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ST6000 Operation

Autohelm™

Contents

1. Introduction

This Handbook describes how to operate your ST6000 and is intended for use after the autopilot has been set up. Full details of setting up and initial sea trials procedures are described in the Installation Handbook.

Basic Principles

When switched on, the ST6000 will be in Standby mode. To select automatic steering simply steady the vessel on the required heading and push Auto. At any time to return to manual steering push Standby.

Autopilot control has been simplified to a set of pushbutton operations, all of which are confirmed with a beep tone. In addition to the main 6 button course control keypad, the secondary 4 button keypad provides the following functions:-

- Track
  - selects the built in track control to allow the autopilot to steer under the supervision of Radio Navigation System.
- Response
  - selects 3 levels of course keeping response.
- Display
  - selects
    1) waypoint information for display (when available).
    2) the watch alarm.
    3) illumination level.

Warning

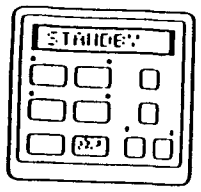
Hand steering is not possible when 'Auto' is selected. The 'Standby' button must be pressed to disengage the Autopilot drive.

It is the skippers responsibility to brief all crew members on this procedure.

When used with a Stern Drive Actuator a special emergency manual override facility is provided. For details see Page 12.

2. Operator Controls

Auto



Push to engage automatic steering and maintain current heading.

OR

Push and hold down for 1 second to return to previous automatic heading. (Display returns to Auto after 10 seconds).

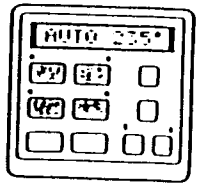
Automatic Heading

AUTO 235°

Previous Automatic Heading

HDG 180°
LAST 180°

Course Changes (−1, +1, −10, +10)

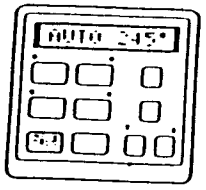


Push to alter course to port (−) and starboard (+) in increments of 1 and 10 degrees.

New Automatic Heading

AUTO 245°

Standby

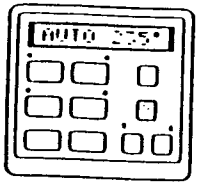


Push to disengage the autopilot for manual steering. (The previous automatic heading is memorised).

Current Heading

STANDBY

Track (see operating hints)



Push to select track control from Auto.
Push again to return to automatic steering.

OR

Push and hold down for 1 second to select previous track control heading from Auto or Track.

(Display returns to Track after 10 seconds).

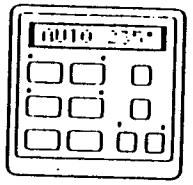
Automatic Heading

TRACK

HDG 180°
LAST 180°

Response

- Response Level Adjustment (see Operating Hints)



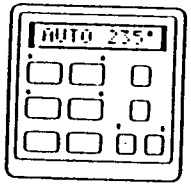
Push to increase (▲) or decrease (▼) response level.

To display response level without changing it push both Response keys together briefly.

Response Level

LEVEL 1

- Rudder Gain Adjustment (see Operating Hints)



Push and hold down for 1 second both Response keys together to display rudder gain level.

Within 10 seconds push once to increase (▲) or decrease (▼) rudder gain.

Rudder Gain Level

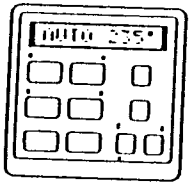
RUDDER 5

Rudder Gain Level

RUDDER 4

(Response and Rudder levels are displayed for 10 seconds only)

Illumination



Push and hold down Display for 1 second to switch on illumination.

Within 10 seconds push Display to select illumination level.

Illumination Level

LAMP 3

3 = High
2 = Medium
1 = Low
OFF = Off

(Illumination level is displayed for 10 seconds only)

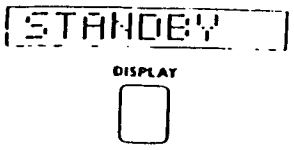
3. Additional Displays

Display

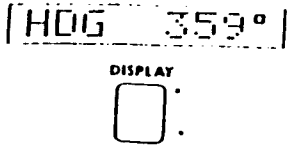
The Display pushbutton is used to cycle through additional information menus. These menus depend on the autopilot mode and if navigation information is available.

Standby Mode

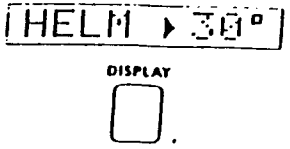
- Main Display



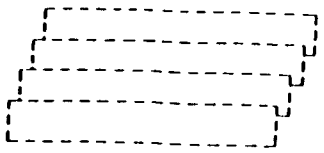
- Compass Heading



- Rudder Angle



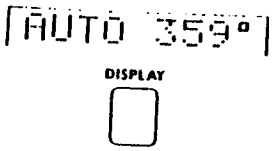
- Navigation Displays



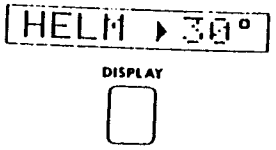
See section on Navigation Displays.

Auto Mode

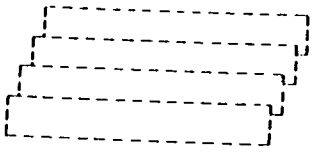
- Main Display



- Rudder Angle

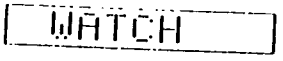


- Navigation Displays



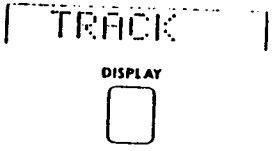
See section on Navigation Displays.

- Watch Alarm

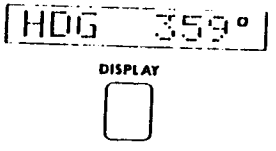


Track Mode

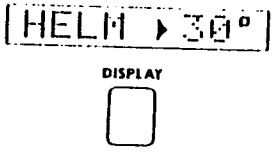
- Main Display



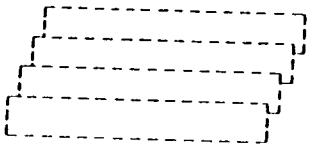
- Locked Course



- Rudder Angle

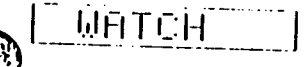


- Navigation Displays



See section on Navigation Displays.

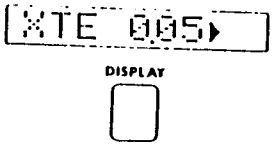
- Watch Alarm



Navigation Displays

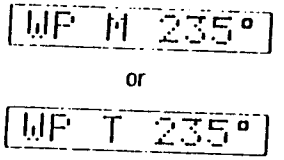
With the Navigation Receiver operating in waypoint mode, the following information can b displayed (provided that the Navigation Receiv transmits the appropriate information – see Installation Handbook).

- Cross Track Error



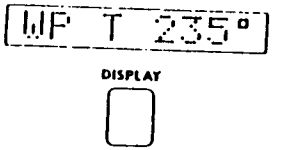
The arrows show the direction to steer to rejoin the desired Track:
▸ Starboard
◂ Port

- Bearing to Waypoint



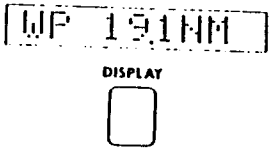
• Magnetic

or

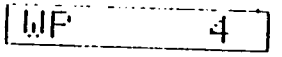


• True

- Distance to Waypoint

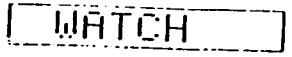


- Waypoint Number



Watch Alarm (not available in Standby)

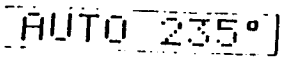
- Engage the Autopilot in Auto/Track/Windvane mode.
- To select Watch alarm push Display repeatedly until Watch appears.



The 4 minute timer is now running:-

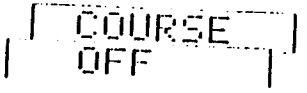
- After 3 minutes 'Watch' flashes on all control units.
- After 4 minutes the alarm sounds on all control units.

- Push Auto at any time to reset the timer to 4 minutes and silence the alarm.
- To cancel the Watch alarm at any time push Display.



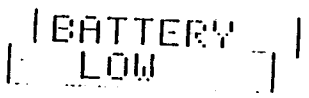
Warning Messages

- Off Course Alarm



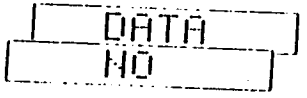
– Sounds if the vessel deviates from the automatic heading by more than the selected amount for over 20 seconds.

- Low Battery Alarm

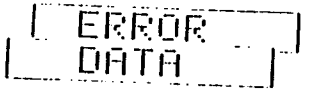


– Sounds if the course computer supply voltage falls below 11 volts for over 20 seconds.

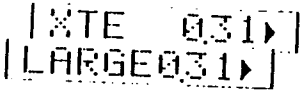
- Track Mode Alarms



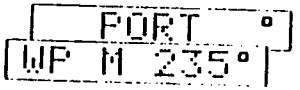
– Sounds if no waypoint data is received from the Radio Navigation System for over 20 seconds.



– Sounds if the data has the incorrect format or if an invalid flag is set.

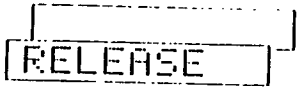


– Sounds if the cross track error exceeds 0.30n.m.



– Sounds when the target waypoint number changes. The displayed bearing is to the new waypoint. PORT or STBD indicates in which direction the autopilot will turn onto the new waypoint bearing.
Push Track to silence the alarm and automatically steer onto the new bearing to waypoint.

- Manual Override Alarm
(Installations with stern drive actuators only).



– Sounds for 10 seconds when the autopilot is manually overridden at the steering wheel. After 10 seconds the autopilot will return to Standby automatically.

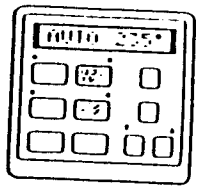
Note: Push Standby to silence an alarm and select Standby mode (unless indicated otherwise).

4. Additional Information for Sailing Vessels

Autotack

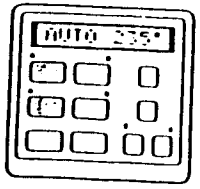
The ST6000 has a built in Autotack function which will turn the vessel through 100°. This operates in both compass and vane modes as follows:-

Vane



Push +1 and +10 keys together to initiate a tack turning to Starboard.

AUTO 335°



Push −1 and −10 keys together to initiate a tack turning to Port.

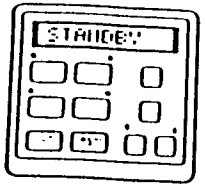
AUTO 135°

Note: It is important that the rudder angle transducer is accurately aligned as the Autotack function mirrors standing helm and any offset will change the initial tack angle.

Wind Trim (Windvane Operation)

Wind Trim allows the autopilot to be supervised by apparent wind direction. The wind direction is read either:-

- From the SeaTalk bus (requires Autohelm ST 50 unit).
  OR
- From an NMEA 0183 input on the control unit.



Push both red keys together to select Wind Trim and maintain the current apparent wind angle.

Push and hold down for 1 second both red keys together to return to the previous apparent wind angle.

Automatic Heading

VANE 235°

Previous Automatic Heading

HDG 180°
LAST 180°

Wind Change Alarm

Wind Trim uses the fluxgate compass as the primary heading reference and automatically adjusts the compass heading to maintain the original apparent wind angle. If changes in apparent wind angle adjust the original automatic heading by more than 15° the wind change alarm will sound.

CHANGE
WIND

- The alarm is silenced by pushing both red keys together briefly.

Display of Wind Angle

If the wind angle information is supplied using the NMEA 0183 input or SeaTalk bus, the apparent wind angle and tack sense (◀ for port, ▶ for starboard) is added to the display menu and accessed via the Display button.

VANE 235°

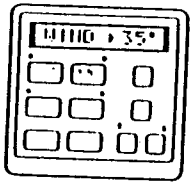
DISPLAY

- Apparent Wind Angle

WIND ▶ 35°

- The apparent Wind Angle is 35° — Starboard Tack.

- Adjust Apparent Wind Angle



Use the ±1 or ±10 degree buttons to change heading and hence adjust the apparent wind angle.

WIND ▶ 45°

Using Wind Trim

It is important to understand that "Wind Tr
prevents over-reaction to gusts or sudden v
shifts. One minute is required to change the
heading in response to a permanent change
apparent wind angle. Do not attempt to ove
the automatic sequence with the course cha
buttons.

In gusty conditions sail a few degrees off t
wind and pay frequent attention to sail trim
helm balance using the rudder angle indicati

Performance will normally be improved by
reefing headsail and mainsail a little early rat
than too late.

5. Operating Hints

Response Level Adjustment

The ST6000 has three response levels which enable tighter course keeping to be achieved in certain cases:-

Level 1 — Automatic Sea State Control
Level 2 — Automatic Sea State Inhibit
Level 3 — Automatic Sea State Inhibit and counter rudder.

When the autopilot is switched on, the response level is set to 1. This provides the best compromise between power consumption and course keeping accuracy and is suitable for nearly all situations.

Increasing Response level provides tighter course keeping at the expense of increased power consumption and general wear and tear. It is advisable to use the minimum response level necessary to achieve the desired course keeping accuracy. On larger power vessels level 3 can improve slow speed steering where the natural yaw damping of the vessel is reduced.

Note: Level 3 is not recommended for use at planing speeds or in rough seas.

Track

To make full use of Track control the following simple points should be observed:-

- Always steer the vessel to within 0.1n.m. of track and bring the heading to within 5° of the bearing to the next waypoint before selecting Track.
- Always check that there are no navigational hazards either side of the intended track.
- Always maintain an accurate log with regular plots to verify the computed position read from the Radio Navigation Receiver.
- Maintain a proper lookout at all times.

Waypoint Advance

The navigation receiver is transmitting the waypoint number to the ST6000 the waypoint alarm will sound whenever a new target waypoint is selected (see Page 7). When the alarm is sounding the ST6000 will maintain the present heading and automatic track control is suspended. Check the displayed new bearing to waypoint and when it is safe to turn onto it, engage the automatic track control by simply pushing Track. This accepts the new target waypoint and will steer the vessel onto the new bearing to waypoint.

The tidal offset may be very different on the new bearing, and it is good practise to check the cross track error after a couple of minutes. If the cross track error continues to increase make a course adjustment of say 10 degrees in the direction of the arrow. This will help the Track control correct more quickly for the new tidal vector.

Automatic Trim

If Automatic Trim has been selected during calibration the ST6000 will correct for trim changes. This correction can take up to one minute to apply the rudder offset necessary to restore the set automatic heading. Large course changes which change the apparent wind direction can produce large trim changes. In these cases the autopilot will not immediately assume the new automatic heading, and only settle onto course when the Automatic Trim has been fully established.

To minimise the inherent time delay the following procedure may be adopted for large course changes.

- Note required new heading.
- Select Standby and steer manually.
- Bring vessel onto new heading.
- Select Auto and let vessel settle onto course.
- Bring to final course with 1° 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 autopilot.

Rudder Gain

The rudder gain level selected during initial sea trials will normally provide excellent steering performance over a wide range of conditions. However, 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 (southerly) headings.

Rudder Gain Adjustment (Sail)

It is not normally necessary to adjust the autopilot gain setting once the correct level has been established during initial sea trials.

Depending on the yachts individual steering characteristics a change of one level may improve course keeping accuracy when going from northerly to southerly (increase) or southerly to northerly (decrease) headings.

The effect may be judged by carrying out a sea trial in smooth water conditions and observing the results.

Note: The effect is reversed for the southern hemisphere.

Rudder Gain Adjustment (Powercraft)

The tendency towards northerly (southerly) heading instability is more obvious in high speed craft and can be corrected by a reduction in the rudder gain setting. At speeds in excess of 30 knots a reduction of two levels can be required on headings between 315° and 045° (northern hemisphere) or 135° and 230° (southern hemisphere).

Two options are available to control this:-

- Manual (Low speed and displacement craft)
  The rudder gain control may change by one level when going from northerly to southerly (increase) or southerly to northerly (decrease) headings.
  The effect may be judged by carrying out a sea trial in smooth water conditions and observing the results.
  Note: The effect is reversed for the southern hemisphere.
- Autoadapt (High speed planing craft)
  The ST6000 can be set to automatically reduce the effects of Northerly heading instability. This feature is selected in calibration mode by entering the Latitude (see Installation Handbook, Calibration, section on 'Auto Adapt'). When selected the ST6000 automatically adjusts the Rudder Gain depending on the compass heading, removing the need for manual adjustment.

Rudder Gain/Speed Adjustment (Powercraft)

High speed planning craft exhibit very different steering characteristics when on and off the plane. As a result it is generally necessary to adjust the Rudder Gain setting when going from displacement speed to planing speed or vice versa.

Two options are available to achieve this:-

- Automatic
  When the ST 6000 is used with an Autohelm ST50 Speed Instrument or Tridata, Rudder Gain is adjusted automatically with boat speed. There should be no need for any manual adjustment.
- Manual
  (No ST50 Speed/Tridata)
  The Rudder Gain setting may be increased by one or two levels when dropping from planing speed to cruise speed and decreased by the same amount when returning to planing speeds.

Note: It is important to make the gain adjustment after dropping to displacement speed and before returning to planing speed.

Note: The adjustment of Gain with boat speed is normally only required for high speed planing powercraft.

Unsatisfactory Steering Performance

If the ST6000 has been installed and set up in accordance with the instructions in the Installation Manual it will provide excellent steering performance over a wide range of conditions.

If performance drops but the autopilot is still working correctly, the following simple checks should find the fault:-

- Has a magnetic influence been introduced near the fluxgate compass? i.e. anchor, chain, radio equipment, loudspeaker, tools, generator etc. Check that the autopilot compass heading still corresponds with the steering compass.
- Are all fuses intact, circuit breakers engaged?
- Are all screw connections tight and free of corrosion.

- If the autopilot fails to hold course check the Rudder Gain level. Has it been changed from the initial sea trials level (check in Installation Manual)?
- If the vessel wanders check that the Rudder Reference Transducer linkage is secure with no free play.

Hydraulic Drive Units only:-

- Check that all unions are tight and bleed system to remove air.

Failure of Drive Unit to Disengage

The mechanical drive actuators of the ST6000 are designed to 'Fail Safe' – When power is disconnected the drive unit will disengage leaving the steering system free for manual control.

When Standby is selected the actuator will Disengage leaving the steering free.

It is remotely possible that a fault could develop which could cause the actuator to remain engaged even when Standby is selected. If this happens:-

- DISCONNECT THE MAIN CIRCUIT BREAKER TO THE AUTOPILOT – THE STEERING WILL IMMEDIATELY BE FREE.

or

- IN AN EMERGENCY THE ACTUATOR CLUTCH CAN NORMALLY BE OVERRIDDEN BY TURNING THE STEERING WHEEL HARD.

t is emphasised that this fault is extremely nlikely and can be immediately corrected as escribed.

If preferred a separate Override switch can be tted close to the steering position which will reak the actuator clutch drive for Emergency se.

tern Drive Actuator

anual Override Option

hen used with a stern drive actuator, the T6000 can be set up to automatically release e drive if the steering wheel is turned in an nergency situation. After releasing the drive it the ST6000 will return to Standby and und the manual override alarm for 10 conds.

Note: This feature is for use with a stern drive actuator only.

Control Unit Display Adjustment

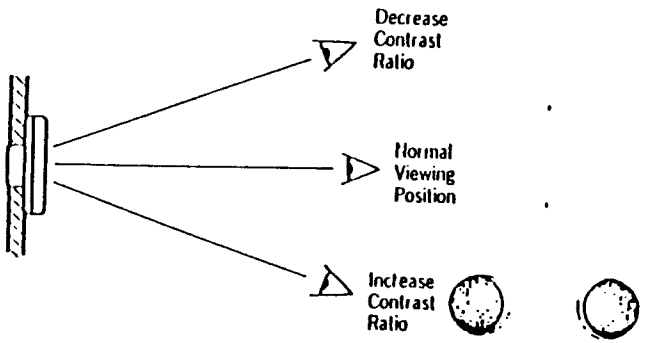
The control unit display is designed to provide good legibility over a wide range of viewing angles. However it is recommended that wherever possible the control unit is mounted so that the viewing angle is normal to the LCD display when the helmsman is in the usual steering position. If the control unit is mounted so that the usual viewing position is at an angle to the LCD display the LCD contrast can be adjusted to improve legibility.

- Push Display and Track together momentarily.

DISPLAY

- Push ▲ to increase, ▼ to decrease contrast level. Continue until the display has optimum legibility when viewed from the usual helming position.
- Push Display and Track together momentarily to store the selected contrast level.

Note: Increasing the contrast level will suit installations where the instrument is normally viewed from below.



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. The working parts of the drive system are sealed and lubricated for life during manufacture and therefore do not require servicing.

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

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

7. Safety

Passage making under autopilot can greatly increase the pleasure of the voyage and ens the crew can relax. However this can lead to dangerous lack of attention to basic seaman The following rules should always be observe

- Maintain a permanent watch and check regularly all round for other vessels and obstacles to navigations. No matter how clear the sea may appear a dangerous situation can develop rapidly.
- Maintain an accurate record of the vessel position either by use of a radio navigatio receiver or visual bearings.
- Maintain a continuous plot of position on a current chart. Ensure the locked autopilot heading steers you clear of all obstacles. Make proper allowance for Tidal Set – the autopilot cannot!
- Even when your autopilot is locked to the desired Track using a radio navigation receiver maintain a log and a regular positional plot. Radio navigation signals ca produce significant errors under some circumstances and the autopilot cannot detect this situation.
- Ensure that all members of crew are familia with the procedures required to engage an disengage the autopilot.
- When searoom is restricted a crew membe must be close to a control unit at all times i under autopilot control.
- On Powercraft permanent watch should be maintained at the steering station when at speed with the autopilot engaged.

Your Autohelm ST6000 will add a new dimension to your boating enjoyment, however is the responsibility of the skipper to ensure the safety of the vessel at all times by careful observance of these basic rules.

8. Fault Location Procedure

The ST6000 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 power 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.

If the autopilot switches on but does not operate correctly, check the rudder angle and heading displays on the control unit. If these appear incorrect, double check all connections from the course computer to the compass and rudder reference transducers.

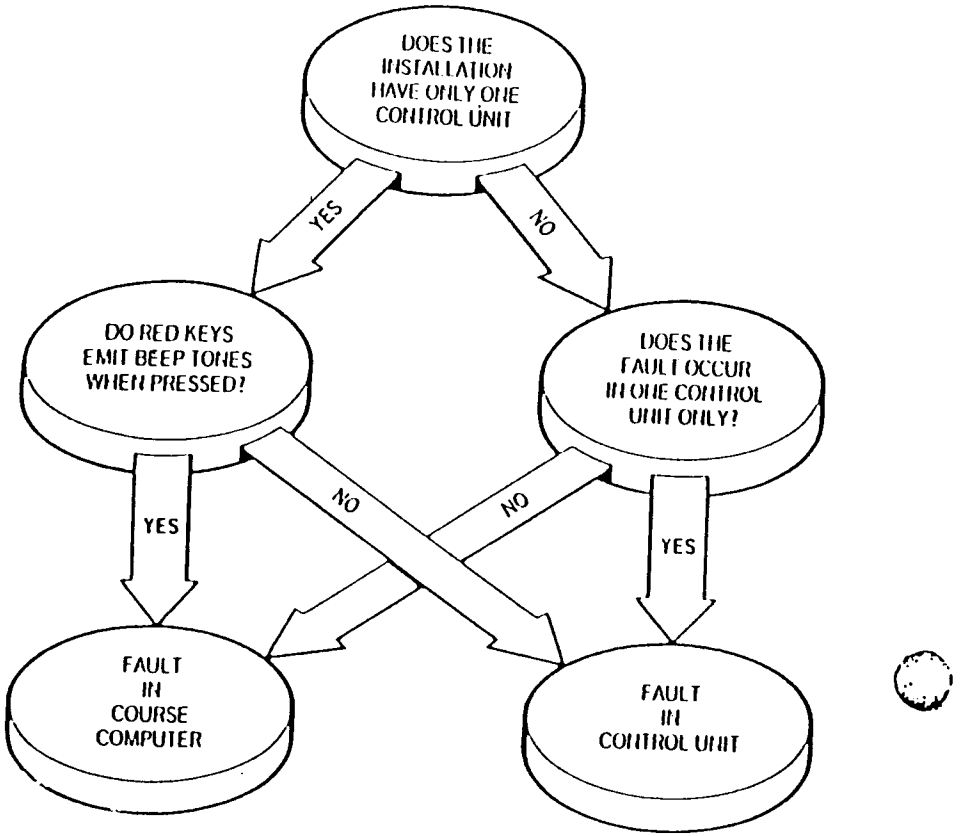
In the case of a sailing yacht fitted with a windvane system if a fault occurs only in vane mode then it is likely that a fault has developed in the vane head or the interconnection system.

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 from the connector unit for servicing. (see Installation Manual).

Control Units are removed by undoing the two thumb nuts (accessed from behind). Disconnect the cables by rotating the locking rings anticlockwise before separating the connectors.

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.



9. 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 serviced 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 produce 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 installation must have been inspected and approved by Nautech or its approved insta
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 insta or operated not in accordance with standards defined in this handbook.
   (b) Repairs have been attempted by person other than Nautech approved Service personnel.
   (c) The warranty card has not been complet correctly or is not accompanied by proof purchase.

Claim Procedure

1. The product should be sent direct to Nautec or its appointed Distributor or Service Centr nearest to the vessel. The completed Warra Card and proof of purchase must accompan the claim. The product will then be serviced free of charge and returned promptly direct the sender.
2. Nautech, its Distributors and Service Centre are not liable for any charges arising from vis 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 f any such services at the local rate.

After Sales Service

Your ST6000 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.

ST6000 Installation

Autohelm™

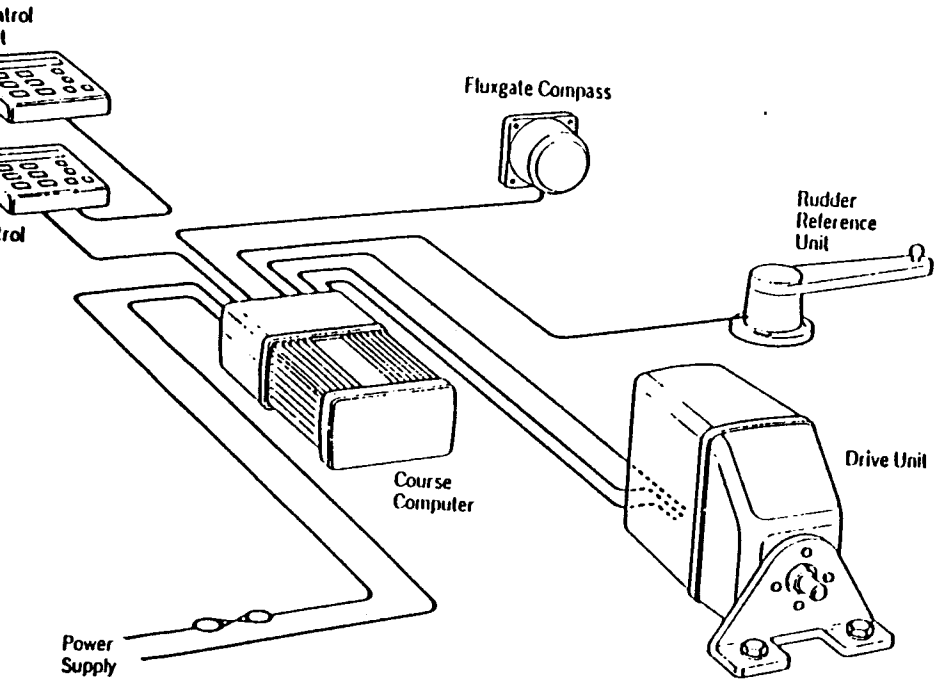
Contents

he ST6000 is a modular automatic pilot system
at can be built up to match the individual
quirements of most types of vessel. A range of
h efficiency rotary, linear, and hydraulic
dder drive units are available.
The ST6000 is SeaTalk compatible providing
data sharing with the Autohelm range of
Talk instruments.

The control unit has a built in interface which will accept navigation and wind angle data to 0180/0183 format.

A twin control unit installation is shown below. The most basic installation (Z123 + drive unit) would consist only of a central course computer, drive unit, fluxgate compass, rudder reference unit and a single control unit.

1

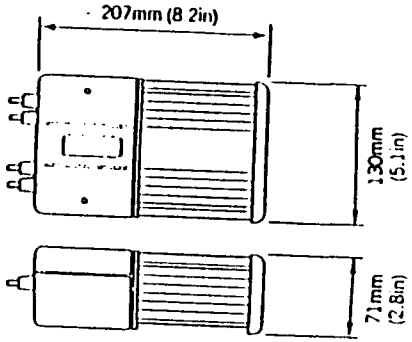


1.1.1 Course Computer

The course computer houses the microprocessor, electronic control circuitry and power amplifier for the drive unit.

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

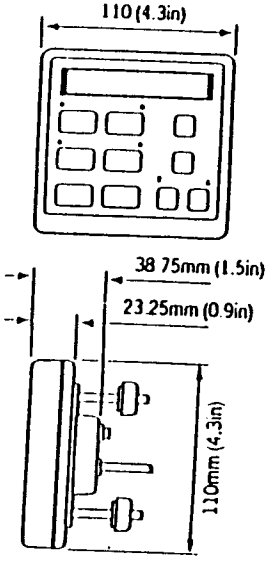
The course computer is available for operation with a 12V power supply only.



1.1.2 Control Unit (Cat. No. Z124)

The control unit is designed for above or below deck mounting.

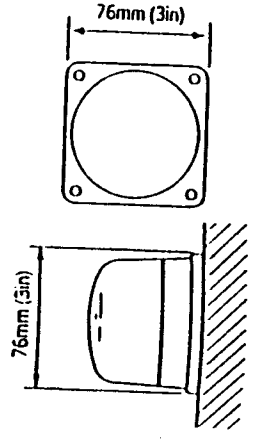
The control unit accepts NMEA navigation and wind angle data input.



1.1.3 Fluxgate Compass (Cat. No. Z130)

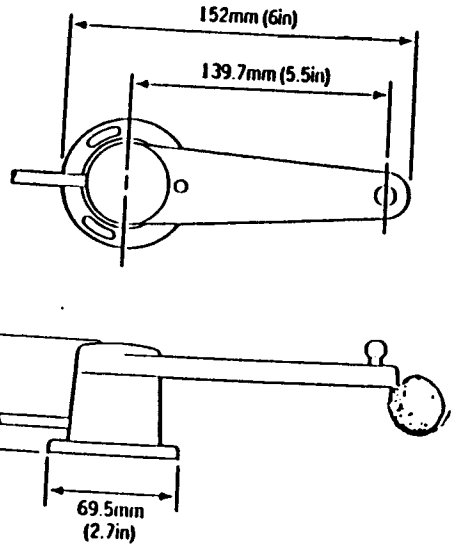
The fluxgate compass has been especially developed for marine application. The compass contains a gimbal mechanism to permit accurate readings with pitch and roll movements up to ±35°. The compass is bulkhead mounted below decks and connects directly to the course computer.

The fluxgate compass may be mounted above deck on steel vessels however autopilot performance may be degraded due to the increased motion.



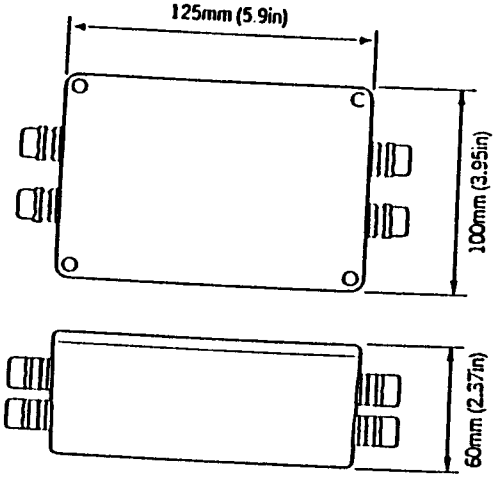
.4 Rudder Reference Transducer
t. No. Z131)

rudder reference transducer provides the
rse computer with a precise rudder position.
mounted on a suitable base adjacent to the
der stock. The interconnecting cable
nects directly to the course computer
nector unit.



5 Type CR Interface Unit
No. Z085)

ndard ST6000 course computer can be
cted to the solenoids on a constant
ng hydraulic power pack using the Type CR
ace unit. The unit also provides
ctions to energise a solenoid operated
s valve if required. The type CR Interface
hould only be used with 12V systems.



1.2 Drive Systems

The ST6000 offers a choice of Mechanical, Stern Drive or Hydraulic Drive Units. All vessels with hydraulic steering will require a hydraulic drive unit (see 1.2.4).

Mechanical steering systems may be driven with either a rotary or linear drive unit. If space permits the linear drive unit provides the simplest installation by connecting directly to the rudder stock tiller arm. It may also be used to power steer the vessel if steering linkage failure occurs.

Vessels with stern drive (I/O) engines and cable operated power steering valves should use the stern drive actuator (see 1.2.3).

1.2.1 Rotary Drive Unit (Cat. No. Z037)

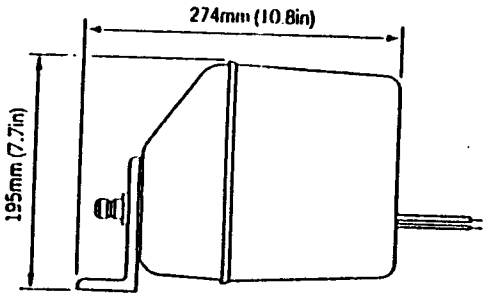
The Autohelm Rotory Drive Units provide smooth powerful steering commands with virtually silent operation.

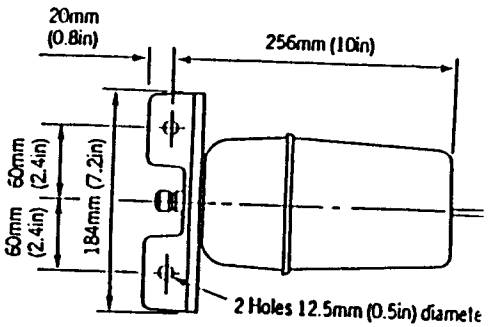
A rugged electric motor drives a precision epicyclic gearbox via a high tensile belt drive. An electronic clutch is totally fail-safe yet transmits high torque loads with no slippage.

The drive units can be mounted in any attitude simplifying installation.

Specifications

Supply Voltage	12 volts
Peak Output Torque	20Nm (180lb in)
Maximum Shaft Speed	33 rpm
Power Consumption (typical average)	2 – 4 amps
Suitable for vessels up to	14m (45ft) LOA
Maximum displacement	11800Kg (26000lbs





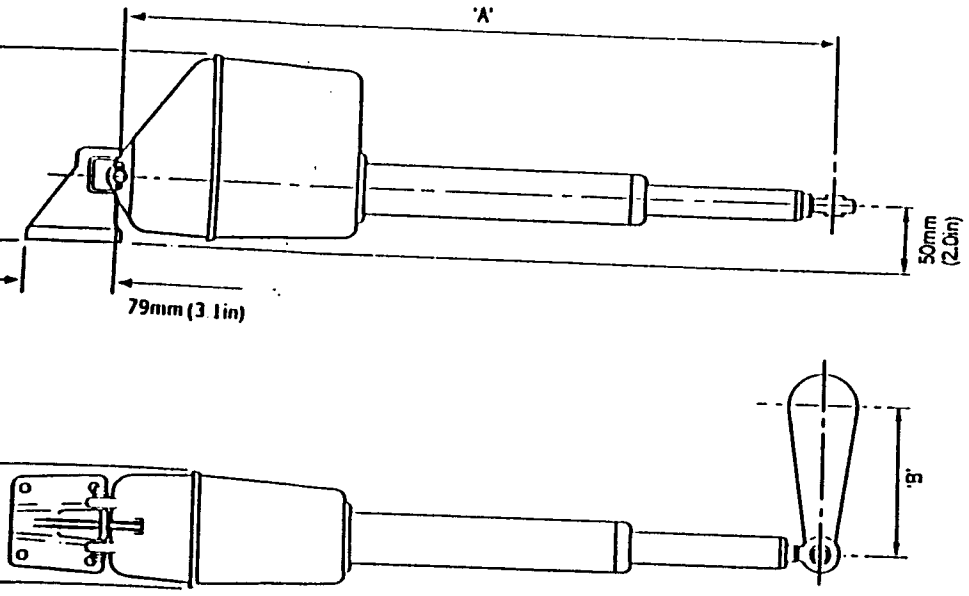
2.2 Linear Drive Unit (Cat. No. Z039)

e Autohelm Linear Drive Units are of
'standing design which features powerful
ust, fast hard overtimes and near silent
eration. When backdriven the movement is
ooth with minimal backdrive force. Using a
h tensile belt drive and epicyclic reduction
rbox the powerful electric motor is controlled
n electronic fail-safe clutch.
he design is highly efficient and provides
performance for minimum current
sumption.

ler arm of adequate strength must be used
ansfer drive from the drive unit to the
der shaft. Both Edson and Whitlock Marine
ide suitable standard tillers.

Specifications

Supply Voltage	12 volts
Peak Thrust	295Kg (650lb)
Maximum Stroke Speed	28mm/sec (1.1in/sec)
Maximum Stroke	300mm (12in)
Overall Length at Mid Stroke 'A'	700mm (27.5in)
Tiller Arm Length 'B' (±35° Rudder)	250mm (10in)
Maximum Rudder Torque	735Nm (6500lb In)
Power Consumption (typical average)	1.5 – 3 amps
Suitable for vessels up to	14m (45ft) LOA
Maximum displacement	11800Kg (26000lbs)



4 off Fixing holes suitable for 10mm (0.4in) bolts.

1.2.3 Stern Drive Actuator

The Stern Drive Actuator must only be used on stern drives with cable operated power assisted steering.

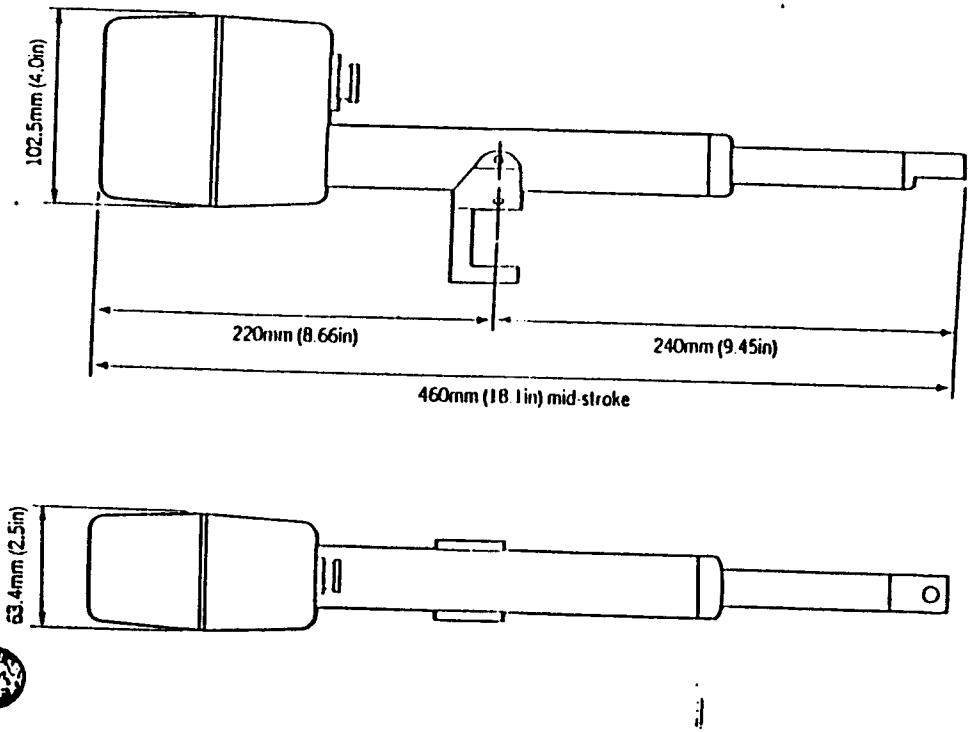
The drive unit operates the power steering valve identically to the steering cable. A clutch disengages the drive unit to allow manual steering when the autopilot is disengaged.

Two installation kits are available to allow connection to different engine manufacturers equipment.

Cat. No.	Manufacturer
D129	Volvo Penta
D137	Mercruiser/OMC/Yamaha

Specifications

Description	Size
Hardover/Hardover time (Unloaded)	8.8 secs
Stroke	190mm (7.5in)
Power Consumption (Typical Average)	1.5 – 3 amps
Maximum Thrust	150 Kg f (330lbs

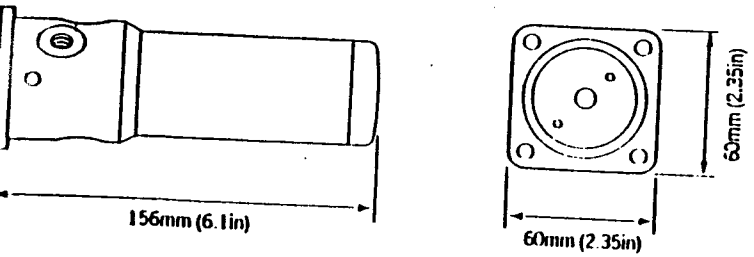


.2.4 Hydraulic Drive Units

wo reversing hydraulic drive units are available epending on the size of the vessel and the splacement of the ram.
The vessel size and displacement commendations given below apply to directly iven steering systems. When a power steering stem is fitted the vessel size and displacement commendations can be ignored.

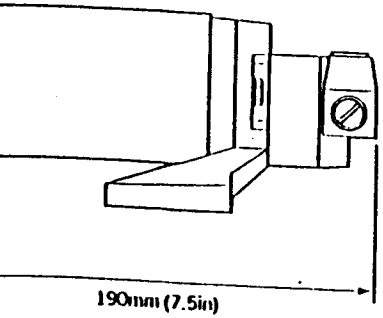
pe 0

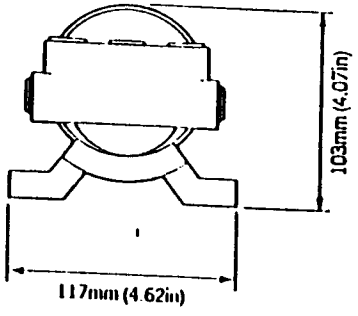
e type 0 hydraulic drive unit consists of a twin inder piston pump.
The high volumetric efficiency of the piston mp provides precise control.



e 1

ydraulic drive unit consists of a precision pump with integral check valve block n by a continuously rated servo motor. The drive motor is connected directly to the e computer which also regulates peak pressure.





Specifications

	Type 0	Type 1
Supply Voltage	12 volts	12 volts
Regulated Peak Pressure	30 bar (450 psi)	50 bar (750 psi)
Flow Control		Integral Pilot Check Valve
Peak Flow Rate (unloaded)	490cc/min (30in³/min)	1100cc/min (67in³/min)
Minimum Ram Capacity	50cc (3in³)	130cc (8in³)
Maximum Ram Capacity	130cc (8in³)	230cc (14in³)
Ram Type	Double Ended (balanced)	Single or Double Ended
Power Consumption (typical average)	1.5 – 2.5 amps	2 – 4 amps
Maximum Vessel Size	8m (26ft)	13m (42ft)
Maximum Vessel Displacement	3000Kg (6600lbs)	11800Kg (26000lbs)

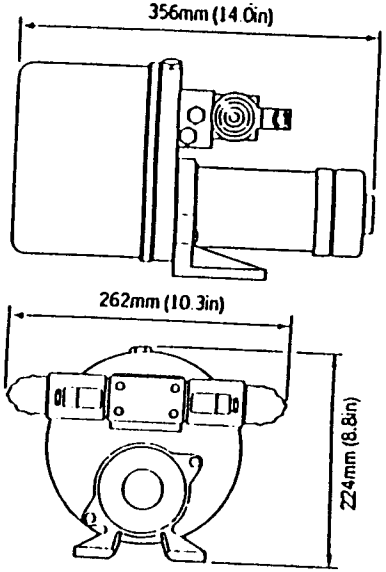
1.2.5 Constant Running Power Pack

When steering loads require a ram capacity above 400cc (24in³) the Autohelm Constant Running Powerpack provides the ideal autopilot drive system.

Hydraulic fluid is provided from a self contained reservoir and flow to the steering ram is controlled by integral solenoid operated valves.

For the most rugged and demanding steering applications the Autohelm Constant Running Powerpack is the optimum solution.

Used with a solenoid operated bypass valve and separate hydraulic ram this system is recommended for heavy duty applications on large mechanically steered vessels.



	Type CR1	Type CR2
Supply Voltage	12 volts	12 volts
Regulated Peak Pressure	50 bar (750 psi)	50 bar (750 psi)
Peak Flow Rate (unloaded)	3000cc/min (180in³/min)	4500cc/min (270in³/min)
Minimum Ram Capacity	400cc (24in³)	750cc (46in³)
Maximum Ram Capacity	750cc (46in³)	1500cc (92in³)
Ram Type	Single or Double Ended	Single or Double Ended

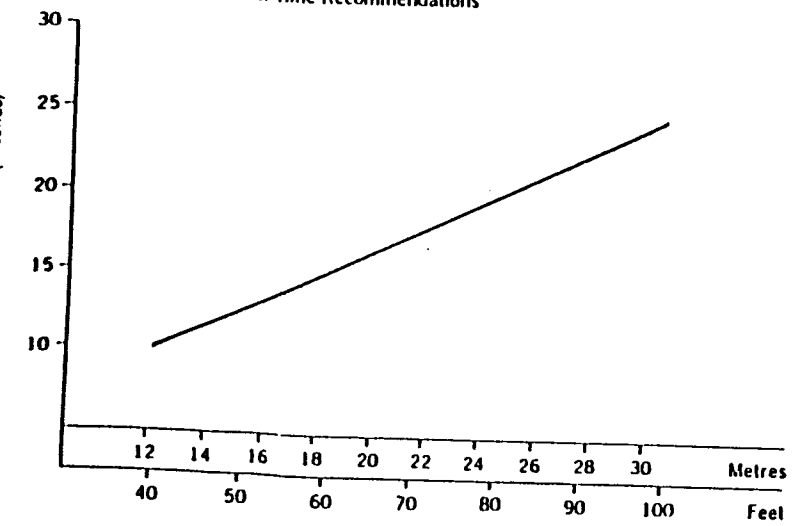
Power Pack Selection (Constant Running)
Hydraulic power pack selection depends on the vessels overall length and the displacement of the steering cylinder.

Using figure 2 establish the target hardover time for your vessel. This is combined with the steering cylinder displacement in figure 3 to select the appropriate hydraulic power pack.

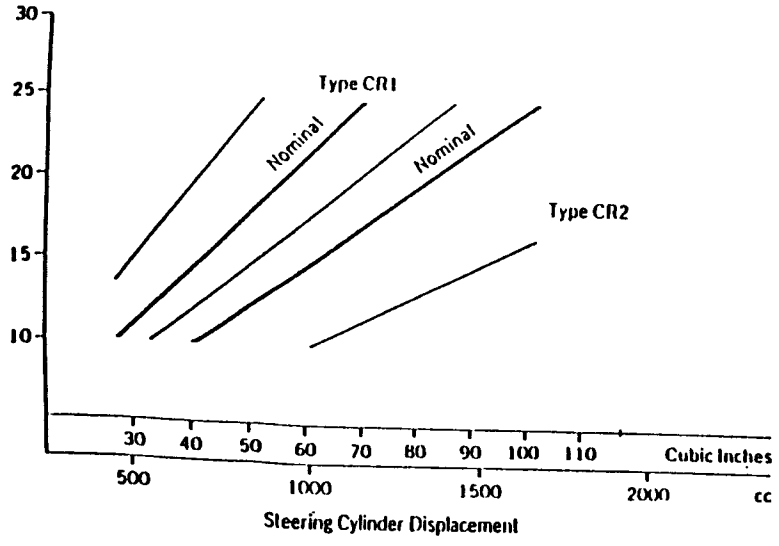
Note: If power packs other than the Autohelm models are used with the ST 6000 the following solenoid specifications must comply:

Pull in Voltage — less than 8V
Drop out Voltage — greater than 2V
Operating Current — less than 5A

ig. 2
Hardover — Hardover Time Recommendations



3
Power Pack Selection



2. Installation

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/SSB radios, Aerial Cables etc).

Mounting Instructions

- Remove Terminal box lid (Fig. 4).
- Unscrew two internal thumb retaining nu (Fig. 4).
- Unplug terminal box.
- Position terminal box in correct location, mark off and pilot drill for the 4 self tappin screws supplied (Fig. 5).
- Screw terminal box into place.
- Plug course computer unit to terminal box Retighten thumb retaining screws.

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

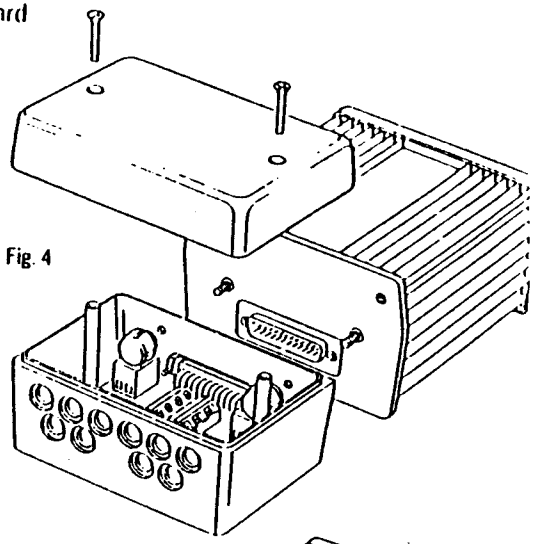


Fig. 4

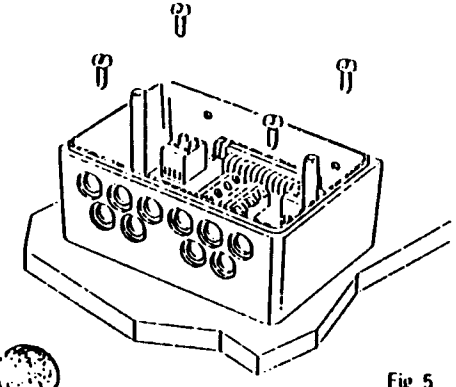
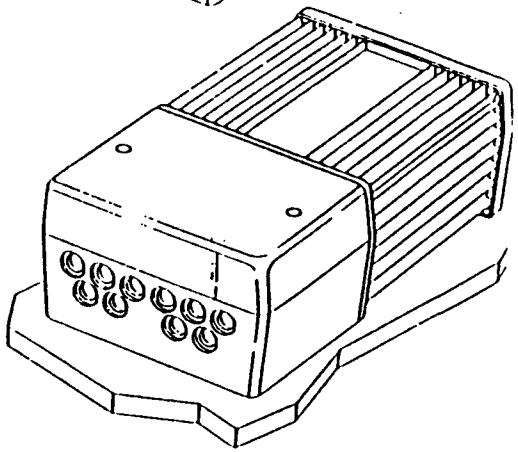


Fig. 5



2.1.2 Control Unit

The control units must be mounted close to the steering stations and are designed for above or below deck installation. Position them where they are:-

- Normally viewed straight on for best display legability.
- Reasonably well protected from physical damage.
- At least 230mm (9in) from a compass.
- At least 500mm (20in) from radio receiving equipment.
- Accessible from behind to secure in place and run cables.

Note: The back cover is designed to breath through a duct in the cable boss to prevent moisture accumulation.

Mounting Procedure (Fig. 6)

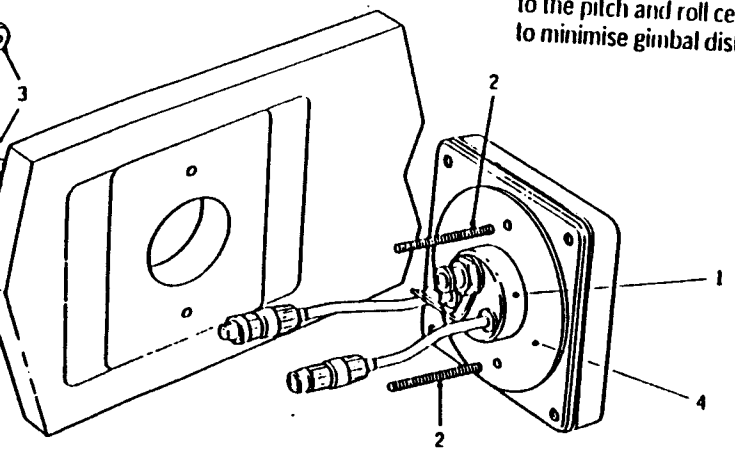
The mounting surface must be smooth and flat.

- Use the template provided to mark the centres of the two fixing holes and central boss.

Note: Adjacent instruments should have a 6mm 1/4in) separation to allow room for the rotective covers.

- Drill to 4mm (5/32in) diameter.
  Use 50mm (2in) diameter cutter to drill the hole for the central boss 1.
  Screw the two fixing studs 2 into the back cover.

.6

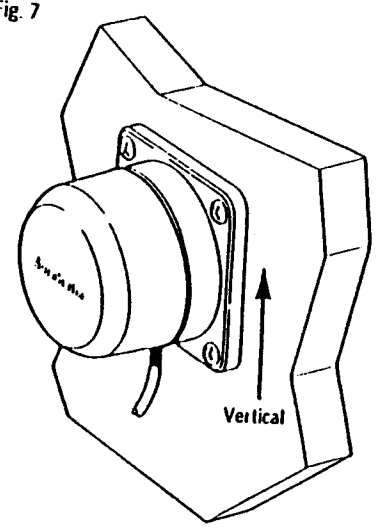


- Pass the cable tails through the central hole and secure the instrument with the thumb nuts provided 3. (A sealing gasket 4 is already attached to the back cover).

2.1.3 Fluxgate Compass

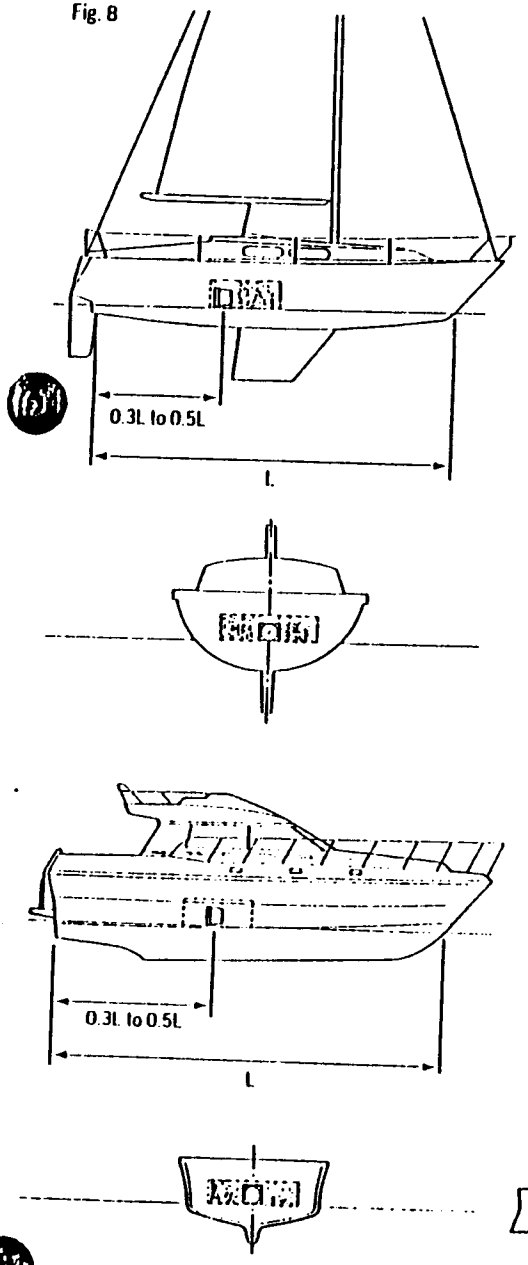
The fluxgate compass may be attached to a convenient vertical surface using the self tapping screws provided (Fig. 7).

Fig. 7



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. 8



It is very important to ensure that the fluxgate is positioned at least 0.8m (2ft 6in) 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 ot magnetic devices which may cause deviatio and reduce the sensitivity of the sensor. If a doubt exists over magnetic suitability of the chosen site, the position may be surveyed u a simple hand bearing compass. The hand bearing compass should be fixed in the cho position and the vessel swung through 360° Relative differences in reading between the hand bearing compass and the vessel's mai steering compass should ideally not exceed on any heading.

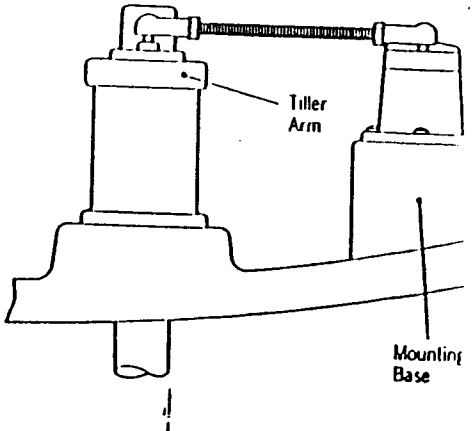
Installation Precautions

Correct installation of the course computer a fluxgate compass is vital to the successful performance of the ST6000.

2.1.4 Rudder Reference Transducer

The rudder reference unit must be mounted a suitable base adjacent to the rudder stock (Fig. 9) using the self tapping screws provide The base height must ensure correct vertical alignment of the rudder reference unit arm a tiller arm. If it is more convenient, the rudder reference unit may be mounted upside down (logo downwards), but if this is done, the red green wires must be reversed in the connecti unit.

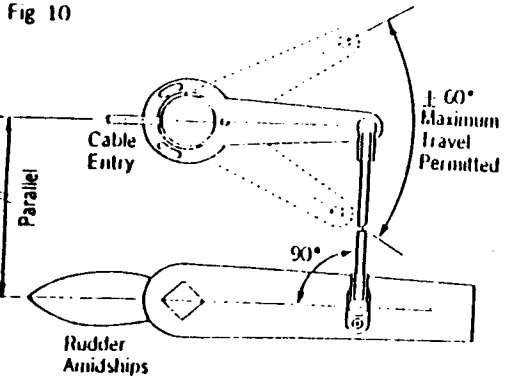
Fig. 9



The rudder reference unit has a built in spr to remove any free play in the linkage to the tiller. This gives very precise rudder position.

The rudder reference arm movement is limited to ±60°. Care must be taken during installation to ensure the rudder reference arm is opposite the cable entry when the rudder is amid ships. Failure to do this could result in damage if the rudder reference arm is driven onto its end stops by the steering system (Fig. 10).

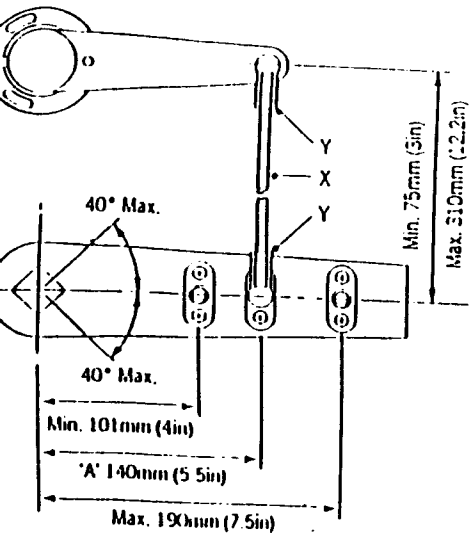
Fig. 10



Control Dimensions

t is important to ensure that the dimensions set ut in Fig. 11 are within the limits set and the iller arm and rudder reference arm are parallel o each other.

ig. 11



With the rudder amidships, the rudder reference arm should be opposite the cable entry and at 90° to the connecting bar. Minor adjustment can be made by slackening off the 3 securing screws and rotating the transducer body.

The tiller pin must be positioned within the limits shown in Fig. 11. Ideally dimension A should be 140mm (5.5in). However changing this within the limits shown will not degrade the autopilot performance but will slightly alter the scaling of the rudder angle display on the control unit. The tiller pin is secured to the tiller arm using the self tapping screws provided.

Cut the studding X (Fig. 11) to length and screw on the lock nuts Y (Fig. 11) and ball pin sockets. The sockets can then be pressed onto the pins. Move the rudder from side to side to ensure the linkage is free from any obstruction at all rudder angles.

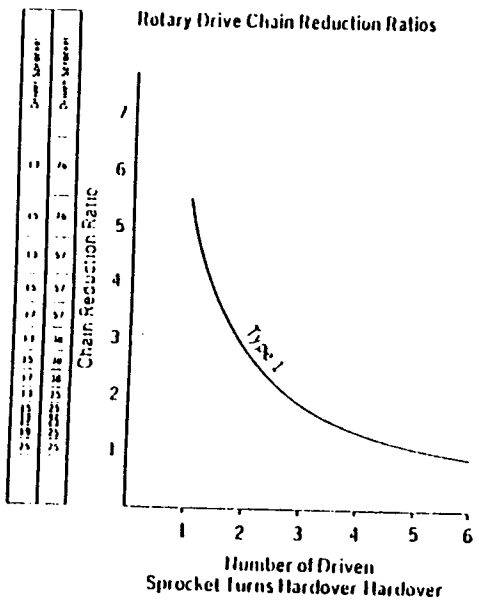
2.2 Drive Systems

2.2.1 Rotary Drive Unit

The rotary drive unit is coupled to the steering mechanism by a chain drive. Most steering gear manufacturers supply special autopilot drive attachments and many include this facility as standard.

Having selected the position for attachment of the autopilot drive chain it is necessary to determine the chain reduction ratio. Count the number of turns of the steering gears' shaft (this is the driven sprocket) when the rudder is driven from hardover to hardover. Use Fig. 13 to determine the sprocket sizes required.

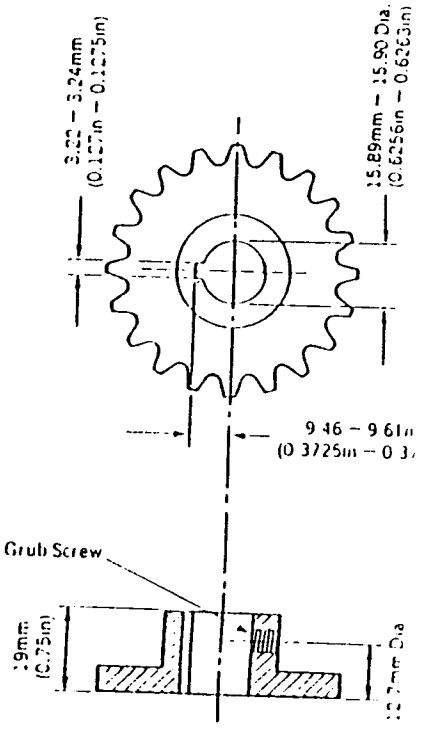
Fig. 13



These reduction ratios will provide good steering performance for most vessels with an approximate 10 second Hardover-Hardover time. If the vessel is thought to have unusual steering characteristics, Nautech's Product Support Department or one of our authorised representatives should be contacted for advice.

Standard 3/8" or 1/2" pitch chain is recommended for the chain drive and the drive sprocket ideally must not have less than 13 teeth. Bore and keyway dimensions for th unit sprocket are detailed in Fig. 14. It is essential that these bore and keyway dimensions are strictly adhered to. All spr must be keyed and grub screwed to their and finally secured with 'Loctite'.

Fig. 14



The drive unit is mounted by bolting to a substantial frame member (Fig. 15). The mounting foot is secured to the drive unit b four equally spaced caphead screws and m rotated through 90° to provide a more convenient mounting position if required (Fig 16). In some cases, it may be necessary fabricate a special frame to mount the drive It should be noted that chain tension can e 230Kgs (500lbs) and thus an extremely rigi mounting structure is vital to maintain good chain alignment. Installation failures can oc this area and it is desirable to 'over enginee the drive unit mounting. All fastenings shou secured by lock washers.

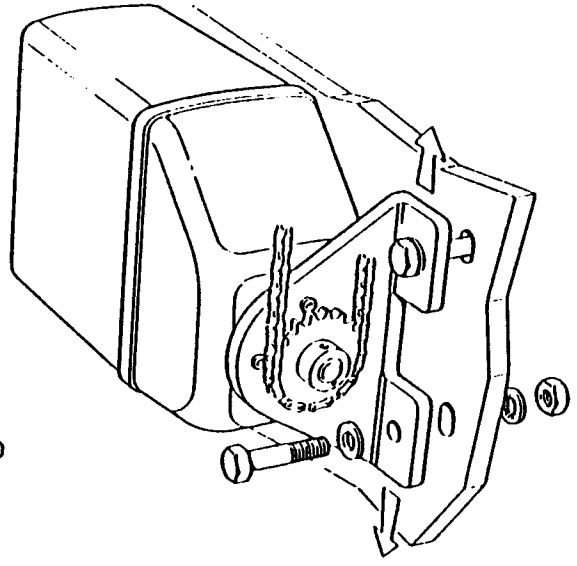
Provision must also be made for chain adjustment which is most easily achieved by removable shims placed under the mounting foot or by elongated clearance holes in the mounting frame as illustrated in Figs. 15 and 16.

Both sprockets must be accurately aligned to run in the same plane and correct alignment must be carefully checked by means of a straight edge.

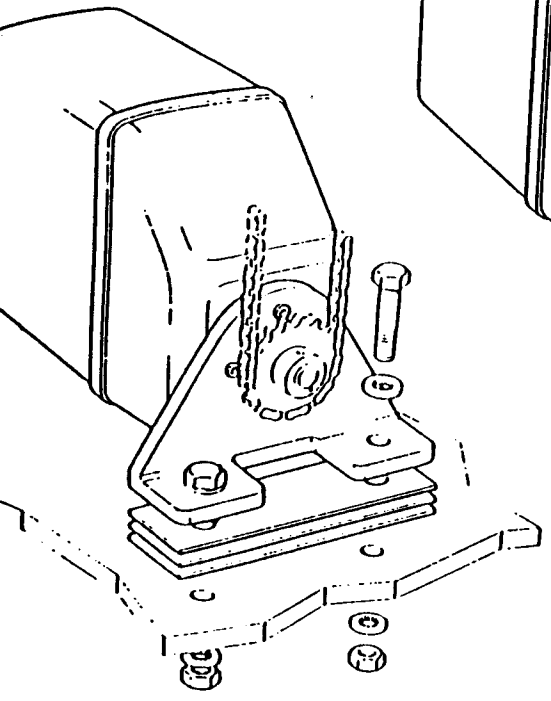
The gearbox may be mounted in any convenient attitude. In addition, the drive sprocket may face any direction since steering sense can be corrected when the installation is complete by reversing the polarity of the drive motor connection (see section 3.5). Finally, the chain should be tensioned until it is just tight and contributes negligible lost motion to the drive system. Total lost motion between the driven sprocket attached to the steering system and the rudder stock should not exceed 2% of total movement under any circumstances. If lost motion exceeds this level it must be corrected, otherwise steering performance will be impaired.

Having completed the drive unit installation, turn the steering wheel from hardover to hardover and check that the chain and sprockets driving the actuator move freely and in alignment.

Fig. 16



g. 15



2.2.2 Linear Drive Unit (Fig. 17)

The linear drive unit couples directly to the rudder stock at the tiller arm radius shown below:-

It is preferable to couple the linear drive unit to the rudder stock via an independent tiller arm (Edson and Whitlock offer a standard fitting). In certain cases, however, it may be possible to couple the pushrod to the same tiller arm or rudder quadrant employed by the main steering linkage. It is important to note that the linear drive system can exert a thrust of over 295Kgs (650lbs). If any doubt exists about the strength of the existing tiller arm or rudder quadrant the steering gear manufacturer must be consulted.

When siting the linear drive unit, the following points should be noted:-

- The drive unit mounting bracket may be attached to any horizontal or vertical surface. If necessary the drive unit may be mounted upside down.
- The ball end fitting will allow up to 5° misalignment between the pushrod and tiller arm plane of rotation. Accurate angular alignment is extremely important and under no circumstances should the above limit be exceeded.
- The mounting bracket should be bolted to a substantial frame member. Always over engineer to ensure reliability and maintenance of correct alignment.
- With the rudder amidships the drive unit must be at right angles to the tiller arm.

Installation

The pushrod ball end must be attached to tiller arm using the fixing bolt supplied with flange positioned between the ball end and tiller arm (Fig. 18). It is vitally important tha lock washer supplied is used and that the r fully tightened.

The mounting bracket should be attached with four stainless steel M10 bolts with lock or lock washers.

Having installed the drive unit turn the steering wheel from hardover to hardover a check that:-

- no part of the drive unit fouls the vessels structure.
- the mechanical limit stop on the vessels' steering system is reached before the actuator reaches its mechanical limit.
- angular movement of the ball end fitting i less than 5°.

Fig. 18

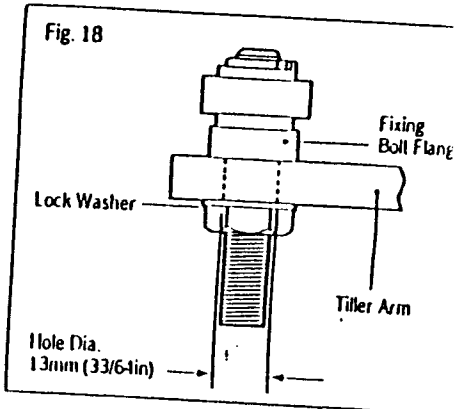
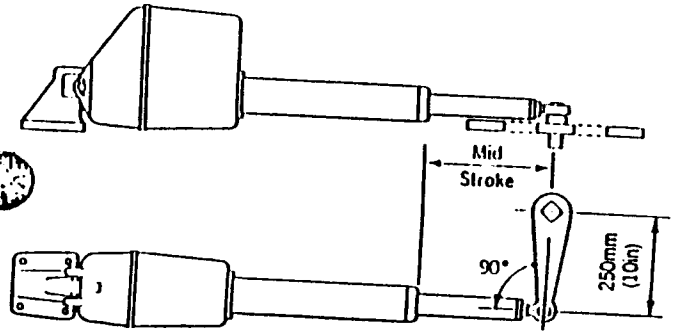
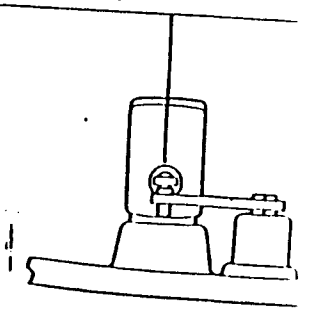


Fig. 17





2.2.3 Stern Drive Actuator

The drive unit can be fitted to power assisted stern drive systems made by Volvo Penta, Mercruiser, OMC and Yamaha. A different installation kit is required for each manufacturer.

Volvo Penta Installation

(Using D129 Kit, Fig. 19)

The stern drive actuator should be connected to the centre hole on the tiller arm. On twin engine installations this is the position used to connect the engine tie bar to link the two tiller arms.

Installation

- Push the mounting bracket behind the steering cable sliding the location pins either side (top and bottom) of the Volvo power steering block (Fig. 20).
- Ensuring that the bracket clamp is correctly orientated (larger diameter towards engine) place the bracket clamp between the valve block and cable clamp nut and attach with the four hexagonal bolts supplied. Tighten the four bolts evenly until the bracket is securely located (Fig. 20).

Fig. 19

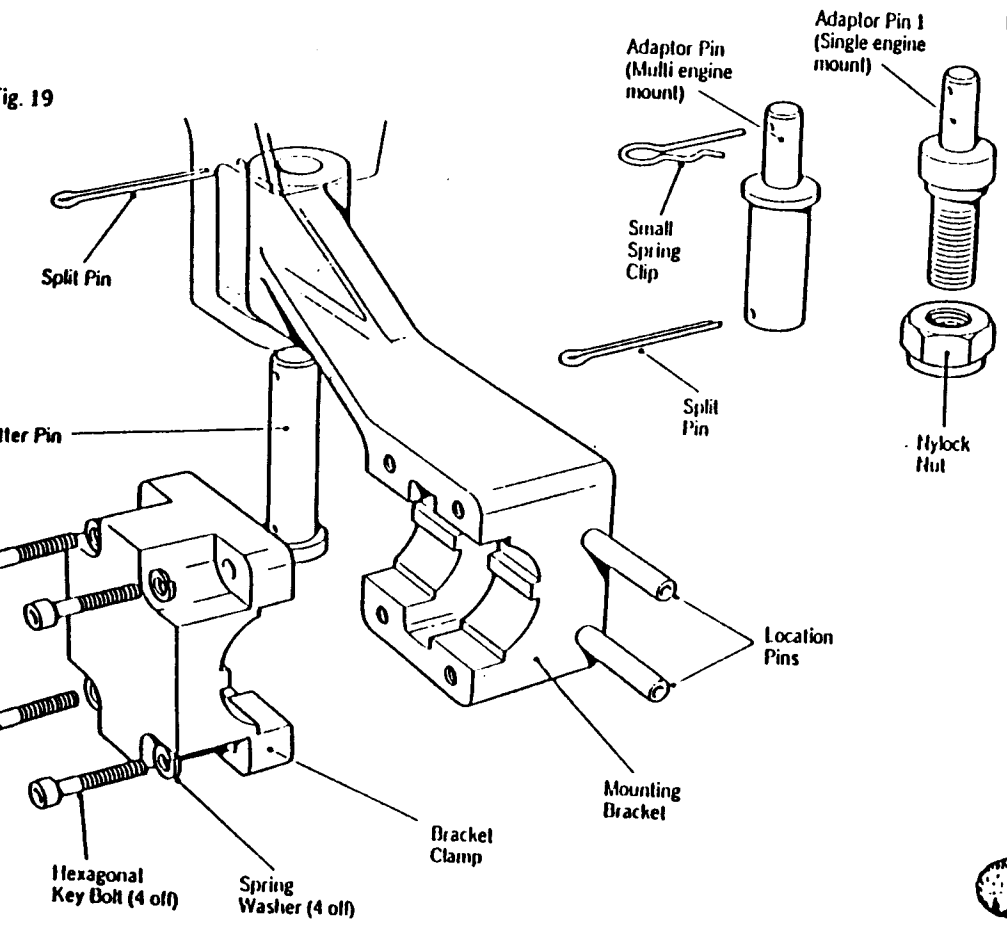
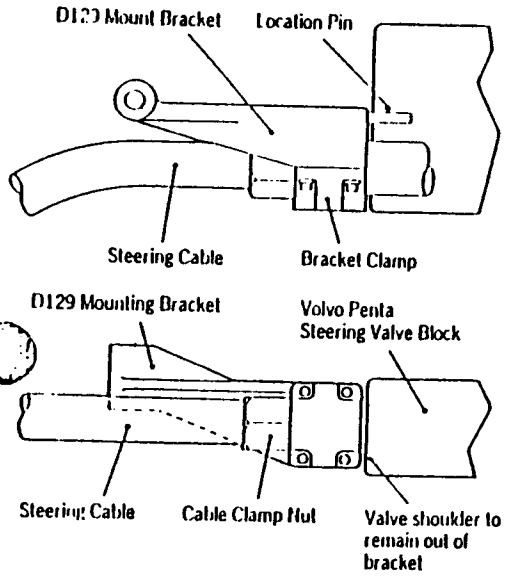
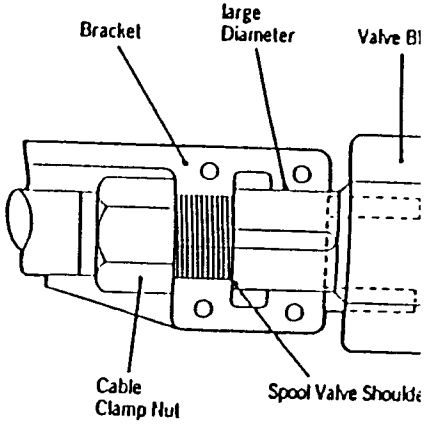


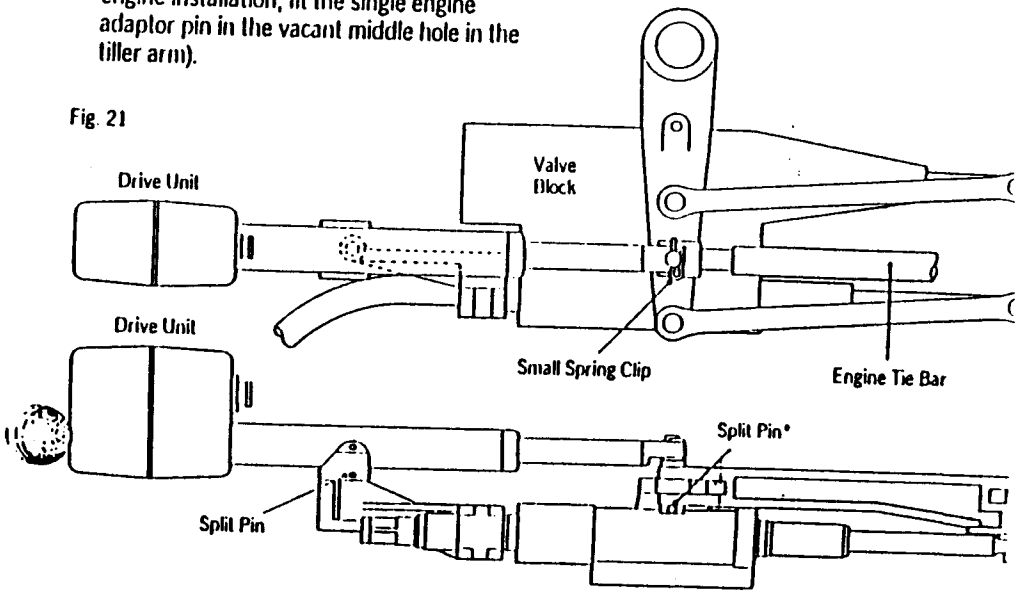
Fig. 20





- Uncouple the engine tie bar from the outdrive tiller arm by bending back the lock tabs and removing the cotter pin. This should be replaced with the multi-engine adaptor pin, ensuring that it is secured properly with a split pin* (Fig. 21) (on single engine installation, fit the single engine adaptor pin in the vacant middle hole in the tiller arm).
- Attach the drive unit to the bracket usir long cotter pin and split pin provided. T small spring clip can then be used to att the drive unit to the adaptor pin (Fig. 21).
- Slowly turn the steering system from ha over to hard over. IT IS MOST IMPORTA that the drive unit and the adaptor pin bracket do not touch any part of the engi or steering system.

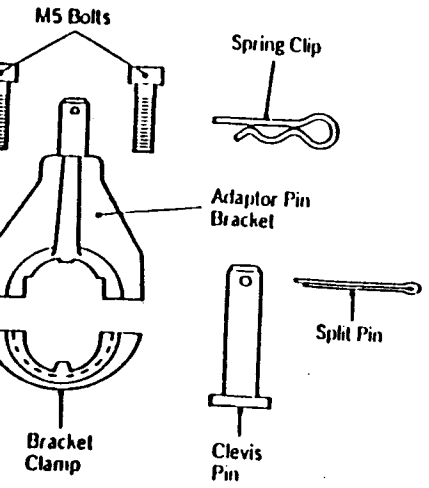
Fig. 21



lercruiser Installation
Using D137 Kit) (Also OMC & Yamaha)
he drive unit should be mounted onto the tiller
nd block and the pushrod connected to the
able end sheath via a custom mounting
acket. The first stage of installation is to fit the
stom bracket:-

ercruiser Bracket Mounting Kit (D137)

. 22



e View

Installation
- Remove locating pin attaching cable rod to tiller end block and slide the drive unit 'C' bracket over the end block.
- Secure by pushing the supplied clevis pin upwards through the drive unit 'C' bracket, end block and cable rod end.
- Secure the assembly by inserting the two split pins through the drive 'C' bracket (Fig. 23).
- With the helm turned hard to port, assemble the adaptor pin bracket and bracket clamp onto the cable end sheath using the 2 socket head bolts provided. This should be positioned 165mm (6.5in) from the drive unit 'C' bracket clevis pin. Make sure the adaptor pin bracket points upwards. (See Figs. 23, 24 & 25).
- Position the drive unit pushrod over the top of the adaptor pin and secure with the spring clip (Figs. 23 & 25).
- Slowly turn the steering system from hard over to hard over. IT IS MOST IMPORTANT that the drive unit and the adaptor pin bracket do not touch any part of the engine or steering system.

Fig. 23

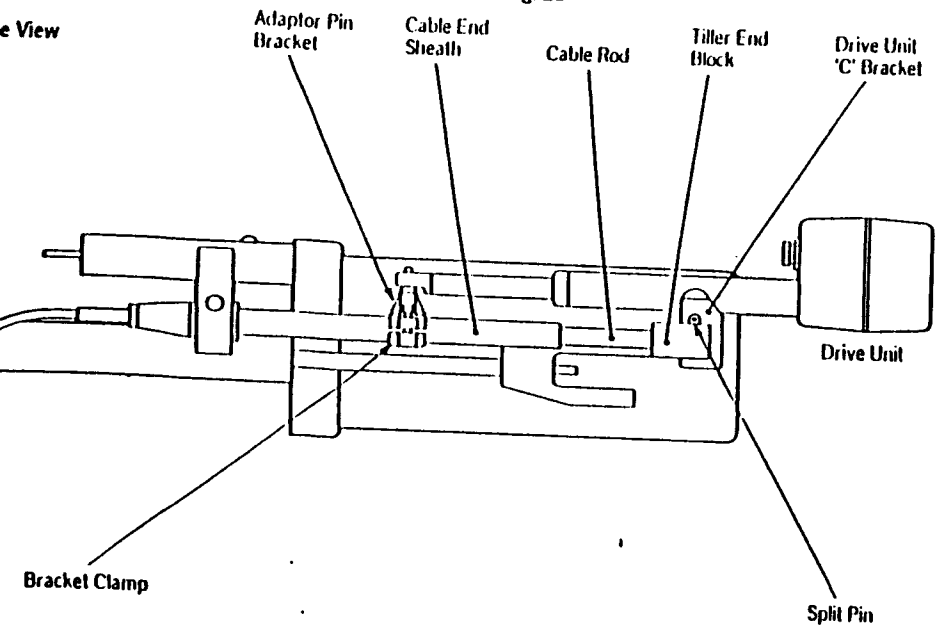


Fig. 24

Side View (Steering hard to port)

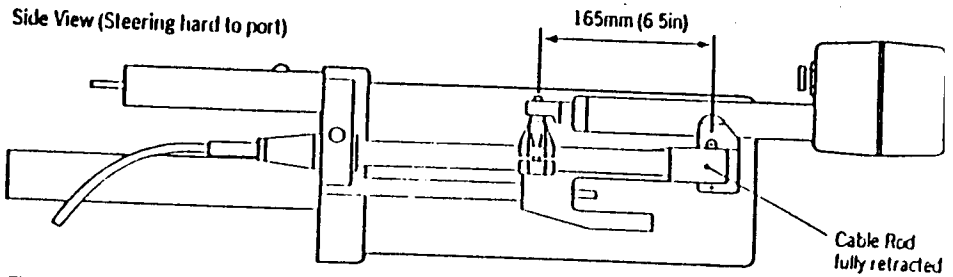
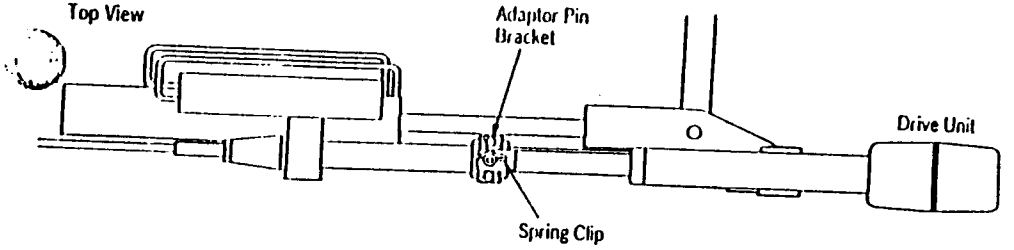


Fig. 25

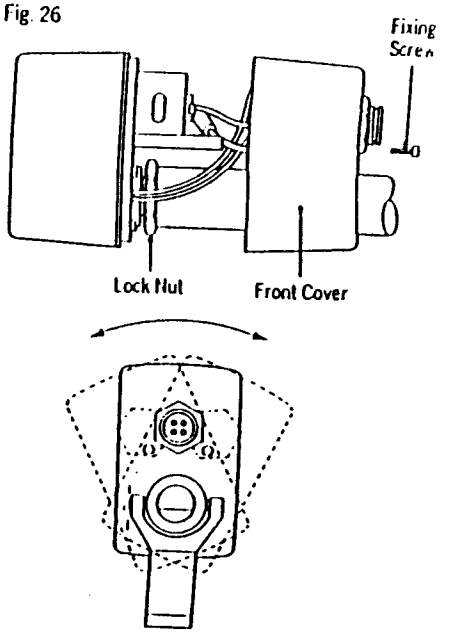
Top View



Mounting in a Restricted Area
If an obstruction prevents installation of the drive unit as supplied, the main body can be rotated relative to the mounting bracket as follows (Fig. 26):
- Remove the 2 fixing screws and gently slide the cover forwards, ensuring that the four cables do not pull from the plus inside the cover.
- Slacken off the lock nut and rotate the main body as required.
- Retighten the lock nut securely and make sure that the lock nut is no more than one turn from the start of the thread.
- Replace the cover taking care not to trap any cables.
- Using the steering wheel move from hard over to hard over and check that no part of the drive unit touches any part of the vessel/fittings.

Cable Connection
- Plug in the power cable supplied with the drive unit making sure that thhe connector is locked in place by turning the locking ring clockwise.
- Route the cable back to the course computer. Secure the cable close to the drive unit but allowing sufficient free length to accommodate the drive unit movement.
- Once again using the steering wheel to mc the rudder from hard over to hard over an check that the cable does not catch on any part of the vessel/fittings.

Fig. 26



2.2.4 Hydraulic Drive Units

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, these are illustrated in Fig. 27. 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.

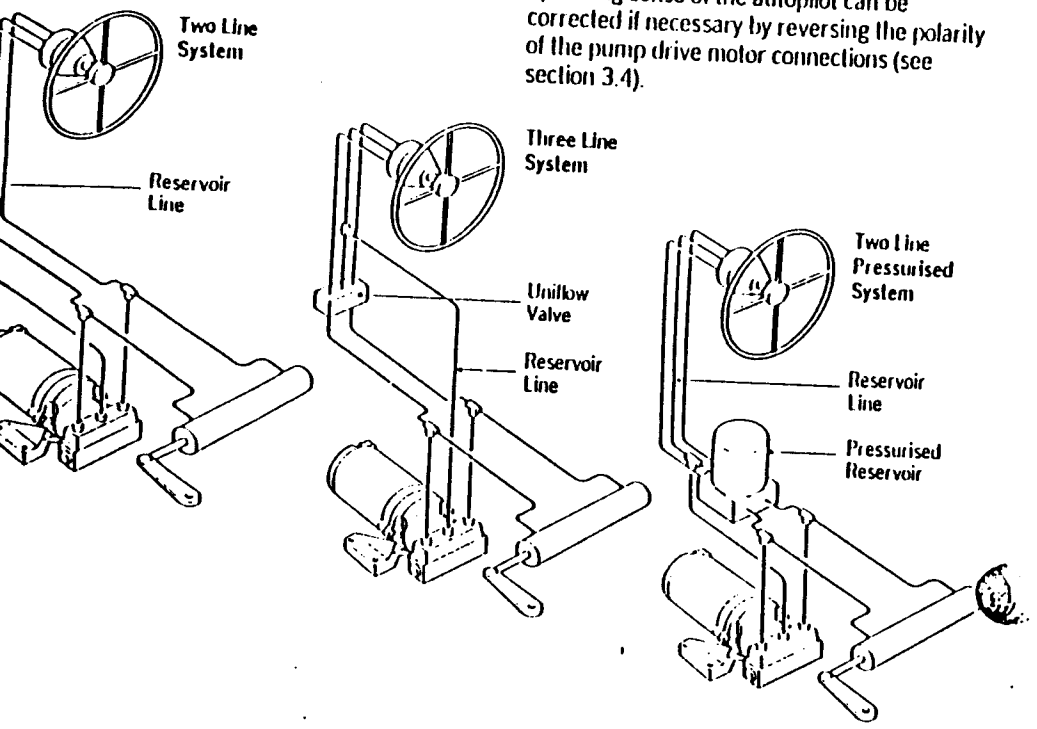
When the installation has been completed the hydraulic pump may be operated by switching the control unit to Auto and operating the +10° and −10° course change buttons. Greater motor movements will be obtained if the rudder gain is set to maximum.

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 3.4).

Fig. 27

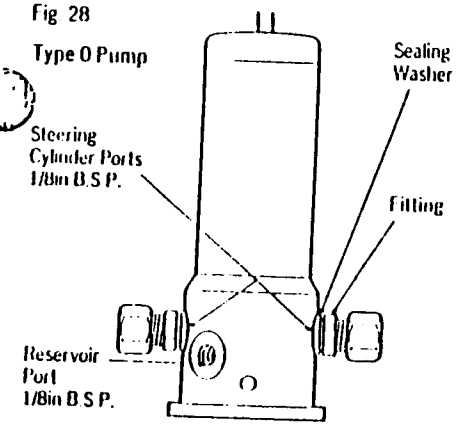


Type 0 Installation (Cat. No. Z081)

The Type 0 pump must be mounted vertically with the mounting flange bolted to a suitable horizontal or vertical 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. 27).

Fig 28



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

The two cylinder ports are positioned opposite one another on the pump body. The reservoir port is marked R and is at 45°. 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.

Type 1 Installation (Cat. No. Z041)

The pump should be mounted on a suitable horizontal surface.

All ports are tapped 1/4in B.S.P. Three B.S.P. to 1/4in N.P.T. adaptors are included convert to N.P.T. where required (Fig. 29). sealing washers supplied should be placed between the fitting and the pump (Fig. 30).

Fig. 29

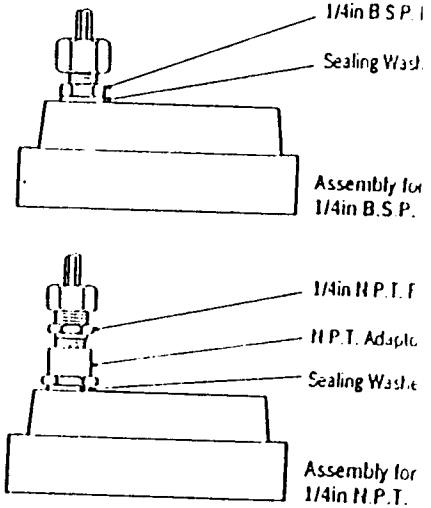
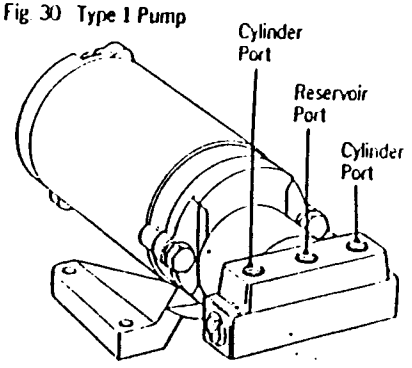


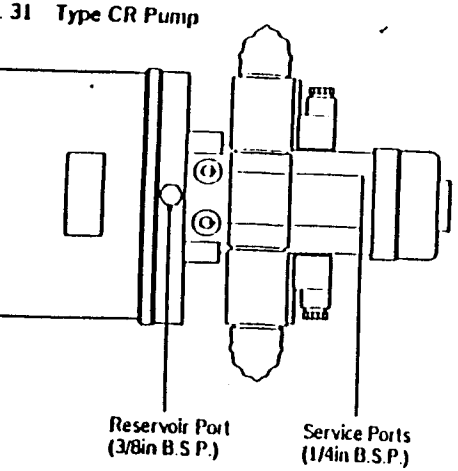
Fig. 30 Type 1 Pump



Type CR Installation

The hydraulic power pack (Fig. 31) should b bolted to a suitable horizontal surface. The service ports are tapped to 1/4in B.S.P. and reservoir port is tapped to 3/8in B.S.P. Thre N.P.T. adaptors are included for conversion N.P.T. where required.

. 31 Type CR Pump



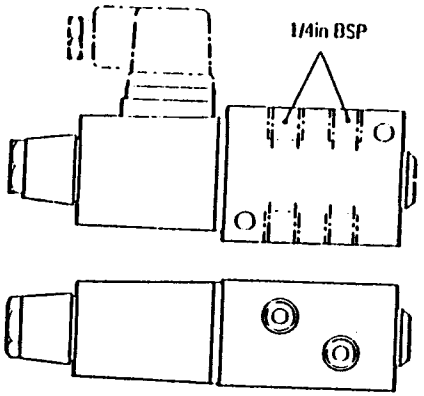
ass Valve (Cat. No. Z079) (Fig. 33)
e autopilot operated hydraulic cylinder is
pendent of the manual steering system a
noid operated by-pass valve should be fitted
ow the cylinder to backdrive when manual
ing. The bypass valve should be connected
e 'by-pass' connector on the Type CR
lace Unit.
e bypass valve Fig. 32 should be fitted
een the autopilot steering cylinder ports
ill normally be de-energised to allow the
er to backdrive. When the autopilot is
ed, the valve is energised by the Type CR
ace to allow the autopilot steering cylinder
e the rudder. If the steering cylinder is

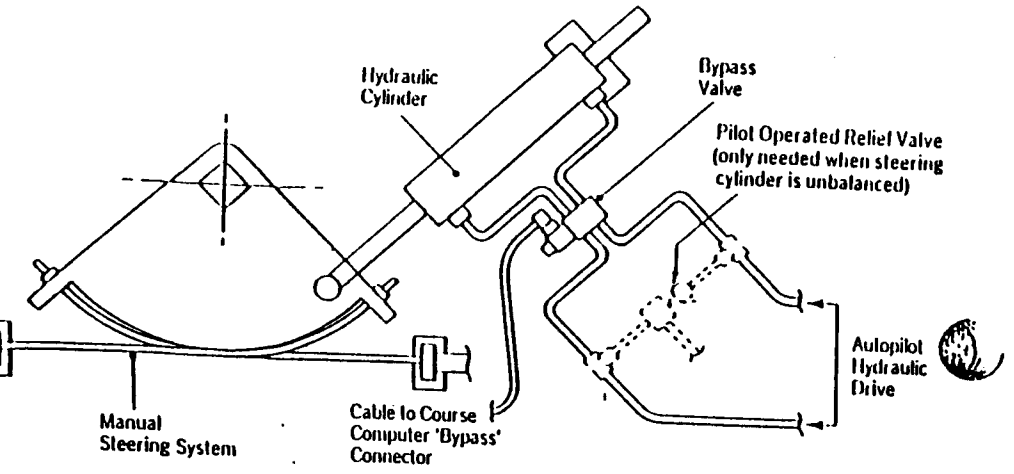
unbalanced (single ended) a pilot operated pressure relief valve must be connected as shown (Fig. 32 dotted) to enable excess oil to be returned to the reservoir when the cylinder ram is retracting.

Note

- If the bypass valve is used on systems with a reversing gear pump (i.e. without the type CR Interface Unit) a 5 amp relay should be used to energise the bypass valve. The relay should have a 12V coil, taking less than 500ma and be driven by the clutch output on the course computer connector unit.

Fig. 33





2.3 Cabling and Power Supply

2.3.1 Signal Cabling System Components

Cable connections for all components are shown schematically in Fig. 1. All components connect to the course computer connector unit where they are permanently wired to connector bloc mounted on a central printed circuit board (F 35). The 6m (20ft) cable with the 3 pin connec at one end is used to connect the first control unit to the course computer connector unit (BUS). Additional units are connected using SeaTalk cable to the first control unit (see 2.3

Fig. 34

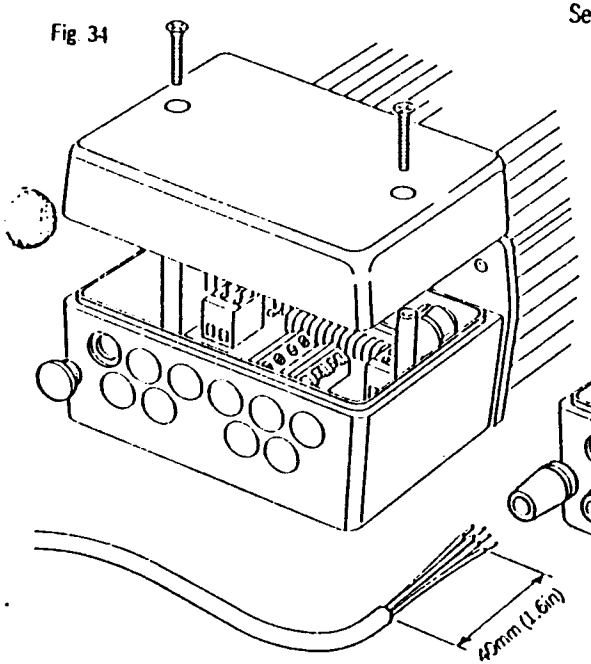
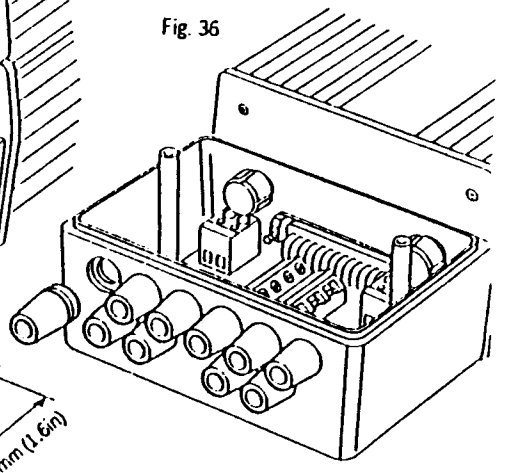
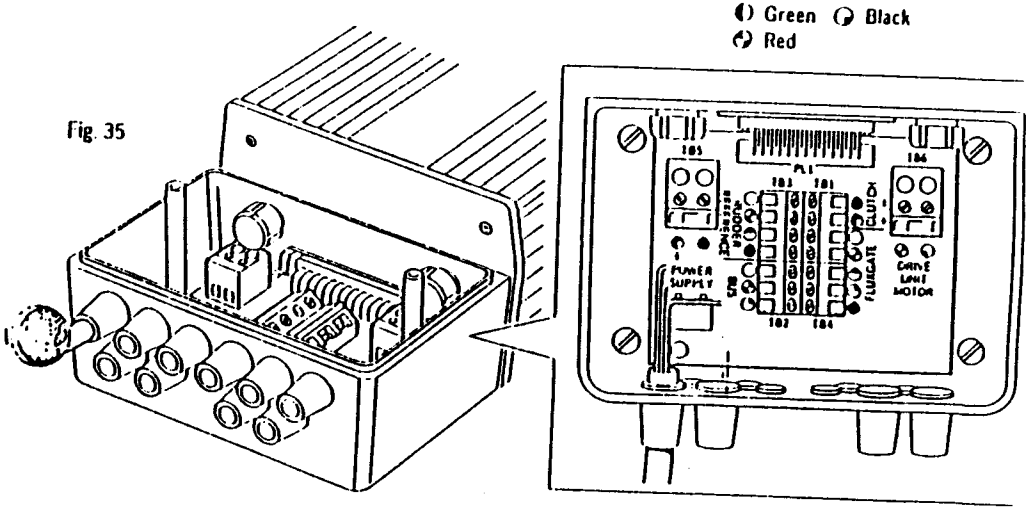


Fig. 36



KEY ○ White ● Brown
◔ Yellow ● Blue
◐ Green ◔ Black
◔ Red

Fig. 35



Where additional cables have to be brought nto the connector unit, the blanking discs Fig. 34) should be pressed out and replaced vith the rubber grommets supplied.

After cutting the interconnecting cable to ength (Fig. 36), it may be passed through the nserted rubber grommet and prepared for onnection to the relevant connector block ig. 35).

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

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

t. No.	Used On
086 vo core unscreened) 083 (Complete reel)	Clutch
088 ur core screened) 085 (complete reel)	Fluxgate Compass

The total length of interconnecting cable to fluxgate should not exceed 30m (100ft). If it ecessary to exceed the above maximum gth recommendation, please consult utech's Product Support Department for cific advice. In general the length of rconnecting cables should be kept to an olute minimum to reduce the possibility of rference by other electronic equipment.

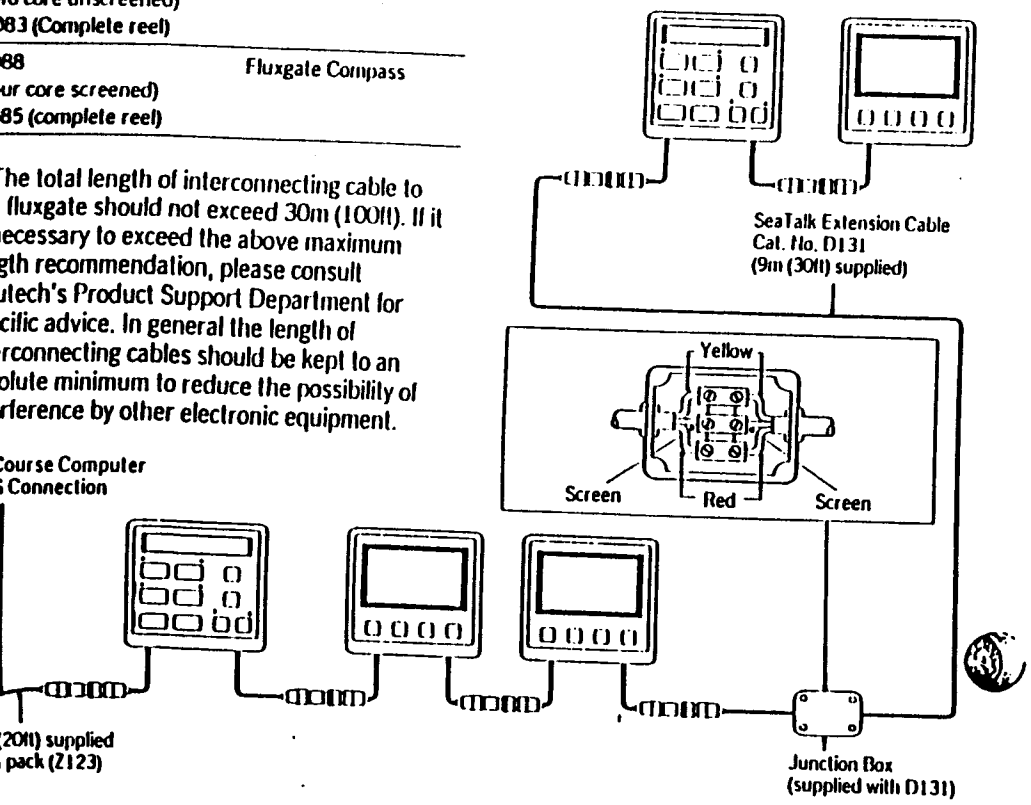
All cables should be run at least 1m (3ft) from existing cables carrying radio frequency or pulsed signals, and should be clamped at 0.5m (1.5ft) intervals.

2.3.2 Connection to other SeaTalk Units

All Autopilot Control Units and SeaTalk (Fig. 37) instruments receive both power and information from the SeaTalk bus. Each instrument has two SeaTalk connectors (3 pin) on short 150mm (6in) tails 1 to allow adjacent units to simply plug together.

Separated units are connected using the supplied SeaTalk Extension cable (or a D131 Extension Kit). This is supplied with a SeaTalk connector fitted to each end and with a junction box to rejoin the cable if it is cut to ease routing or for shortening.

Fig. 36



If preferred, any 2 core screen cable which has the following specification may be used in the place of the SeaTalk cable.

	Minimum Copper Area	AWG
Screen	0.5mm²	20
2 Cores	0.5mm²	20

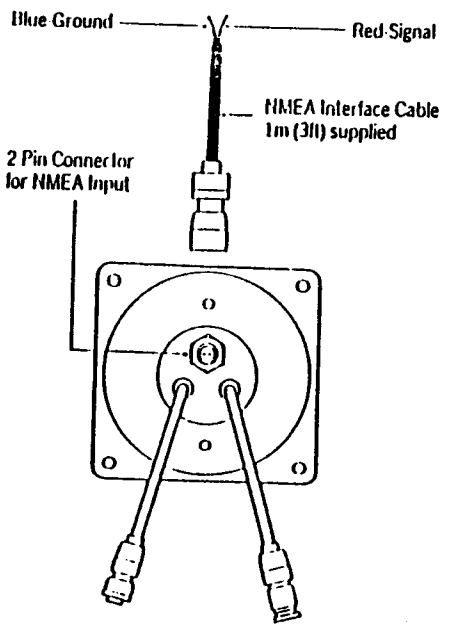
Note: No more than 12 SeaTalk units should be connected to the course computer.

2.3.3 Connection for NMEA Data Input

The ST6000 control unit (Fig. 38) has a 2 pin connector for NMEA data input. This will accept navigation data (cross track error, bearing to waypoint, distance to waypoint and waypoint number) for use in Track mode and wind angle data for use in Vane mode. Details of the data required is given in sections 6 and 7.

The 1m (3ft) NMEA interface cable supplied should be used to connect to the back of the control unit. The red wire should be connected to the signal output and the blue to signal ground.

Fig. 38



2.3.4 D.C.Power Supply

The ST6000 requires a single 11 – 16V DC power supply from the vessels central distribution panel. This connects directly int course computer connector box.

Before commencing power cabling all inter connecting terminal blocks should be screwe into a position where they will remain dry an protected. When planning the position of the course computer (ref. 2.1.1) it is important to minimise the overall length of power cable between the course computer and the vessel central distribution panel. Excessive lengths generate losses in the cable and will reduce system performance. In addition the cable length between the course computer and driv unit must be less than 5m (16.5ft).

Having sited the course computer, measure the total cable length between drive unit, cou computer and the vessels central distribution panel and select the appropriate cable size fr the table below.

Note

As the ST6000 operates from a single power supply it is very important that the correct cal size is selected. Failure to do so could result in the autopilot resetting from Auto to Standby mode when in operation.

Total Cable Length	Cable Type	Copper Area	Cable Gaug
Up to 7m	50/0.25	2.5mm²	12 AV
Up to 10m	56/0.3	4.0mm²	10 AV
Up to 16m	84/0.3	6.0mm²	8 AW

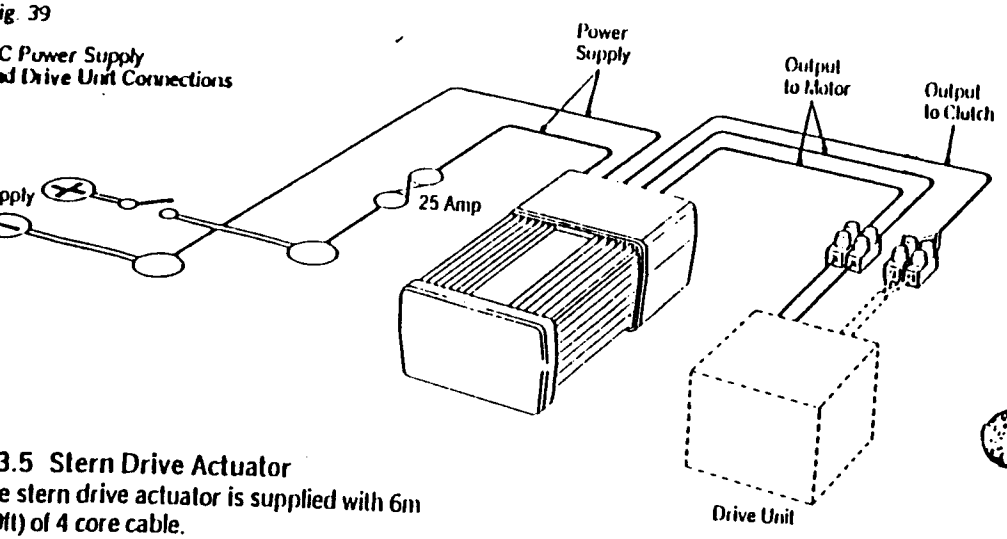
The power supply must be fed from the mai distribution panel and connected to the power supply terminals in the course computer connector unit. It should be protected with a 25A fuse or circuit breaker (Fig. 39).

Caution

DO NOT connect the drive unit motor cables in the course computer connector unit until the Functional Test in Section 3.1 has been carried out.

ig. 39

C Power Supply
d Drive Unit Connections



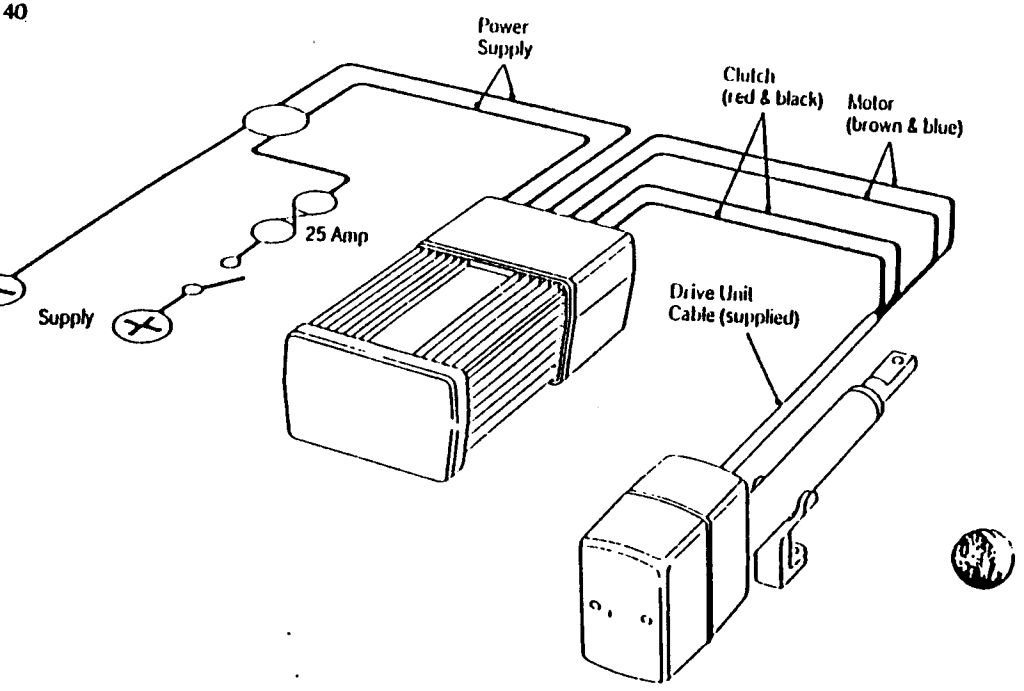
3.5 Stern Drive Actuator

e stern drive actuator is supplied with 6m ft) of 4 core cable.

The blue and brown cores are fitted with ade connectors (Fig. 40). These should be moved and the cable stripped back ready for nnection into the course computer connector after the functional test in Section 3.1 has n carried out.

The remaining two cores (red and black) drive the actuator clutch and should also be connected into the connector box.

40



3. Functional Test

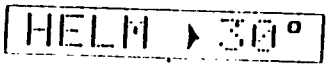
The following functional test and set up procedures must be carried out before sea trials are attempted.

3.1 Switch On

Switch on the electrical supply from the main panel. All control units will emit a short beep tone and display 'ST6000' to indicate the computer is active. Within 2 seconds Standby will be displayed to indicate the autopilot is in Standby mode.

3.2 Rudder Angle Sense

Push Display twice. Moving the helm hardover to starboard should increase the rudder angle and display the starboard direction indicator (▶). If the port indicator (◀) is displayed then the red and green wires of the rudder reference transducer should be reversed.



(30° starboard rudder.)

3.3 Mechanical Test
(Manual Steering)

The steering system and drive unit/rudder reference unit should be carefully inspected and the following points checked using the steering wheel to drive the vessels steering from hardover to hardover.

- The steering system reaches the Rudder End Stops before the Drive Actuator reaches its end stops (Linear/Stern Drive).
- No part of the Autopilot Drive System fouls any part of the steering system or vessel's structure through full travel (all drives).
- The mechanical alignment of the drive unit is as specified in this manual (Linear/Stern Drive).
- The mechanical alignment of the Rudder Reference Unit is as specified in this manual (all drives).
- All connecting wires are secured clear of the bilge and cannot foul any part of the steering system. Any connectors are tightly secured (all drives).
- All securing bolts are fully tightened and mechanical locking arrangements as specified are in place (all drives).

3.4 Rudder Angle Alignment

With the rudder amidships, check that the rudder angle display reads zero. Any misalignment must be removed by rotating rudder reference transducer within the slot the body.

3.5 Operating Sense

Switch off the power and connect the drive to the course computer.

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

- Push Auto.
- Push +10 which should move the rudde few degrees to produce a turn to starboa

If the rudder moves hardover to port the mo connections between the course computer a drive unit should be reversed.

3.6 Rudder Deadband

The factory preset rudder deadband level (s 4.1) will provide stable rudder positioning on most steering systems. On some steering systems where a rotary or hydraulic drive un sited a long way from the rudder, slight instability may occur. This can be removed b increasing the 'damping' level (see 4.3). Any increase should be minimised as it will reduc the autopilots course keeping accuracy.

3.7 Mechanical Test
(Autopilot Steering)

Rotary/Linear/Hydraulic Drives

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 coul cause injury.

- Push Auto.
- Push the ∯10 button repeatedly to drive rudder hardover onto end stops (*Note: Ma* require increasing the rudder limit (see 4..
- Ensure the drive unit mounting shows no sign of movement.

- For hydraulic systems ensure there is no seepage of hydraulic fluid and that the steering ram moves smoothly.
- Repeat using the −10 button to drive the rudder hardover to the opposite end stop.

Current Limit and Cutout

When the rudder is driven onto end stops drive will be 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.

3.8 Mechanical Test — Stern Drive
(Autopilot Steering)

t is recommended that the 'Auto Release' acility is used when the Autohelm mechanical tern drive actuator is installed. This is selected nd tested as follows:

Select 'Auto Release' in calibration mode (see 4.3).
Select 'Auto Release' "ON" (1).
Exit calibration mode.
Manually drive the steering hard over to starboard.
With the vessel's engines running engage Auto and with repeated presses of the −10 button drive the steering to the opposite lock (Port).
The autopilot should drive the steering onto the end stops, sound an alarm whilst displaying the Release message and then revert to Standby status.
Re-engage the autopilot (Auto) and repeat he above driving the steering hard to tarboard using the +10 button.
he autopilot should again drive onto the ndstop, alarm/display Release and return to tandby..

If the ST 6000 sounds the alarm and ys Release before reaching the opposite arefully check the vessel's steering system y stiffness or mechanical jamming. e condition persists set the 'Auto Release' on to "OFF" (0) and contact the Product rt Department at Nautech for further e.

Warning

- The 'Auto Release' function should always be set to "OFF" (0) if using any drive unit other than a stern drive actuator.
- Auto Release is not available in drive level 4.

3.9 Rudder Angle Limit
(All Drive Units)

Having checked the correct functioning of the drive unit and the appropriate End Stop Cutout/Auto Release function the programmable rudder angle unit should be set.

The rudder angle limit sets the maximum angle to which the autopilot will move the rudder. This should be set to just less than the vessels mechanical limit stop to avoid putting the steering system under unnecessary load.

- Using the rudder angle display record maximum rudder angle in both directions and set up the rudder angle limit in calibration mode (see 4.3) to 5 degrees less than the minimum angle recorded.

4. Calibration

4.1 Recommended Settings

As supplied the ST6000 can be switched on and tested safely without any adjustments to the factory calibration settings.

The table below lists the suggested settings for sailing and power displacement and planing power vessels. These will provide good performance for initial sea trials and can be fine tuned later to optimise performance.

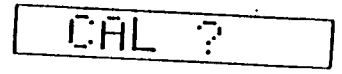
	Vessel Type	
	Displacement	Planing
	Factory preset	Set to
Rudder Gain (level)	5	2
Rate Gain (level)	2	1
Rudder Angle Limit (degrees)	30	30
Turn Rate Limit (degrees/sec)	20	5
Cruise Speed (knots)	8	25
Off Course Alarm (degrees)	20	20
Trim Level	1	1
Auto Adapt	OFF	ON

	Autopilot Drive Unit Type		
	Mechanical	Stern Drive	Hydraulic
	Factory preset	Set to	Set to
Drive Type	3	3	4
Rudder Position Deadband (level) See 3.8	1	1	1
Auto Release	OFF	ON	OFF

4.2 Selecting and Exiting fro Calibration Mode

To select calibration mode:-

- Push Standby.
- Push and hold down for 2 seconds, Tr and Display together.

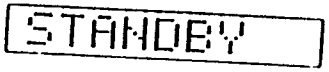


- Repeat push and hold down for 2 secor Track and Display together to enter calibration mode.

To exit calibration mode at any point.

a) Saving any changes made:-

- Push and hold down for 2 seconds, Trac and Display together.

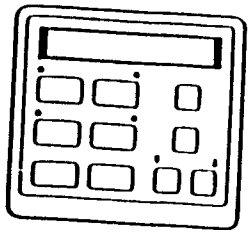


b) Ignoring any changes made:-

- Push Standby.

4.3 Adjusting Calibration

In calibration mode, the Display button is used to scroll through the menu. The displayed value is adjusted using the Response buttons (hold button down for fast scroll).



CAL Cal.

DISPLAY

Rudder Gain, levels 1 to 9, (see 5.6)

RUDDER 5 Cal.

DISPLAY

Rate Gain, levels 1 to 9, (see 5.7) (Counter Rudder).

RATE 4 Cal.

DISPLAY

Rudder Angle Limit, 15° to 40° (see 3.6).

LIMIT 25° Cal.
RUDDER 25° Cal.

DISPLAY

- Rate of Turn Limit, 5° to 20°/sec.

LIMIT 20° Cal.
TURN 20° Cal.

DISPLAY

- Cruise Speed, for Track mode operation, 4 to 60 knots.

SPEED 6 Cal.
CRUISE 6 Cal.

DISPLAY

- Off-Course Alarm, 15° to 40° angle.

COURSE 20° Cal.
OFF 20° Cal.

DISPLAY

- Automatic Trim, (see 5.4).

TRIM 1 Cal.

0 = OFF
1 = ON

DISPLAY

- Remote Control Identifier. (For Future Use).

REMOTE 1 Cal.

DISPLAY

- Autopilot Drive Unit Type.

DRIVE 3 Cal.

1 = Future Use
2 = Future Use
3 = Mechanical with Rudder Reference
4 = Hydraulic with Rudder Reference

DISPLAY

Rudder Position Deadband (levels 1 to 9), (See 3.7).

DAMPINGS Cal.
RUDDER 5 Cal.

DISPLAY

- Northerly/Southerly Heading Instability

ADAPTOFF Cal.
AUTO OFF Cal.

Select Hemisphere

OFF
N (North)
S (South)

DISPLAY

LAT H 0° Cal.

Enter Local Latitude using Response Keys.

A typical display in the Northern Hemisphere would be:

LAT H 50° Cal.

and in the Southern Hemisphere.

LAT S 35° Cal.

- Auto Release (see 3.8).

AUTO 1 Cal.
RELEASED Cal.

0 = OFF
1 = ON

The Auto Release facility is designed to provide Emergency Manual Override wh used with the Autohelm Stern Drive Actuator.

For all other Drive Systems Auto Relea must be selected "OFF" (0).

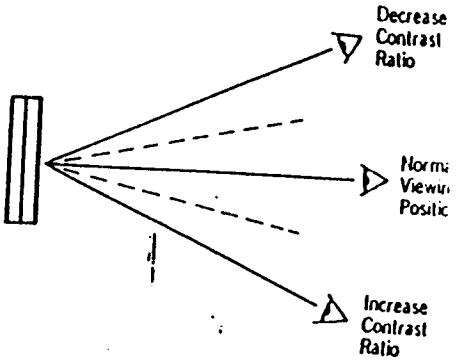
4.4 Display Contrast Adjustmer

The LCD Contrast can be adjusted to suit a w range of control unit viewing angles.

- Push display and track together momentarily.
- Push response ▲ to increase contrast (suit viewing from below).
- Push response ▼ to decrease contrast (sui viewing from above).

Adjust the display for optimum viewing.

- Push display and track together momentar to store selection and return to previous operating mode.



.5 Recording Calibration ettings

aving fine tuned the calibration settings during itial sea trials, record them in the following ble for future reference.

	Setting
Rudder Gain	
Rate Gain	
Rudder Limit	
Turn Limit	
Cruise Speed	
Off Course	
Automatic Trim	
Manual Type	
Drive	
Damping	
Auto Adapt	
Auto Release	

Once calibration has been carried out, further ustment can be made at any time.

4.6 Rudder and Rate Gain Tables

- Rudder Gain

Level	Value
1	0.1
2	0.14
3	0.19
4	0.25
5	0.35
6	0.47
7	0.65
8	0.88
9	1.2

- Rate Gain (Seconds)

Level	Value
1	0.2
2	0.24
3	0.3
4	0.37
5	0.45
6	0.55
7	0.67
8	0.82
9	1.0

5. Initial Sea Trials

Initial sea trials should be carried out in calm conditions with plenty of sea room. As the vessel will be constantly changing heading it is very important to maintain a constant look out.

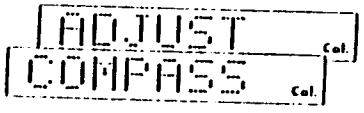
Before sea trials:-

- Carry out the functional test (section 3.0) to verify that the autopilot is operating correctly and that you are familiar with all of its controls.
- If a planing vessel, check that the rudder gain is set to 2 and turn rate limit to 5 degrees as recommended in section 4.1. The lower turn rate limit is very important for safety at planing speeds where large course changes can otherwise produce violent turns.
- If the system has a hydraulic drive unit set up the drive type to 4 (see 4.1).
- Read the Operating Manual.

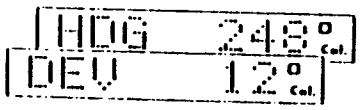
5.1 Automatic Deviation Correction

The ST6000 will correct the fluxgate compass for operation in most deviating magnetic fields. This should be carried out in calm conditions preferably in flat water.

- To select compass adjust Push and hold Standby for 1 second.



- Keeping boat speed below 2 knots, turn the vessel slowly so that it takes at least 3 minutes to complete 360°. Keep turning until the display changes to show the amount of deviation the autopilot has corrected:-



Note: If the amount exceeds 15°, it is recommended the fluxgate should be resited.

- Use the course change buttons to adjust the displayed heading until it agrees with the steering compass or a known transit bearing.

Note: 000° is always followed by OFF. Th will supress the display of compass and automatic headings on the control unit.

- To exit compass adjust and store the compass settings push and hold Standby 1 second.
- To exit compass adjust without saving an new settings push Standby momentarily.

5.2 First Sea Trials

- Hold the course steady for 5 to 10 second
- Press Auto to lock onto the current headi In calm conditions a perfectly constant heading will be maintained.
- Alter course to port and starboard in multiple increments of 1 and 10 degrees from any control unit. Course changes should be prompt and without any sign of overshooting.
- Press Standby to disengage the autopilot f return to hand steering.

5.3 Response Control

There are three response levels to provide lighter than normal course keeping when restricted sea room requires. Select each level turn and observe the autopilot activity.

Level 1 — Automatic Sea State Control

This provides the optimum compromise between power consumption and course keeping accuracy and is suitable for most situations.

The automatic sea state control can be observed during the sea trial.

When the autopilot is initially engaged in Aut 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 vesse are gradually neglected until finally the autopilo will respond only to true variations in course.

To ensure precise course adjustments the se state control is automatically reset whenever a 10° course change is selected.

Level 2 — Automatic Sea State Inhibit

Where increased course keeping accuracy is required the automatic sea state control can be

inhibited by moving to response level 2.
Autopilot activity and therefore power consumption will be increased.

Level 3 — Automatic Sea State Inhibit
— Counter Rudder

Where maximum course keeping accuracy is required move to response level 3. This introduces counter rudder (rate) to increase the natural damping of the vessel. On power craft level 3 is useful at slow speed where the natural damping of the vessel is reduced. Autopilot activity and therefore power consumption will be at a maximum.

The minimum response level necessary to achieve the desired course keeping should be used to reduce power consumption and autopilot wear and tear.

4.4 Automatic Trim Control

The ST6000 automatically corrects for trim. No adjustment of the pilot is necessary.

After each course change the Automatic Trim is cancelled and the ST6000 will re-establish the correct trim for the new heading. It should be noted that if a large course change is keyed in (greater than 60°) the autopilot will not assume the final selected course immediately. The vessel will come to within say 10° of the desired course and will only settle onto course when the Automatic Trim has been fully established. This may take up to two minutes.

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° course change increments.

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

Important Note

With automatic trim control is switched off (see section 4.3), regular checks on the vessels heading should be made as changes in standing helm will change the course steered by the autopilot.

5.5 Rudder Gain Adjustment

(Displacement Craft)

The rudder gain level recommended in Section 4.1 will provide stable control for initial sea trials. However, vessel's can vary widely in their response to the helm, and further adjustment to the rudder gain may improve the autopilots steering characteristics. Setting up rudder gain should be carried out with Response level 1.

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 setting.

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 setting. 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 and wear and tear generally.

Typically if at cruising speed a course change of 40° results in an overshoot of between 2 and 5°, the rudder gain is correctly adjusted.

5.6 Rudder Gain Adjustment

(High Speed Planing Craft)

It is particularly important that the Rudder Gain is correctly set on high speed craft. Incorrect adjustment will lead to poor steering performance and is a dangerous condition at high speed. Adjust as follows:

Optimum Setting

- Set to Rudder Gain for optimum steering performance at the vessels normal cruising speed.
- Push and hold down both Response keys together for 1 second to gain access to Rudder Gain. Adjust either side of the calibrated setting to provide optimum autopilot steering.

Auto Adapt

- It is recommended that for high speed craft the Auto Adapt facility is selected. This automatically reduces the effects of Northerly/Southerly heading instability.

This feature is selected in calibration by entering the vessels operating latitude (see 4.4). When selected it automatically adjusts the Rudder Gain depending on heading removing the need for manual adjustment.

Warning: If Auto Adapt is not selected manual adjustment of rudder gain is normally required when going from Northerly to Southerly headings or vice versa. Failure to do so can lead to poor course keeping.

Adjustment with Speed

- Due to the significant differences in dynamic stability between planing and non-planing conditions most high speed craft require Rudder Gain adjustment when going from planing to displacement speeds or vice versa. The required adjustment can be achieved automatically or manually.
- When the ST6000 is used with the speed input from an Autohelm ST50 SPEED or TRIDATA instrument the Rudder Gain is automatically adjusted with boat speed. After setting the gain at planing speed no further manual adjustment should be required.
- If no ST50 speed input is available manual adjustment should be carried out to the Rudder Gain setting via the Response keys (see above) adjusting as follows:
  - Speed decreases from planing to displacement
    — Increase gain by 1 or 2 levels.
  - Speed increases from displacement to planing
    — Decrease gain by 1 or 2 levels.

Warning: The manual gain adjustment must be made after reducing from planing to displacement speed and before increasing from displacement to planing speed.

5.7 Manual Override

(Stern Drive Actuators only)

Manual override is selected during calibration using the Auto Release option. It must only be used on installations fitted with the stern drive actuator. When it has been selected, the ST6000 can be overridden to allow hand steering by turning the steering wheel. This will return the ST6000 to Standby and sound the control unit buzzer for 10 seconds. There is a slight delay before the ST6000 will return to Standby. Excessive force is not required and will not reduce this delay.

With the ST6000 in Auto and clear of obstruction turn the steering wheel to observe the manual override. Repeat two or three times until you are confident with its operation.

The manual override is intended for emergency use only. The ST6000 should normally be disengaged by pushing the Standby button on the control unit.

5.8 Rate Gain Adjustment

(Counter Rudder)

Counter rudder increases the natural yaw damping of the vessel and at the expense of increased autopilot activity, will generally provide improved course keeping accuracy.

5.9 Compass Alignment

If it is necessary to change Compass Alignment without carrying out the Automatic Deviation Correction proceed as follows:-

- Push and hold Standby for 1 second to select compass adjust mode.
- Push Display once to bypass Automatic Deviation Correction
- Use the course change buttons to adjust the heading displayed
- To exit compass adjust and store the new setting push and hold Standby for 1 second
- To exit compass adjust without saving the new setting push Standby momentarily
- To confirm the alignment procedure has been correctly carried out, switch off power, switch back on and check displayed heading. Repeat the alignment procedure if incorrect

6. Track Control

Track control allows the ST6000 to maintain track between two waypoints entered on a GPS, Decca, Loran, or satellite Navigation System. The Navigation System must have a suitable autopilot output which at minimum transmits cross track error to one of the following formats.

NMEA 0180 – simple or complex
NMEA 0183 – XTE
XTR
APA
APB
RMB

If the Navigation System transmits the correct NMEA 183 sentences, (shown below), the autopilot will receive and display bearing to waypoint, distance to waypoint and waypoint number.

NMEA 0183 Sentence Headers

Bearing Waypoint	Distance to Waypoint	Waypoint Number
APB	WDR	APB
BPI	WDC	APA
BWR	BPI	BPI
BWC	BWR	BWR
BER	BWC	WDR
BEC	BER	BWC
RMB	BEC	WDC
	RMB	RMB
		BOD
		WCV
		BER
		BEC

1 Functional Test

ore attempting sea trials confirm that the trol unit is receiving navigation data by using Display button to bring it up on the control LCD.

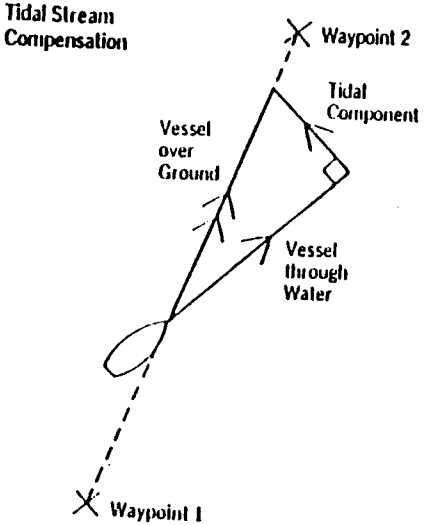
ote: If data is not being received it is ossible to select Track mode.

6.2 Operating Hints

Basic Principles

The control unit accepts cross track error data from the Navigation System and computes course changes to maintain the desired track. It is primarily designed to keep a vessel on track, automatically compensating for tidal streams and leeway.

To obtain best performance in the track following mode the track should be manually acquired by steering the vessel to within 0.1nm of track and then bringing the heading to within 5° of the bearing to the next waypoint before pressing the Track button.



Under most conditions the Track control will hold the track to within ± 0.05nm (300ft) or better.

The autopilot takes account of vessel speed when computing course changes to ensure optimum performance over a wide range of vessel speeds. If an Autohelm ST 50 Speed or TRIDATA instrument is connected the control unit will use measured vessel speed, otherwise the cruise speed entered during calibration will be used.

Under most conditions the Track control will hold the track to within ± 0.05nm (300ft) or better.

Waypoint Advance

If your navigation receiver transmits valid waypoint number and bearing to waypoint NMEA headers (see table) it is possible to advance from one waypoint to the next by simply pressing the Track button.

As the vessel passes the target waypoint the navigation receiver should select, manually or automatically, the next target waypoint. The ST6000 will detect and display the bearing to the new waypoint whilst sounding an alarm to indicate waypoint arrival.

Note: While the waypoint advance alarm is sounding, track control is stopped and the ST6000 will maintain the current heading.

Once it is considered safe to turn onto the new track press the Track button once. This will cancel the waypoint arrival alarm and steer the boat towards the next waypoint.

Limitations

Although there is no need to fully understand the details of the track keeping algorithm, it is very important to understand its limitations to obtain the best performance from the Track control. The most significant of these limitations is imposed if NMEA 0180 cross track error data is transmitted by the Radio Navigation Receiver. This data is restricted to ±0.30nm, which means that even if the vessel were 5 miles to starboard of track, the transmitted data would still be 0.30nm.

Attempts to engage Track control beyond the 0.30nm limit will lead to excessive overshoots and can result in the vessel circling. For this reason the alarm code is displayed (see operating handbook) whenever the cross track error exceeds 0.30nm. The requirement to remain within 0.30nm of track also limits the maximum allowable angular error between the track course and the vessel's heading. If the angular error is too great, the Track control will be unable to cancel it within the 0.30nm limit leading to the problems outlined above.

The NMEA 0183 format transmits cross track error data up to 9.99nm and enables the Track control to operate with larger cross track errors.

However, the alarm code will still be displayed in case there are navigational hazards close to the intended track.

Low Speed Operation

Operating the Track control at low speeds requires more care as the effect of tidal stream is far more significant than at higher speeds. In general terms, providing the tidal flow is less than 35% of the vessel speed no noticeable difference will occur in the performance of the Track control. However, extra care should be taken to ensure that the vessel is as close as possible to track, and that the direction made good over the ground is as close as possible to the direction of the next waypoint before engaging Track control. Under these circumstances positive positional checks at regular intervals are vital especially if navigational hazards are close.

Dodges

Full control remains available from all control units when the autopilot is in Track control. Dodges are accomplished by simply selecting the desired course change on the Autohelm keypad. Once the hazard has been avoided the course change selected for the dodge manoeuvre should be cancelled by selecting an equal course change in the opposite direction. Provided the vessel remains within 0.1nm of track there is no need to steer back towards the track.

Safety

Passage making in Track control removes the chores of compensation for wind and tidal drift and will aid precise navigation. It is most important however to maintain an accurate log with regular plots and to verify the computed position read from the Radio Navigation Receiver with a dead reckoned position from recording the average course steered and the distance logged. In open water such plots should be at least hourly and more frequent in confined waters or when potential hazards are near.

Local variations in radio signal quality and changes in the tidal stream will produce deviations from the desired track. When setting

up waypoints, remember that deviations will occur, and thoroughly check along each track and to 0.5nm each side to ensure that there are no hazards within the zone. Always confirm the position given by the Radio Navigation Receiver using an easily identifiable fixed object at the start of a passage to check and enable compensation to be made for fixed positional errors.

The use of Radio Navigation control will enable accurate track keeping even in complex navigational situations. It cannot remove the responsibility of the skipper to ensure the safety of his vessel at all times by careful navigation and frequent position checks.

7. Windvane Control (Sail Only)

Windvane Control allows the ST6000 to maintain an apparent wind angle. There are two methods of supplying the ST6000 with wind angle:-

- Using the NMEA 0183 output from another manufacturers instrument system and connecting it to the ST6000 control unit. N.B. The NMEA 0183 output must transmit VWR (Relative wind bearing).
- Using an Autohelm ST50 wind instrument connected using the SeaTalk bus.

The ST6000 uses Wind Trim to eliminate the effects of turbulence and short term wind variations and provide smooth precise performance under windvane with minimum power consumption. Wind Trim uses the fluxgate compass as the primary heading reference, and as changes in the apparent wind angle occur the compass heading is adjusted to maintain the original apparent wind angle.

Operating Hints

Wind Trim adjusts the compass course over a 1 minute period, providing optimum response for offshore conditions where genuine shifts in wind direction occur gradually. In gusty and unsteady inshore conditions it's best to sail a few degrees further off the wind so that changes in apparent wind direction can be tolerated.

It is also important to ensure that the amount of standing helm is minimised by careful sail trim and positioning of the mainsheet traveller.

It is recommended that the headsail and mainsail are reefed a little early rather than too late.