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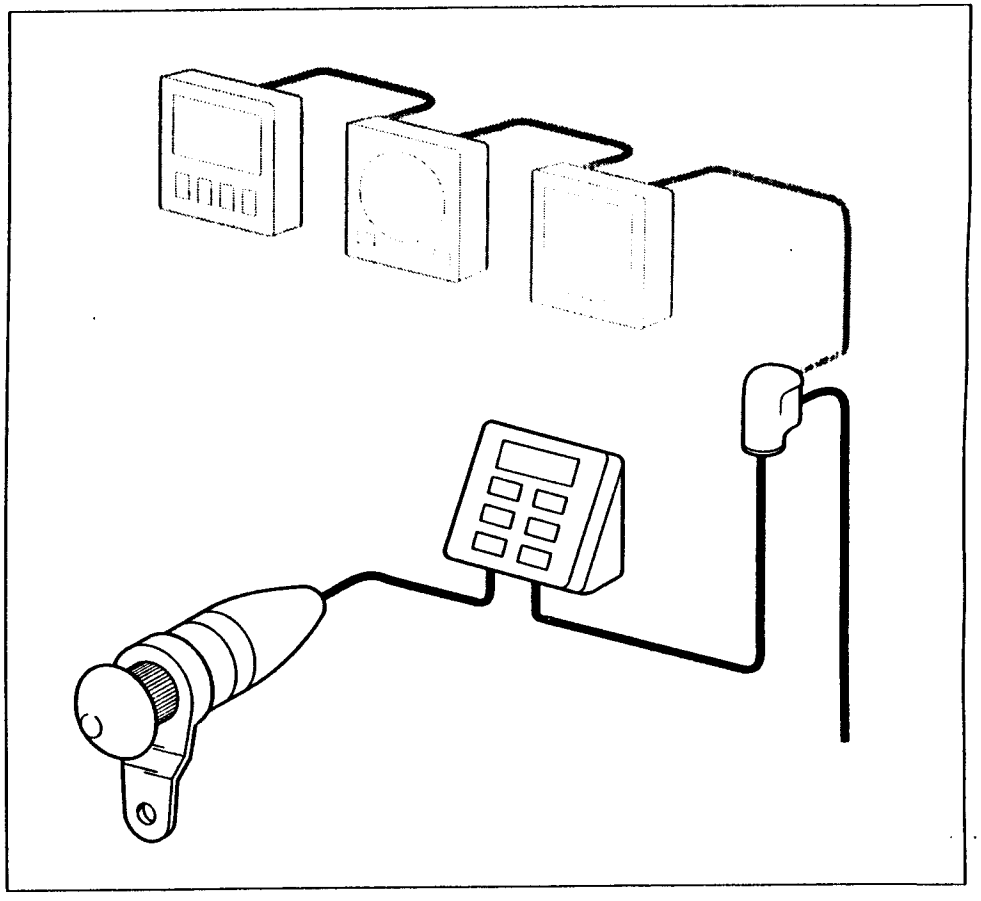
Autohelm®

ST3000

WHEELDRIVE AUTOPILOT

Operation and Installation

Nautech Limited, Anchorage Park, Portsmouth
PO3 5TD, England. Telephone (0705) 693611
Fax (0705) 694642, Telex 86384 NAUTEC G



ST3000 Wheel Drive Autopilot

Contents

Specifications

- Power Supply
  - 10 to 15V d.c.
- Current consumption
  - Standby: 65mA (120mA with lighting)
  - Auto: between 0.7A and 2.5A depending on boat trim, helm load and sailing conditions
- Operating temperature
  - 0°C to +70°C
- 6 button digital keypad
- LCD display of heading, locked course and navigational information
- User calibration for optimum performance
- 'WindTrim' control in wind vane mode
- SeaTalk compatible
- Automatic compass deviation correction
- Northerly/Southerly heading compensation
- Automatic heading deadband
- Automatic tack
- Built-in radio navigation interface
- Waypoint advance feature

Introduction

The ST3000 is a cockpit autopilot for wheel steered yachts. It is designed for owner installation and comprises of 2 units:

- Bracket mounted control head
- Proven wheel drive actuator

The control head is SeaTalk compatible and therefore can share all data transmitted from other Autohelm SeaTalk instruments:

- Wind information from a Wind instrument can be used for windvane steering without the need to install a separate vane
- Boat speed from the Speed instrument for optimum Track keeping performance
- SeaTalk compatibility also allows additional fixed and handheld autopilot control units to be easily connected at secondary steering and control positions

If a SeaTalk interface is included the Control head can be used with any position transducer (GPS, Decca, Loran) transmitting NMEA 0183 data.

The wheel drive unit is attached by a single pin to a clevis permanently fixed to the cockpit structure. Drive is transmitted to the wheel by a tensioned toothed belt. A lever operated eccentric bush in the drive unit mounting arm enables belt tension to be released to facilitate manual override by allowing the belt to slip. The drive disengagement system is both effective and reliable.

The ST3000 can be calibrated to suit each installation giving maximum performance with many types of boats and steering systems.

Important Note:

The ST3000 is recommended for wheel steered vessels up to 15,000 lb (7000kg) displacement. Above this limit and for heavy duty applications, such as single handed racing or long distance ocean sailing, one of the more powerful Autohelm autopilots (ST6000, ST7000) is advised.

Safety

Passage making under autopilot can greatly increase the pleasure of the voyage and ensure the crew can relax. However, this can lead to a dangerous lack of attention to basic seamanship. The following rules should always be observed:-

- 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's position either by use of a radio navigation 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 can produce significant errors under some circumstances and the autopilot cannot detect this situation
- **Ensure that all members of crew are familiar with the procedures required to disengage the autopilot – Hand steering is not possible when the wheel drive clutch lever is engaged**
- When searoom is restricted a crew member must be close to the control head at all times if under autopilot control

Your Autohelm ST3000 will add a new dimension to your boating enjoyment. However, it is the responsibility of the skipper to ensure the safety of the vessel at all times by careful observance of these basic rules.

Basic Operation

Contents

Chapter 1: Operation

1.1 Basic principles

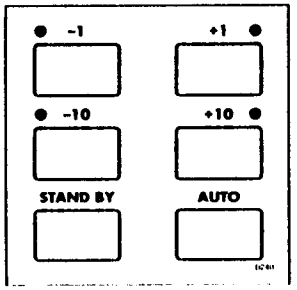
When switched on, the ST3000 will be in 'Standby' mode. To select automatic steering simply steady the vessel on the required heading engage the clutch lever and push **Auto**. At any time to return to manual steering release the clutch and push **Standby**.

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 single key functions there are several dual key press functions. Course changes can be made at any time using the **–1**, **+1**, **–10**, and **+10** degree keys.

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

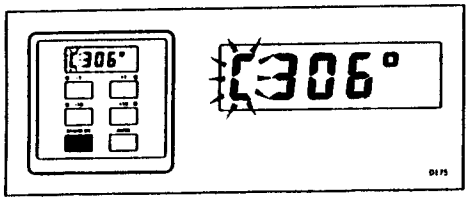
Remember, a large ship can travel two miles in five minutes – just the time it takes to make a cup of coffee.

The next few pages list all of the pushbutton operations needed for full autopilot control.



1.2 Operator controls

Standby

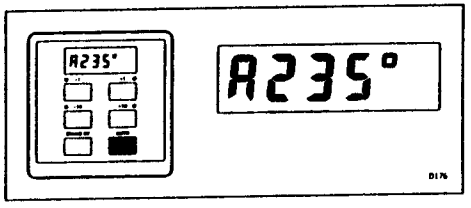


- Push to disengage the autopilot for hand steering

  The previous auto heading is memorised and can be recalled using the **Auto** key (see 'Auto').

  In 'Standby' the display shows the vessels current compass heading.

Auto



- Push to engage automatic steering and maintain current heading

  In 'Auto' the display shows the locked autopilot heading.

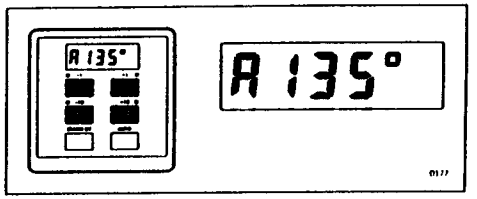
  If for any reason the vessel is steered away from the selected locked heading (e.g. Dodge manoeuvre or selecting 'Standby') then:

- Push and hold down **Auto** for 1 second

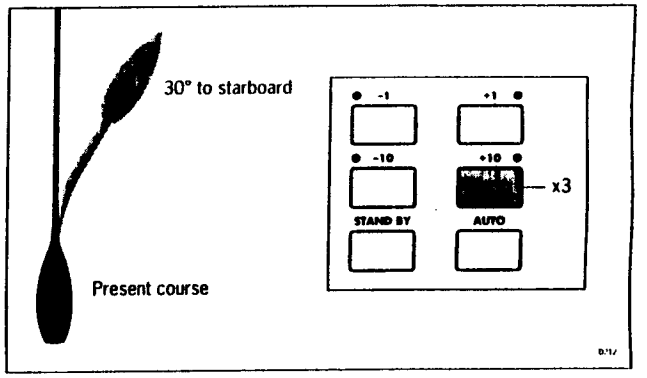
  The previous locked heading will be flashed for 10 seconds. To select this heading, and resume the original course, press the **Auto** key once within 10 seconds.

  Also see 'Dodge' – page 10.

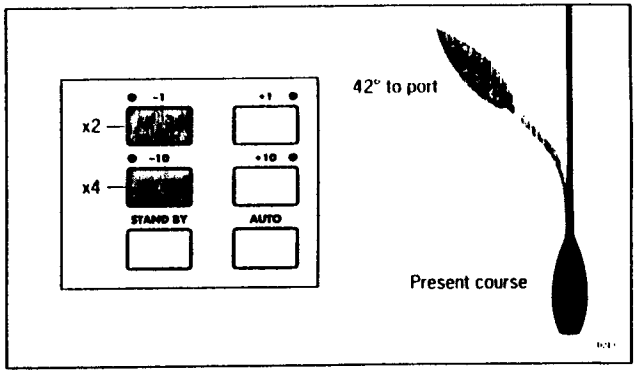
Course changes (–1, +1, –10, +10)



- Push to alter course to Port (–) and Starboard (+) in increments of 1° and 10°



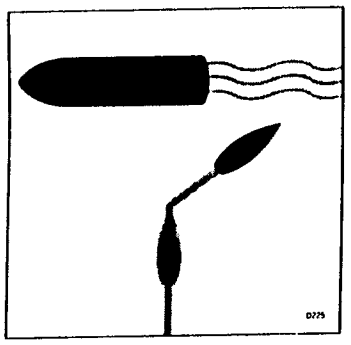
30° course change to Starboard

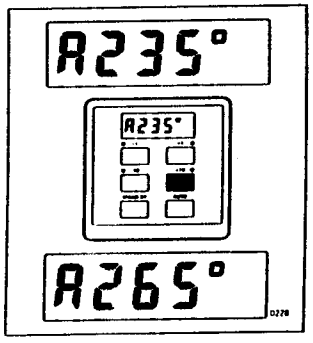


42° course change to Port

Dodge

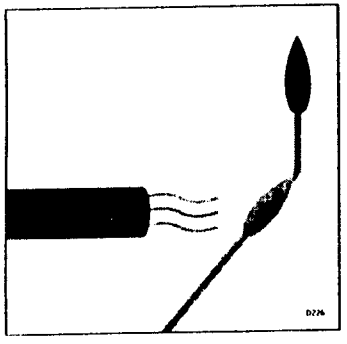
In order to avoid an obstacle under autopilot control select a course change in the appropriate direction (say starboard 30° = 3 x +10°).

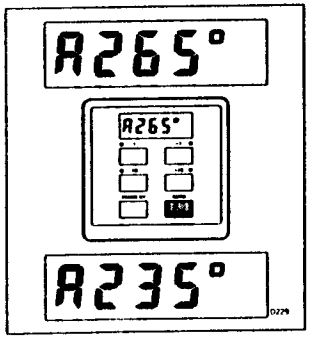




When safely clear of the obstacle press **Auto** and hold down for 1 second.

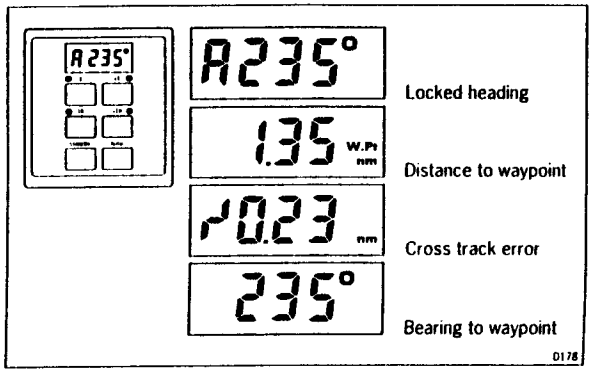
The previous locked heading will now be flashed on the screen. To return to the old course press **Auto** within 10 seconds.





Alternatively the previous course change can be reversed via the key pad example: 3 x –10°.

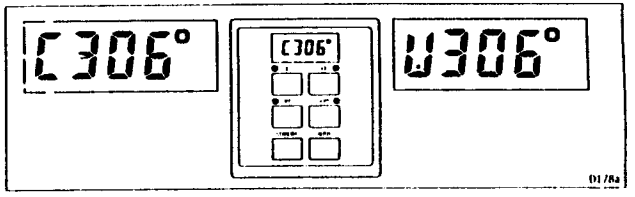
"Track Control"



- Push **+10** and **-10** degree keys together to select "Track Control" from Auto. Push again to return to automatic steering.

  Once in "Track Control, the autopilot will follow a predetermined tracl setup on a GPS/Decca/Loran navigator receiver, see "Advanced operation" for more details.

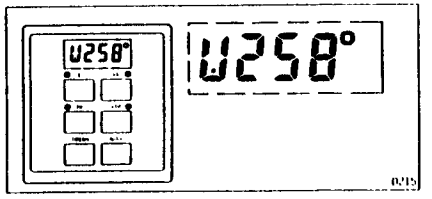
Windvane Mode (Windtrim)



- Push **Auto** and **Standby** together to select "Windtrim" and maintain the current apparent wind angle.

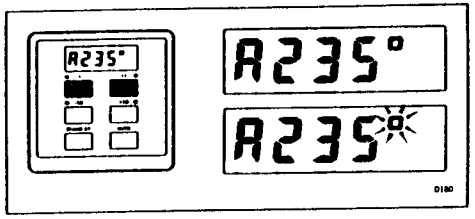
  If for any reason the vessel is steered away from the selected appar wind angle (i.e. dodge manoeuvre or selecting standby) then:

- Push and hold the **Auto** and **Standby** keys together for 1 second t return to the previous apparent wind angle.



Whilst in windvane mode, the control head will beep once every 30 seco

Automatic Deadband Control (Auto seastate)



- Press the **+1** and **–1** degree course change keys together to toggle between auto deadband and fixed minimum deadband. The degree sign will flash when the fixed minimum dead band is selected

  This can only be done with the Autopilot in 'Auto' mode.

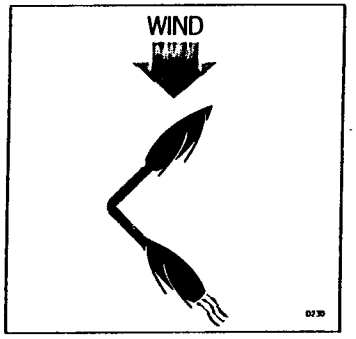
  'Automatic deadband' (Auto seastate) will cause the pilot to gradually neglect repetitive movements of the vessel and only respond to true variations in course. This provides the best compromise between power consumption and course keeping accuracy by neglecting unnecessary rudder movements.

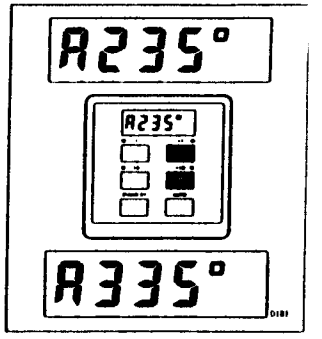
  'Minimum deadband' will always provide the tightest course keeping possible but at the expense of increased power consumption and drive unit activity.

Automatic Tack (Autotack)

The ST3000 has a built in automatic tack facility which will turn the vessel through 100° in the required direction. This feature is available in both Compass and Vane modes.

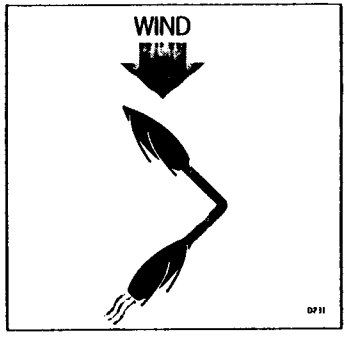
- Press the **+1** and **+10** degree keys together to tack through 100° to starboard

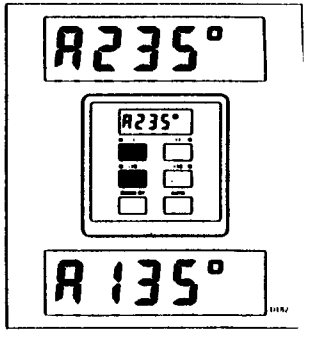




Or:

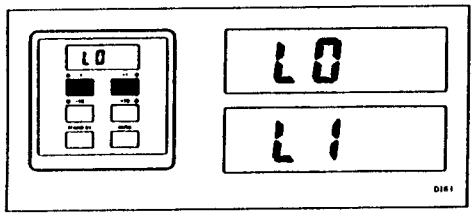
- Press the **–1** and **–10** degree keys together to Tack through 100° to port





Illumination

Illumination for the control head display can be switched on for night time viewing. This can only be done with the autopilot in 'Standby' mode.

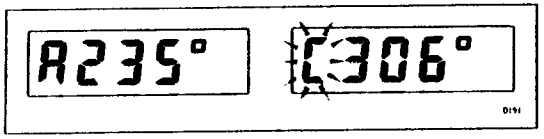


- Press the **+1** and **−1** keys together to toggle illumination on and off

Also if other SeaTalk instruments or autopilot control units are connected to the SeaTalk bus the illumination on the ST3000 can be switched on or off from these units.

Off course alarm

The off course alarm will sound if the locked autopilot heading and the vessels current heading differ, for greater than 20 seconds, by more than the value set in calibration level 6.



To cancel the off course alarm push **Standby** to return to hand steering.

If the off course alarm sounds it is usually an indication that the vessel is carrying too much sail, or that the sails are badly balanced. In this case a significant improvement in course keeping can usually be obtained by improving sail balance.

1.3 Operating hints

It is very important to understand the effect of sudden trim changes on steering performance. When a sudden trim change occurs, due for example to weather helm or sail imbalance, there will be a delay before tl automatic trim applies rudder to restore the locked heading. This correction can take up to one minute. 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 will only settle onto course when the automatic trim has bee fully established.

To minimise the 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 steerir 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.

In gusting conditions the course may tend to wander slightly, particularly the case of a sailing yacht with badly balanced sails. In the latter case, a significant improvement in course keeping can always be obtained by improving sail balance. Bear in mind the following important points:

- Do not allow the yacht to heel over excessively
- Ease the mainsheet traveller to leeward to reduce heeling and weathe helm
- If necessary reef the mainsail a little early

It is also advisable whenever possible to avoid sailing with the wind dead astern in very strong winds and large seas.

Ideally, the wind should be brought at least 30° away from a dead run an in severe conditions it may be advisable to remove the mainsail altogeth and sail under headsail only. Provided these simple precautions are take the autopilot will be able to maintain competent control in gale force conditions.

Advanced Operation

Contents

Advanced operation

The ST3000 has been set-up at the factory to provide stable performance for most types of boat. Depending on personal choice, type of boat and steering system many of the functions and features available in the ST3000 can be fine tuned. This is normally required if:

- The pilot does not maintain a selected heading
- The boat appears to be unstable on Northerly headings (Southerly headings in the southern hemisphere)
- You wish to display True compass headings
- You operate in 'Track Control' mode
- You wish to change the Off Course alarm angle

The ST3000 is also capable of being supervised by a Navigation system such as a GPS, Decca or Loran receiver – automatically compensating fo tidal streams and leeway. Courses relative to the apparent wind direction can also be maintained if the ST3000 is connected to a wind instrument.

'Advanced Operation' offers a complete guide to ST3000 calibration and comprehensively covers operation in both 'Track Control' and 'WindTrim' supervisory modes. It also shows how the system can be expanded to include other SeaTalk products.

Chapter 2: Using 'Track Control' and 'WindTrim'

2.1 Operation in 'Track Control'

'Track Control' allows the ST3000 to maintain track between two waypoints entered on a GPS, Decca, or Loran based Navigation system.

Operating hints

The Autopilot can receive cross track error data via the SeaTalk bus from the following sources:

- ST50 Navdata
- ST50 Navcenter
- ST6000 Autopilot Control Unit
- ST7000 Autopilot Control Unit
- SeaTalk Interface Box

Note: All of the above must be connected to a navigation system transmitting data to the NMEA 0180 or 0183 format. The ST3000 will then compute course changes which will keep your boat on a pre-determined track, automatically compensating for tidal streams and leeway.

When initiating 'Track Control' the track can be acquired in one of two ways:

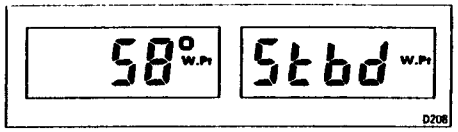
- Automatic acquisition (NMEA 0183 Cross Track Error and Bearing to Waypoint data required from the receiver)
- Manual acquisition (NMEA 0180 or 0183 Cross Track Error data required only)

Manual acquisition is achieved 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. The pilot is then switched over to 'Track Control' by firstly entering 'Auto' and then pressing the **+10** and **-10** degree keys together to initiate 'Track Control'. The Display will alternate between cross track error and the locked pilot heading.

Automatic acquisition can only be achieved if the pilot is receiving cross track error and bearing to waypoint information via the SeaTalk bus. It is initiated as follows:

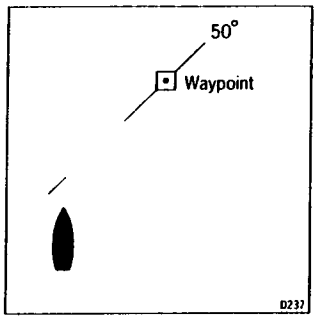
- Bring the vessel to within 0.1nm of Track
- Press **Auto**
- Press **+10** and **-10** degree keys together to enter 'Track Control'

An alarm will sound and the display will show:



The information on the display alternates between the direction in which the boat will turn to take up the track and the new bearing to waypoint.

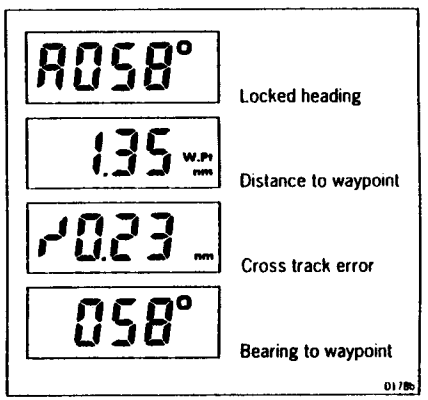
Check that it's safe to turn onto the new course.



- Press the **+10** and **-10** degree keys together.

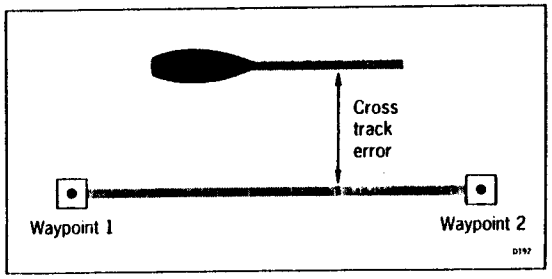
The boat will now turn on to the new course and the alarm will cancel.

The following navigation information will now be continuously cycled on t display:

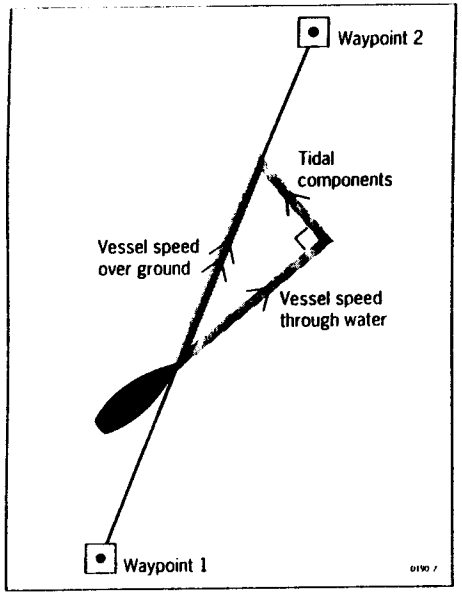


Cross Track Error

Cross track error is the vessel distance from a planned route. This is displayed in nautical miles and is read directly from your position transducer (see above).



Tidal Stream Compensation



Under most conditions 'Track Control' will hold the selected 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 ST50 Speed or Tridata instrument is connected to the SeaTalk bus the control head will use measured vessel speed, otherwise the cruise speed entered during calibration level 5 will be used.

Waypoint Advance

If your navigation receiver transmits valid 'Waypoint Number' and 'Bearing to Waypoint' NMEA headers it is possible to advance from one waypoint to the next by simply pressing the **–10** and **+ 10** degree keys together.

As the vessel passes the target waypoint the navigation receiver should select, manually or automatically, the next target waypoint. The ST3000 will detect the new target waypoint number and display the new bearing to waypoint and also the direction it will turn to acquire it. This will be accompanied by an alarm to indicate waypoint arrival (see page 25).

Note: While the waypoint advance alarm is sounding, 'Track Control' is suspended and the ST3000 will maintain the current boat heading. A check should be made to verify it is safe to turn onto the new track and then the **+10** and **–10** degree keys pressed together. This will cancel the waypoint arrival alarm and steer the boat towards the next waypoint. Unless the 'Waypoint Advance' is accepted in the above way the alarm will continue to sound and the current course be maintained.

Limitations

Although there is no need to fully understand the details of the track keeping algorithm, it is very important to understand its limitations so as to obtain the best performance from '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 page 25) 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 99.99nm and enables the 'Track Control' to operate with larger cross track errors. However, the alarm code will still be displayed over 0.30nm in case there are navigational hazards close to the intended track.

Low speed operation

Operation of the manual acquisition of 'Track Control' at low speeds requires additional care as the effect of tidal streams 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 '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 the control head 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 position transducer using an easily identifiable fixed object at the start of a passage to check and enable compensation to be made for fixed positional errors.

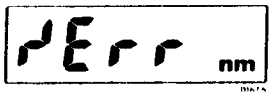
The use of 'Track Control' will enable accurate track keeping even in complex navigational situations. It cannot remove the responsibility of the skipper to ensure the safety of his vessel at all times by careful navigation and frequent position checks.

Warning messages

NMEA data not received

The 'no data' display will be shown if 'Track Control' is engaged when the autopilot is not receiving track information.

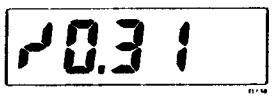
NMEA data error



The 'data error' display will be shown if 'Track Control' is engaged whilst the position transducer (GPS, Loran, Decca) is receiving a low strength signal.

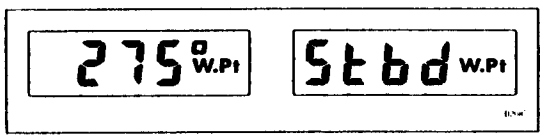
This will clear as soon as the signal strength improves.

Large cross track error



The 'large cross track error' alarm sounds if the cross track error received by the pilot exceeds 0.3nm.

Waypoint advance



The waypoint advance alarm sounds whenever the radio navigation receiver (GPS, Loran, Decca) changes the target waypoint number. When this occurs the pilot will continue on its current heading but flash the bearing to the next waypoint on the display. This will alternate with the direction in which the boat will turn to take up that bearing. You should check to ensure that such a manoeuvre would be safe and, when you are ready to make the turn, momentarily press the **+10** and **–10** degree keys together. The pilot will then turn onto the new bearing and track towards the next waypoint.

Note: The waypoint advance will only operate on pilots receiving bearing t waypoint information.

2.2 Operation in 'WindTrim' mode

'WindTrim' mode allows the ST3000 to maintain course relative to an apparent wind angle. It uses 'WindTrim' to eliminate the effects of turbulence and short term wind variations and provide smooth precise performance under windvane with minimum power consumption. 'WindTrim' uses the fluxgate compass as the primary heading reference, and as changes in the apparent wind angle occur the locked compass heading is adjusted to maintain the original apparent wind angle. To use 'WindTrim' the ST3000 must receive wind information from one of the following sources:

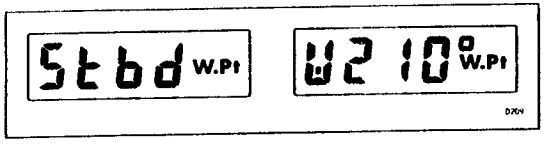
- SeaTalk Wind instrument – connected to the ST3000 via the SeaTalk bus
- NMEA wind information connected via the SeaTalk Interface Box (cat no Z137)
- Autohelm windvane (cat no Z087) – connected via the SeaTalk Interface Box (cat no Z137)
- ST6000 or ST7000 control unit

Operating hints

'WindTrim' filters the windvane output, providing optimum response for offshore conditions where genuine shifts in wind direction occur gradually. In gusty and unsteady inshore conditions it is 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.

Wind shift alarm

If changes in apparent wind angle adjust the original locked compass heading by more than 15° the wind change alarm will sound.



The display will then alternate between the current 'WindTrim' heading and the direction of wind shift.

- Push **Standby** and **Auto** together momentarily to accept the alarm and reset the wind shift alarm datum to the current compass heading. Before doing so verify that the new course datum does not take the vessel into

Chapter 3: Adjusting autopilot performance

Setting up Rudder Gain

The factory set rudder gain level will provide stable control for initial sea trials. However, vessels can vary widely in their response to the helm, ar further adjustment to the rudder gain may improve the autopilot's steeri characteristics.

- Steer onto a specific course
- Hold the course steady for 5 to 10 seconds
- Operate the clutch lever
- Press **Auto** to engage the autopilot on the current heading

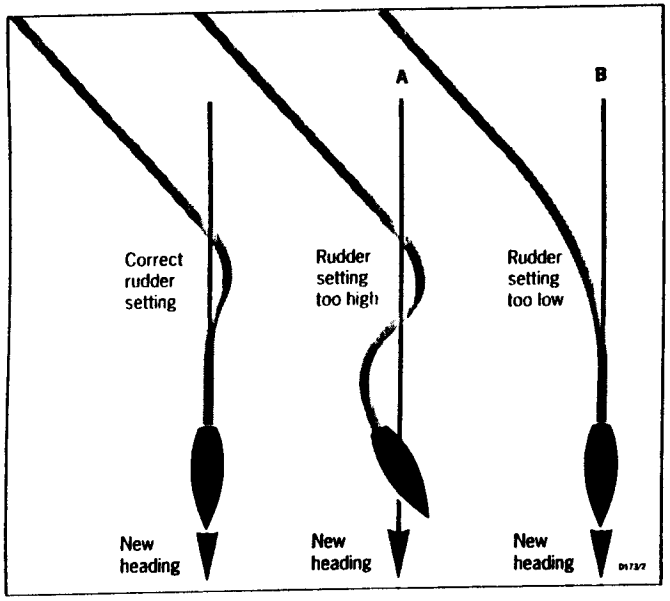
In calm conditions the boat should maintain the locked heading.

The following test will check if the rudder level is set too high or too low.

In clear water and with the autopilot in 'Auto' alter course to starboard by 40° by pressing the **+10** degree key four times.

Typically, at cruising speed, a course change of 40° should result in a crisp turn followed by an overshoot of no more than 2° to 5°. If this occu the rudder gain is correctly adjusted.

An excessively high rudder setting results in oversteer which can be recognised by distinct overshoot of more than 5° **(A)**. This condition car be corrected by reducing the rudder gain setting.



These actions are most easily recognised in calm sea conditions where wave action does not mask basic steering performance.

Refer to chapter 4: 'Autopilot re-calibration', for instructions on how to adjust the rudder gain setting.

Repeat the test until a crisp course change with no more than 2° to 5° of overshoot is achieved.

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.

Similarly, an insufficient rudder control setting will result in understeer which gives sluggish steering performance **(B)**. If the vessel takes a long time to make the turn and there is no overshoot then the rudder setting is too low.

Chapter 4: Autopilot re-calibration

The ST3000 can be adjusted to meet the characteristics of your vessel and steering system.

The calibration routine allows the following parameters to be adjusted from their factory default settings.

- Rudder gain (value on power up
- Off course alarm limit
- Northerly/Southerly turning error compensation

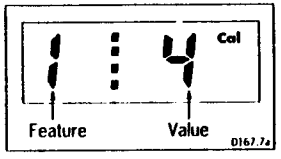
The autopilot also requires certain other information:

- Average cruise speed
- Local variation

This section will look at each feature in-turn and explain how to fine tune it to suit your particular boat.

4.1 Entering calibration mode

- Press the **Standby** button for 5 seconds until the display shows "CAL"
- Within 10 seconds, press **Standby** again for 5 seconds.

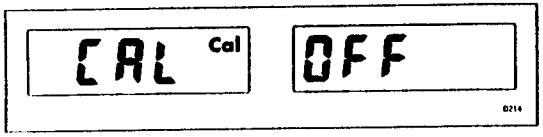


The number on the left identifies the feature (see table 4.3) and the number on the right the selected value for that feature.

Each feature can be cycled through using the **Auto** key.

The existing values can be viewed at any time without alteration, a simple momentary push of the **Standby** key will return the pilot to its normal operating mode without affecting the previous settings.

Note: If on entering calibration the display shows:



Please refer to 'Disabled calibration access' – section 4.5 for details on how to adjust.

4.2 Exiting calibration mode

You can exit calibration at any time in one of two ways:

- Press **Standby** for 1 second

  This will enter any adjusted values into memory.

- Momentarily press **Standby**

  This will exit calibration without entering any adjusted values into memory.

4.3 Suggested initial calibration settings

Listed below are suggested initial calibration settings for sailing and power-displacement vessels. These will provide safe performance for the initial sea trial.

The unit is supplied set up for sailing vessels.

If you change any of the settings you can record them in the 'Adjusted Values' column for future reference.

Feature No	Feature	Sail Setting	Adjusted Values
1	Rudder Gain	5	
5	Average Cruise speed	8	
6	Off course alarm angle	20	
9	Local magnetic variation	Off	
10	North/South turning errror correction	Off	
11	Current vessel Latitude	xx	

4.4 Calibrating the autopilot to suit your boat

Calibrate the pilot as follows:

- Enter calibration mode as described in section 4.1

The display will show:

Calibration Level 1 (Rudder Gain)

Calibration level 1 is Rudder gain. This requires setting up whilst under way. Please refer to Rudder gain adjustment in chapter 3.

Calibration Level 5 (Cruise Speed)

Calibration level 5 sets the boats normal cruising speed for use in 'Track Control'.

- Press the **Auto** key

When interfacing with Radio navigation systems the ST3000 uses the vessels average cruising speed to perform track calculations.

Adjust the cruise speed with the **+1** and **–1** degree buttons.

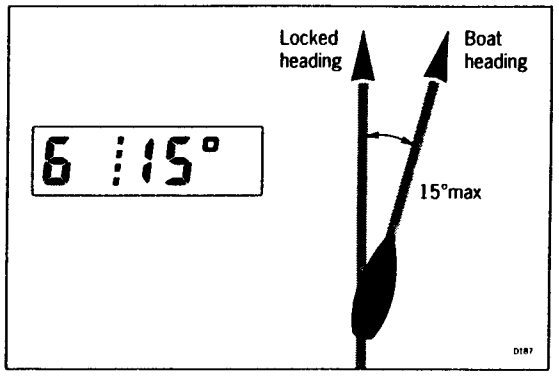
Note: If an ST50 Speed or Tridata instrument is connected to the SeaTalk bus they will transmit boat speed information directly to the autopilot.

Calibration Level 6 (Off course alarm angle)

Calibration level 6 is Off course alarm angle. This is an alarm to warn you if the autopilot is unable to maintain its set course.

- Press the **Auto** key

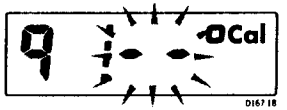
The off-course alarm operates if the autopilot strays off course by more than the alarm angle limit for more than 20 seconds. This limit can be set in 1° increments anywhere between 15° and 40° using the **+1** and **–1** degree course change buttons.



Calibration Level 9 (Magnetic variation)

Calibration level 9 tells the pilot the level of magnetic variation present at the boats current position.

- Press the **Auto** key



You should enter your local variation using **+1** and **–1** degree keys. This value will then be transmitted onto the SeaTalk bus and picked up by oth SeaTalk instruments such as the Multi repeater.

Note: – ve variation: East

+ve variation: West

Calibration Level 10 (Northerly/Southerly heading error correction)

Calibration level 10 allows Northerly or Southerly heading error correcti to be switched in.

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 (ar conversely southerly headings in the Southern hemisphere). This is caus by the increasing angle of dip of the earth's magnetic field at higher latitudes which has the effect of amplifying rudder response on northerl (southerly) headings. This error effects all magnetic compasses and ge worse the further away from the equator you are.

The ST3000 is able to compensate for this and provide precise course keeping on all headings by automatically adjusting the gain of the autopilot depending on heading.

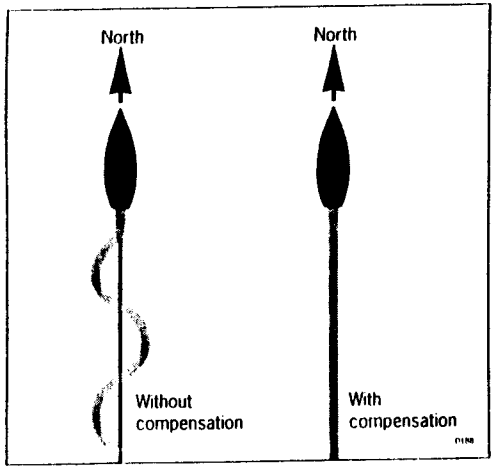
- Press the **Auto** key

Use the **+1** and **–1** degree keys to select:

0 = Off

1 = Northern Hemisphere

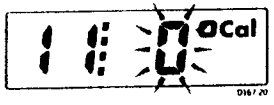
2 = Southern Hemisphere



Calibration Level 11 (Current Vessel Latitude)

Calibration level 11 requires the boats current latitude (to the nearest degree) in order to compensate for Northerly/Southerly heading error .

- Press the **Auto** key



- Set up latitude using the **–1** and **+1** degree keys

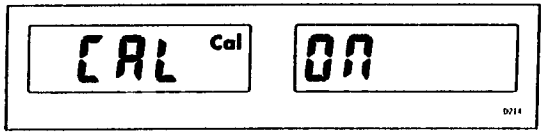
Note: If the correction is set to 0 in Calibration Level 10 then level 11 will be omitted and pressing the Auto key in Calibration Level 10 will move the display directly onto level 1 again.

4.5 Disabled calibration access

It is possible to disable the calibration set-up to prevent unauthorised access.

This is achieved as follows:

- Press and hold the **–1** and **Standby** keys for 10 seconds until the display shows:



- Toggle the calibration access on and off using the **–1** and **+1** degree keys
- Store the access by pressing the **–1** and **Standby** keys for 10 seconds until the Control head returns to normal operation

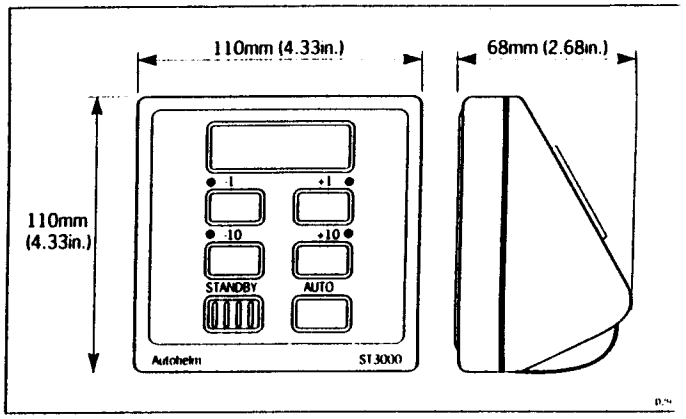
If preferred this page can be removed from the handbook after access has been switched off.

Installation

Contents

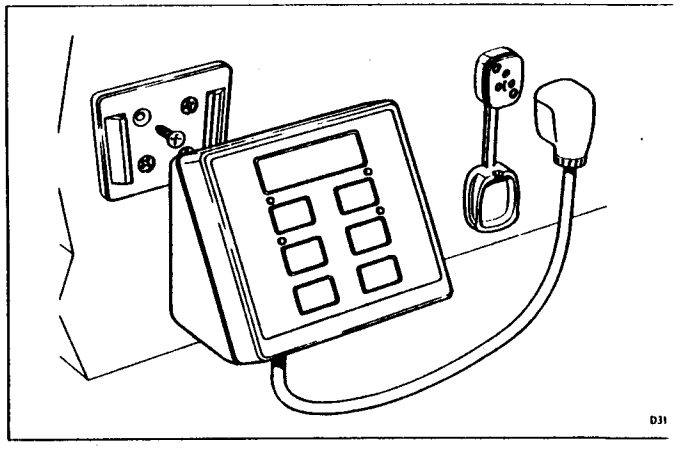
Chapter 5: Installation

5.1 Control head



Mounting procedure

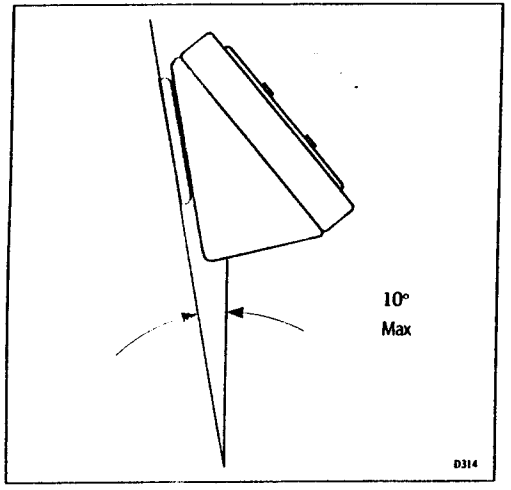
The control unit slots into a permanently mounted socket sited in the cockpit. It contains a gimballed fluxgate compass and therefore has some restrictions on mounting position.



The control unit should be sited where it can be operated easily from the steering position. It should also be positioned at least 80cm (2.5ft) away from the main steering compass to avoid deviation of both compasses.

Deviation should be avoided if possible and thus the control unit should be sited as far away from other magnetic or iron devices as practical.

Having selected the best mounting site, the mounting socket can be secured to a convenient wooden or glass fibre surface using the self tapping screws provided. The mounting surface may slope away from the vertical by a maximum of 10°. This will allow correct operation with the boat heeled at an angle of up to 40°.



The ST3000 is SeaTalk compatible receiving and transmitting information to other instruments and autopilot control units via the SeaTalk bus. Both power and data are supplied via a custom waterproof plug and socket. The plug comes ready assembled and the socket can be mounted in the cockpit area adjacent to the ST3000 Control unit.

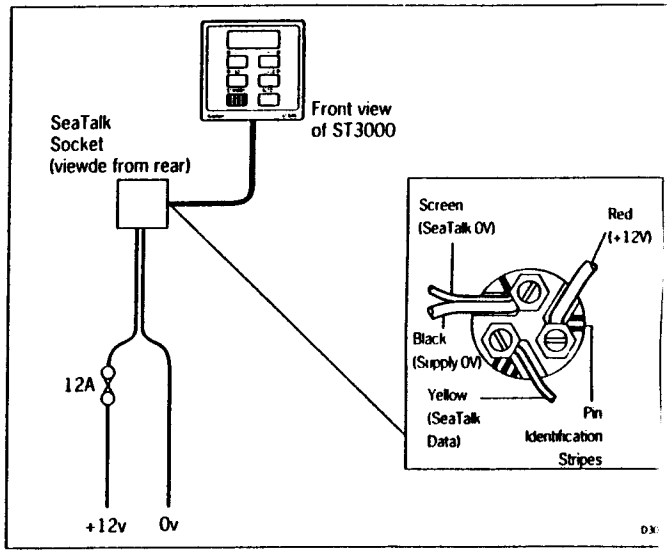
Cabling and SeaTalk socket installation

The ST3000 is SeaTalk compatible receiving and transmitting information to other instruments and autopilot control units via the SeaTalk bus. It cannot source power from the SeaTalk bus and therefore requires its own dedicated power supply.

Both power and data are supplied to the ST3000 via a custom waterproof plug and socket. The plug comes ready assembled and the socket can be mounted in the cockpit area adjacent to the autopilot.

Power cabling

Power should be routed directly from the vessels central distribution pan and protected via a 12A fuse or circuit breaker as shown:



The following table shows the minimum cable size acceptable for the power supply:

Cable length	Copper area	AWG
Up to 2.5m (8ft)	1.5mm2	16
Up to 4.0m (13ft)	2.5mm2	14

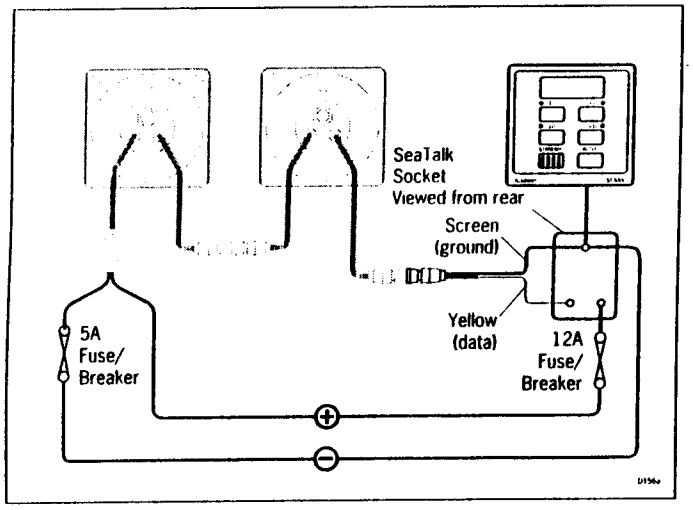
Important!

Correct cable size is critical for correct autopilot operation.

The cable you choose may meet the required current specification but, too small, will drop voltage between the supply and the autopilot. This w reduce the power at the wheel.

SeaTalk data cabling

The ST3000 is wired to the SeaTalk bus using an extension cable (cat no D131). It can be plugged directly to the spare SeaTalk tail on the last instrument or autopilot control unit, cut to length and then connected to the back of the SeaTalk socket as shown.

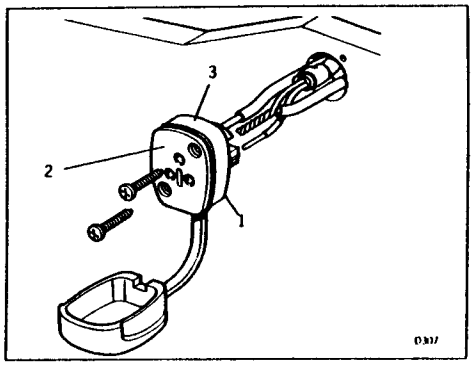


The fuse used with the ST3000 is too large to offer safe protection to the SeaTalk bus. Any SeaTalk instruments fitted must therefore be powered via a separate 5A fuse/breaker as shown above.

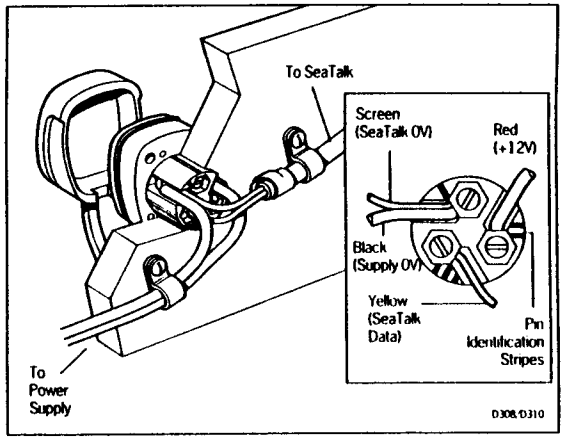
Mounting

The socket is assembled as follows:

- Fix the self adhesive template onto the bulkhead at the selected socket location
- Carefully drill the 18mm (23/32in) clearance hole and 2.4mm (3/32in) pilot holes. Remove the template
- Fit the plug cap (1) to the socket body (2) as shown
- Locate the 'O' ring seal (3) into the groove between the plug cap and socket body



- Cut and strip back the power and, if fitted, SeaTalk cables
- Thread both cables through the bulkhead hole and wire into the socket as shown making sure the wires are connected to the correct pin



- Attach the socket to the bulkhead using the two self tapping screws supplied
- Restrain cables as shown

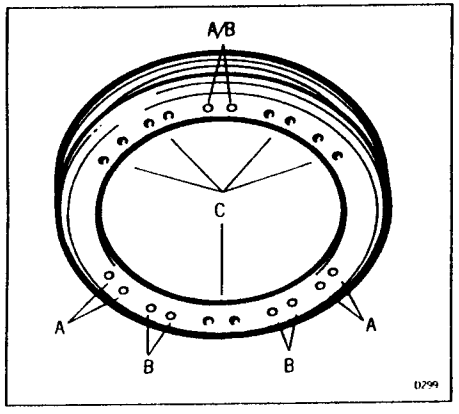
5.2 Drive actuator installation

The Autohelm 3000 is designed to operate with steering systems having between 1 and 3 turns lock to lock. Steering systems with more than 3 turns lock to lock may cause impaired steering performance due to reduced rate of rudder application.

Lost motion in the steering system must not exceed 2% of total movement. This is equivalent to 15° of free wheel movement for a system with 2 turns lock to lock. If lost motion exceeds this level it must be corrected otherwise steering performance will be impaired.

5.3 Wheel drum attachment

The drum is clamped onto the wheel spokes using the three U-bolts provided and may be used on wheels with 3, 5 or 6 spokes. For 4 spoke wheels, Nautech's Product Support department should be contacted to obtain a specially drilled drum.

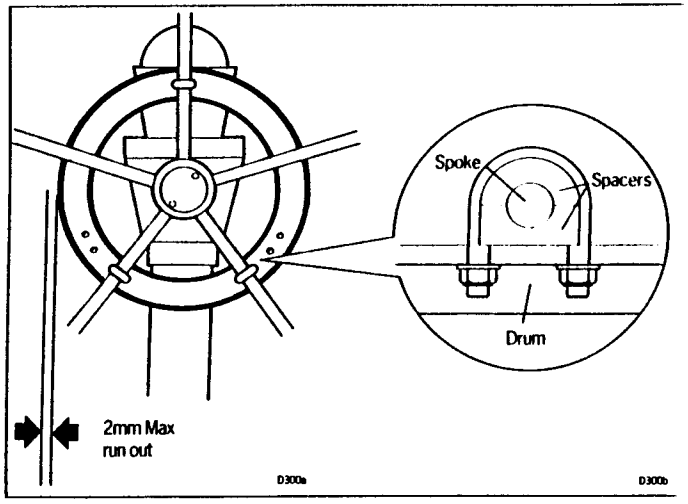


A holes – 3 and 6 spoke wheels

B holes – 5 spoke wheels

The 'C' holes are for wheels with spoke diameter of 26mm (1in) and require special U-bolts (cat no D103).

The wheel drum should ideally be fitted behind the wheel (i.e. between the wheel and the pedestal as shown).



In this case it will be necessary to remove the wheel.

If there is insufficient clearance behind the wheel the wheel drum may be fitted on the other side.

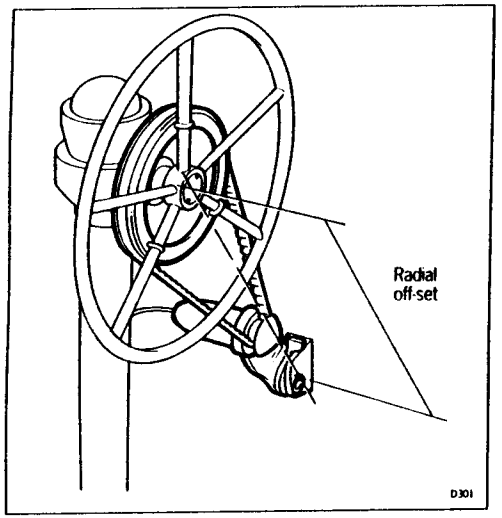
The drum attachment kit has three complete sets of spacers to compensate for differing spoke diameters. Marked alongside each spacer is the spoke diameter to which it relates. When fitting the drum simply break off the appropriate spacers.

The wheel drum is clamped to the wheel spokes by the U-bolts provided. After roughly positioning the drum, the clamp nuts should be lightly tightened and concentricity checked by spinning the wheel. The drum should then be tapped central to achieve a total run-out of no more than 2mm (1/16in) before the clamp's nuts are finally tightened.

5.4 Drive unit installation

Standard installation

The drive unit is normally mounted on the cockpit side wall.

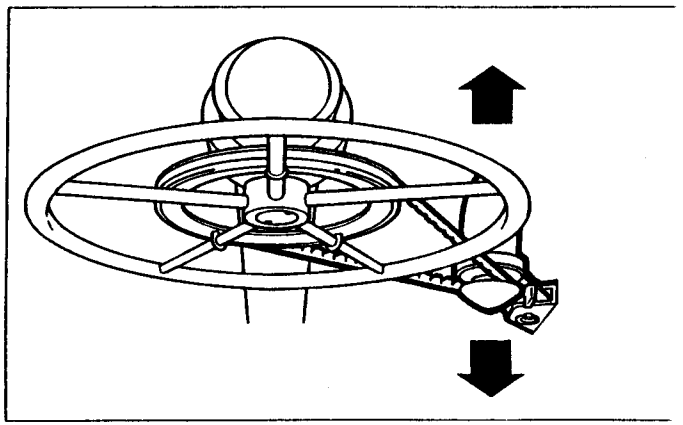


Alternative belt sizes are available to increase or decrease the radial offset of the mounting pin. These are used in cases where the standard belt does not allow a convenient location for the mounting clevis.

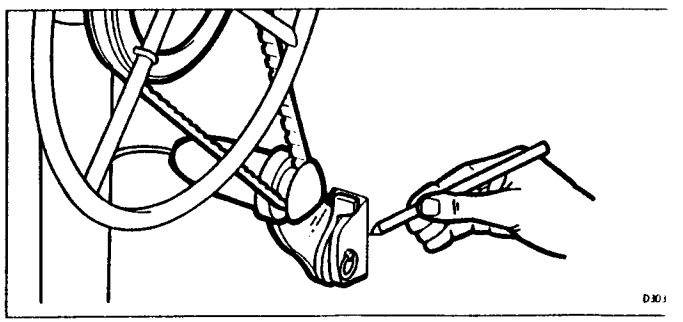
Belt size	Radial Off-Set
B-	512mm (20.1in)
A-	546mm (21.5in)
Standard Belt	598mm (23.6in)
A+	850mm (33.5in)
B+	850mm (33.5in)

The mounting clevis should be positioned as follows:-

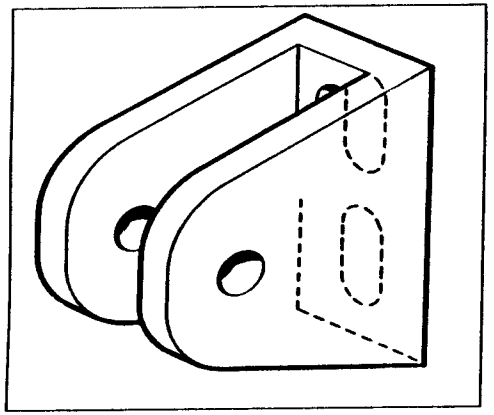
- Attach the mounting clevis to the drive unit using the pin provided and loop the belt drive over both the drum and the drive sprocket
- Offer the clevis against the vertical side wall after first rotating the eccentric clutch lever fully clockwise against its stop. (i.e. to the 'tight belt' position)
- Push the clevis downwards against the side wall until the belt is just taut and then adjust its fore-and-aft position until the belt lies parallel to the wheel. A long straight edge, such as a sail batten, will enable the paralle run of the belt to be easily checked



- Having found the correct position for the clevis carefully mark round its base to record its position



- Remove the drive unit and mark round the inside of the elongated fixing holes

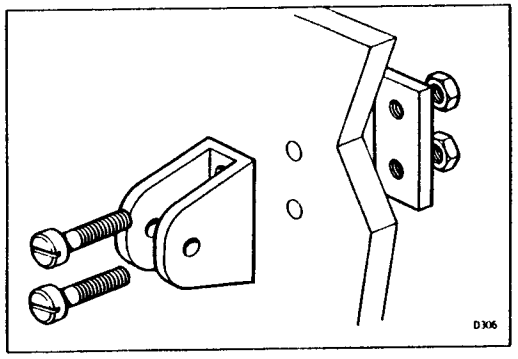


- Finally drill two 8mm (5/16in) clearance holes for the clevis fixing bolts at the lower end of each elongated hole position

This allows the belt to be subsequently tightened.

Note: Before drilling the holes check that you have access to the other side of the mounting wall to attach the nuts!

The mounting clevis may now be bolted into position with the fixing bolts positioned mid-way in the elongated holes.



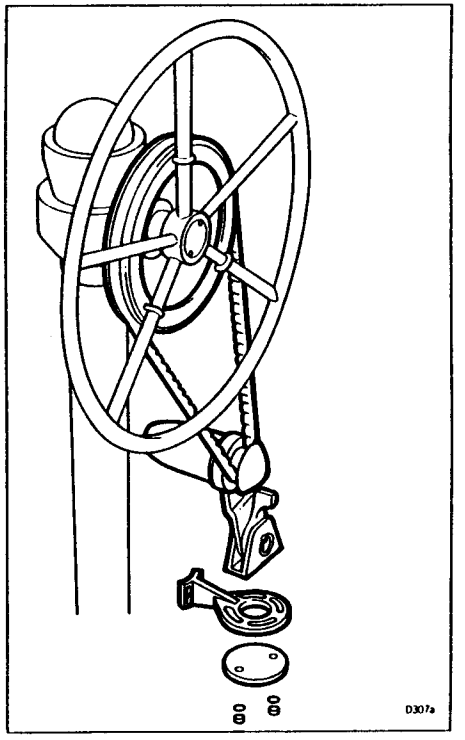
This will ensure that the belt is taut when it is tensioned by rotating the clutch lever fully clockwise. Re-assemble the complete drive system and check the operation of the clutch. The clutch lever may be repositioned on the splined eccentric bush if necessary to ensure that the lever can rotate 180° without obstruction.

When the belt is tensioned by rotating the clutch lever fully clockwise it should be possible to back wind the drive unit by slowly rotating the wheel. If belt slip occurs increase belt tension by reclamping the clevis in a slightly lower position. When the clutch lever is rotated fully anti-clockwise the wheel drum should slip easily against the belt.

Do not over tighten the belt.

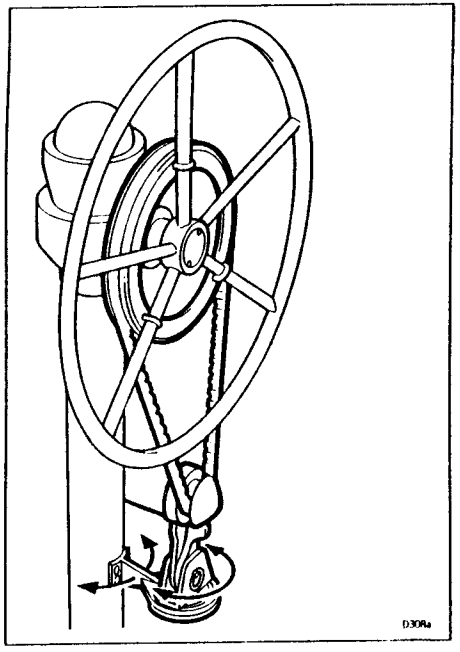
5.5 Pedestal mounting bracket

A special mounting bracket is available to mount the drive unit directly onto the wheel pedestal.

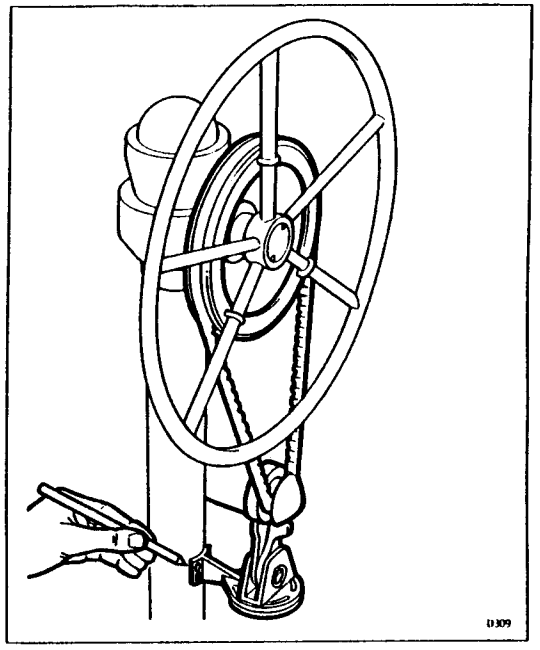


The bracket should be positioned as follows:

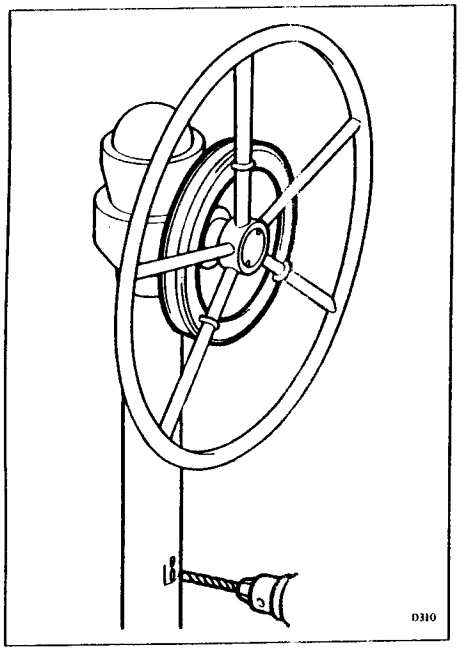
- Loosely attach the mounting clevis to the pedestal bracket using the backing plate and the two bolts provided
- Attach the mounting clevis to the drive unit using the pin provided and loop the belt drive over both the drum and the drive unit sprocket
- Place the bracket onto the pedestal after first rotating the clutch lever fully clockwise against its stop
- Push the bracket downwards against the pedestal until the belt is just taut. By sliding the pedestal bracket around the pedestal and rotating the clevis bracket ensure that the belt lies parallel to the wheel



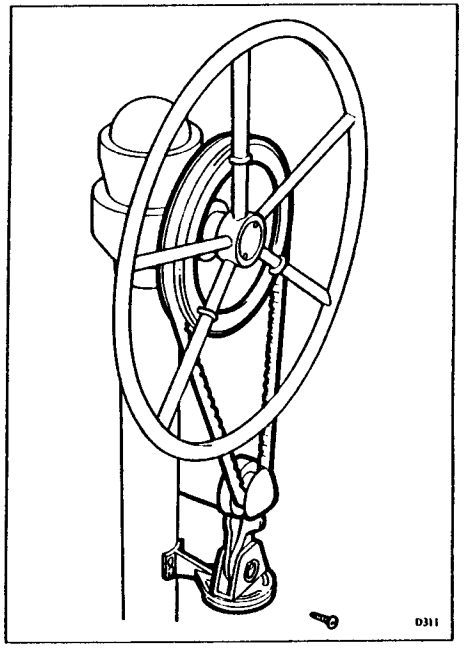
- Having found the correct position for the pedestal bracket carefully mark round its base to record its position. Then remove the bracket ar mark round the inside of the elongated fixing holes
- The clevis mounting bolts can now be tightened



- Finally drill four 4.3mm (11/64in) holes for the pedestal bracket fixing screws at the lower end of each elongated hole position. This allows the pedestal bracket to be subsequently tightened



The mounting pedestal bracket may now be screwed into position with the self tapping screws positioned mid-way in the elongated holes.



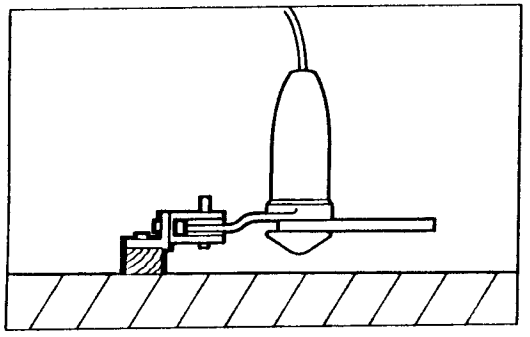
This will ensure that the belt is taut when it is tensioned by rotating the clutch lever fully clockwise. Re-assemble the complete drive system and check the operation of the clutch. The clutch lever may be repositioned on the splined eccentric bush if necessary to ensure that the lever can rotate 180° without obstruction.

When the belt is tensioned by rotating the clutch lever fully clockwise it should be possible to back wind the drive unit by slowly rotating the wheel. If belt slip occurs increase belt tension by reclamping the clevis in a slightly lower position. When the clutch lever is rotated fully anti-clockwise the wheel drum should slip easily against the belt.

Do not over tighten belt.

5.6 Attachment to athwartships bulkheads

In cases where the steering wheel is mounted on a bulkhead, special provision usually must be made to mount the drive unit. (L) brackets are available to mount the clevis on a bulkhead as shown.



Hardwood packing may be required to gain correct alignment to the wheel drum.

5.7 Alternative mounting positions

The wheel drive unit may be positioned on either the port or starboard side of the wheel. The fluxgate compass is calibrated to give correct steering sense when the drive unit sprocket is facing aft. Access to the clutch lever is also easier when the drive unit is mounted this way round.

If an obstruction precludes mounting the drive unit with the drive sprocket facing aft it may be mounted the other way round. In this case it will be necessary to re-adjust the motor drive sense to regain correct steering – see section 6.2 Initial Sea trial.

Cabling

The Drive unit plugs directly into the socket on the underside of the Control head.

Chapter 6: Functional Test and Initial Sea Trial

This section of the handbook consists of a set of simple tests followed by a short sea trial. This will confirm that the system is wired correctly and is also set-up to suit your type of boat.

6.1 Functional test

Switch on

Having installed your ST3000 wheel autopilot, switch on the main power breaker.

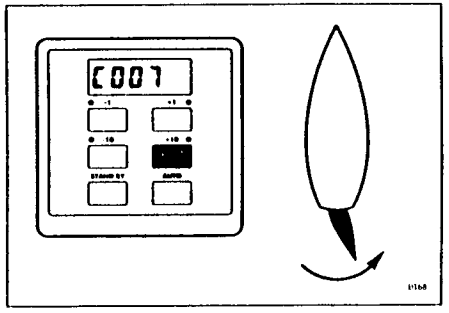
The Control head should beep and display ST3000. Within 2 seconds a compass heading preceded by a flashing 'C' should be displayed e.g. 'C' 234. This shows the Control head is active. If the head does not beep please refer to chapter 9 – 'Fault Finding'.

Operating sense

The operating sense of the autopilot defines the direction helm will be applied when a course change button is pressed or the vessel goes off course. It can be checked as follows:

- Operate the clutch lever
- Press **+10** degree key

The wheel should move to produce a turn to starboard.



If it drives to port then please refer to page 61 for instructions on how to reverse the Operating Sense.

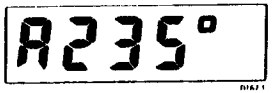
Note: This should only occur if the drive unit is mounted with the drive sprocket facing forward.

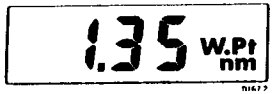
Navigation interface (GPS, Decca, Loran)

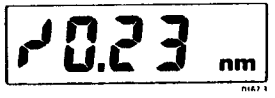
If the ST3000 is interfaced to a position transducer, then the interface can be simply checked as follows:

- Set up a Track on the position transducer to give a cross track error of between 0 and 0.3nm
- Enter 'Auto' mode by pressing the **Auto** key
- Enter 'Track' mode by pressing **+10** and **–10** degree keys together

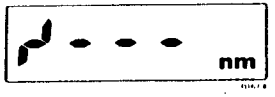
After 3 seconds the pilot should automatically scroll through three navigation displays:







If instead it shows one of the following error displays then there is either a wiring error or the position transducer is not set-up to transmit the required data format:



This display indicates data is not being received. The most likely reason being a cabling error – either open circuit, short circuit or wires reversed.

This indicates that the signals being received by the position transducer are too weak for reliable navigation. Reference should be made to the position transducer handbook for further action.

Wind transducer interface

If the ST3000 is connected to a wind instrument then the link between the two instruments should be checked as follows:

- Press the **Standby** and **Auto** keys together

The ST3000 should then display the locked heading preceded by a 'W' as shown.

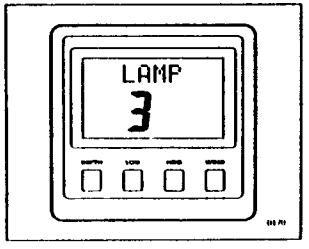
If the display continues to show the current heading preceded with a flashing 'C' then wind data is not being received by the ST3000.

The most likely reason being a cabling error – either open circuit, short circuit or wires reversed.

SeaTalk bus

If the ST3000 has been linked to other SeaTalk instruments via the SeaTalk bus the link can be checked as follows:

- Push **Standby** on the autopilot Control head
- Select display illumination level 3 on any other SeaTalk instrument or autopilot control unit



The ST3000 should immediately respond by switching on its display illumination.

If the illumination does not switch on then a cabling fault exists in the SeaTalk cabling between the ST3000 Control head and the Instruments/ Control unit.

6.2 Initial Sea trial

Having checked that the system is functioning correctly a short sea trial is now required to complete the setting up. This should be carried out in calm waters clear of any obstructions (and in the case of powered craft at no more than medium speed).

The ST3000 has a built-in calibration capability which enables it to be fine tuned to suit the individual vessel, its steering system and dynamic steering characteristics. As supplied from the factory the unit is calibrated to provide safe stable autopilot control for the majority of vessels (see section 4.3).

Before carrying out the first sail trial it is recommended that the calibration levels be checked and if necessary reset to the recommended levels.

This procedure will only take a minute or so and full details are given in chapter 4.

- Do not attempt to make any permanent change to the recommended calibration values until a sail trial has been carried out
- It is important that the initial sail trial is carried out in conditions of light wind and calm water so that autopilot performance can be assessed without the influence of strong winds or large waves

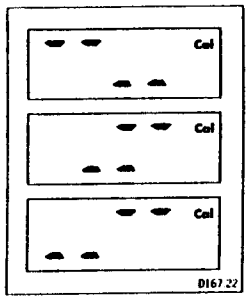
Note: At any time during the sea trial you can disengage the wheel drive clutch to return to hand steering.

Automatic Compass deviation correction

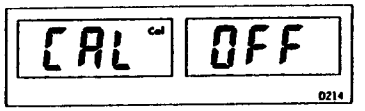
The ST3000 will correct its own internal fluxgate compass for most deviating magnetic fields. **Before carrying out the initial sail trial it is vital to carry out the Compass Deviation Correction.** Failure to do so may result in the autopilot performance being impaired on some compass headings. This procedure should be carried out in calm conditions preferably in flat water.

Select compass correction as follows:

- Push and hold Standby for 1 second.



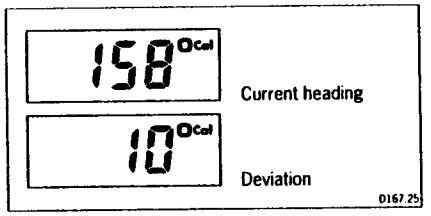
Note: If on entering calibration the display shows:



Please refer to "Disabled calibration access" - section 4.5 for details on how to adjust.

With a boat speed below 2 knots, turn your vessel in very slow circles, taking approximately 3 minutes per 360°, until the display changes to show the amount of deviation the autopilot has detected (the deviation display alternates with the current heading display).

Note: Normally it will take at least 1.5 to 3 complete circles to complete the linearisation procedure.



Steady your vessel on to a known transit bearing and use the **+1°** and **-1** course change keys to increase or decrease the displayed heading until agrees with the ships steering compass or the known transit bearing.

Exit compass adjust and store the compass correction/alignment as follows:

- Push and hold **Standby** for 1 second

or, to exit compass adjust without saving any new settings

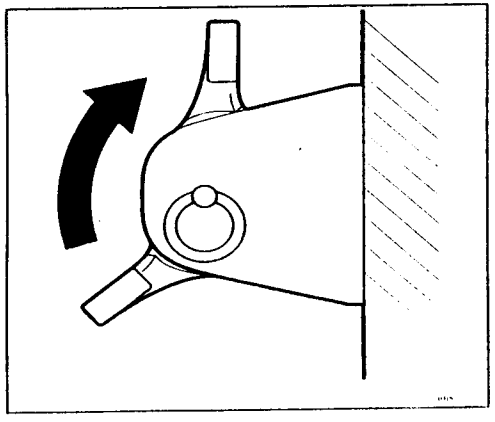
- Push **Standby** momentarily

Note: For installations where an ST50 Steering Compass Instrument is connected to the SeaTalk bus and the Steering Compass has a fluxgate transducer connected, it is only necessary to carry out the auto deviation correction on the Steering Compass Instrument, (refer to Steering Compass handbook instructions).

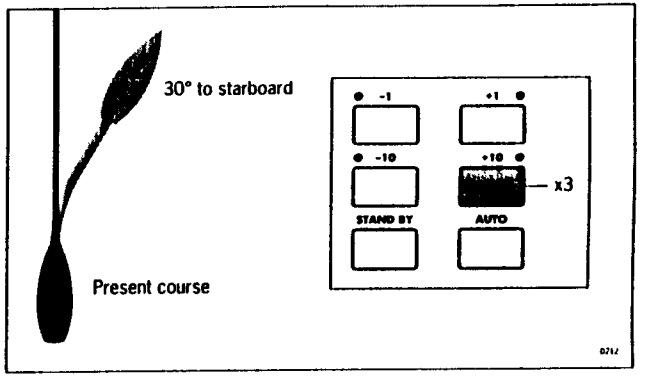
Autopilot operation

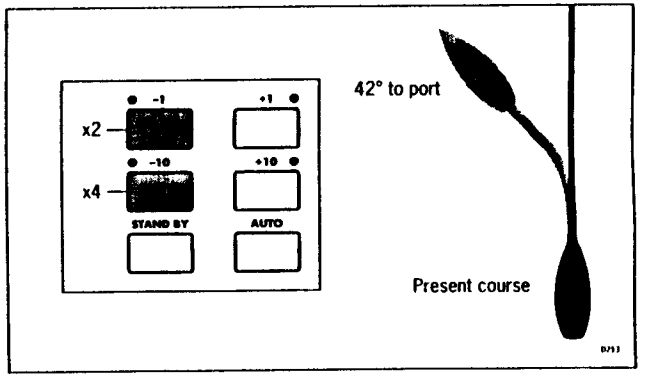
Having calibrated the compass the following procedure is recommended to familiarise yourself with autopilot operation:

- Steer onto a compass heading and hold the course steady
- Engage the clutch by rotating the clutch lever clockwise



- Push **Auto** to lock onto the current heading. In calm sea conditions a constant heading will be achieved
- Alter course to port or starboard in multiples of 1° and 10°





- Push **Standby** and disengage the wheel drive clutch by rotating the clutc lever anti-clockwise to return to hand steering

Operating sense reversal

The operating sense of the Autopilot can be reversed as follows:

- Press the **+1** and **–1** degree keys together for 5 seconds

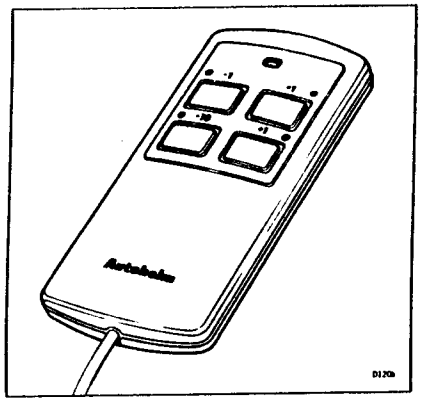
The display will then show either port or starboard and the phase of the autopilot will automatically change.

The Control head will automatically revert back to its normal operation after 5 seconds.

Chapter 7: Accessories

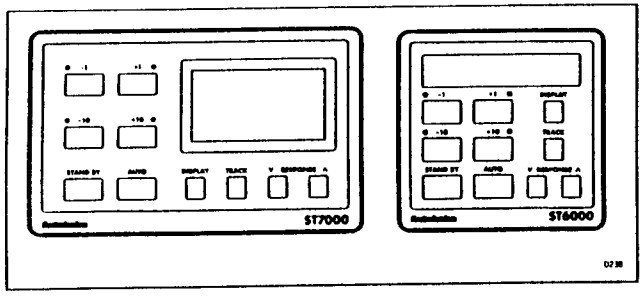
Various accessories are available for your ST3000 autopilot. These include:

- Handheld remote control (Z101)



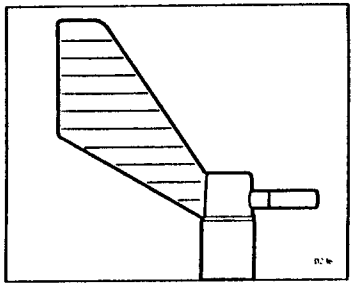
The handheld remote is supplied with 6m (20ft) of cable and a waterproof plug and socket. It allows you remote access to the four autopilot course change buttons.

- Fixed control units – ST7000 (Z082), ST6000 (Z124)



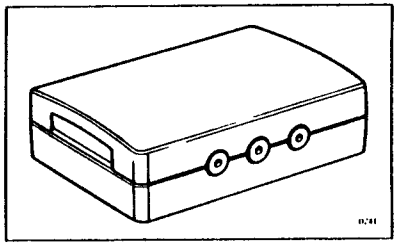
These control units are available for permanent mounting at additional positions where autopilot control is desired.

- Digital Windvane (Z087)



The digital windvane also requires the SeaTalk interface. When combined with the ST3000 these two pieces of equipment allow you to steer your boat on any course relative to an apparent wind angle.

- SeaTalk Interface (Z137)



The SeaTalk Interface will convert all SeaTalk data to NMEA 0183. This allows you to feed NMEA 0183 Navigation data to a plotter or Speed, and Compass NMEA information back to a position transducer for dead reckoning, (assuming the correct instruments are present on the SeaTalk bus to generate the information initially).

Chapter 8: Maintenance

Control head

- In certain conditions, condensation may appear on the window. This will not harm the unit, and can be cleared by switching on the illumination
- Never use any chemical or abrasive materials to clean your ST3000. If the Control head becomes dirty wipe clean with a damp cloth

Drive unit

- Never use any chemical or abrasive materials to clean your drive unit If the wheel drive becomes dirty wipe clean with a damp cloth
- If it is noticed that the drive is slipping whilst operating under normal operating conditions it should be returned to your nearest service center for inspection

Cabling

- Avoid running cables through bilges where possible and secure any coiled lengths at regular intervals
- Avoid running cables close to fluorescent lights, engines, radio transmitting equipment etc
- Check cabling for chafing or damage to outer casing, replace where necessary and re-secure

Advice

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

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

If a fault does develop the autopilots plugability ensures that only the defective unit be returned.

Before this is done please double check that the power supply cable is sound and that all connections are tight and free from corrosion. Then refer to the fault finding section of this manual. If the fault cannot be traced then please contact your nearest Autohelm dealer or service center for advice.

Always quote the serial number, which is printed on the label on the back of the control head.

Chapter 9: Fault Finding

All Autohelm products are subject to a comprehensive test procedure prior to packing and shipment. In the unlikely event that a fault does arise the following check list should help cure the problem.

Fault	Cause	Action
Control Head display blank	No supply	Check supply. Check Fuse/breaker. Return head for repair
Drive unit steers helm hard over as soon as Auto is engaged	Drive phase set incorrectly	Refer to chapter 6 and carry out the functional test.
Displayed compass heading does not agree with Ships compass	Compass requires deviation correction and alignment	Refer to chapter 6 Automatic compass deviation correction
Vessel turns slowly and takes a long time to come onto course	Rudder gain too low	Refer to chapter 3 Setting up Rudder gain
Vessel overshoots when turning onto a new course	Rudder gain too high	Refer to chapter 3 Setting up Rudder gain
Pilot appears to be unstable or Northerly headings (Southerly in Southern hemisphere)	Northerly/Southerly heading correction not set-up	Refer to chapter 4 Autopilot re-calibration and set-up levels 10 and 11
Display shows Cal – Off when entering calibration	Calibration locked out	Security protection switched on by owner
Control head will not talk to other SeaTalk instruments or Control units	Cabling problem	Check security of all SeaTalk connectors and cables
Control head will not receive information from a Position Transducer (GPS, Loran etc.)	Position Transducer not transmitting correct sentances	Refer to relevant SeaTalk handbook for information on required NMEA information
Pilot will not auto-advance between waypoints	No Bearing to waypoint information transmitted from the position transducer	Refer to position transducer handbook
Pilot will not display Distance to waypoint, Bearing to waypoint or waypoint number	Incorrect NMEA sentances transmitted from Position transducer	Refer to relevant SeaTalk handbook for information on required NMEA information

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