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# Installation & Operating Handbook

**Autohelm<sup>TM</sup>**

PowerPilot

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# 1. GENERAL DESCRIPTION

Congratulations on choosing the **Autohelm PowerPilot**. It offers outstanding self steering capability for a wide range of modern powercraft equipped with hydraulic steering.

The **PowerPilot** uses microprocessor based technology and easy to use control pads to give you total command under autopilot control without the need for constant adjustments.

The **PowerPilot** is manufactured by the world's largest producer of Marine autopilots with Technical Advice, Service and Support ready to help you get the most from your Autohelm.

The **PowerPilot** is modular and designed for easy installation with flexibility to cope with the variation of individual craft and owner specifications. It is supplied as standard with the course computer, one control unit, fluxgate compass, hydraulic drive unit, and rudder reference transducer. The basic **Autohelm PowerPilot** can be extended to suit individual requirements. The basic system is illustrated below in Figure 1.

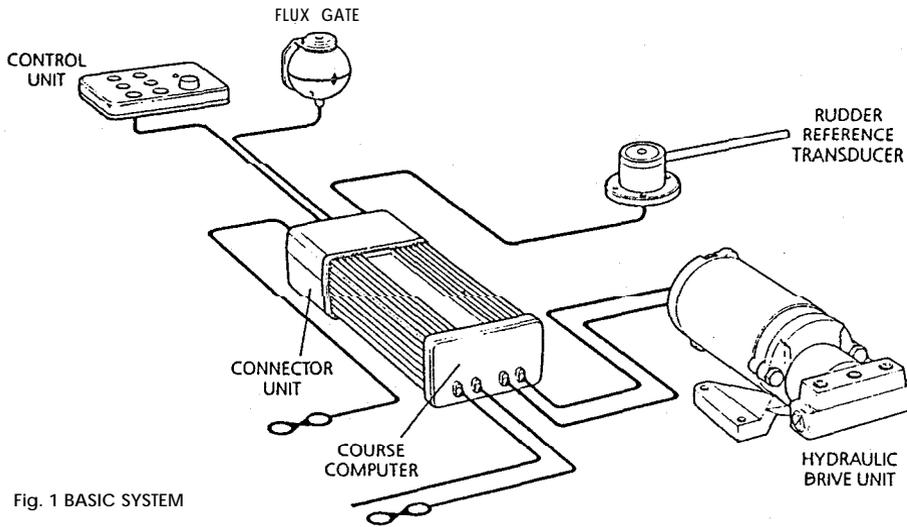
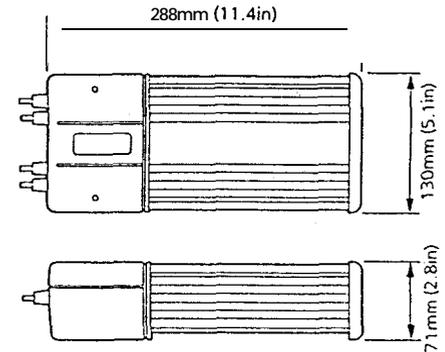


Fig. 1 BASIC SYSTEM

## 1.1 Course Computer

The course computer houses the microprocessor, electronic control circuitry and power amplifier to drive the hydraulic pump.

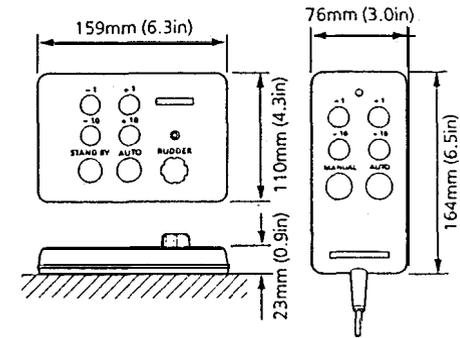
The course computer is splash proof only and must be mounted in a dry and protected position.



## 1.1.2 Control Unit

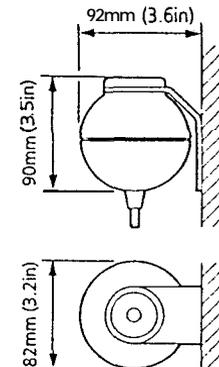
The six button control unit is fully waterproof and is mounted close to the steering position. It is designed for surface mounting, or alternatively can be bracket mounted if required (bracket mounting kit Cat. No. D105).

A second control unit (Cat. No. 2054) and a hand held control unit (Cat. No. 2056) can be added to the system. The hand held control unit is fitted with a 6m (19ft) wander lead and plugs into a bulkhead mounted waterproof socket.



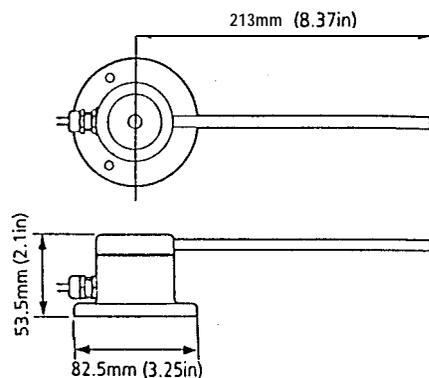
## 1.1.3 Fluxgate Compass

The fluxgate compass has been especially developed for marine application. The compass contains a gimbal mechanism to permit accurate readings with pitch and roll movements up to  $\pm 40^\circ$ . The compass is bulkhead mounted below decks and connects directly to the course computer.



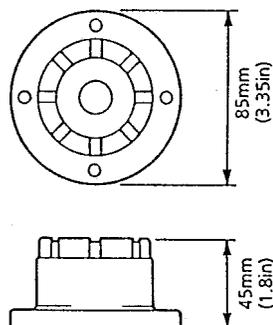
### 1.1.4 Rudder Reference Transducer

The rudder reference transducer provides the course computer with a precise rudder position. It is mounted on a suitable base adjacent to the rudder stock. The interconnecting cable connects directly to the course computer connector unit.



### 1.1.5 Auxiliary Alarm (Cat. No. 2035)

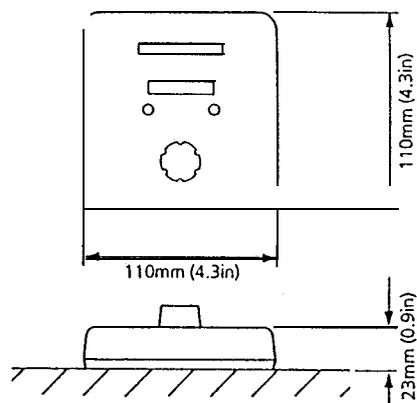
The autopilot is provided with an automatic off course alarm system which sounds from all control units and provides sufficient audible warning under most conditions. In cases where a high power alarm is necessary, an auxiliary alarm can be fitted. The auxiliary alarm is connected to the main connector unit via a two core cable.



### 1.1.6 Radio Navigation Interface

(Cat. No. 2057)  
The PowerPilot can be interfaced to any Loran, Decca or Satellite Navigation receiver having a suitable cross track error output to NMEA 0180/0182/0183. The radio navigation interface computes the course adjustments to enable the PowerPilot to steer to a selected waypoint.

The unit is waterproof and designed for surface mounting (normally adjacent to the Loran/Satellite Navigation receiver). If required the unit can be bracket mounted using the bracket mounting kit (Cat. No. D104).



## 1.2 HYDRAULIC DRIVE UNITS

The PowerPilot is available with one of two hydraulic drive units, depending on the size of the vessel and the displacement of the ram.

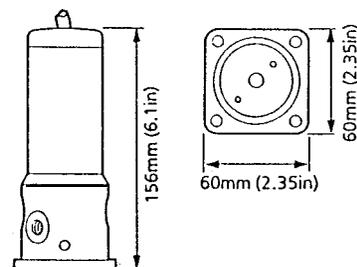
The vessel size and displacement recommendations given below apply to directly driven steering systems. When a power steering system is fitted the vessel size and displacement recommendations can be ignored.

### 1.2.1 Type 0 Hydraulic Drive

The type 0 hydraulic drive unit consists of a twin cylinder piston pump powered by a small but powerful reversing electric motor.

The high volumetric efficiency of the piston pump provides precise control, with the twin pistons offering smoother and quieter operation than would be found with a single cylinder design.

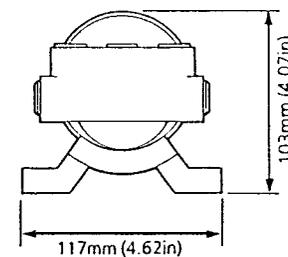
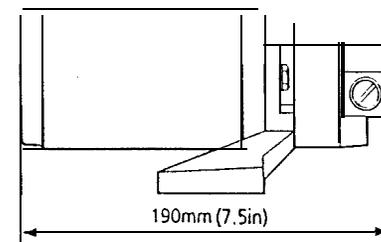
Description	Size
Maximum Vessel Size	8m (26ft)
Maximum Vessel Displacement	3000 Kg (6600 lbs)
Maximum Ram Capacity	130cc (8.0in <sup>3</sup> )
Minimum Ram Capacity	50cc (3in <sup>3</sup> )
Regulated Peak Pressure	30 bar (450lb in <sup>2</sup> )
Peak Flow Rate (Unloaded)	490cdmin (30in <sup>3</sup> /min)
Power Consumption (Typical Average)	1.5-2.5 amps
Ram Type	Double Ended (Balanced)



### 1.2.2 Type 1 Hydraulic Drive

The hydraulic drive unit consists of a precision gear pump with integral valve block driven by a continuously rated servo motor. The pump drive motor is connected directly to the course computer which also regulates peak pump pressure and eliminates the need for end stroke limit switches.

Description	Size
Maximum Vessel Size	1m (36ft)
Maximum Vessel Displacement	5500 Kg (12000 lbs)
Maximum Ram Capacity	230cc (14in <sup>3</sup> )
Minimum Ram Capacity	130cc (8in <sup>3</sup> )
Regulated Peak Pressure	50 bar (750psi)
Peak Flow Rate (Unloaded)	1100cc/min (67in <sup>3</sup> /min)
Power Consumption (Typical Average)	3.5-6 amps
Ram Type	Single or Double Ended (unbalanced or balanced)



## 2. INSTALLATION

### WARNING

The Autohelm PowerPilot requires correct installation if it is to provide accurate safe self steering. Whilst designed for simple installation we strongly recommend that the system should be installed

professionally or alternatively professional advice be obtained if you intend to install the system yourself.

The manufacturers can accept no liability for any claims arising from incorrect installation or product usage.

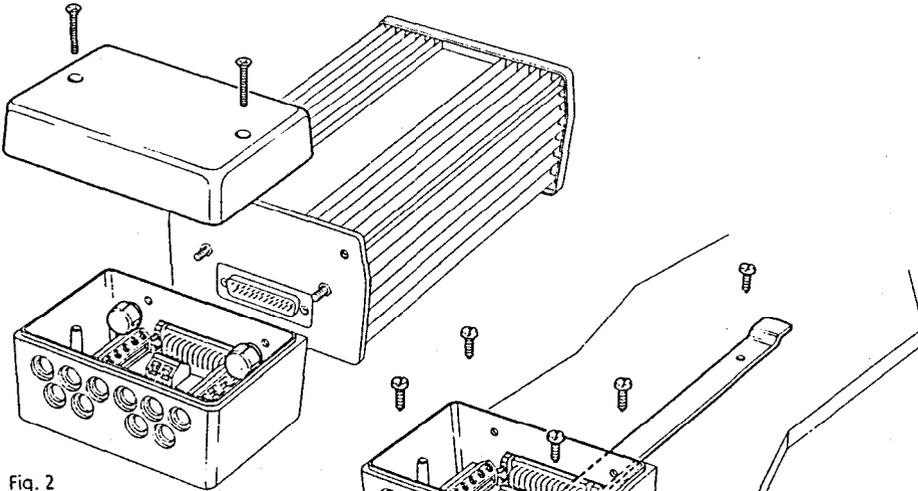


Fig. 2

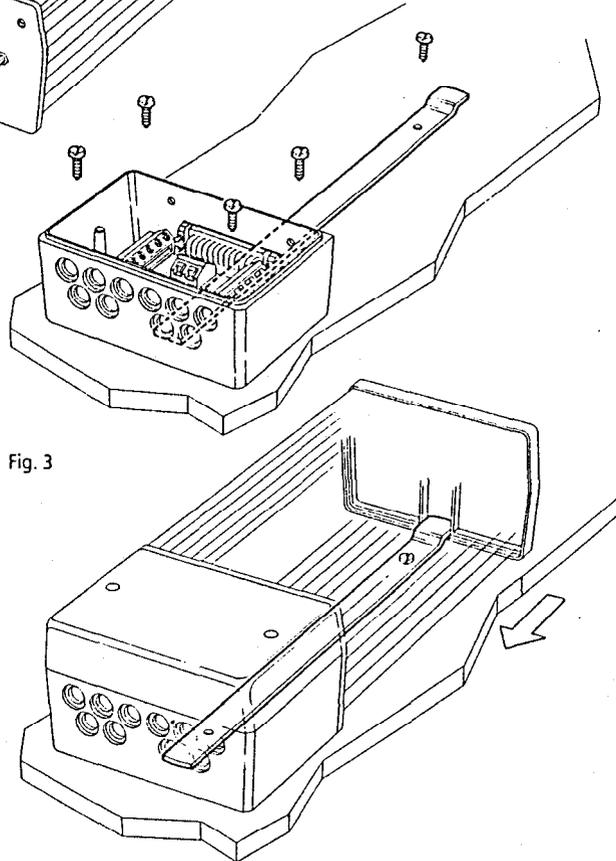


Fig. 3

### 2.1.1 Course Computer

#### Mounting Position - Below Deck

The course computer should be positioned in a dry protected area of the vessel free from high operating temperatures and excessive vibration. It can be mounted in any attitude. Care must be taken to allow at least 15mm (6in) clearance all round to aid heat dissipation from the power amplifier in the unit. Do not mount in the engine room.

DO NOT position the course computer so that it will:

- Receive any direct water splash/spray (from Bilge/Hatch etc).
- Be liable to physical damage from heavy items.
- Be covered by other equipment or onboard gear.
- Be close to major sources of transmitted energy (Generators/S% radios, Aerial Cables etc).

#### Mounting Instructions

- Remove Terminal box lid (Fig. 2).
- Unscrew two internal thumb retaining nuts (Fig. 2).
- Unplug terminal box and mounting spine.
- Position terminal box and mounting spine in correct location, mark off and pilot drill for the 5 self tapping screws supplied (Fig. 3).
- Screw terminal box and mounting spine into place.
- Plug course computer unit to terminal box. Retighten thumb retaining screws.

The course computer is now ready for wiring (see 2.3).

### 2.1.2 Control Units

**Mounting Position** - Control units must be mounted close to the steering stations. The unit is fully water-proof and suitable for external location. If the control unit is permanently exposed when the boat is not

in use we strongly recommend the use of a protective cover (optional extra Cat. No. D101).

### WARNING

Safe operation of the PowerPilot requires that the control unit be mounted within easy reach of the helmsman when in the normal steering position. Position the control unit to ensure this requirement is met.

#### Mounting Instructions

The unit is attached with reusable positive locking pads. In most cases, the pads may be stuck directly onto the mounting surface.

- Using the template supplied, select the control unit position, mark off and drill the 17mm (5/8in) hole for the interconnect cable.
- Attach the positive-lock pads to the rear of the control unit (Fig. 4).

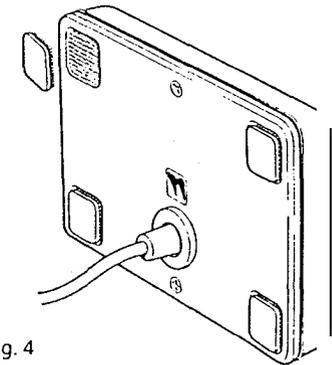
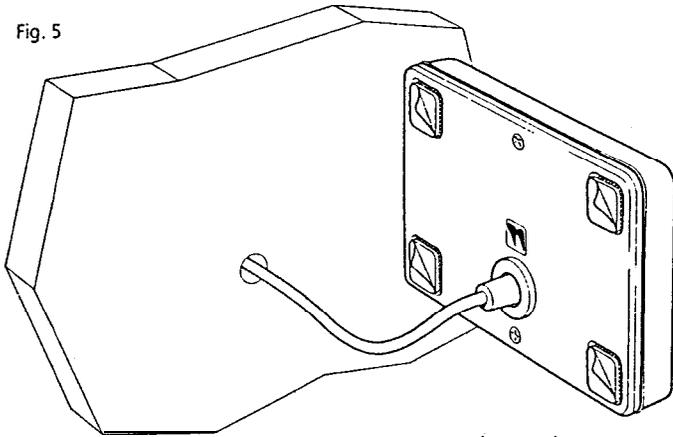


Fig. 4

- Thoroughly clean the mounting surface with alcohol (or equivalent) and allow to dry.

Fig. 5

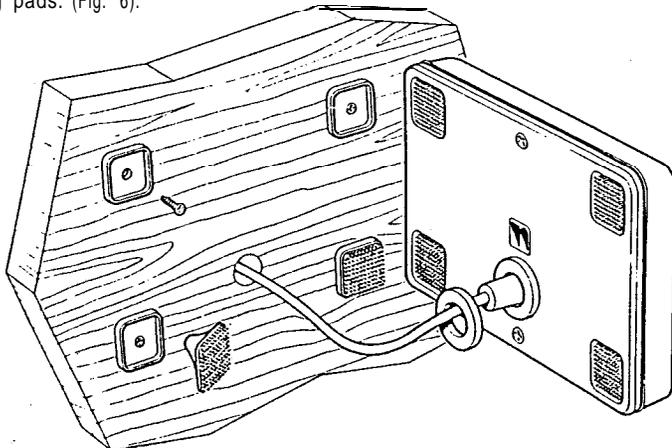


- Thread the interconnect cable through the 17mm (5/8in) hole, peel off the backing from the pads (Fig. 5).
- Press the unit onto the mounting surface maintaining pressure for 30 seconds to ensure a strong bond.

The control unit interconnect cable is now ready for connection to the course computer (See 2.3).

Where the control unit is to be mounted to a painted, varnished or untreated wood surface the carriers supplied should be used to provide a sound bonding surface for the mounting pads. (Fig. 6).

Fig. 6



#### Instructions

- Using the template supplied mark off and drill the 17mm (5/8in) hole and mark off and pilot drill the fixing holes for the carriers.
- Screw the holders into position using the self tapping screws provided.
- Clean the holder surface with alcohol (or equivalent) and stick the positive lock pads into place (Fig. 6).
- Note An additional foam seal must be used in this method to provide sealing.
- Carefully align the control unit with the holders and press firmly into place to secure a positive attachment.

#### Removing a Control Unit

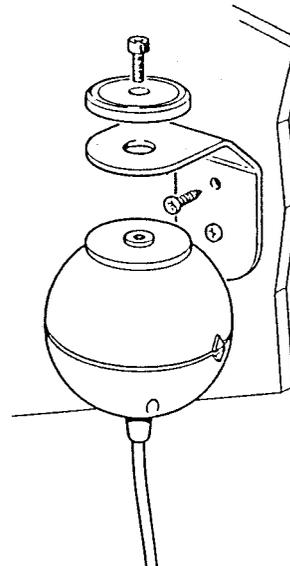
- Using a flat lever gently unlock the securing pads starting at one corner.
- Do not use excessive force.
- The unit may be re-attached by pressing it back onto the security pads.

#### 2.1.3 Fluxgate Compass

The fluxgate compass may be attached to a convenient bulkhead using the self tapping screws provided. Unscrew the top cap to release the compass housing from the mounting bracket (Fig. 7). Screw the bracket to the bulkhead using the self tapping screws provided and finally re-attach the compass body to the mounting bracket.

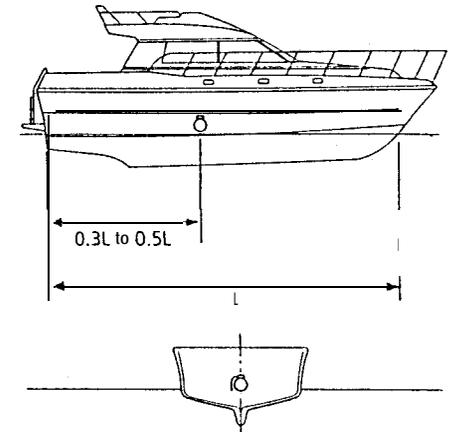
Correct positioning of the fluxgate is crucial if ultimate performance from the autopilot installation is to be achieved. The fluxgate should ideally be positioned as near as possible to the pitch and roll centre of the vessel in order to minimise gimbal disturbance (Fig. 8).

Fig. 7



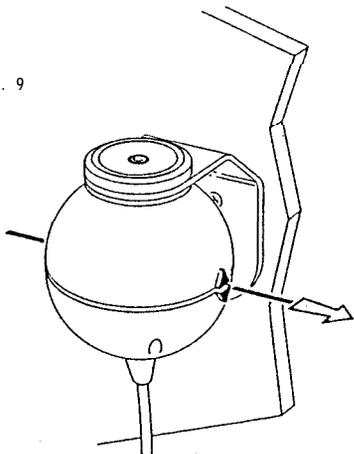
It is very important to ensure that the fluxgate is positioned at least 0.8m (2ft6in) away from the vessel's steering compass in order to avoid deviation of both compasses. The fluxgate must also be positioned as far away as possible from large iron masses, such as the engine and other magnetic devices which may cause deviation and reduce the sensitivity of the sensor. If any doubt exists over magnetic suitability of the chosen site, the position may be surveyed using a simple hand bearing compass. The hand bearing compass should be fixed in the chosen position and the vessel swung through 360°. Relative differences in reading between the hand bearing compass and the vessel's main steering compass should ideally not exceed 5° on any heading.

Fig. 8



When the installation is complete the fluxgate compass should be approximately aligned with the vessel's centre line by rotating the body until the arrows on the joint line face the bows (Fig. 9).

Fig. 9



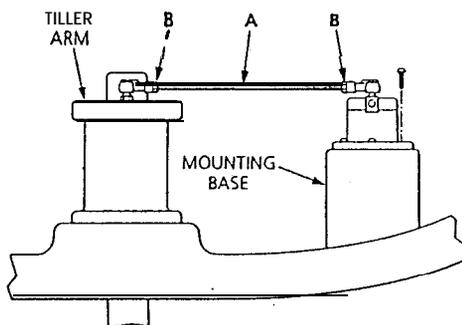
**Installation Precautions**

Correct installation of the course computer and fluxgate compass is vital to the successful performance of the Autohelm Pow&Pilot. The installation precautions must be heeded if poor performance or even failure of the autopilot is to be avoided.

**2.1.4 Rudder Reference Transducer**

The rudder reference unit must be mounted on a suitable base adjacent to the rudder stock (Fig. 10) using the self tapping screws provided. The base height must ensure correct vertical alignment of

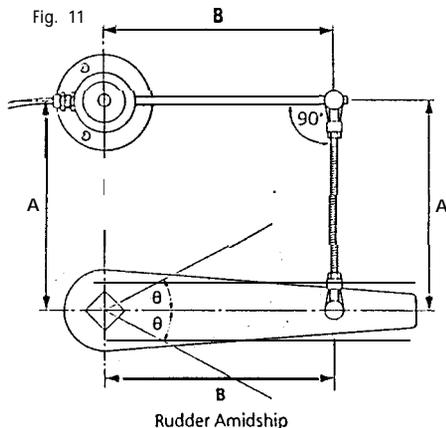
Fig. 10



the rudder reference unit arm and tiller arm. If it is more convenient, the rudder reference unit may be mounted upside down (label downwards), but if this is done, the red and green wires must be reversed in the connector unit.

It is important to ensure that dimensions A and B (fig. 11) are the same at both points and that when the rudder is amidships the unit arm is opposite the cable gland and makes an angle of 90° with the connecting bar.

Fig. 11



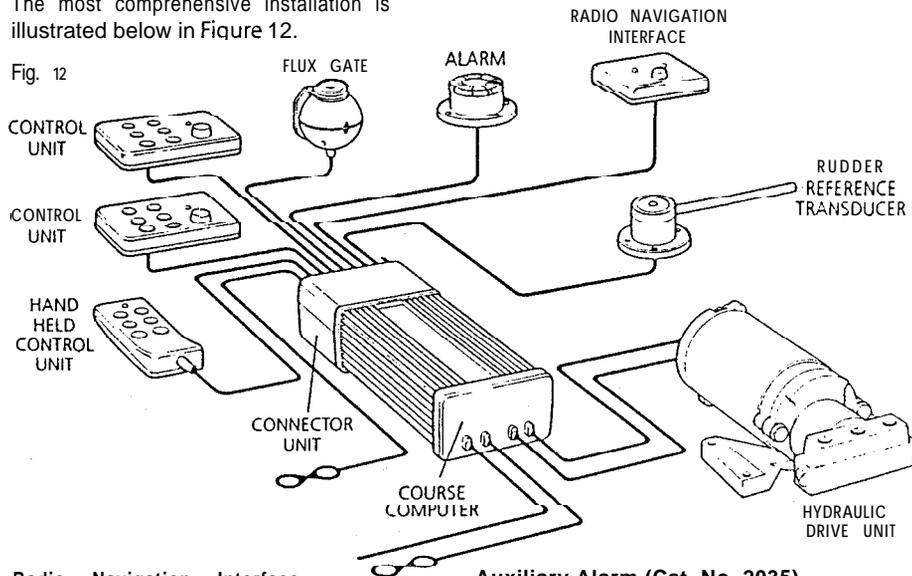
Dimension	Minimum	Maximum
A	75mm(3in)	310mm(12in)
B	120mm(4.7in)	200mm(8in)
θ	↔	40°

Having selected a suitable position (Fig. 10), the interconnecting link A may be cut to length and the linkage fastened ensuring that the locking nuts B are secure. The tiller arm should be tapped M6 to a depth of 20mm (13/16in) or through drilled to accept the ball joint supplied. The rudder should then be moved from side to side to ensure the linkage is free from any obstruction,

**2.1.5 Accessories**

The most comprehensive installation is illustrated below in Figure 12.

Fig. 12



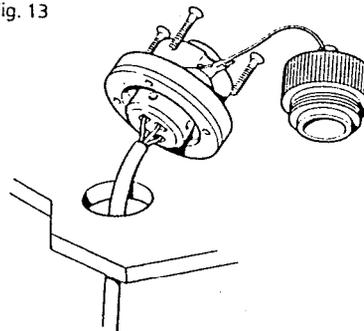
**Radio Navigation Interface (Cat. No. 2057)**

This is installed using the same procedure as given for the control unit. (See 2.1.2).

**Remote Control Unit**

The remote control socket is pre-wired with the interconnecting cable. A 22mm (7/8in) diameter hole should be bored through the mounting panel and the socket screwed into position using the four self tapping screws provided (Fig. 13).

Fig. 13

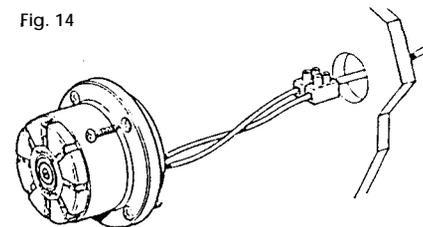


**Auxiliary Alarm (Cat. No. 2035)**

The auxiliary alarm unit is waterproof and may therefore be mounted in any position. The alarm unit is supplied with a terminal block to connect a two core interconnection cable to the course computer. A 22mm (7/8in) hole should be bored through the mounting panel/deck to pass through the two way connector block and interconnecting cable (Fig. 14).

Finally, the alarm unit should be screwed into position using the four self tapping screws provided. A foam seal on the alarm mounting flange will ensure a watertight joint to the mounting surface.

Fig. 14



## 2.2 HYDRAULIC DRIVE UNIT

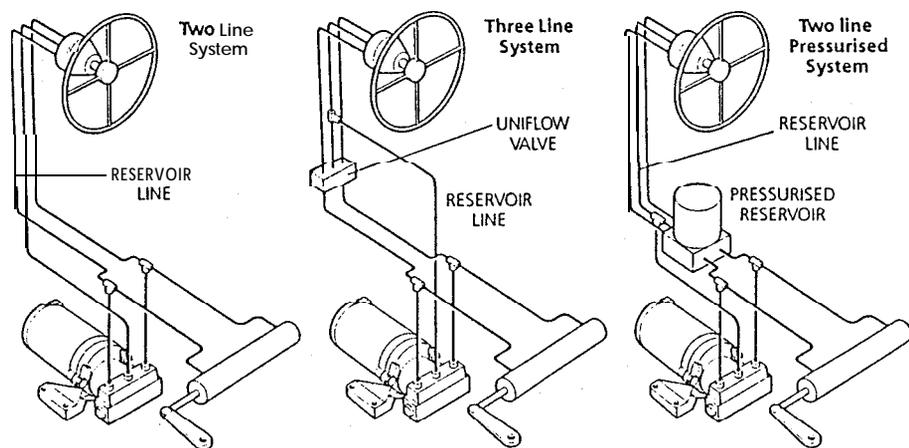
### General guidelines

The hydraulic drive unit should be mounted clear of spray and the possibility of immersion in water. It should be located as near as possible to the hydraulic steering cylinder. It is important to bolt the hydraulic drive unit securely to a substantial member to avoid any possibility of vibration that could damage the inter-connecting pipework.

There are three basic types of hydraulic steering system, and these are illustrated in Fig. 15. Typical connection points for the drive unit are shown in each case. In all cases it is strongly recommended that the steering gear manufacturer be consulted.

Minimisation of hydraulic fluid loss during connection of the drive unit will help to reduce the time and effort required later to bleed the system of trapped air. Absolute cleanliness is essential since even the smallest particle of foreign matter could interfere with the correct function of precision check valves in the steering system.

Fig. 15



When the installation has been completed the hydraulic pump may be operated by switching the control unit to Auto and operating the  $+10^\circ$  and  $-10^\circ$  course change buttons. Greater motor movements will be obtained if the rudder control is set to maximum.

The hydraulic steering system should be bled according to the manufacturer's instructions. From time to time during the bleeding process the drive unit should be run in both directions to clear trapped air from the pump and inter-connecting pipe work.

If the air is left in the system the steering will feel spongy particularly when the wheel is rotated to the hardover position. Trapped air will severely impair correct operation of the autopilot and the steering system and must be removed.

During the installation of the system it has not been necessary to keep track of the connection sense to the hydraulic steering circuit since operating sense of the autopilot can be corrected if necessary by reversing the polarity of the pump drive motor connections (see section 3.3.1).

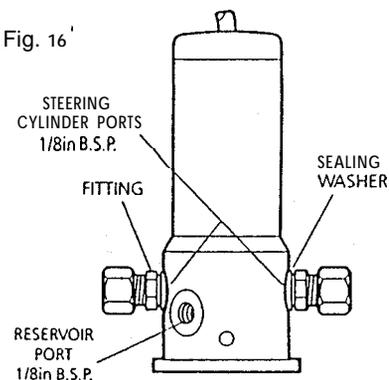
### 2.2.1 Type 0 Installation

The Type 0 pump must be mounted vertically with the mounting flange bolted to a suitable horizontal surface using four 6mm (1/4in) bolts.

All ports are tapped 1/8in B.S.P. Three 1/8in B.S.P. to 1/4in N.P.T. adaptors are included to convert to N.P.T. where required. The sealing washers supplied should be placed between the fitting and the pump (Fig. 16).

It is recommended that 1/4in fittings or larger are used throughout to minimise transmission losses.

Fig. 16



The two cylinder ports are positioned opposite one another on the pump body. The reservoir port is marked R and is at  $45^\circ$ . All connections to the pump should be made with flexible hose.

#### Important Note

All connections in the reservoir line must be sound as any air introduced to this line will seriously degrade pump performance.

#### Bleeding

The type 0 pump is sensitive to trapped air, and care must be taken during installation and commissioning to remove it. Before connecting the hoses to the pump:

- Ensure all hoses are filled with oil
- Prime the pump ports with oil

When operating the hydraulic pump to bleed the system, turn the helm pump in opposition. This will help any air expelled from the hydraulic pump rise to the helm pump reservoir.

### 2.2.2 Type 1 Installation

The Type 1 pump should be mounted on a suitable horizontal surface.

All ports are tapped 1/4in B.S.P. Three 1/4in B.S.P. to 1/4in N.P.T. adaptors are included to convert to N.P.T. where required (Fig. 17). The sealing washers supplied should be placed between the fitting and the pump (Fig. 18).

Fig. 17

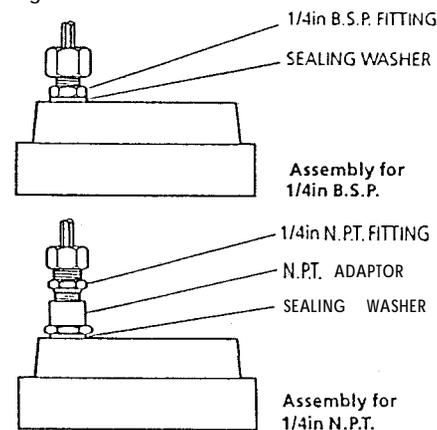
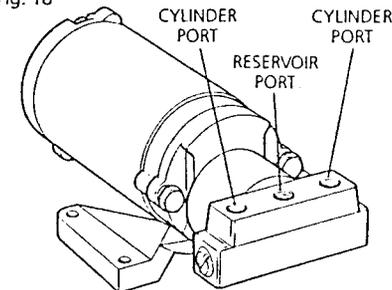


Fig. 18



## 2.3 CABLING AND POWER SUPPLIES

### 2.3.1 Signal Cabling

Cable interconnections between all sub system modules are shown schematically (in Figs 1 and 12). All peripheral units

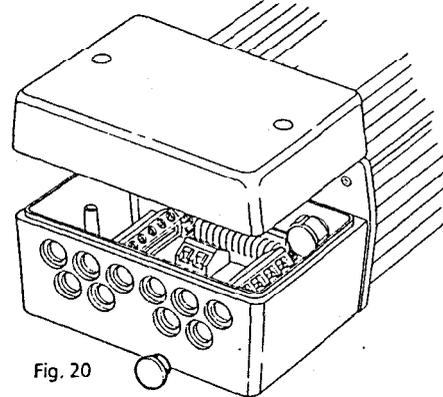


Fig. 20

connect to the connector unit where they are permanently hard wired to colour coded connector blocks situated on a central printed circuit board (Fig. 19).

The end face of the connector unit is fitted with ten blanking discs (Fig. 20), which are easily pressed out and replaced by the special rubber grommets supplied with each peripheral unit fixing kit

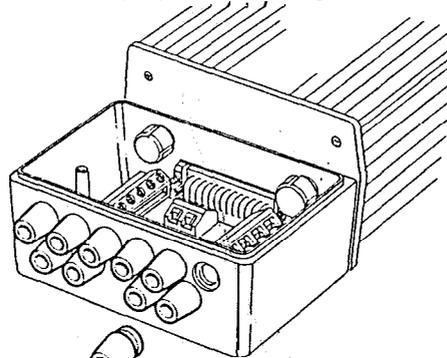


Fig. 21

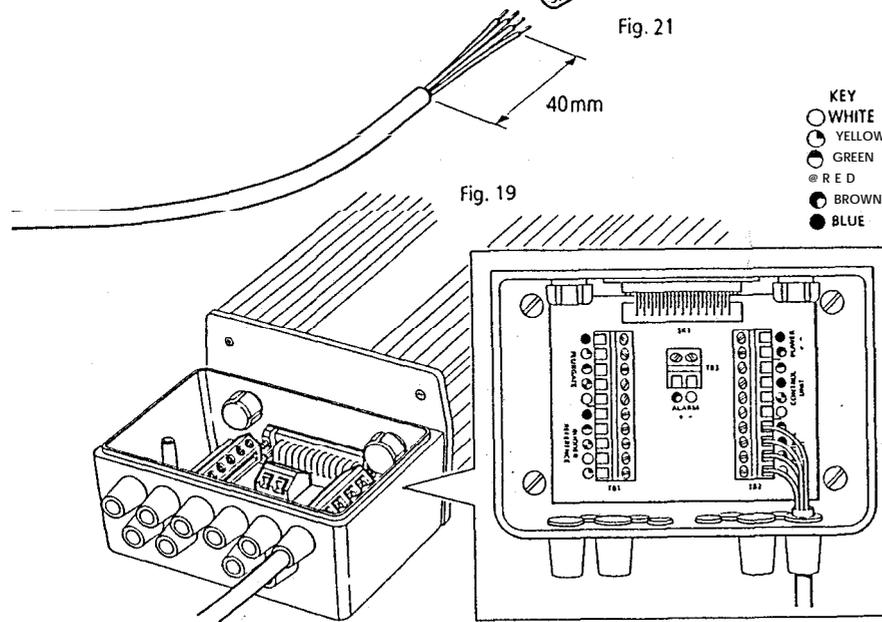


Fig. 19

(Fig. 21). After cutting the interconnecting cable to length (Fig. 21), it may be passed through the inserted rubber grommet and prepared for connection to the relevant connector block (Fig. 19).

Each connector block is clearly identified on the printed circuit board and each wire position is identified by coloured dots which match the individual wire colours. The cable screen should be connected to terminals identified by a white dot.

Each peripheral unit is supplied with 6m (20ft) of interconnecting cable. Additional cabling can be supplied in 12m (40ft) cut lengths as follows:-

Cat. No.	Used On
D086 (Two core unscreened)	Alarm, Electronic power supply and Clutch
D087 (Three core screened)	Control units, and Radio Navigation Interface
D088 (Four core screened)	Fluxgate Compass

The total length of screened core cable connected to the serial bus (connectors A1 -A5) should not exceed 30m (100ft). Similarly, the total length of interconnecting cable to the fluxgate should not exceed 20m (60ft). If it is necessary to exceed the above maximum length recommendations, please consult Nautech's Product Support Department for specific advice. In general the length of interconnecting cables should be kept to an absolute minimum to reduce the possibility of interference by other electronic equipment.

All cables should be run at least 1 m (3ft) from existing cables carrying radio frequency or pulsed signals, and should be damped at 0.5m (1.5ft) intervals.

### 2.3.2 DC Power Supplies

(Fig. 22).

Flexible connection tails fitted with insulated spade connectors are supplied with the course computer to connect the main power supply (Blue and Brown) and drive unit motor connections (Red and Black).

All four flexible wire tails are preconnected to a four-way heavy duty terminal block for connection to the main power cabling. Similarly, the drive unit is supplied with flexible tails for the motor power connection (Red and Black).

Before commencing power cabling, all interconnecting terminal blocks should be screwed into a position where they will remain dry and protected. When planning the position of the course computer (ref.2.1.1), it is important to reduce the overall length of heavy power cable between the drive unit and the vessel's central power distribution panel to a minimum.

Excessive lengths will generate losses in the cable and will reduce system performance. In addition, the cable length between the course computer and drive unit must be less than 5m (16ft).

Having sited the course computer, measure the total cable length between the drive unit and the vessel's central distribution panel and select the appropriate cable size from the table below.

Total Cable Length	Cable Type	Copper Area	Cable Gauge
Up to 7m	50/0.25	2.5mm <sup>2</sup>	14 AWG
Up to 10m	56/0.3	4.0mm <sup>2</sup>	12 AWG
Up to 16m	84/0.3	6.0mm <sup>2</sup>	10 AWG

The power supply must be led from the main distribution panel and protected by means of a 25 amp fuse or current overload trip switch. A separate 5 amp fuse must be fitted in the electronic power supply cable.

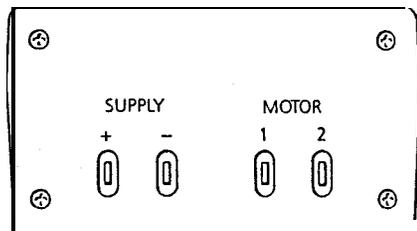
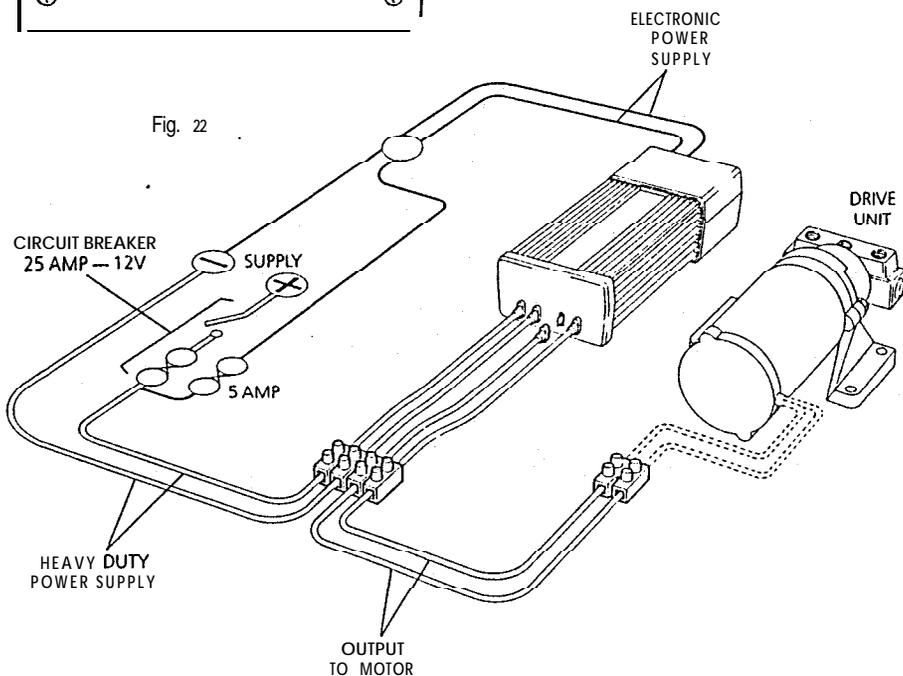


Fig. 22



It is very important that both the electronic and heavy duty power supplies are isolated by a switch in the positive supply line.

When connecting the power supplies to the main distribution panel and to the course computer spade connectors, it is essential that the polarity is correct (Brown positive, Blue negative).

### 3. OPERATION

#### 3.1 BASIC PRINCIPLES

The following description of the Autohelm PowerPilot's principle of operation will help you to fully understand its controls.

Deviation from course is continuously monitored by a sensitive fluxgate compass and corrective rudder is applied by the drive unit to return the vessel to course. The applied rudder is proportional to course error at any time and thus when the course is restored the rudder will be neutralised. The amount of rudder applied for a given off-course error must match both the steering characteristics of the vessel and speed through the water. A vessel with a small rudder for example, will require more corrective helm than a similar sized vessel with a larger rudder. Similarly, a high speed power boat will require considerably less corrective helm at planing speeds than it will at lower displacement speeds.

When changes in vessel trim occur due to variations in wind pressure or engine throttle setting the course can only be maintained by the application of permanent rudder off-set (standing helm) to restore balance. If permanent rudder off-set is not applied to restore balance the vessel will bear on to a new heading. Under these circumstances the Autohelm PowerPilot detects that the original course is not being restored and continues to apply additional rudder off-set in the appropriate direction until the vessel returns to the original heading. Automatic trimming capability ensures that the originally set course is held irrespective of any changes in balance that may occur during the course of a passage.

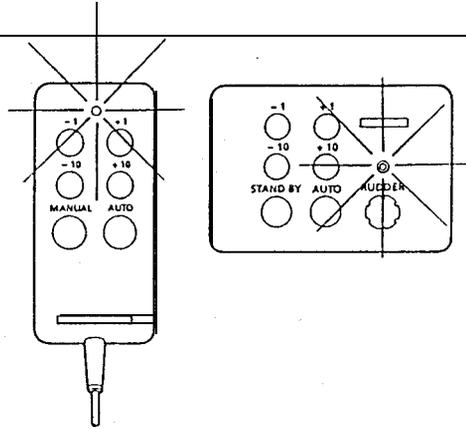
Autohelm PowerPilot's central computer also continuously monitors the pattern of applied rudder correction and can distinguish unnecessary repetitive corrections caused by pitch and roll of the

vessel from those necessary to maintain the selected heading. If unnecessary repetitive corrections continue the computer will automatically neglect them so that autopilot activity and power consumption is continuously optimised at minimum levels.

The high degree of control automation made possible by the system's central micro computer simplifies user control to a series of push button operations.

### 3.2.3 Operating Mode indication and Course Display

The operating mode of the autopilot is indicated by a flashing red LED, as summarised below:-



OPERATING MODE	LED FLASHING CODE
STAND BY Autopilot switched on but not engaged	
AU-t-0 Autopilot engaged to steer compass heading	
MANUAL Hand held control power steering in operation	

### 3.2.4 Off-Course Alarm

When the autopilot is set to Auto mode a built in off-course alarm is automatically set up. The off-course alarm will sound from all control units when the vessel deviates for any reason from the original course by more than  $15^\circ$  for over 20 seconds. If an auxiliary alarm is fitted this will also be sounded after a one minute delay to allow the watchkeeper to take corrective action.

The alarm will be silenced if the vessel returns to within  $15^\circ$  of the original course. If the vessel does not return within course limits the alarm can only be silenced by disengaging the autopilot and resetting a new course.

### 3.3 FUNCTIONAL TEST PROCEDURES

The following functional tests and set up procedures must be carried out before sea trials are attempted.

#### 3.3.1 Setting Up

##### Switch On

Switch on the electrical supply from the main panel. All control units will emit a short beep tone to indicate that the computer is now active. The autopilot will start up in **Stand By mode**.

##### Operating Sense

The operating sense of the autopilot can be checked as follows:-

##### \* Select Auto

- Select + 10 which should move the rudder a few degrees to produce a turn to starboard.

If this does not occur, correct operating sense can be restored as follows:-

- \* If the rudder immediately drives hard over to starboard, the red and green wires of the rudder reference transducer should be reversed in the connector unit.

- If the rudder immediately drives hard over to port, the motor connections between the course computer and drive unit should be reversed.
- If the rudder drives a few degrees to port, reverse the motor connections, and reverse the red and green wires of the rudder reference transducer.

N.B. Reversal of the motor connections should be permanently made at one of the main terminal blocks and not by reversing the spade connector flying leads to the course computer.

#### 3.3.2 Functional Test Procedure

- Switch on and note that all control units are live and signalling Stand by mode.
- Key Auto on any fixed control unit and note that Auto mode is indicated on all control units.
- Key course change commands from all control units noting that corresponding helm movements occur.
- Key **Manual** on the hand held control unit (if fitted) and note that **Manual** mode is signalled from all control units.
- Key power steer commands via the course control keys of the hand held control unit and note that corresponding incremental helm movements occur.
- Key **Stand by**

The automatic trimming capability of the autopilot can be observed by the following test:

Key Auto followed by a  $10^\circ$  course change to starboard. This effectively simulates a condition where the need for standing helm has developed and the vessel is not returning to course. You will notice that an initial fixed helm movement is applied and that after a short interval the drive unit will continue to apply further incremental helm movements. If

left in this condition the rudder will eventually be driven hard over. If, however, the vessel were moving through the water, the progressive application of additional helm would eventually return the vessel to the correct course with the necessary standing helm applied. Return to course can be simulated by keying  $\leftarrow$  10 (to return to the current heading). The progressive application of standing helm will cease when the fluxgate senses that the course error has been removed.

### 3.3.3 Drive Unit Test Procedures

Before attempting sea trials it is important to check that the vital link with the steering system provided by the hydraulic pump and rudder reference transducer are free from obstruction and operating correctly.

#### Warning

When the steering system is being moved manually or under drive from the autopilot do **not** touch any part of the system. The forces exerted are considerable and could cause injury.

With an assistant to turn the main steering wheel get into a position where the tiller and rudder reference transducer can be seen.

- With the autopilot in Stand by turn the sheering wheel from hard over to hard over.
- Check that the rudder reference transducer and linkage do not foul any part of the steering mechanism or vessel's structure.
- Select Auto and use the + 10 button to drive the rudder hard over (use maximum rudder setting).
- Use the  $\leftarrow$  10 button to drive the rudder hard over in the opposite direction.

- Check that the steering ram moves smoothly and that there is no excessive play.
- Check that all unions are tight and there is no seepage of hydraulic fluid.

#### Current Limit and Cutout

When the rudder is driven onto end stops drive to the hydraulic pump may cut out after a few seconds. This is normal. Drive will only be restored if the rudder moves away from the end stop or if drive is required in the opposite direction.

The performance of the Autohelm PowerPilot will only reach the designed levels if the installation of the hydraulic pump and rudder reference transducer is correctly engineered and adjusted. It is strongly advised that these be checked before sea trials.

## 4. SEA TRIALS

Initial sea trials should be carried out in calm conditions with plenty of sea room. The previously conducted functional test will have verified that the autopilot is operating correctly and that you are familiar with all of its controls.

Set the rudder control on all control units to minimum.

Initial sea trials on fast planing vessels should be conducted at no more than half engine speed. Minimum setting of the rudder control should provide stable steering performance.

Fine setting of the rudder control is discussed later (4.2).

### 4.1 FIRST SEA TRIALS

During first sea trials, the vessel will be constantly changing heading, and it is, therefore, very important to maintain a constant look-out. The following initial trial procedure is recommended:-

- @ Steer on to a compass heading and hold the course steady.
- Press Auto to lock on to the current heading. In calm sea conditions a perfectly constant heading will be maintained.
- Alter course to port or starboard in multiple increments of 1 and 10 degrees from any control unit. Course changes should be prompt and without any sign of overshooting.
- If a hand held control unit is fitted key Manual to change over to remote power steering. Practice power steering using the four course control keys..
- Press Stand by to disengage the autopilot for return to hand steering.

#### Automatic Sea State Control

During the sea trial, the operation of the automatic sea state control can be observed. When the autopilot is initially engaged in Auto mode the autopilot will respond to all pitch and roll movements.

During the first minute of operation, it will be noticed that repetitive movements of the vessel are gradually neglected until finally the autopilot will respond only to true variations in course.

To ensure precise course adjustments the sea state control is automatically reset whenever a  $10^\circ$  course change is selected.

#### Automatic Trim Control

The Autohelm PowerPilot automatically corrects for trim. No adjustment of the pilot is necessary.

After each course change the Automatic Trim is cancelled and the Autohelm PowerPilot will re-establish the correct trim for the new heading. This process takes approximately one second per degree of course change. It should be noted that if a large course change is keyed in (greater than  $60^\circ$ ) the pilot will not assume the final selected course immediately. The vessel will come to within say  $10^\circ$  of the desired course and will only settle onto course when the Automatic Trim has been fully established.

It is recommended the following procedure is adopted for large course changes.

- Note required new heading
- Select Stand by and steer manually
- Bring vessel onto new heading
- Select Auto and let vessel settle onto course
- Bring to final course with  $1^\circ$  increments.

It is sound seamanship to make major course changes only whilst steering manually. In this way any obstructions or other vessels may be cleared properly and due account taken of the changed wind and sea conditions on the new heading prior to engaging the pilot.

## 4.2 RUDDER CONTROL ADJUSTMENT

The rudder control setting recommended on page 22 will provide stable control for initial sea trials. However, power craft can vary widely in their response to the helm and further adjustment of the rudder control setting may improve the Autohelm's steering characteristics.

An excessively high rudder control setting results in **oversteer** which can be recognised by the vessel swinging from side to side of the automatic heading accompanied by excessive rudder movement. In addition, distinct overshoot **will** be observed when the course is changed. This condition can be corrected by reducing the rudder control setting (**rotating rudder control anti-clockwise**).

Similarly, an insufficient rudder control setting results in **understeer** which gives sluggish steering performance and is particularly apparent when changing course. This is corrected by increasing the rudder control setting (**rotating rudder control clockwise**). These tendencies are most easily recognised in calm sea conditions where wave action does not mask basic steering performance. The rudder control setting is not over critical and **should** be set to the lowest setting consistent with accurate course keeping. This will minimise actuator movements and hence reduce power consumption.

It may be noticed that the autopilot tends to be a little less stable on northerly headings in the higher latitudes of the northern hemisphere (and **conversely** southerly headings in the southern hemisphere). This is caused by the increasing angle of dip of the earth's magnetic field at higher latitudes which has the effect of amplifying rudder response on northerly headings. The tendency towards northerly heading instability is usually more **obvious** in

higher speed craft and when it occurs can be corrected by reducing the rudder control setting. In excess of 30 knots, a reduction by at least two positions can often be required within 45° of North.

### Planing Craft

**On** fast planing craft which operate over a wide speed range, the rudder control setting often requires reduction at higher speeds where steering effectiveness is increased. Oversteer can be extremely violent at planing speeds and it is recommended that the rudder control setting is reduced before opening the throttle.

## 5. OPERATING HINTS

Autohelm PowerPilot's central course computer continuously optimises automatic steering performance eliminating the need for operator supervision.

It is, however, very important to understand the effect of sudden trim changes on steering performance.

At planing speeds, where only a small proportion of the hull is in contact with the water, variations in wind speed and direction can produce significant changes in trim. Similarly, variations in vessel attitude and engine settings also produce trim changes. When a change in trim occurs the automatic trim compensation system requires at least 120 seconds to apply the necessary rudder off-set to restore the automatic heading. In gusting conditions, therefore, particularly when the wind is forward of the beam, the course may tend to wander slightly.

Passage making under automatic pilot is a very pleasant experience which can lead to the temptation of relaxing permanent watch. This must always be avoided no matter how clear the sea may appear to be.

### 5.1 UNSATISFACTORY STEERING PERFORMANCE

If the Autohelm PowerPilot has been correctly specified, installed in accordance with the instructions and adjusted correctly it will provide outstandingly good steering precision over a very wide range of wind and sea conditions.

If the performance falls below your expectations and the pilot appears to be working correctly the fault will normally be found by carrying out the simple checks outlined below. Before reporting your difficulties to an Autohelm specialist, please check the following:-

\* Have the test procedures and adjustments detailed in Section 3.3

been carried out correctly? Check again.

- Has the fluxgate compass been installed in an area free from large magnetic deviation? If in doubt use a hand bearing compass to check.
- If performance has changed recently has a magnetic influence been introduced near the fluxgate compass? — anchor/chain/radio equipment/loudspeaker/tools/AC generator, etc.
- Is battery voltage correct? 12v.
- Are fuses intact and of correct rating?
- Are circuit breakers engaged?
- Is wiring of correct diameter and are screw connectors firmly tight?
- If pilot fails to hold course → check rudder setting at control units.

#### If vessel wanders under pilot control

- Verify that hydraulic pump is correct for size and type of vessel.
- Check steering ram and actuator are of compatible type and bleed system to remove air.
- Check rudder reference transducer linkages for security and correct alignment.

## 6. MAINTENANCE

The autopilot is one of the most used and hardest working items of equipment on board, and therefore must receive its fair share of attention and routine maintenance.

Regular inspection of the installation is recommended in the following areas where applicable.

1. Check that Hydraulic Steering systems are free from leaks and trapped air. Bleed when necessary to remove air from the system.
2. Check that all inter-connecting cable terminals are fully tightened and corrosion free.
3. Check that external waterproof sockets are capped when not in use and periodically spray with WD40 (or similar) to protect from corrosion.
4. Check that the heavy power supply cable connections are tight and free from corrosion.

## 7. FAULT LOCATION PROCEDURE

Autohelm PowerPilot has been designed to achieve very high standards of reliability combined with ease of servicing.

If a fault should appear, please double check that all connections in the connector unit are sound and that the heavy power cable connections are tight and free from corrosion. If you are satisfied that all connections are sound, the simple check procedure tabulated below will assist you to locate the most likely fault area.

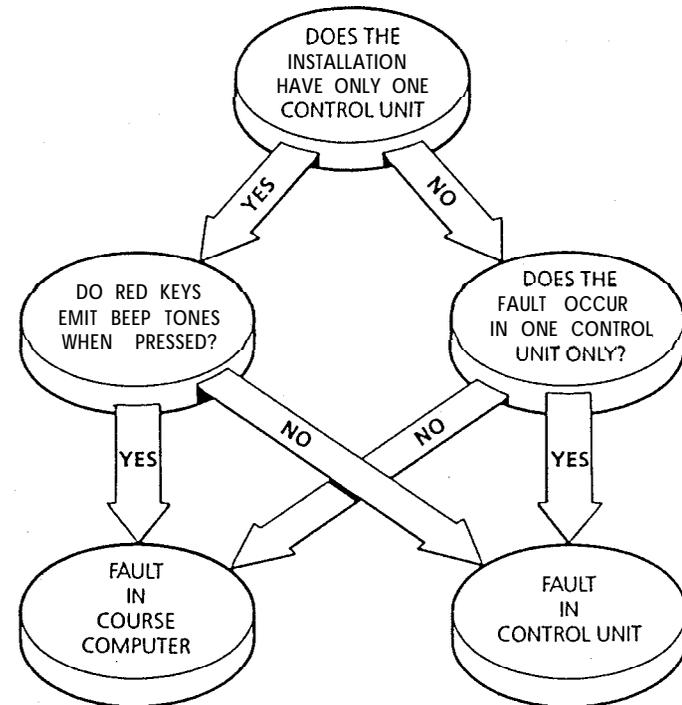
Since the course computer houses the majority of the electronic control system there is a high probability that if an electronic fault has occurred it will be

located in this area. The course computer unplugs easily for servicing (Section 2.1.1).

Control units are removed using a suitable lever to separate the pads starting at one corner. Do not use excessive force. Disconnect from the connector unit and withdraw the interconnecting cable (Section 2.1.2).

The faulty unit should be removed and returned to your nearest service agent.

If any difficulties arise, please consult Nautech's Product Support Department in the U.K. or your own National distributor who will also be able to provide expert assistance.



## 8. WARRANTY, AFTER SALES SERVICE

### LIMITED WARRANTY

Nautech or its appointed Distributors or Service Centres will, subject to the conditions below, rectify any failures in this product due to faulty manufacture which becomes apparent within twelve months of its purchase date.

Equipment used in the country of purchase should be sent directly to the authorised Distributor for that country or its appointed Service Centres. The product will then be service free of charge and returned promptly direct to the sender.

Equipment used outside the country of purchase can be **either:-**

- a. Returned to the Distributor or Dealer in whose country of from whom the equipment was originally purchased -it will then be serviced free of charge and promptly returned direct to the sender, or
- b. The product can be returned freight pre-paid to the authorised Distributor or its appointed Service Centres in the country in which the product is being used. It will then be serviced and returned direct to the sender on the basis that the Distributor or Service Centre will supply any parts used free of charge but the sender will be invoiced for the necessary **labour** and return shipment at the local rate.

### CONDITIONS

The warranty is invalid **if:-**

- a. The product has been misused, installed or operated not in accordance with the standards defined in this manual.
- b. Repairs have been attempted by persons other than Nautech approved Service personnel.

### FULL INTERNATIONAL WARRANTY

Nautech or its appointed Distributors or Service Centres will, subject to the conditions below, rectify any failures in this product due to faulty manufacture which become apparent within twelve months of its purchase date wherever the vessel and the product may be operated.

### CONDITIONS

1. The product must be installed aboard the vessel in the country of purchase.
2. The product must be installed in accordance with the recommendations issued by Nautech Ltd.
3. The installation must be carried out by an installer approved by Nautech: alternatively the installation must have been inspected and approved by Nautech or its approved installer.
4. The Warranty Registration Card must be completed **by:-**
  - The Owner or User
  - The Dealer supplying the product
  - The Installer
5. The Full International Warranty is invalid if:-
  - (a) The product has been misused, or installed or operated not in accordance with standards defined in this handbook.
  - (b) Repairs have been attempted by persons other than Nautech \*approved Service personnel.
  - (c) The warranty card has not been completed correctly or is not accompanied by proof of purchase.

### CLAIM PROCEDURE

1. The product should be sent direct to Nautech or its appointed Distributor or Service Centre nearest to the vessel. The completed Warranty Card and proof of purchase must accompany

the claim. The product will then be serviced free of charge and returned promptly direct to the sender.

2. **Nautech, its** Distributors and Service Centres, are not liable for any charges arising from visits to the vessel not to attend to the product, whether under warranty or not, nor for sea trials or any other work associated with the installation. The right is reserved to charge for any such services at the local rate.

### AFTER SALES SERVICE

Your Autohelm PowerPilot is designed to give you long service and reliable performance wherever you sail. To ensure that you can always receive prompt and expert attention in case of any difficulty, Nautech has established a worldwide network of AUTOHELM SERVICE CENTRES.

Please contact your nearest Service Centre for assistance. **Always** have **ready:-**

- \* **Your Warranty Card**
- **Proof of Purchase**

## 9. SERVICECENTRES — UK, Eire and Channel Islands

### Factory Service

 **Nautech Ltd**  
Anchorage Park  
Portsmouth  
Hampshire  
0705 693611

### Ports-mouth/Chichester Harbour

 **Greenham Marine Ltd**  
Emsworth Yacht Harbour  
Thorney Road  
Emsworth  
Hampshire  
0243378314

**Pennant Marine**  
Chichester Marina  
Chichester  
West Sussex  
0243 511070

### Hamble River/ Southampton Water

 a K **Electro Marine**  
Stone Pier Yard  
Shore Road  
Warsash  
Hampshire  
048 95 2170

Hudson Marine Electronics  
Mercury Yacht Harbour  
Satchell Lane  
Hamble  
Hampshire  
0703455129

### Isle of Wight

 **Lecmar Marine Electronics**  
Ancasta Marine  
Coves  
I o w  
0983293996

### Lymington/Poole

 **Greenham Marine Ltd**  
King Saltens Lane  
Lymington  
Hampshire  
0590 75771

**Danlea Electronics**  
Cobk Quay  
Poole  
Dorset  
0202673880

**Greenham Marine Ltd**  
Quay West Marina  
23 West Quay Road  
Poole  
Dorset  
0202676363

### Devon

 **Burwin Marine Electronics**  
Island Street  
Sakcombe  
054 884 3321

### Greenham Marine Ltd

Watersports Centre  
Queen Anne Battery  
Coxide  
Plymouth  
0752 228114

### Marine Electronics Systems

Putridge  
Buckland Brewer  
Bideford  
North Devon  
0805 22870

Ocean Marine Services  
43 Bretonside  
Plymouth  
0752 23922

### Quay Electrics (Teignmouth) Ltd

The Sall Loh  
Pump Street  
Brixham  
080 45 3030

### Cornwall

 **Mylor Marine Electronics**  
Mylor Yacht Harbour  
Falmouth  
Cornwall  
0326 74001

### Sewern & Bristol Channel

 AN...D. Electronics  
Unit 302  
Dene Road  
Severnside Trading Estate  
Avonmouth  
Bristol  
0272 821441

### South Wales

 **Caxios Instrumentation Ltd**  
Lion Way  
Enterprise Park  
Llansanlet  
Swansea  
0792 797898

### Dale Sailing Co Ltd

Dale  
Haverford West  
Dyfad  
064 65 349

### North & West Wales

 **Rowlands Marine Electronics Ltd**  
The Outer Harbour  
Pwllheli  
0758613193

### Sailtronic Marine

Church Street  
Glan Conwyn  
Colwyn Bay  
Clwyd  
0492 68 536

### Merseyside

 **Robbins Marine Radio Services**  
North East Coburg Dock  
Liverpool  
051 709 5431

### Lancashire

 **John N Jones Ltd**  
Marine Electronics Services  
190 Dock Street  
Fleetwood  
03917 5241

### Northern Ireland

 Belfast Lough Marine Electronics  
55 Belfast Road  
Carrickfergus  
Co Antrim  
0960365565

### Eire

 **A E Brunker**  
20 Oakwood Park  
Dublin 11  
0001342590

### Rider Services

Glenbrook  
Passage west  
Co Cork  
010353 2184 1176

### Isle of Man

 **Bevan Ltd**  
Steampacket Building  
East Quay  
Ramsey  
Isle of Man  
0624 812583

### S/W Scotland

 **Boat Electrics & Electronics**  
145 Temple Hill  
Troon  
Ayrshire  
0292315355

### western Scotland

 Jeff Rutherford  
Yacht Electrical and  
Electronic Services  
Largs Yacht Haven  
Inver Road  
Largs  
Ayrshire  
0475 686091

### Northern Scotland

 a P Instrumentation Ltd  
Greenbank Road  
East Tullos  
Aberdeen  
0224874003

### Shetland Isles

 **H Williamson & Sons**  
(Scalloway) Ltd  
Main Street  
Scalloway  
Shetland  
059 588 645

### S/E Scotland

 **Fonh Area Marine Electronics**  
Electronics Centre  
Port Edgar  
South Queensferry  
Edinburgh  
0313314343

## 10. OVERSEAS REPRESENTATIVES

### Humberside

 **Electronics Marine Ltd**  
WM Wright Docks  
Hull  
0482 25163

### Norfolk/Suffolk

 **Greenham Marine Ltd**  
winaboats Yard  
Grangewalk  
Wroxham  
Norfolk  
06053 2238

**R 6 J Marine Electronics**  
2 Birch Avenue  
Dovercourt Bay  
Harwich  
0255 502819

**R & J Marine Electronics**  
c/o Suffolk Yacht Harbour  
Levington  
Ipswich  
047 388 737

### Essex

 **Mantsbrite Marine Electronics**  
19d Spital Road  
Maldon  
Essex  
0621 53003

### Kent

 **Harour Marine Services**  
129 Broadway  
Heme Bay  
Kent  
0227 361255

### East Sussex

 **D M S Seatronics**  
Brighton Marina  
Brighton  
0273 605166

### Channel Islands

 **Boatworks +**  
Castle Emplacement  
St Peter Port  
Guernsey  
0481 26071

**Jersey Marine Electronics**  
Unit 2  
La Folie  
St Helier  
Jersey  
0534 21603

**Mainbrayce Ltd**  
Inner Harbour  
Braye  
Alderney  
0481822772

### Argentina

Trimer S.A.  
Fray J.S.M. de Oro 2030/40  
1425 Buenos Aires  
Argentina  
Tel: (010 54 1) 774 3728/4470  
Telex: 007 33 23653 TRIMER AR

### Australia

Solo Marine Pty Ltd  
11 Green Street  
Revesby NSW 2212  
Australia  
Tel: (010 61 2) 774 5255  
Telex: 007 71 127045 SOLMAR AA  
Fax: (010 61 2) 7745291

### Austria

Werner Ober-Yachtelektronik  
A-6890 Lustenau  
Reichsstrasse 38  
Austria  
Tel: (0104315577) 2419  
Fax: (010 43) 5577 24195

### Barbados

C.O. Williams Electrical Co. Ltd  
Warrens  
St Michael  
Maldon  
Barbados  
Tel: (010 1 809) 425 2250  
Telex: 007 392 2366 COW WA  
Fax: (010 1 809) 424 0374

### Belgium

West Diep Yachting Centre SPRL  
8-8450 Nieuwdoort  
Louisweg 2  
Belgium  
Tel: (0103258) 234061  
Fax: (010 32 58) 5823 9248

### Bermuda

Marine Communications  
72 Pitts Bay Road  
Pembroke HM 06

### Bermuda

**Boatworks +**  
Tel: 010 1 809 295-0558  
Telex: 007 290 3795 MARCO BA  
Fax: (010 1 809) 292 0079

### Brazil

**Fast Yachts**  
Control S A.  
Industria E. Comerico  
P.O. Box 12700  
Sao Paulo - SP  
Brazil  
Tel: (010 55) 11 5211944  
Telex: 007 38 11 24612 CNTO RR  
Fax: (010 55) 11 5482070

### British Virgin Islands

Cay Electronics  
P.O. Box 345  
Road Town  
Tortola  
British Virgin Islands  
Tel: (010 1 809 49) 42400  
Telex: 007 255 510 100 6891 ESL UD  
Fax: (010 1 809 49) 44707

### Canada

Tom Taylor Co. Ltd  
72 Fraser Avenue  
Toronto M6K 3E1  
Ontario  
Canada  
Tel: (010 1 416) 530 1811  
Telex: 007 2 1 06524332 TOMTAYCO TOR  
Fax: (010 1 416) 5304345

### Canary Islands

**Nordest**  
C/S Juan Bautista 57  
Santa Cruz de Tenerife  
Canary Islands  
Tel: (010 34 22) 284 671  
Telex: 007 52 92230 COCIN E  
Fax: (010 34 22) 287 311

### Cyprus

Mercury Divers Co. Limited  
53 Spyrou Araouzou Street  
P.O. Box 469  
Limassol  
Cyprus  
Tel: (010 357 51) 65492  
Telex: 007 605 4976 MERC DIVE CY

### Finland

Oy Maritim AB  
Veneentekantie 1  
SF - 002 10 Helsinki  
Finland  
Tel: (010 358) 0 673331  
Telex: 007 57 124788 MARIT SF  
Fax: (010 358) 0 6927917

### France

S.D. Marine Electronique  
1725 Rue Bâillon  
78500 Sartrouville  
France  
Tel: (010 33) 1 3914 6833  
Telex: 007 42 658347 SDMELEC  
Fax: (010 33) 1 3913 3022

### Gibraltar

**Service**  
Bond Instrumentation  
The Dockyard  
Gibraltar  
Tel: (010 350) 73701  
Telex: 007 405 2373 GIBREP GK  
Fax: (010 350) 73726

### Sales

H. Sheppard & Co.  
Waterport  
Gibraltar  
Tel: (010 350) 77183  
Telex: 007 405 2324 MARINA GK

### Greece

**Piraeus Electronic**  
46 Akti Mousiopoulou  
Marina Zeas  
185 36 Piraeus  
Greece  
Tel: (010 301) 453 10 27/418 1797  
Telex: 007 601 241219 DORI GR  
Fax: (010 301) 418 10 91

**Holland****Boomsma's Handelmaatschappij B.V.**

P.O. Box Nr. 5012B  
1305 AC Almere Have"

**Holland**

Tel: (01031 3240) 11524  
Telex: 007 44 70121 GERO NL  
Fax: (010 31 3240) 11519

**Hong Kong**

Far East Yacht Specialists limited

**M 2 floor****Baskerville House**

22 Ice House Street

**Hong Kong**

Tel: (010 852) 5 257015/5 229394  
Telex: 007 802 65925 KREMA HX

**Iceland****Benco Ltd****Lagmula 7**

125 Reykjavik

**Iceland**

Tel: (010 3541) 84077

Telex: 007 501 2334 BOLT X IS  
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