTION	DATE	APP'D
01	ADDED SHALLOW SUMP DIM	05/12/01	
02	DIPSTICK AND ANODE	22/02/06	DM

TITLE BV1903/BV2203 HEAT EXCHANGE WITH TMC 60 GEARBOX

DRAWN BY: TW
CHECKED BY: --

SCALE A4
SIZE A4
DWG NO. 100-05154
PAGE NTS
DATE 29/11/01

BETA MARINE

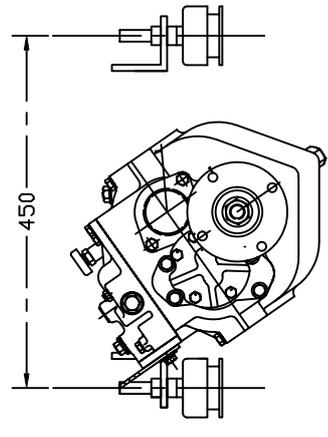
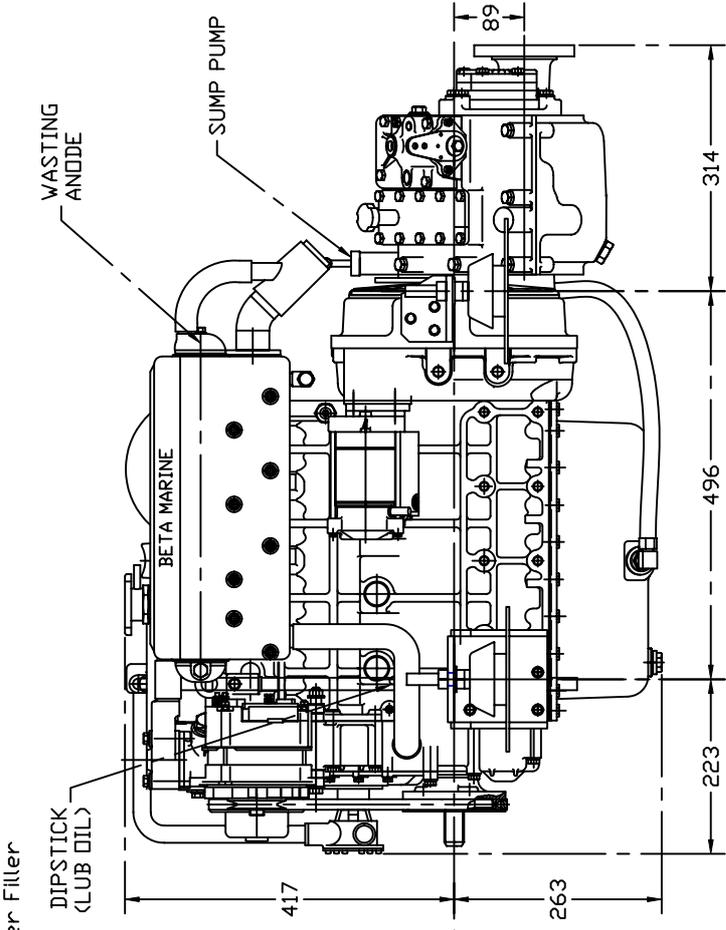
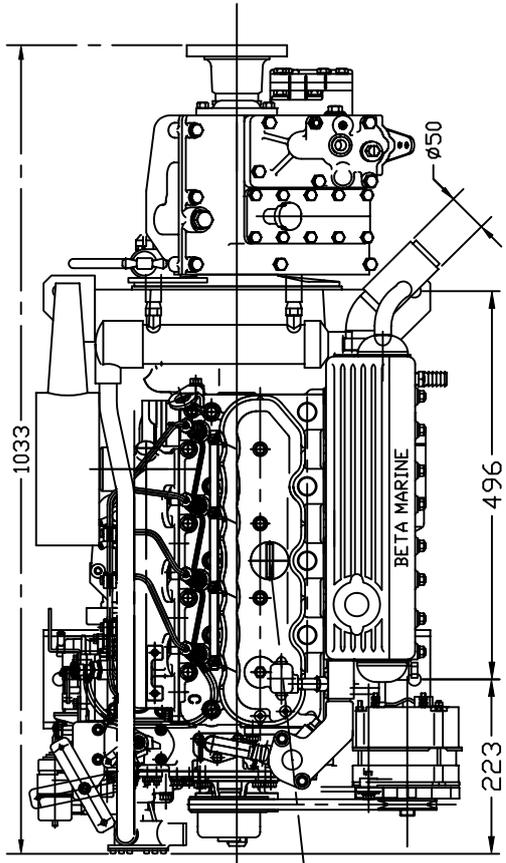


REV	DESCRIPTION	DATE	APP'D	NOTES	COMPLETE UNIT
01	ADDED SHALLOW SUMP DETAIL	14/08/04	LT		
02	NAME	29/11/05			
03	DIPSTICK AND ANODE	22/02/06	DM		

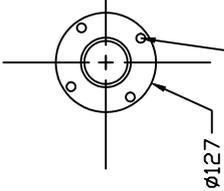
ALL DIMENSIONS IN MM

TITLE		BV1903 AND BV2203 H/E	
HURTH ZF25 (HSW 250 H)			
SIZE	DWG NO.	SCALE	DATE
	100-01333	NTS	15/03/00
REV	02		
DRAWN BY: TW		CHECKED BY:--	

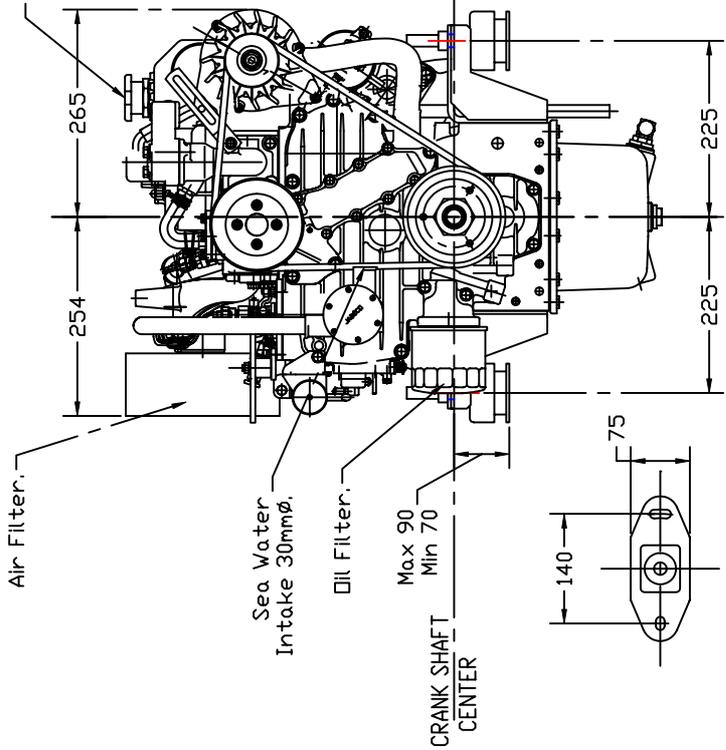
BETA MARINE



PROP TAKEOFF DETAILS



4 HOLES $\phi 11.50$ EQUI-SPACED
ON 107.90 P.C.D.



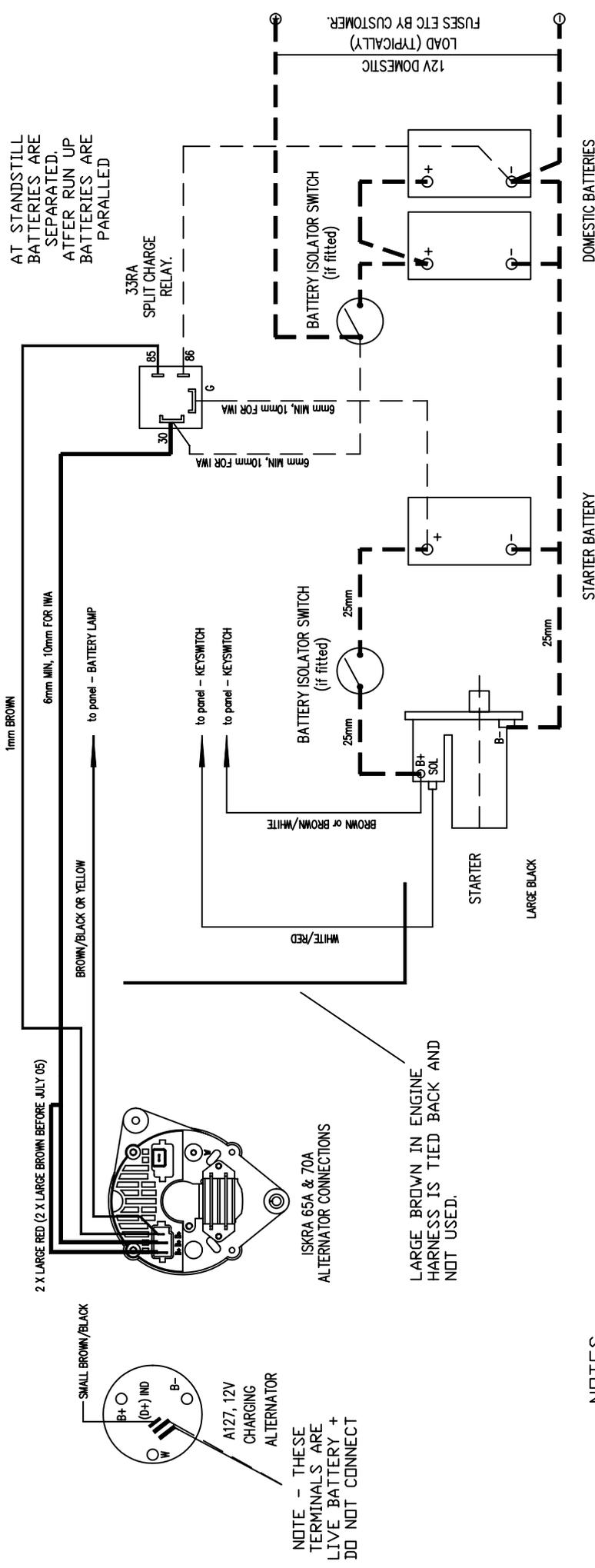
NOTES ALL DIMENSIONS IN MM COMPLETE UNIT

REV	DESCRIPTION	DATE	APP'D
01	DIPSTICK AND ANODE	22/02/06	DM

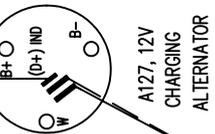
TITLE BV1903-2203-H/E-PRM260

REV	01
DATE	28/03/00
SCALE	NTS
DWG NO.	100-01351
DRAWN BY:--	TW
CHECKED BY:--	L.F.T

BETA MARINE



AT STANDSTILL BATTERIES ARE SEPARATED. AFTER RUN UP BATTERIES ARE PARALLELED



NOTE - THESE TERMINALS ARE LIVE BATTERY + DO NOT CONNECT

ISKRA 65A & 70A ALTERNATOR CONNECTIONS

LARGE BROWN IN ENGINE HARNESS IS TIED BACK AND NOT USED.

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.

BATTERY LEADS MUST BE INCREASED IN CSA FOR RUNS OVER 2M. CONSULT BETA, CABLES SHOWN BY DASHED LINES ARE CUSTOMER SUPPLY. RECOMMENDED MINIMUM CSA'S SHOWN.

WE RECOMMEND THE USE OF MULTISTRANDED CABLE TO BS 6862 PT 1. - 25mm - 196/0.4(EPR/CSP) 6mm - 84/0.3 1mm - 14/0.3

BETA SPLIT CHARGE RELAY PT NO - 200-57640 BETA BATT. ISOLATOR SWITCH PT NO - 200-62200 REFER ALSO TO SPECIFIC ENGINE WIRING DIAGRAM(S) ALSO BETA MARINE NOTES "DUAL BATTERY CHARGING SYSTEMS", BATTERY LEADS, SWITCHES AND 33RA RELAY ARE OPTIONAL EXTRAS AND ARE ONLY SUPPLIED WHEN SPECIFICALLY ORDERED.

REV	DESCRIPTION	DATE	APP'D	NOTES	COMPLETE UNIT
01	REDRAWN ON CAD	01.08.2001	TW	FOUR BLOCKING DIODE SYSTEM REFER TO DRAWING 300-62220, DRAWINGS 200-02189, 300-00212 SHEETS 1, 2 AND 3 ALSO RELATE TO SPLIT CHARGE AND INSULATED SYSTEMS.	TYPICAL INSALLATION FOR SPLIT CHARGE DUAL BATTERY SYSTEM, MACHINE SENSED ALTERNATORS.
02	MINOR MODIFICATIONS AND NOTES	10.10.2001	PAG		TITLE
03	CHANGED STD ALTERNATOR	05.06.2003	DM		SPLIT CHARGE RELAY INSTALLATION.
04	CHANGED NOTES	15.12.2005	DM	(ISSUE 02+ OF THIS DRAWING ALSO REPLACES 300-97720).	
					DWG NO. 300-62210
					DATE OCTOBER 1997
					REV 04
					SHEET 1 OF 1

BETA MARINE

DRAWN BY:- PAG
CHECKED BY:-

BV2203 AND BV1903 100 Amp 12V Output Alternator

In this system the normal 65 amp battery charging alternator is replaced by a very efficient 100 amp alternator, without changing the length of the engine. The drive system has been engineered to incorporate a 6 groove flat drive belt to take the extra load. With a larger diameter drive pulley, the alternator gives out 60 amps even at tick over and 100 amps at 1800 rpm.

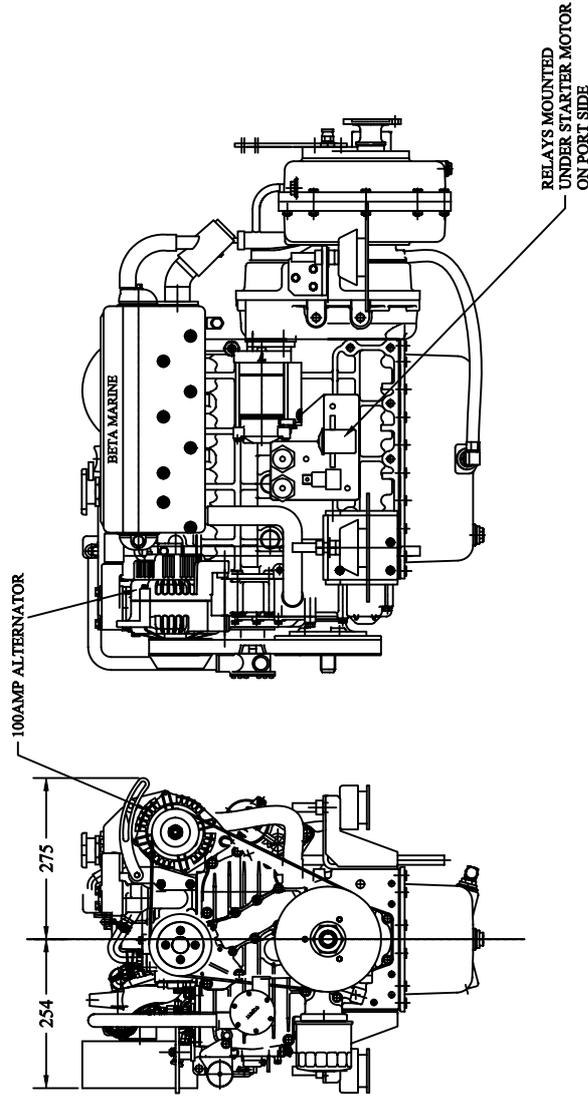
The package can include a second option of a split charge system fitted to the engine to separate the engine start and domestic batteries. The engine wiring harness is also pre-wired to accept the **beta controller** option which gives owners the ultimate in battery charging capacity when engine room space is at a premium.

Note the engine compartment must be correctly vented, with a minimum of a 4" extractor fan continuously rated, and wired into the starter switch.

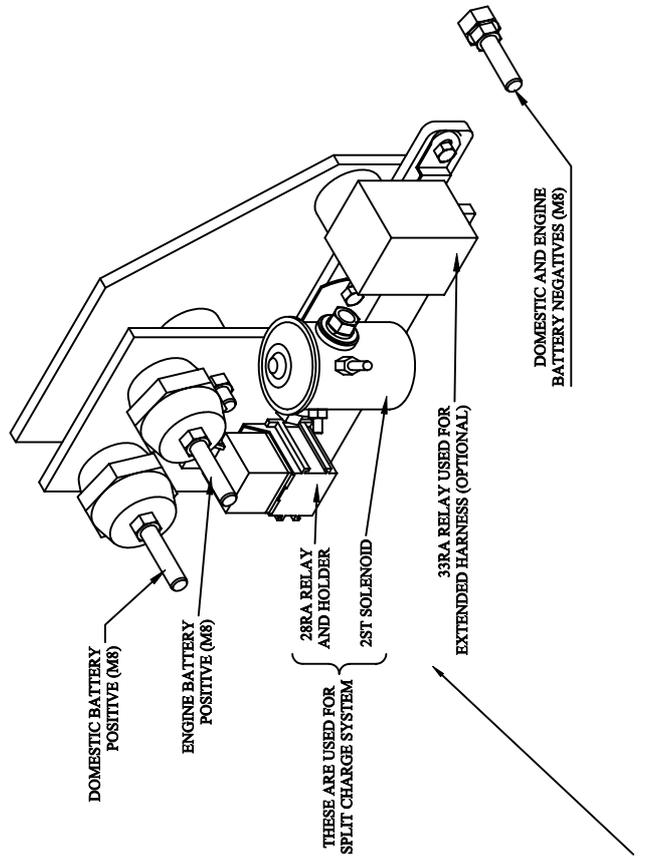
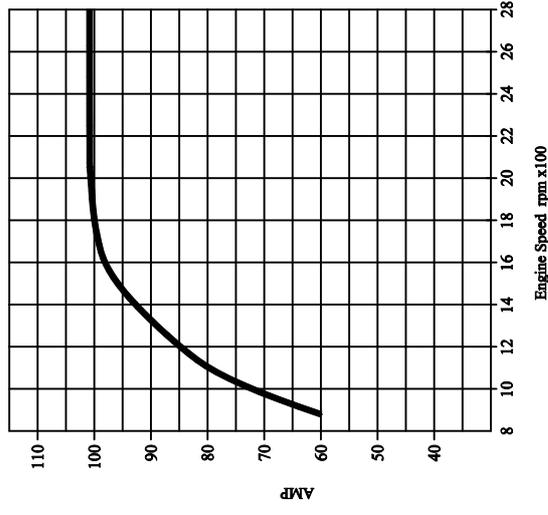
CAUTION TENSION BELT BY HAND

DIAGRAM

BV2203 WITH A PRM 150 SHOWN



100AMP ALTERNATOR OUTPUT



BETA CONTROLLER

SEA SPEC ENGINES

The **BETA CONTROLLER** is an integrated battery charging external regulator. It is designed to be used with Beta s 70 and 100amp Iskra alternators.

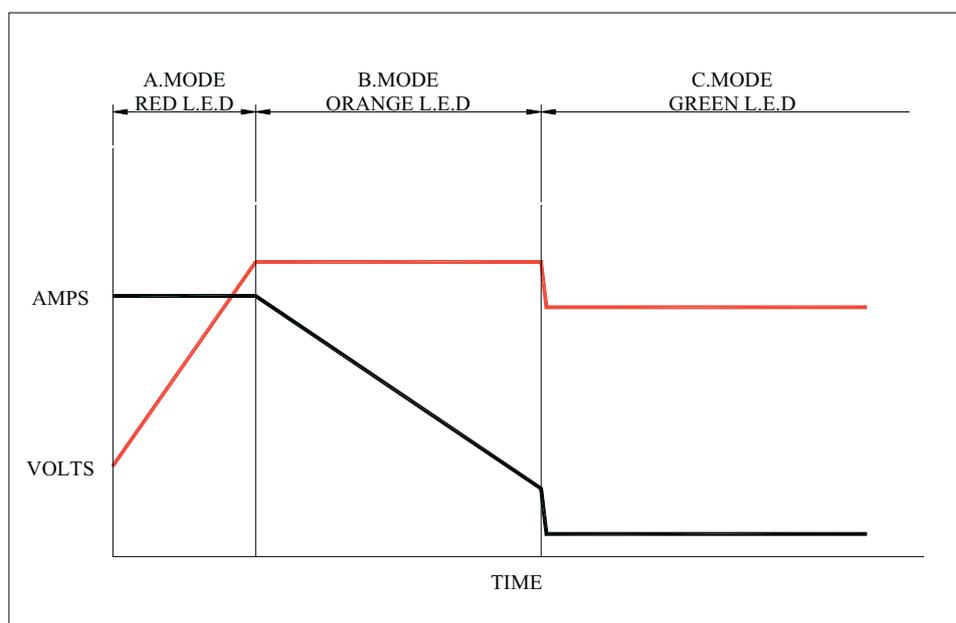
The system utilises a three stage charging characteristic which optimises the rapid charge of battery systems.

The first stage (A mode) is a boost charge, which is indicated by the indicator LED showing red.

The second stage (B mode) is where the voltage is kept at a high level and where the current is between 10% and 95% of the nominal alternator current, the LED shows orange.

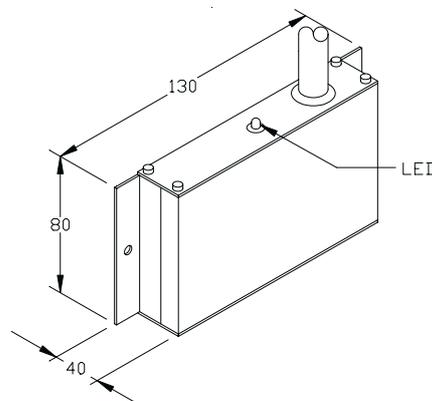
The third and last stage (C mode) is intended for maintenance of battery voltage only. When the alternator current is under a predetermined value for a time greater than 2 minutes, the regulating mode is changed from B to C mode.

The system automatically adjusts the charge mode to suit the load and is set in our works for conventional lead-acid batteries. It can easily be re-set for deep cycle or gel batteries. A more detailed specification can be obtained from **BETA MARINE**.



INSTALLATION

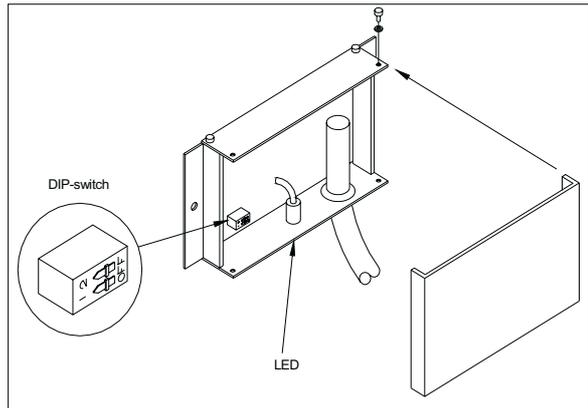
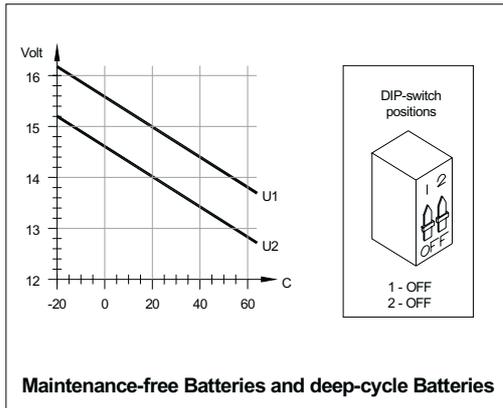
The Beta Controller has been designed for mounting off the engine in a location away from vibration, water and condensation. Ideally as there is a charge mode status LED, the unit should be positioned to allow for inspection of charge operating condition.



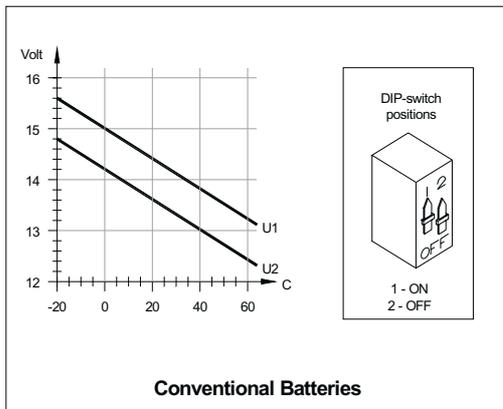
All goods are offered and supplied in accordance with our 'General Terms of Tender Sale'.

1

The graphs below illustrate charging voltages for different battery types.



Cover removal for resetting of DIP switches



U1 = Mode B (Orange lamp)

U2 = Mode C (Green lamp)

Note: ensure all batteries are switched off, controller is disconnected from wiring before removing any covers.

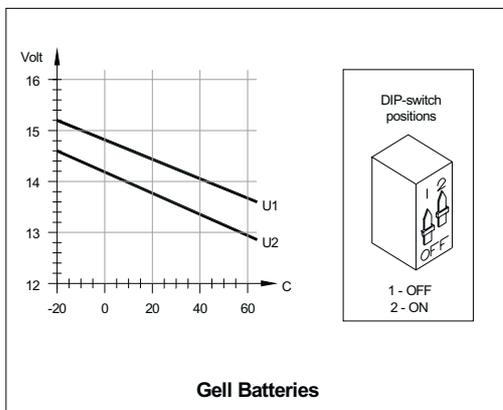
Voltage setting for battery charge is done through the two DIP switches inside the controller. Remove the cover by removing the top four screws and loosening the bottom four. This cover is sealed on to prevent water ingress, this seal must be broken for cover removal.

Set the dip switches to the required settings as illustrated on the charts opposite.

Re-seal controller with silicon sealant or equivalent after setting switches.

As standard the controllers are supplied to Beta Marine to suit lead acid batteries.

If in doubt on battery type check with battery supplier before fitting controller. Beta Marine are not responsible for incorrect switch setting for each installation.



THIS CONTROLLER SHOULD NOT BE MOUNTED ONTO THE ENGINE BODY.

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

2

Declaration of Conformity for Recreational Craft Propulsion Engine with the Exhaust emission requirements of Directive 94/25/EC as amended by 2003/44/EC

(Completed by manufacturer of inboard engines without integral exhaust)

Name of engine manufacturer: Beta Marine Ltd.
 Street: Merretts Mills, Bath Road Town: Stroud
 Post Code: GL5 5EU Country: U.K.

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 JIS K2204:1997 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
BD905 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
Annex I.B – Exhaust Emissions			
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
Annex I.C – Noise Emissions	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.

Name: J. A. Growcoat Signature and title:  C. E. O.
 (identification of the person empowered to sign on behalf of the engine manufacturer)

Date: (yr/month/day) 06 / 01 /01.
 Emissions certificate2.doc

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.

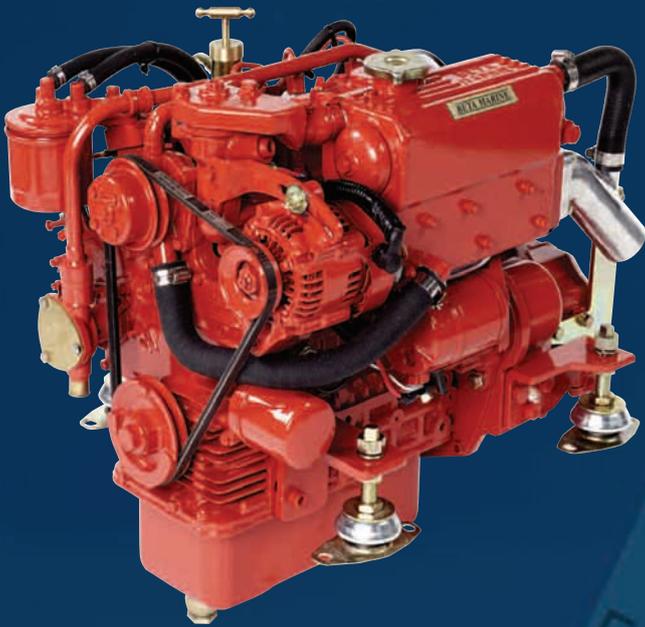
Particular attention must be paid to the installation with respect to the exhaust system. The system must be designed so that water cannot backfeed into the engine. The run must be such that the back pressure at the engine manifold does not exceed the level detailed in the Operator's Maintenance Manual. 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.

REV	DESCRIPTION	DATE	APP'D	NOTES	THIRD ANGLE PROJECTION. DIMENSIONS IN mm. DO NOT SCALE.	COMPLETE UNIT
						TITLE EMISSION DURABILITY.
						DWG NO. 262-06678/01
						DATE 09.12.2005
						REV 00
						SHEET 1 of 1

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CHECKED BY:-

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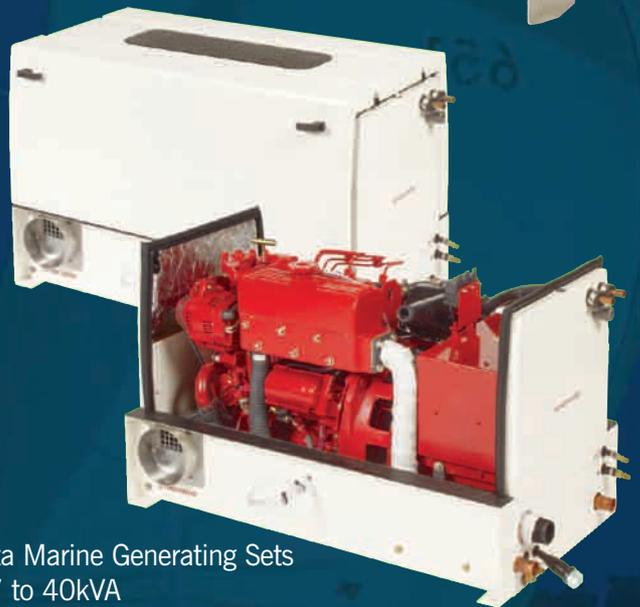
Heat Exchanger Cooled 10 to 90bhp



Sail Drives 13.5 to 50bhp



Keel Cooled 10 to 90bhp



Beta Marine Generating Sets
3.7 to 40kVA

BETA MARINE

Beta Marine Limited
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Quedgeley, Gloucester
GL2 2AD, U.K.

Tel: 01452 723492
Fax: 01452 883742

www.betamarine.co.uk
Technical Spares email: spares@betamarine.co.uk
Technical Warranty email: adrian@betamarine.co.uk



Beta Marine Generating Sets
30 to 900kVA