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SIMRAD
A KONGSBERG Company

M A N U A L

Simrad AP12
Autopilot

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1 General

1.1 Introduction

Combining sophisticated electronics with advanced software and powerful drives, the Simrad AP12 autopilot provides accurate and dependable steering in varying sea conditions with minimal current consumption.

The AP12, a state of the art autopilot system with many advanced features, is simple to operate and occupies little space on the dash. Five keys access all functions and pilot status is indicated clearly by LEDs.

To ensure the best results from your autopilot it is essential that the unit is installed correctly - please read this manual thoroughly before attempting installation and use.

Thank you for choosing Simrad

We hope you will also be interested in our full range of marine electronic equipment, which are all manufactured to the same high standards as the AP12. Please contact your nearest Simrad Agent for a catalogue showing our full range of high tech marine electronic equipment.

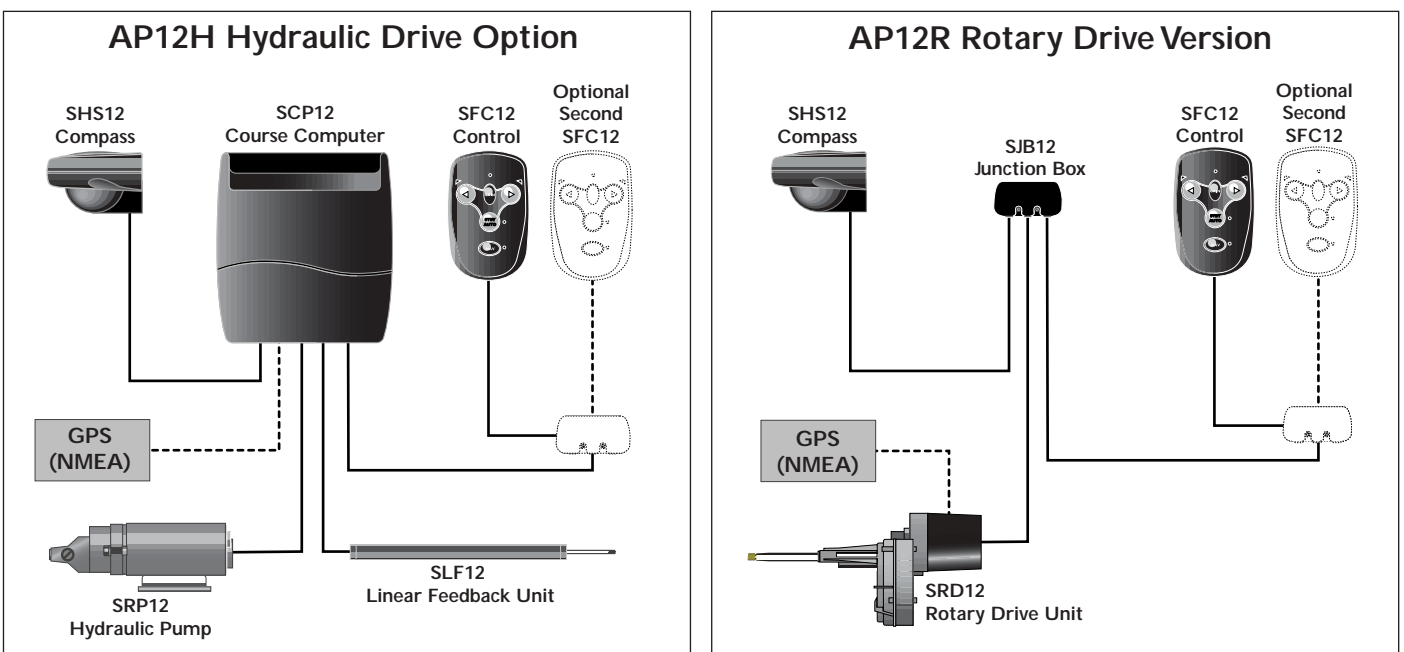
Simrad operate a policy of continual development and reserve the right to alter and improve the specification of their products without notice.

1.2 AP12 System Configurations

The AP12 autopilot system is designed for power vessels and is available in two configurations.

- The **AP12H** - designed for hydraulically steered boats with a ram displacement of 15 in³ (250cc).
- The **AP12R** - designed for powerboats with a push-pull steering cable system which are 30 ft (9M) or smaller in length.

Although the operation and functions of these two versions are identical, there are some differences in the configuration and installation of the AP12H and AP12R. To make installation easier, there are two separate installation sections in this manual. Section 4 relates to the installation of the AP12H Hydraulic version, section 5 is for the AP12R Rotary version. Some of the setup and calibration routines apply only to the AP12H, but this is clearly indicated at the beginning of the relevant section.



2 Operation

2.1 General

The keypad of the AP12 is easy to operate. Using the five keys it is simple to change modes, set the course to steer and adjust navigational functions.

When powered up the AP12 enters Standby Mode indicated by the flashing LED adjacent to the **Stby/Auto** key (Fig 2.1).

While in Standby Mode, the helmsman is in control. The boat can be hand steered using the helm as normal, or “power steered” using the ◀ and ▶ (Port and Starboard) keys on the control head.

- The control unit’s LEDs are always dimly lit, providing night illumination for the keypad. All functions are confirmed audibly by a “beep” and visually by LEDs.

2.2 Autopilot Mode

To engage Autopilot Mode, press the **Stby/Auto** key and the pilot will lock onto the current course. The Stby/Auto LED will be permanently lit while the pilot is in Autopilot Mode (Fig 2.2).

- To lock the pilot onto the desired course, either steer the correct course and then engage the pilot, or engage the pilot and then adjust the heading until the correct course is being steered (see section 2.3).

AP12R Rotary Pilot - it is recommended that if a sudden course change is necessary while in Auto Mode (e.g. to avoid an obstacle) the clutch is disengaged and the autopilot is returned to Standby Mode by pressing **Stby/Auto**. *In an emergency the clutch can be overridden by firmly turning the steering helm, although the autopilot will try to bring the boat back to the set course.*

AP12H Hydraulic Pilot - The autopilot must be disengaged by pressing **Stby/Auto** if a sudden course change is necessary otherwise the autopilot will counteract any movement made manually to the helm.



Fig 2.1 - Standby Mode



Fig 2.2 - Engaging Autopilot Mode



Fig 2.3 - Course adjustment to Port

2.3 Adjusting Course

While in Autopilot Mode, precise course adjustments can be easily made -

- Press the ◀ or ▶ key once to make a 1° course adjustment, confirmed by one beep and the Port or Starboard LED flashing once.
- Press and hold the key for a 10° course change, confirmed by a double beep and a double flash of the Port or Starboard LED (Fig 2.3).

2.4 Nav Mode

The AP12 has an inbuilt interface which allows it to be connected to NMEA0183 compatible equipment such as GPS, LORAN, Chart Plotters etc.

Once connected, the AP12 can steer using data from this source in addition to the compass, allowing a highly accurate course to waypoint (Fig 2.4).

- To enter Nav Mode the pilot must be in Auto Mode and receiving waypoint or route data from the navigational receiver.

Press the **Nav** key to activate Nav Mode (Fig 2.5). The Nav LED will light and the pilot will steer to the first waypoint.

- If no NMEA data is being received, the AP12 will beep twice and will not enter Nav Mode.
- If the **Nav** key is pressed while in Standby Mode, the pilot will beep once if Nav Mode is available when in Auto Mode, or twice if Nav Mode will not be available.

At the target waypoint, an intermittent alarm will sound. As a safety feature (to avoid an unexpected course change) the next waypoint will not be loaded until the **Nav** key is pressed again. When the boat reaches the final waypoint, the pilot will switch back to Auto Mode, holding the current course.

Note - If a course correction is made while in Nav Mode using the ◀ and ▶ keys, the boat will gradually return to the original track (Fig 2.6), so the boat can “dodge” an obstacle without exiting Nav Mode or having to reset the boat on the correct course.

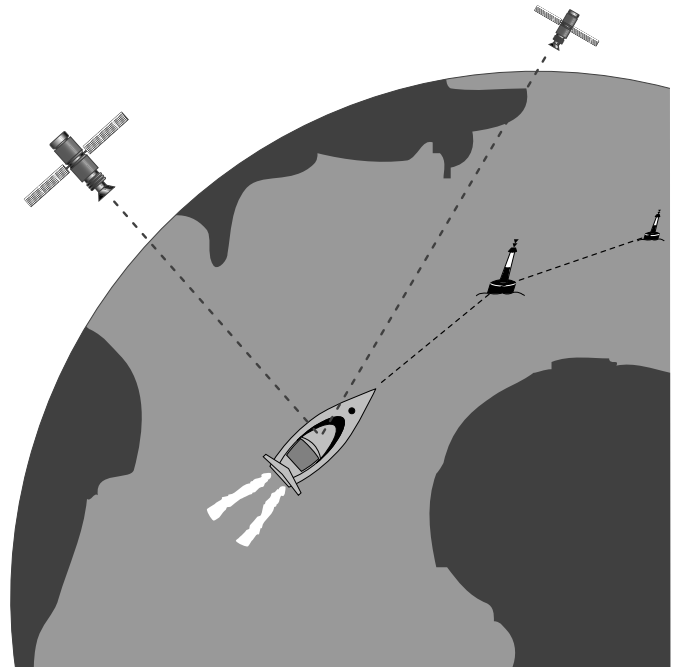


Fig 2.4 - Nav Mode - Steering by satellite



Fig 2.5 - Activating Nav Mode

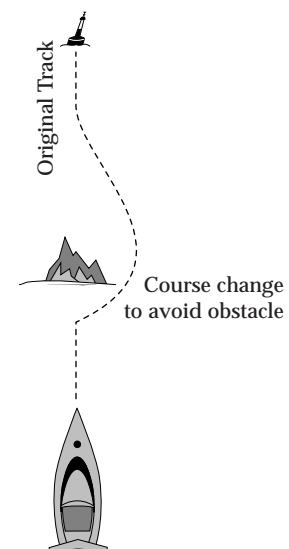


Fig 2.6 - Course Adjustment in Nav Mode

3 Parameter Adjustment

The AP12 uses highly advanced steering software, which constantly assesses how the boat is being affected by the sea conditions. By adjusting its own performance, the pilot is able to maintain the most accurate course for these conditions, just as a human pilot would. So in a rough sea, the pilot is not overworked and battery drain is kept to a minimum. While the Gain is adjusted manually to suit the boat, all other performance functions are totally automatic.

3.1 Rudder Movement (Gain)

The AP12 will make corrections if it detects that the boat is off course. How much rudder it applies to correct this is set by the Gain (sometimes referred to as the rudder ratio).

- The Gain setting can be compared to driving a motor vehicle - at high speeds, very little helm movement is necessary to steer the vehicle (**LOW Gain**). When driving at slow speeds, more helm movement is necessary (**HIGH Gain**).

- Fig 3.1A shows when the Gain is too low: the boat takes a long time to correct the heading.
- Fig 3.1B is ideal - errors are quickly corrected.
- Fig 3.1C the Gain is too high - the boat starts to “S”, or oscillate around the correct heading.
- Excessive Gain (Fig 3.1D) makes the boat oscillate increasingly off course.

The Gain can be adjusted in all modes, without interrupting the operation of the pilot.

Press the Gain key - the Gain LED will flash and beep a repeated sequence. The number of flashes / beeps in the sequence indicates the Gain setting (1-9). The default setting is 5, which should give good course keeping in most situations.

To increase the Gain press the ► key the required number of times, to a maximum level of 9 (Fig 3.2). To decrease the Gain press the ◀ key the required number of times, to a minimum level of 1.

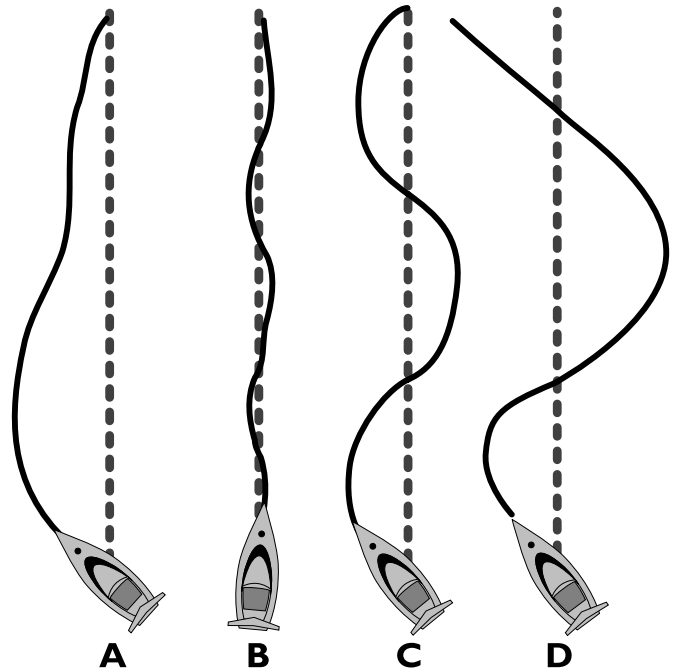


Fig 3.1 - Effects of Gain setting



Fig 3.2 - Increasing Gain level

- For example: If the Gain was set at 4 (four flashes of the Gain LED and four beeps) and the Gain needed to be increased to 7, pressing the ► key three times would adjust the Gain accordingly. The Gain LED would then flash seven times and seven beeps would be heard.

To exit Gain mode, press **Gain** again (the pilot will exit Gain mode automatically if no key is pressed after three flash/beep cycles).

3.2 Seastate

In a rough sea, more heading errors will be detected by the pilot as the heavy seas yaw the boat back and forth. The pilot would normally be overworked trying to correct every error, causing unnecessary strain on the unit and excessive drain on the batteries.

The AP12 monitors the course errors as it goes and it allows a “dead band” within which the boat can go off course without corrections being made (Fig 3.3). This is automatically set and updated by the pilot to give the best compromise between course holding and battery consumption.

3.3 Autotrim

To compensate for changing conditions, a rudder bias (sometimes known as rudder trim) is applied in order to steer a straight course. The amount varies according to factors such as wind strength, boat speed, and trim tab setting. If this was not done then the boat would tend to veer off course.

The AP12 monitors the average course error and applies a bias to the rudder to compensate until the optimum condition is reached (Fig 3.4). This bias is applied gradually to not upset the normal performance of the pilot, so it may take a minute or so to fully compensate after a major course change.

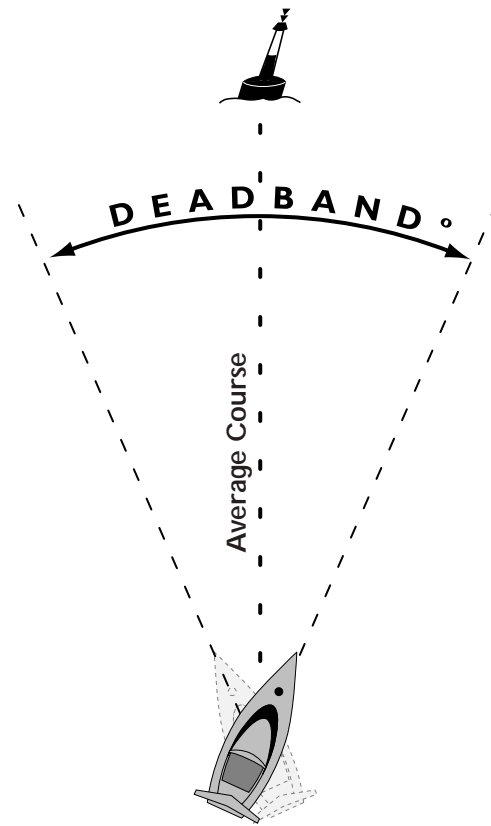


Fig 3.3 - Seastate “deadband”

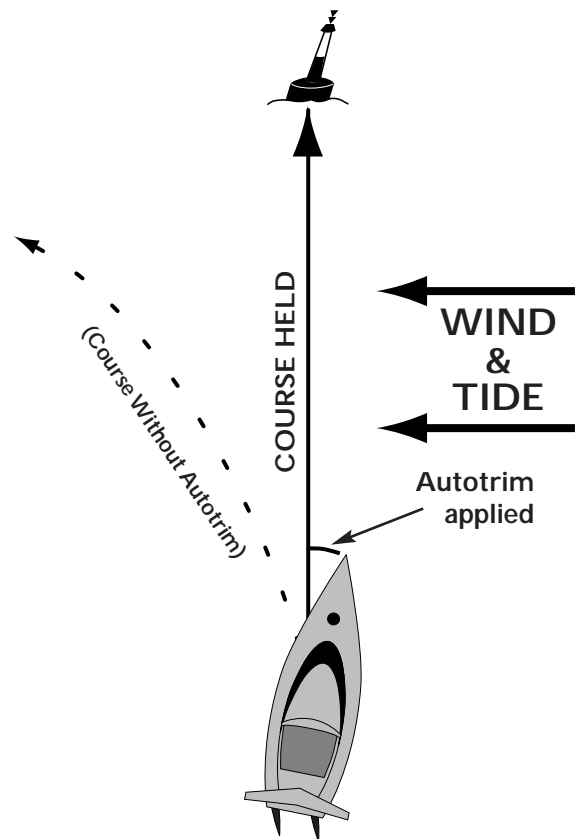


Fig 3.4 - Autotrim principle

4 Installation - AP12H

Section 4 covers the installation of the AP12H Hydraulic version. Please refer to section 5 for AP12R Rotary version installation instructions.

4.1 Pump Installation

The AP12H links a reversing pump into the existing hydraulic steering system on the boat using T-fittings. The pump reproduces the effect caused by turning the helm, so the pilot can steer the boat without attaching any device directly to the helm.

Confirm that the volume of the cylinder of the hydraulic ram is within the capacity of the SRP12 pump. For the pilot to operate efficiently, the cubic capacity of the boat's ram must be less than 250cc (15 in³). With hydraulic systems the ram size is related to the steering load.

- If the volume of the ram cylinder is not known then an approximate calculation can be made for a balanced cylinder (these have the rod emerging from both ends of the cylinder - unbalanced rams have the rod emerging from one end only - Fig 4.1).

$$\text{Volume} = 3.142 \times S(R^2 - r^2)$$

S = Stroke length

R = Cylinder bore radius

r = Push rod radius

If S, R and r are in inches, the volume will be in cubic inches (in³). If they are in centimetres, then the volume will be in cubic centimetres (cc).

An ideal location for the pump is in a gas/inflammable vapour free area, where it will not be immersed in water.

The pump accepts hoses with 1/2in NPT fittings. NPT to BSP adaptors are supplied with European versions to convert BSP hoses to NPT type if necessary (Fig 4.2).

- Try to keep hydraulic fluid loss during connection to the pump as low as possible - this will help to reduce the time and effort required later to bleed the system of trapped air.

- Absolute cleanliness is essential - even the smallest particle of dirt could clog the check valves in the pump.

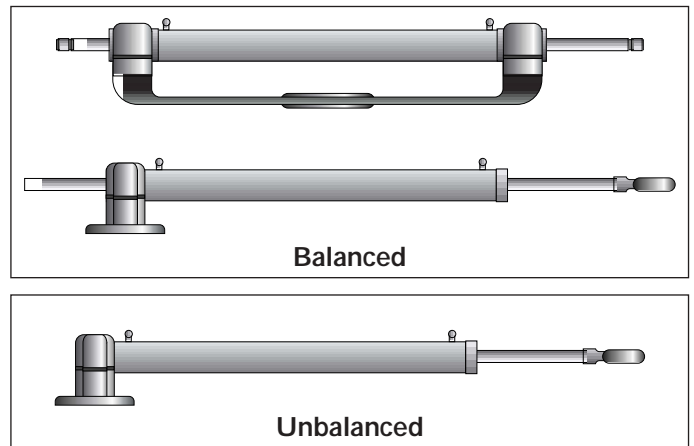


Fig 4.1 - Hydraulic ram types

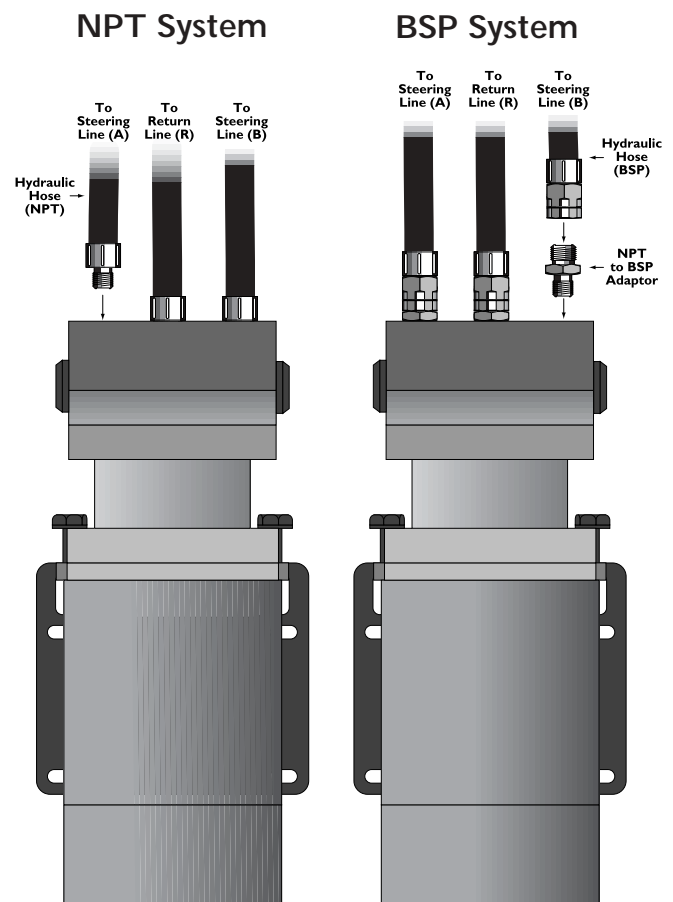


Fig 4.2 - SRP12 pump hose connections

- The helm unit must be fitted with check valves - most are fitted as standard. If not, it will be necessary to install a separate check valve between the helm unit and the SRP12 pump.

Fig 4.3 shows the correct connection for the most common steering configurations on boats with hydraulic steering. If the boat has a different steering system to the ones shown then consult the steering manufacturer or a qualified marine engineer before attempting to install the SRP12.

- **The hydraulic pump can be mounted in any orientation except upside down - that is, mounted with the valve ports pointing straight down. The pump will not prime in this position.**

Choose a location so that it can connect easily with the existing hydraulic system - check that there is easy access to the pump hydraulic connections and valves before mounting. Bolt the unit securely to a sturdy part of the boat to avoid vibration that could damage the interconnecting hoses.

Remove the protective plugs from the valve ports and connect the pump to the steering system using flexible hoses to reduce the vibration being transmitted from the pump to the hydraulic lines. Make sure that the correct fittings are used and fit the NPT to BSP adaptors if necessary. If it is necessary to seal a tapered fitting use a recommended hydraulic oil sealant - **never use PTFE tape.**

- If the boat has a pressurised steering system, always release the air through the valve on the reservoir before cutting the hydraulic lines.
- It is not important which way round the pump outlet connections A & B are connected to the steering lines, as the pilot automatically sets the correct polarity when the unit is configured.

4.2 Bleeding The Steering System

The hydraulic system should be bled according to the manufacturer's instructions. Make sure the correct oil is used to fill the system. If there are no manufacturer's instructions available then follow these basic instructions -

- Bleeding the steering system is a job for at least two people - one at the helm and one at the ram.
- Allow at least 2 litres (4 pints) of hydraulic fluid when bleeding a single helm system, plus an extra litre (2 pints) for each additional steering position.
- Use a cup to catch oil lost during bleeding - the oil can be reused if filtered through a fine mesh first. Any contamination could clog or impair the functioning of the steering system.
- These instructions assume that turning the helm clockwise will extend the ram and turning it counter-clockwise will retract it. The cylinder may be installed the other way around so that the helm is turned counter-clockwise to extend the ram. Check the orientation before bleeding.

4.2.1 Two or Three Line Systems

1. Fill the helm or reservoir to the indicated fill line..
2. Loosen the hose fitting to port A on the SRP12 pump.
3. Turn the helm slowly from lock to lock until a steady stream of oil comes from the hose fitting. Retighten the hose fitting.
4. Repeat steps 2 & 3 with port B.
5. Repeat steps 2 & 3 with the return (R) port.
6. Prime the SRP12 pump by connecting it directly to 12v and driving the rudder to the endstop (Red to 12v+, Black to Ground). Reverse the connections (Black to 12v+, Red to Ground) to run the pump to the other endstop. Make sure that the oil level in the helm/reservoir is kept topped up while doing this. **NOTE - Running the pump dry for more than a few seconds can damage it. The hoses running to the pump must be primed by following steps 2 to 5.**

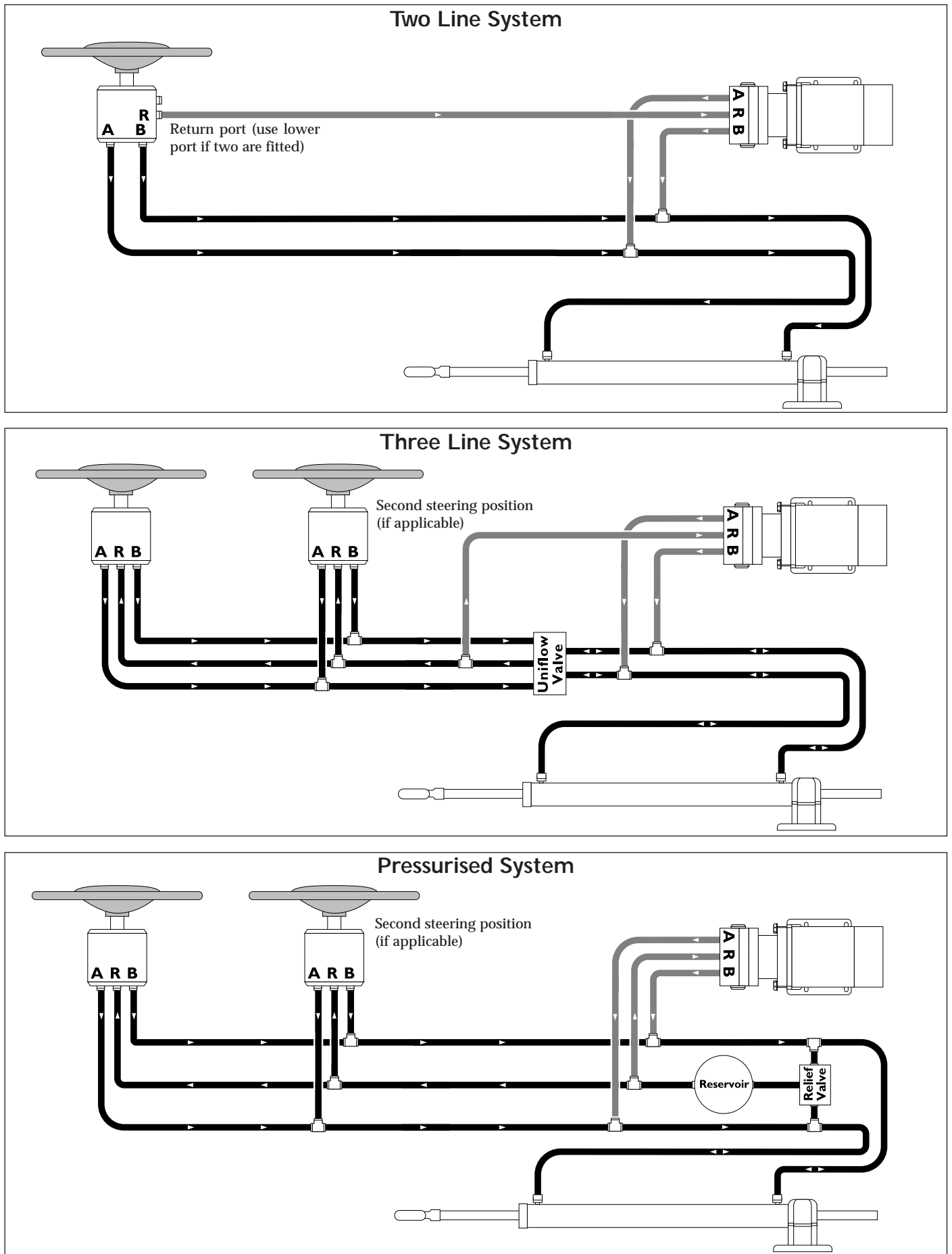


Fig 4.3 - Connecting pump to common hydraulic steering configurations

7. Turn the helm clockwise until the ram is fully extended.

8. Open the bleed valve on the ram cylinder nearest to the extended ram. If there are no bleed valves fitted to the cylinder, loosen the nut connecting the hydraulic hose to the cylinder to allow the air to escape. **Do not completely undo the bleed valve or nut.**

9. Holding the ram to stop it retracting into the cylinder, turn the helm anti-clockwise until a steady stream of oil comes out of the bleeder with no air bubbles (Fig 4.4). Drain at least ½ litre (1 pint) of oil to ensure all air is purged from the system. Retighten the bleed valve.

10. Keep the reservoir/helm unit filled up as oil is pushed down into the system. **Never allow the oil level to drop below the rotor which can be seen through the top filler hole in the helm pump.**

11. When all the air has been bled from the lines, keep hold of the ram and slowly turn the helm while tightening the bleed valve/nut.

12. Release ram and continue to turn the helm counter-clockwise until the ram is fully retracted.

13. Open the bleed valve/hose nut on the opposite end of the cylinder.

14. Holding the ram to stop it extending from the cylinder, turn the helm clockwise until a steady stream of oil comes out of the bleeder with no air bubbles (Fig 4.5). Drain at least ½ litre (1 pint) of oil to ensure all air is purged from the system. Retighten the bleed valve.

15. Keep the reservoir/helm unit filled up as oil is pushed down into the system, taking care that the oil level never drops below the rotor which can be seen through the top filler hole in the helm pump.

16. When all the air has been bled from the lines, keep hold of the ram and slowly turn the helm while tightening the bleed valve/nut.

17. Maintain the helm or reservoir at the indicated fill line.

18. Check every joint and tube for leaks.

19. Fasten all tubing down to prevent fracture due to vibration.

20. The manufacturer's instructions should give details of the correct number of turns lock to lock when the system is properly bled. An excessive number of turns indicates that there is still air in the system.

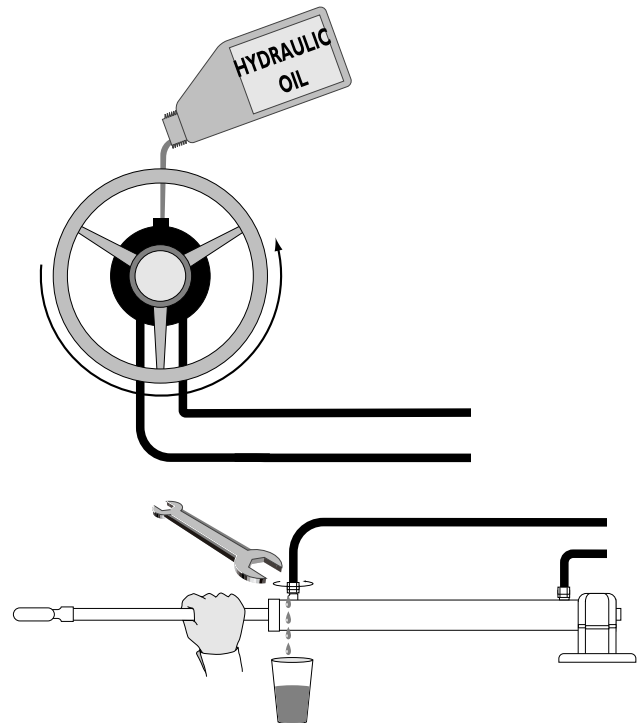


Fig 4.4 - Bleeding starboard hydraulic line

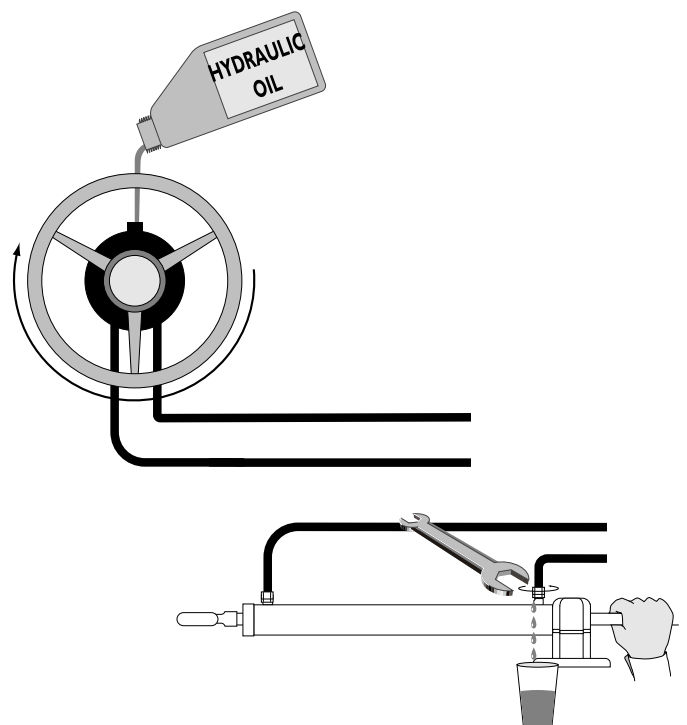


Fig 4.5 - Bleeding port hydraulic line

4.2.2 Pressurised Systems

Bleeding a pressurised system is a more complicated procedure than a standard two or three line system. Simrad recommends that you enquire with the steering system manufacturer for specific bleeding instructions. However, the following instructions apply to most Hynautic or similar pressurised systems.

1. Loosen the relief valve screws. Unscrew by hand counter-clockwise as far as they will go.
2. The reservoir should be fitted with an air valve of the type used on car tyres. Connect a foot pump or compressed air line to the valve and begin to pressurise the system slowly (Fig 4.6).

3. As the system is pressurised, the oil level in the reservoir should drop as it is forced into the system. Stop pressurising the system if the oil level drops below the fill line - release the air pressure in the system through the air valve by pushing the centre pin, remove the reservoir filler cap and top up the reservoir. Replace the filler cap.

4. Continue pressurising the system and topping up the reservoir until the manufacturer's recommended pressure is reached.

5. **Do not allow the reservoir to empty. Always depressurise the system as described in step 3 before removing the reservoir filler cap.**

6. Loosen the hose fitting to port A on the SRP12 pump.

7. Bleed until a steady stream of oil comes from the hose fitting. Retighten the hose fitting.

8. Repeat steps 6 & 7 with port B.

9. Repeat steps 6 & 7 with the Return (R) port.

10. If there is more than one steering position, start with the highest helm. Turn the helm slowly (less than $\frac{1}{2}$ revolution per second) 6 times in **one direction only**.

11. Repeat the above step with each successive lower helm position (Fig 4.7). **This includes the SRP12 pump.**

12. Prime the SRP12 pump by connecting it directly to 12v and driving the rudder to the endstop (Red to 12v+, Black to Ground). Reverse the connections (Black to 12v+, Red to Ground) to run the pump to the other endstop. Make sure that the oil level in the helm/reser-

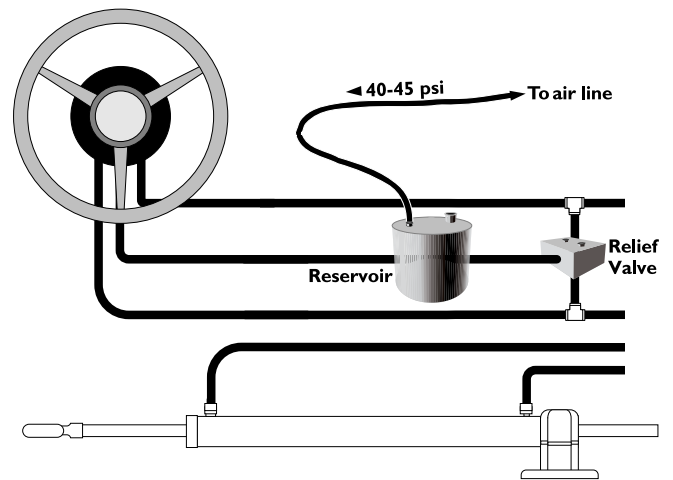


Fig 4.6 - Pressurising steering system

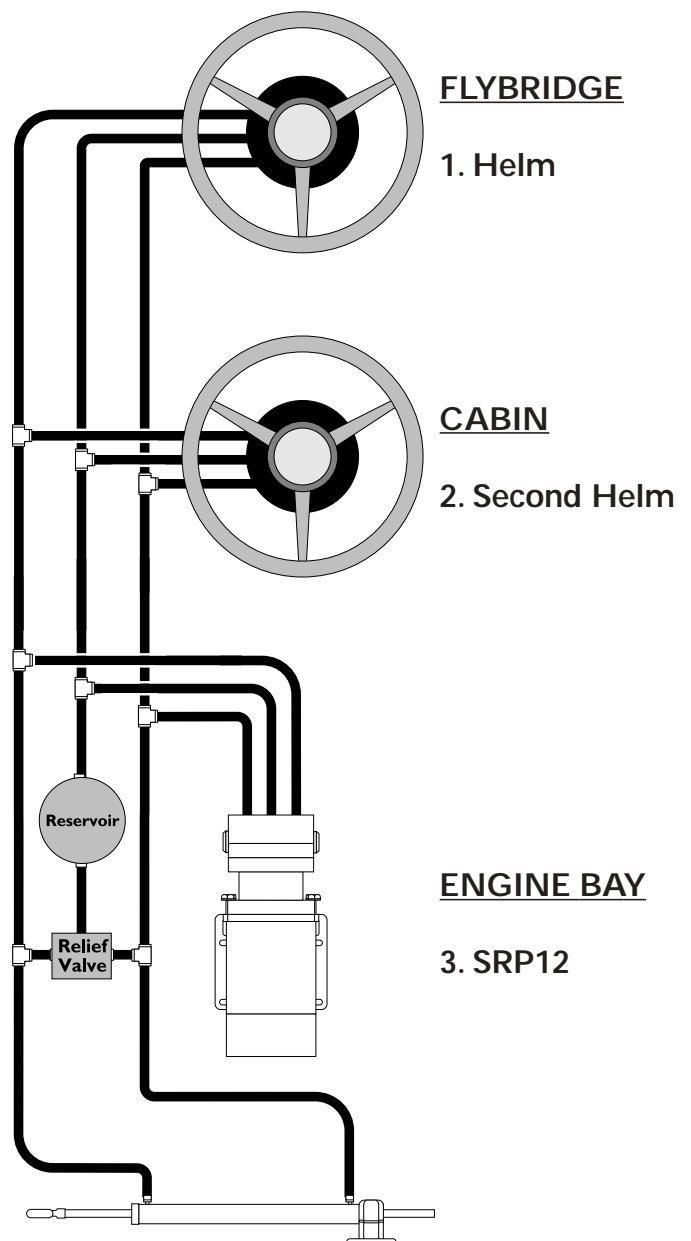


Fig 4.7 - Purging sequence

voir is kept topped up while doing this. **NOTE** - Running the pump dry for more than a few seconds can damage it. The hoses running to the pump must be primed by following steps 6 to 9.

13. After completing the cycle with each helm position to the lowest position (including the SRP12 pump) loosen the bleed valves (or the hose fittings if there are no bleed valves) on the ram cylinder one at a time, allowing air to bleed out until a steady stream of oil comes out of the bleeder with no air bubbles. Drain at least ½ litre (1 pint) of oil to ensure all air is purged from the system. Retighten the bleed valve.

14. Check the reservoir level. If it is less than half full, depressurise the system, remove the filler cap and top up the oil level. Pressurise the system until the manufacturer's recommended pressure is reached.

15. Repeat steps 10 to 14, turning each helm in the opposite direction.

16. Retighten the two relief valve screws.

17. Turn one of the helms hard over.

18. Open the bleed valve/fitting on the ram cylinder at the end that the ram is **extended** from. Bleed until there is a steady stream of oil with no air bubbles (Fig 4.8). Retighten the bleed valve.

19. Turn the helm hard over in the opposite direction. Repeat step 18, opening the opposite bleed valve this time (Fig 4.9).

20. Check the reservoir fluid level - leave reservoir ½ to ¾ full.

21. Pressurise the system until the manufacturer's recommended pressure is reached.

22. The manufacturer's instructions should give details of the correct number of turns lock to lock when the system is properly bled. An excessive number of turns indicates that there is still air in the system.

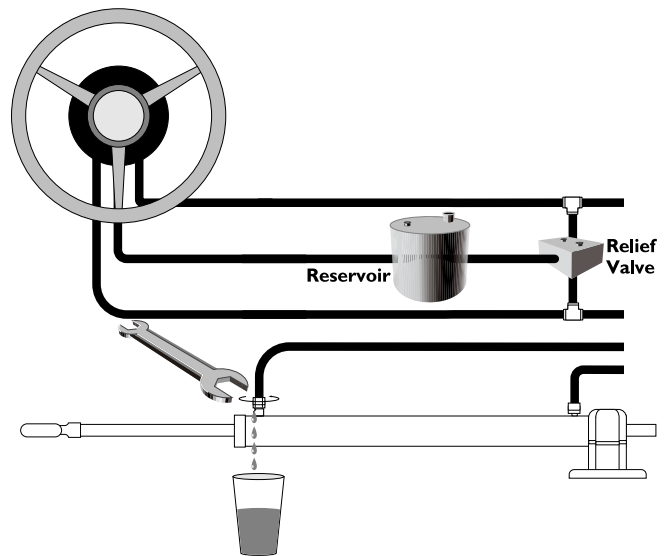


Fig 4.8 - Bleeding first hydraulic line

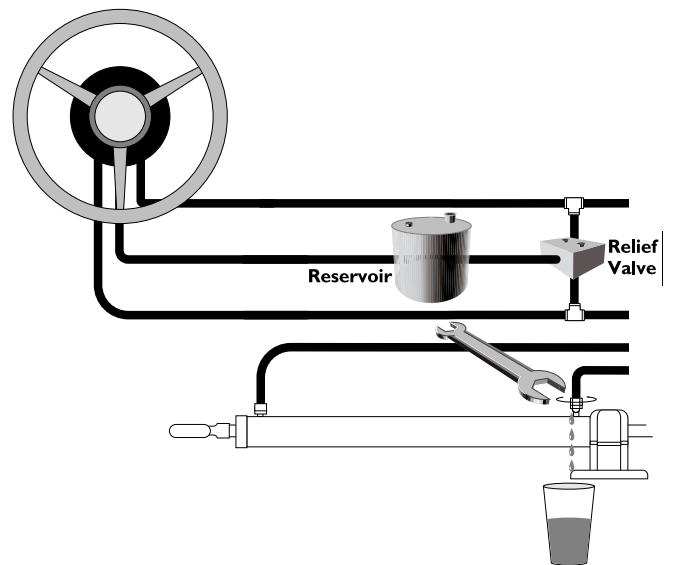
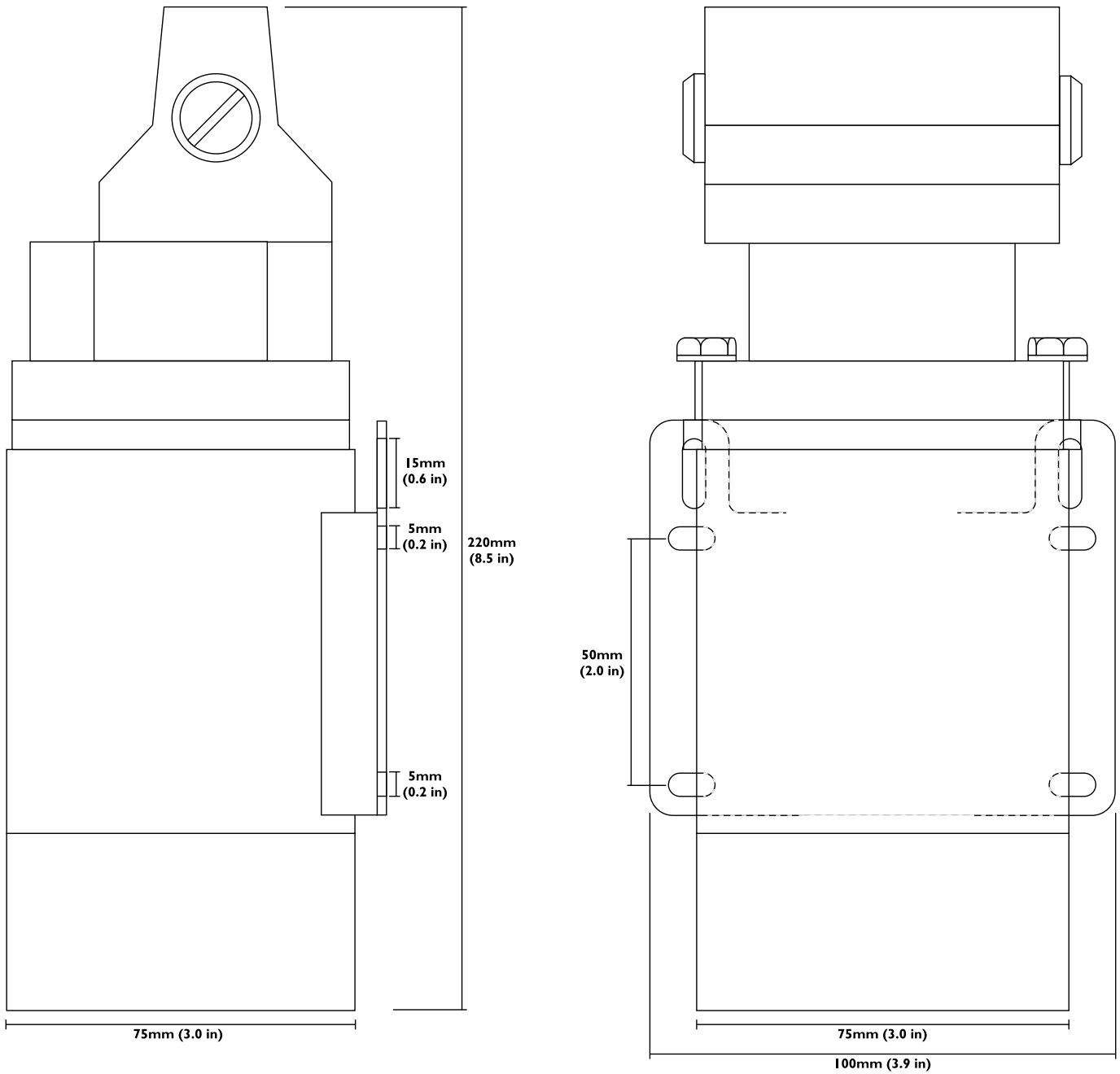


Fig 4.9 - Bleeding second hydraulic line



Components supplied -

M5 x 25mm st stl hex set screw	x 4
M5 st stl plain washer	x 8
M5 st stl full nut	x 4
$\frac{1}{4}$ in(NPT) - $\frac{1}{4}$ in BSP adaptor	x 3 (European version only)

Fig 4.10 - Hydraulic pump & mounting dimensions

4.3 Linear Feedback Unit SLF12

The Linear Feedback Unit SLF12 measures the rudder position and can be installed on most types of boat, including I/O or Outboard drives. It is important that the SLF12 is properly installed with the maximum possible stroke (minimum 150mm [6.0 in]), or it will not give an accurate reading.

The SLF12 is mounted onto the hydraulic ram cylinder using two mounting saddles (Fig 4.11). Make sure that the maximum stroke of the hydraulic ram is less than the 300 mm (12.0 in) maximum stroke of the SLF12. The saddles support the SLF12 body, and can then be positioned on the back of the ram cylinder. Check that the SLF12 and ram are exactly parallel. Use the cable ties supplied to secure the SLF12 and saddles onto the ram.

The SLF12 rod is attached to the ram using the fixing kit supplied (Fig 4.12). Fit the U-bolt and bracket to the ram, checking that it will not interfere with the movement of the ram at any point of steering. Rotate the assembly until the SLF12 rod can be fixed to the slot in the bracket using the two nuts supplied (Fig 4.13) Refer to section 6.3 before tightening the nuts.

When satisfied with the positioning, tighten the U-Bolt nuts fully, and then turn the helm hard over from lock to lock, checking that the SLF12 rod does not bend at any time - this means that the SLF12 is not exactly parallel to the ram, and should be adjusted accordingly.

If the SLF12 cannot be fixed to the ram as described, an accessory kit is available separately (part LFK500) which can be ordered through your local Simrad agent. This contains a separate mounting foot and balljoint assembly for the end of the feedback rod, allowing the SLF12 to be independently fixed to the rudder arm.

- Do not fix the SLF12 directly to the rudder arm if it is attached to the ram using the mounting saddles, as the feedback rod will bend when the rudder is at full lock.
- If connecting to a Teleflex HC5345 steering cylinder the optional LFKSeastar kit should be ordered.

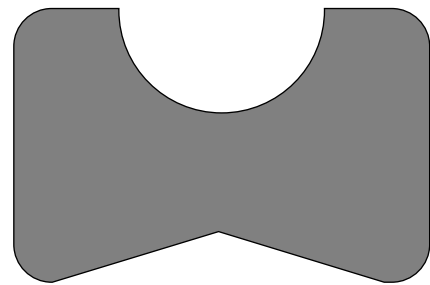


Fig 4.11 - Mounting saddles (x 2)

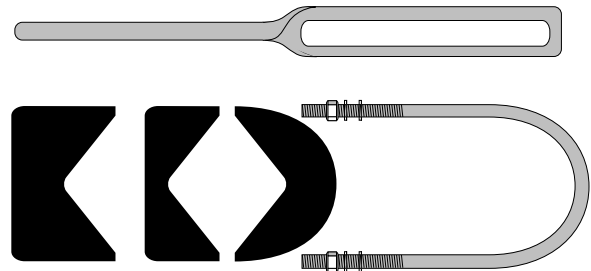


Fig 4.12 - Fixing kit

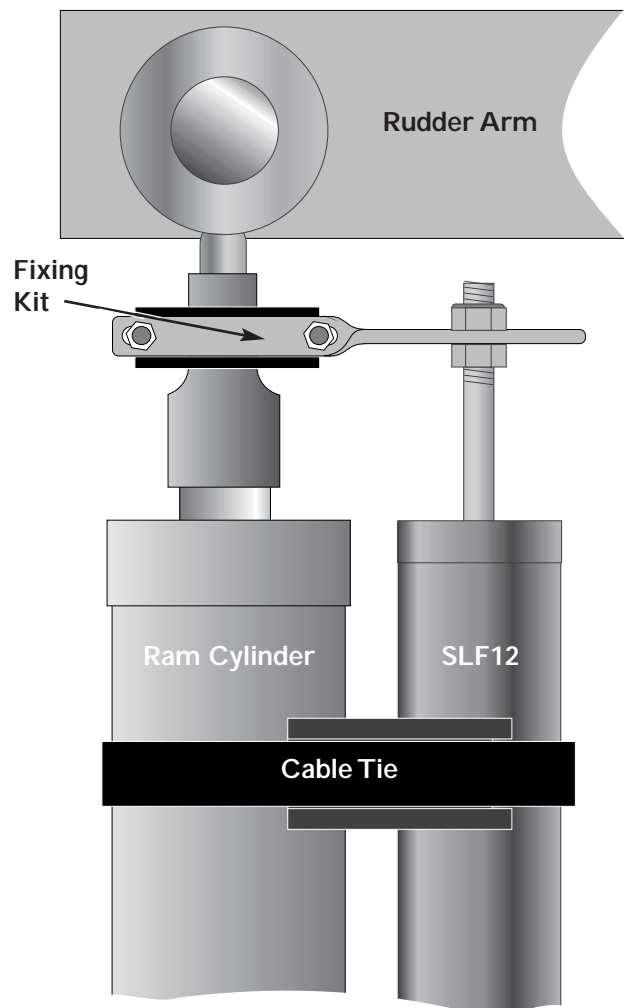


Fig 4.13 - Ram mounting using fixing kit

4.4 Fitting Control Unit SFC12

The control unit SFC12 is held in place using a single bolt and only needs two holes to be drilled. It should be located where it can be easily reached, such as on the dashboard next to the steering position.

- Check that the location is suitable - there should be at least 40mm (1.6 in) clearance behind the dashboard for the shaft and cable.

Mark the centres of the two holes where the control unit is to be positioned with a centre punch, one 38mm (1.5in) vertically above the other. Drill a 25mm (1.0 in) hole at the top mark, and a 5mm (0.2in) hole at the lower mark.

- If drilling into glassfibre (GRP), use a low speed setting on the drill and countersink the holes afterward to avoid cracking or splitting the gelcoat.

Pass the cable through the larger hole and through the fixing nut. Tighten the nut to fix the control unit into place (**do not overtighten**), making sure that the locating peg fits correctly into the smaller hole (Fig 4.14). Check that the cable is not obstructed or kinked before connecting up.

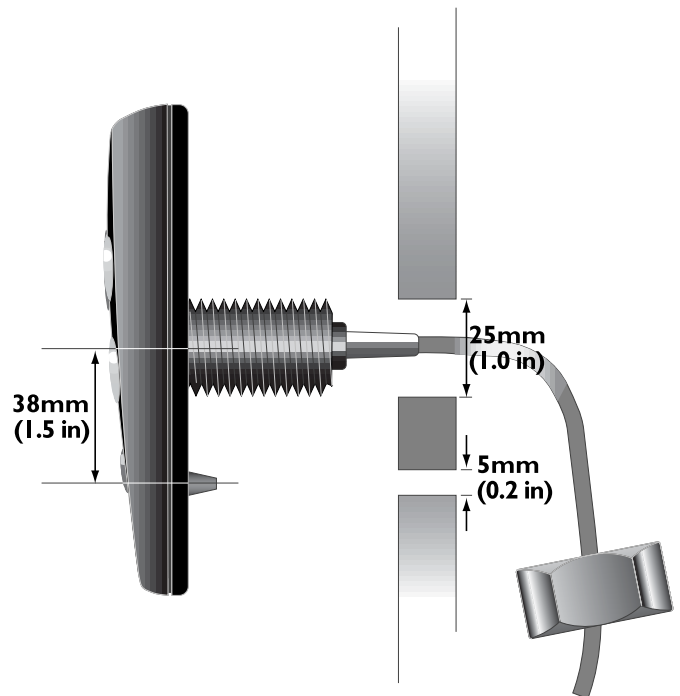


Fig 4.14 - Mounting control unit

4.5 Fitting Compass Unit SHS12

The compass should be positioned as close to the centreline of the boat as possible (Fig 4.15), in one of four possible orientations (see section 6.2). If the boat is GRP or wooden, the compass can be mounted below deck, but must be at least 1m (3 ft) away from any metallic objects such as stereo speakers, heating units etc.

- If the boat has a metal hull (this includes ferrocement), the compass must be mounted above decks on a mast or pole between one and two metres (3 to 7 feet) above deck.

When mounting, make sure that the compass is the right way up and is level. The compass unit can be screwed to a vertical bulkhead using the two No.6 x 3/4in self tapping screws provided. If screwing into GRP, drill pilot holes and countersink them properly, which will stop the gelcoat splitting when the screws are tightened.

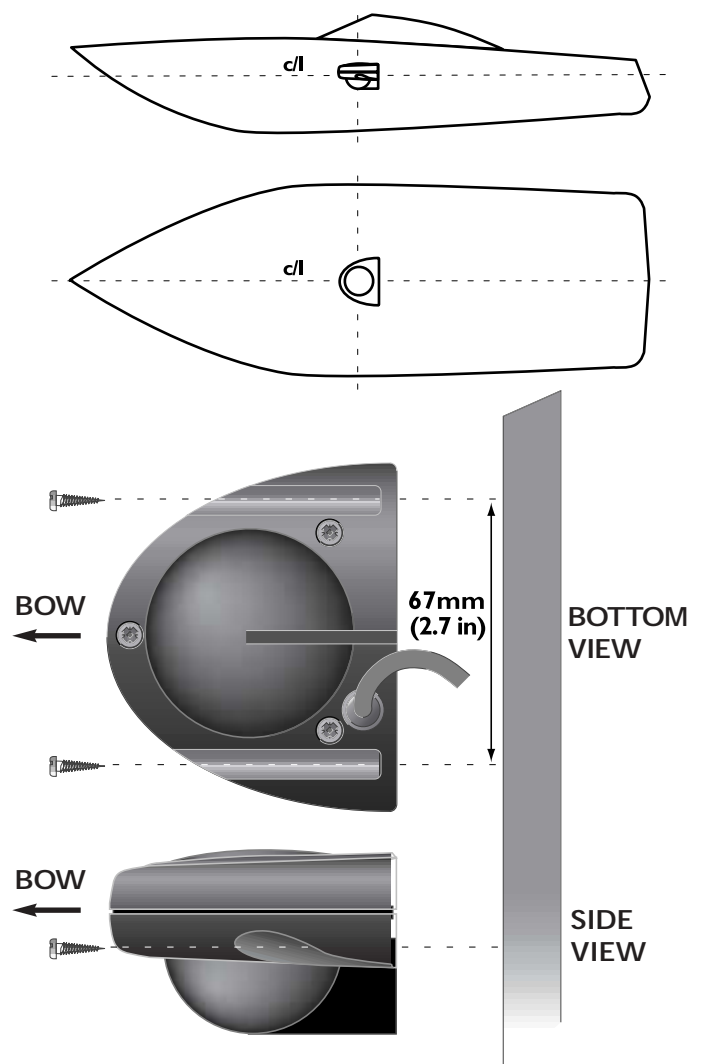


Fig 4.15 - Mounting compass unit

4.6 Fitting Course Computer SCP12

Locate the course computer in a moisture, heat and vibration free area, somewhere between the boat's power source and the pump to minimise power cable lengths.

- The SCP12 should be mounted vertically with the cooling fin uppermost, and be easily accessible once installed.

The unit is held in place using three No.6 x 1 in self tapping screws. To access the mounting holes, remove the terminal cover by loosening the three screws holding it in place. Drill and countersink three pilot holes in the indicated positions if screwing to GRP (Fig 4.16).

4.7 Electrical Installation

- The SCP12 should be connected to the boat's battery via the main switch panel with a properly rated breaker or fuse and switch. It will be much easier to configure the rudder limits if the switch is close to the SFC12 control.

- All AP12H components wire directly to the SCP12 course computer. The terminal bay is clearly labelled, and each terminal block has a specific cable channel.

- It is important that the correct diameter cable is used to supply the 12v power to the SCP12, depending on the length of run necessary (Fig 4.17). For this reason, the SCP12 should be fitted as close to the power supply and pump as possible.

The SLF12, SFC12 and SHS12 are all connected to the course computer using three conductor cables (red, white and black). Each cable is connected to the marked terminal in the connection bay (Fig 4.18). For good connections, wire ends should be tinned if the cables are shortened. Poor connections will impair performance.

- The cables should be kept away from cables which carry radio or pulsed signals (1m / 3 Ft minimum distance is recommended).

Each cable should then be led through the appropriate cable channel, which will hold the cables firmly in position when the terminal cover is replaced.

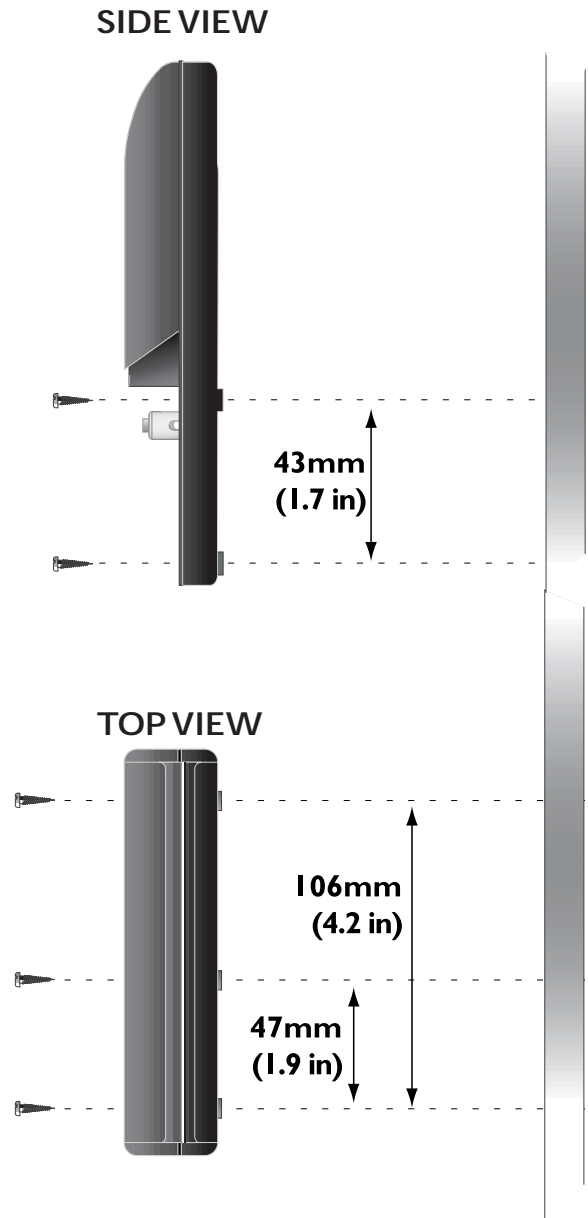


Fig 4.16 - Mounting Course Computer

Length of Cable Run	Cross Section Area	Conductor Type	AWG
Under 5M (16.6Ft)	2.5mm ²	50/0.25	13
5-10M (33.3Ft)	4mm ²	56/0.3	12

Fig 4.17 - Cable selection table

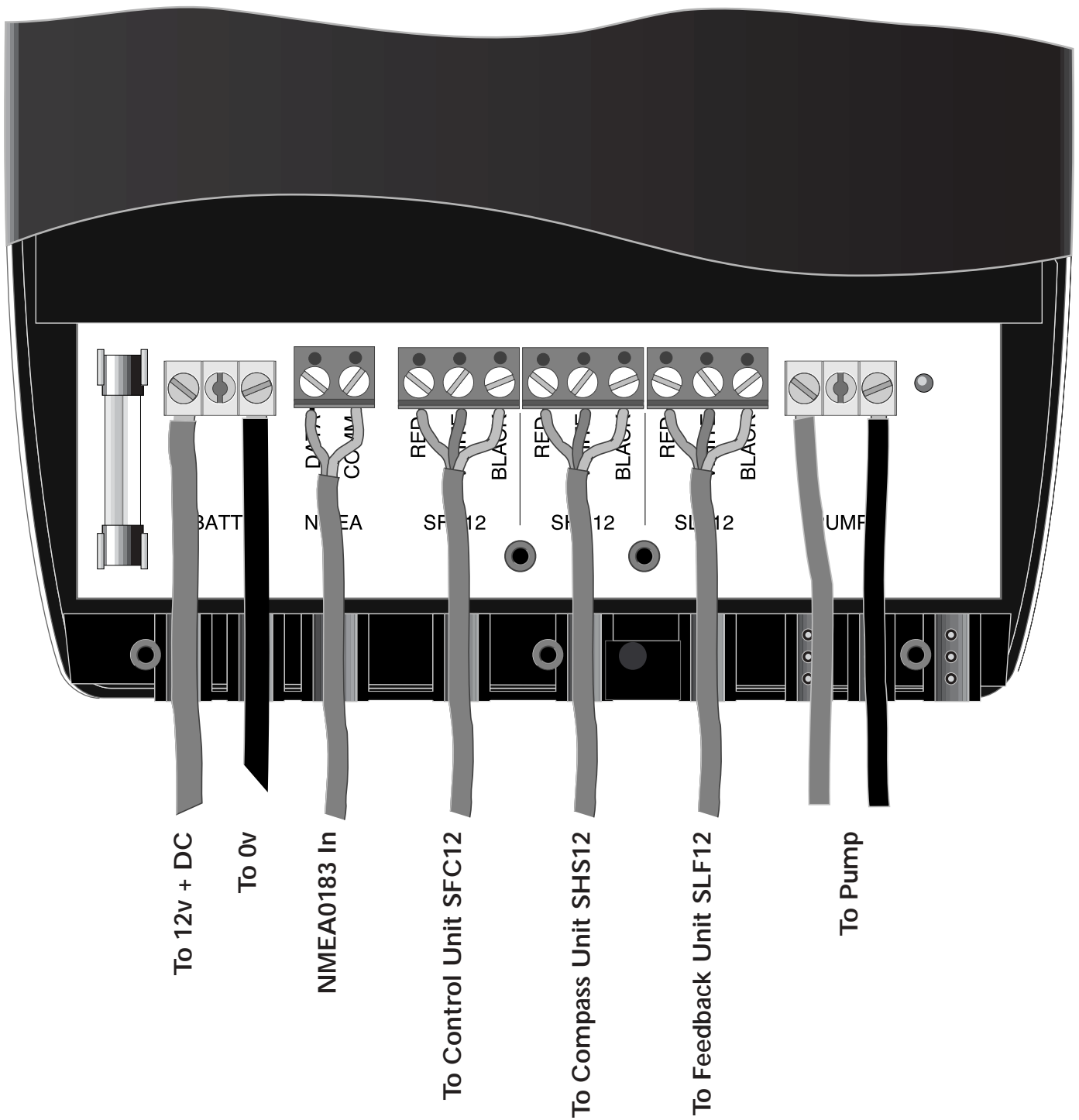


Fig 4.18 - Course Computer SCP12 connections

4.8 Interfacing via NMEA

The AP12 includes a built in NMEA0183 interface so GPS, Loran and Chart Plotters can be connected directly to it. This allows the Nav Mode (Steer to GPS) function to be used.

To interface with the AP12, the **NMEA OUT** connections of the equipment should be wired to the respective NMEA IN Data and Common (COM) terminals of the AP12 course computer (Fig 4.19).

- Some manufacturers may refer to the connections as NMEA OUT + and - instead of NMEA Data and Common.
- Certain equipment may have connections marked NMEA IN. Do not use these.
- If the equipment does not have a NMEA Common (or -) connection, the NMEA Common terminal of the SCP12 course computer should be connected to ground by linking it to the BATT - terminal (Fig 4.20).
- If the vessel has more than one battery bank, when connecting the AP12 to the power supply always check that the pilot and the receiver are not connected to a different battery bank. This is to avoid a possible voltage drop between the interfaced equipment which would render the equipment inoperative.
- The receiver must be running an active route or waypoint for the Nav Mode function to operate.

- While any NMEA0183 compatible receivers should interface with the AP12, Simrad cannot guarantee operation with other manufacturer's equipment, as the Nav Mode function is dependant on specific NMEA0183 sentences of the correct format being available (see section 7.3). Read the relevant section in the receiver's manual before attempting to interface the AP12 with this equipment. If necessary, contact the manufacturer's technical support department or speak to a qualified technical dealer.

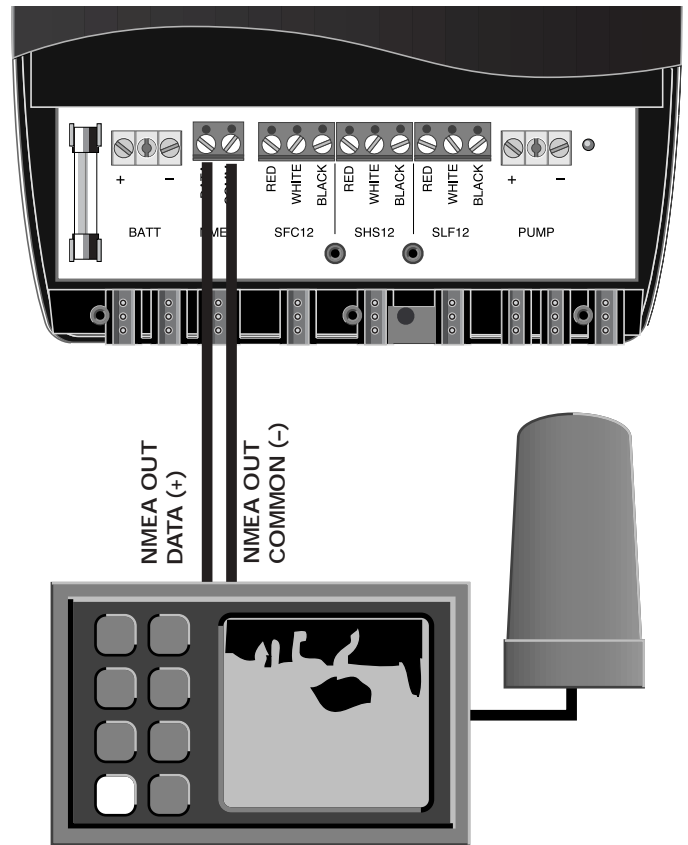


Fig 4.19 - Connecting using NMEA interface

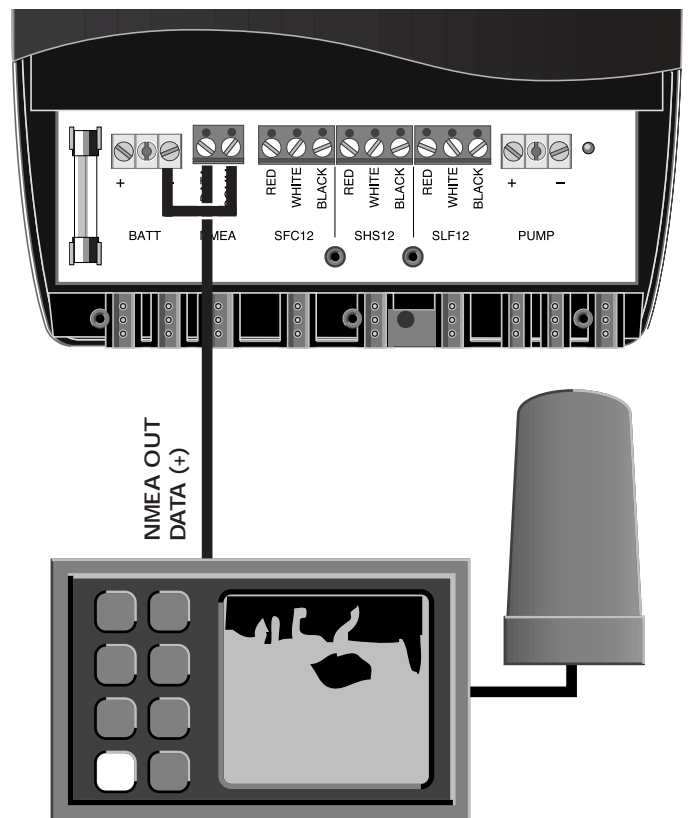


Fig 4.20 - Connecting using NMEA interface :
no Common (-) wire

5 Installation - AP12R

Section 5 covers the installation of the AP12R Rotary drive version only. Please refer to section 4 for AP12H Hydraulic version installation instructions.

5.1 Drive Installation

The SRD12 drive is a combined steering helm and gearbox which completely replaces the existing steering helm unit (Fig 5.1).

The drive unit is based on the popular Morse CMD290 helm unit and is directly compatible with this.

- The drive can also be fitted onto boats using other systems including Teleflex, Uflex, Acco, Mercury, Volvo Penta, Detmar, rack and pinion etc. Depending on the system, it may be necessary to fit an adaptor or change the cable and dashboard bezel kit. Refer to the table below for more details. All codes quoted are Morse part numbers and are available from Morse suppliers.

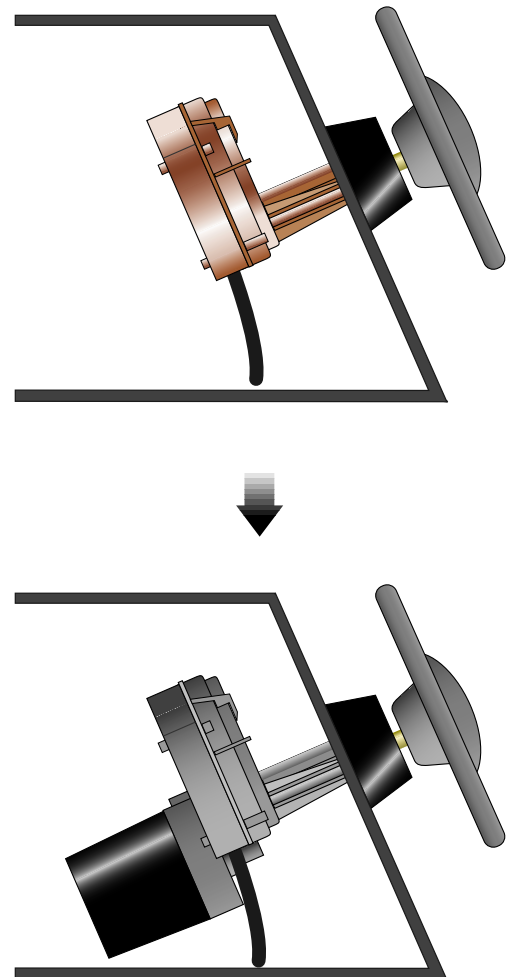


Fig 5.1 - SRD12 totally replaces helm unit

AP12R Compatibility Guide				
Helm System	Cable Adaptor Needed	Bezel Kit Needed		Cable Needed
		20°	90°	
Morse CMD290	NO	NO	NO	NO
Morse CMD250	NO	308561	308559	NO
Morse CMD200 rack & pinion	NO	306527	306504	304411-xx*
Morse CMD2	NO	306527	306504	304411-xx*
Teleflex Safe-T / Big-T	300959	308561	308559	NO
Teleflex rack & pinion	NO	308527	308504	304411-xx*
Teleflex Non-feedback	NO	308561	308559	NO
Teleflex Quick Connect Safe-T	NO	308561	308559	NO
Volvo	NO	308561	308559	NO
Detmar Square or Round Rack	NO	308561	308559	304411-xx*
ACCO / Mercury Wheel must also be changed for one with a 18.75mm (¾ in) shaft	NO	308561	308559	304411-xx*

*xx = length in inches (1 inch = 25mm)

To be able to fit the AP12R to the boat, the following basic requirements must be met -

1. The boat must have at least one **single cable steering helm**. Dual cable systems, which are for high performance boats or boats over 11m (35 Ft) cannot be adapted for the AP12R. However, the AP12R can be fitted to boats with two steering positions, providing that one has a single cable helm.

2. There must be a minimum of 250mm (10.0 in) clearance behind the dashboard for the drive unit to fit (Fig 5.2).

- If the boat has a Morse CMD290 helm system fitted, it can be directly replaced with the SRD12 drive unit.

- Other rotary helm units may need a cable adaptor, dashboard bezel kit, or the whole steering cable may need to be replaced (see compatibility guide, page 21).

- On boats with rack and pinion steering it will be necessary to change the steering cable.

- ACCO or Mercury steering systems will also need to change the steering wheel for one with a 18.75mm ($\frac{3}{4}$ in) shaft aperture.

5.2 Removing Existing Steering Helm

To remove the existing steering helm, take the steering wheel off then unbolt and remove the helm unit. If it is a rack and pinion system then the rack will need to be unbolted from the pinion before it can be removed.

Check that there is enough clearance behind the dashboard for the drive unit before installing - obstructions such as electrical wiring and throttle cables may need to be re-routed.

If a bezel kit is needed, note the angle that the helm is mounted to the dashboard. Bezel kits are available either in the standard 90° configuration, or 20° if the helm is fitted at an angle to the dashboard (Fig 5.3). Note that tilting wheel systems use the existing (original) bezel kit.

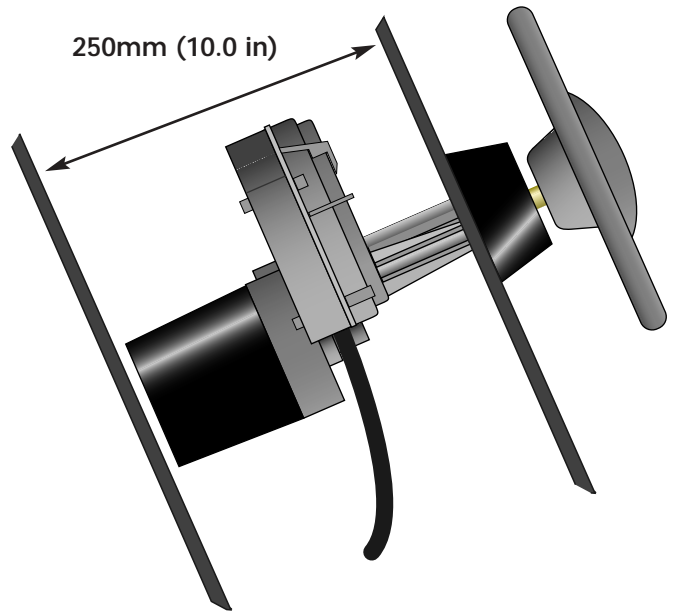


Fig 5.2 - Minimum clearance required

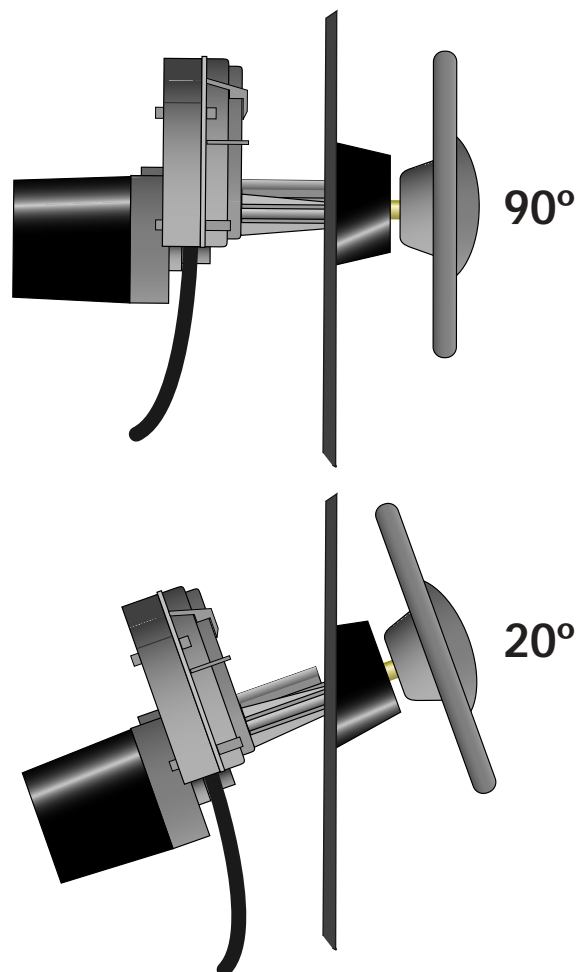


Fig 5.3 - Bezel kits available

- Use the bezel plate as a template to mark the mounting holes that will need to be drilled.
- Take care when drilling not to damage or sever any wiring or cables behind the dashboard - if necessary tape these out of the way temporarily until the holes have been drilled.
- If it is necessary to enlarge the existing steering shaft hole in the dashboard for the drive unit, use a piece of wood clamped over the hole as a guide for the hole saw. This will ensure that the hole is cut accurately and the bit does not jump while drilling, which could scratch or damage the dashboard. **Exercise caution while doing this.**

Fit the bezel plate to the dashboard, but do not fit the plastic cover at this point.

Remove the steering cable from the helm unit by unfastening the retaining bolt at the cable entry and exit ports. Pull the cable out away from the helm unit (Fig 5.4), then the cable inside can be wound out by turning the steering shaft (it may help if the wheel is refitted).

- Make a careful note of how the helm unit is fitted to the dash and which side of the helm that the cable is inserted - if this is refitted incorrectly the steering will work in reverse.

If the steering cable is not compatible with the SRD12 drive unit it will need to be changed for a Morse cable, which can be ordered from any Morse stockist. The part number of the cable is 304411-xx, where xx refers to the length of the cable required in inches (1 inch = 25mm).

See section 5.4 for advice on changing the cable.

5.3 Fitting SRD12 Drive Unit

Before winding the cable into the SRD12 drive unit, apply a thin coat of Teflon grease to the exposed section of the cable. Insert the plastic take-up tube into the exit port and refit the retaining bolt to hold it in place (Fig 5.5).

If required, fit the cable adaptor to the steering cable to enable it to fit to the drive unit.

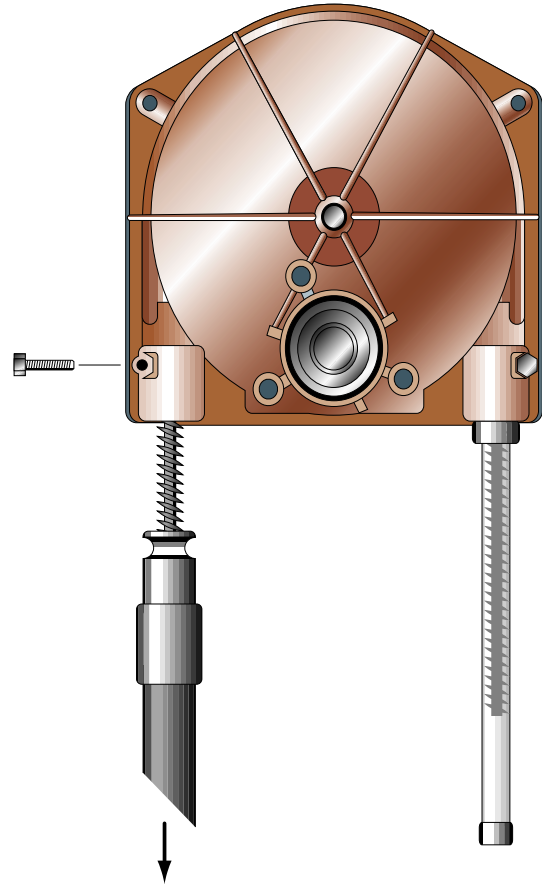


Fig 5.4 - Remove retaining bolts to allow cable outer to be disconnected

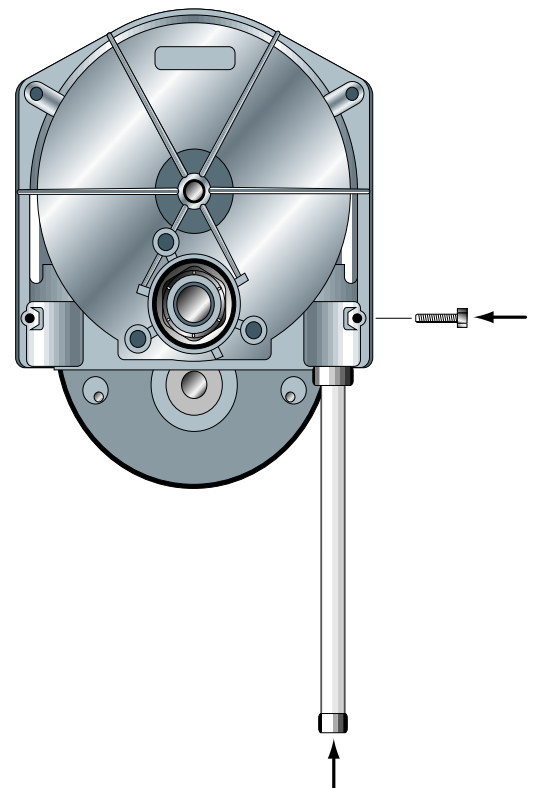


Fig 5.5 - Fit take-up tube to the exit port and replace retaining bolt

Insert the steering cable into the entry port of the drive unit and wind it in by turning the steering shaft. The cable should wind into the drive unit and emerge through the exit port into the take-up tube (Fig 5.6). Push the cable outer retainer into the entry port and refit the retaining bolt to hold it in place.

Position the drive unit behind the dashboard, and bolt it to the bezel plate. Fit the plastic cover over the bezel plate (this should simply snap into place). Secure the bezel retaining ring to the drive shaft, insert the locating key (or “woodruff key”) into the recess on the steering shaft and refit the steering wheel (Fig 5.7).

- Depending on the layout of the dashboard and steering system, it may be easier to fit the drive unit to the dashboard first, then insert the cable.

Rotate the wheel fully from lock to lock to check that the steering works smoothly across its full range and that it is steering in the right direction. If the rudder moves in the opposite direction to the wheel, the cable has been inserted into the drive unit the wrong way and needs to be inserted in the other port - swap the cable and take-up tube over.

5.4 Changing the Steering Cable

The accessibility of the steering cable run will depend on the size of the boat - on smaller powerboats the cable is usually easily accessible, but larger boats may run the cable through ducts that are more difficult to access.

- Changing the cable will be easier if a mouse (or “tag line”) is attached to the end of the existing cable before it is removed. This can be used to pull the new cable through.

- Use a strong line for the mouse that is not likely to snap easily, but is thin enough to pass down the duct behind the cable.

- Tie the mouse securely to the cable and use tape to reinforce the joint. Pull the cable through from the rudder end while feeding the mouse line from the steering end. When the old cable has been completely removed, attach the mouse to the new cable and use it to pull it back through from the rudder end.

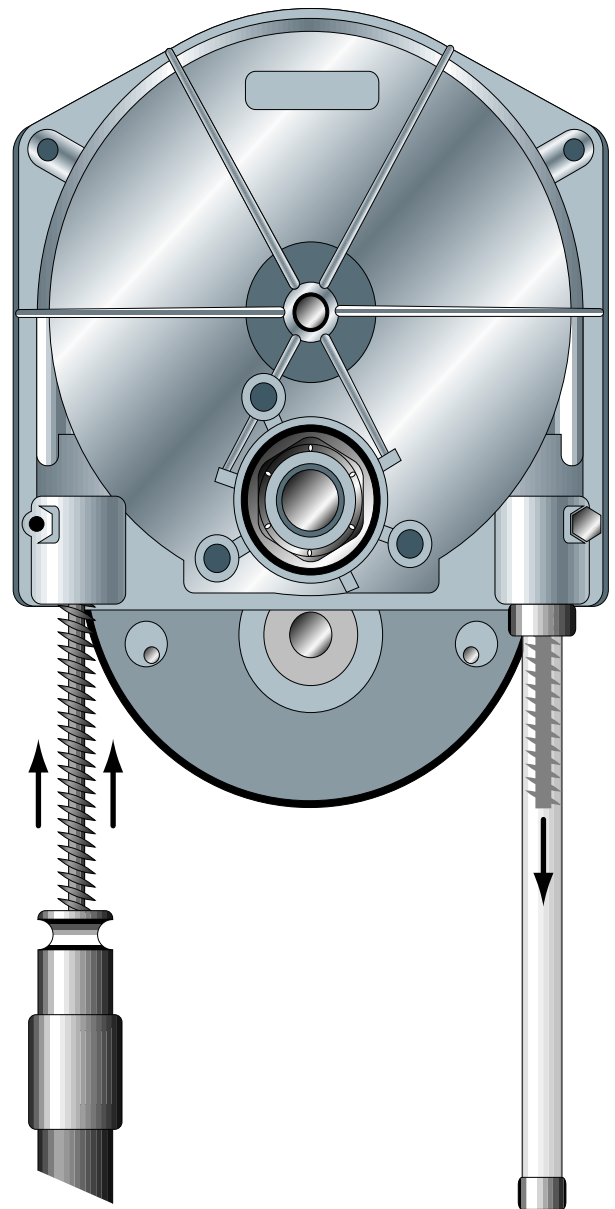


Fig 5.6 - Wind steering cable into helm

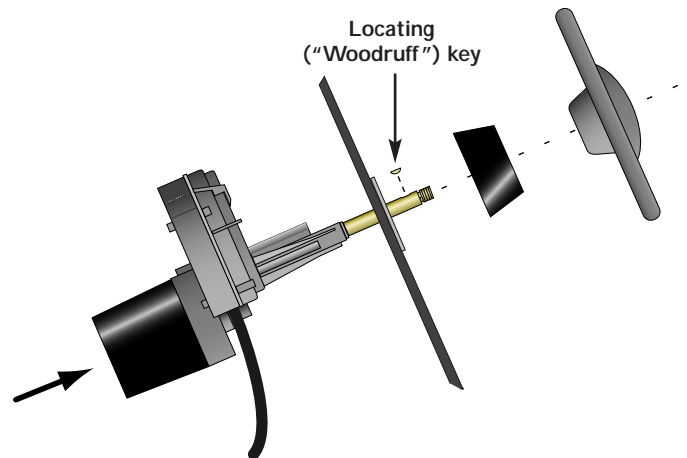


Fig 5.7 - Fitting drive to dashboard and attaching wheel

Attach the new cable to the steering arm of the boat by pulling out the cotter pin and clevis pin to release the old steering shaft and replacing it with the new steering shaft. Line up the shaft with the steering arm by turning the steering wheel and re-insert the cotter and clevis pins.

5.5 Fitting Control Unit SFC12

The control unit SFC12 is held in place using a single bolt and only needs two holes to be drilled. It should be located where it can be easily reached, such as on the dashboard next to the steering position.

- Check that the location is suitable - there should be at least 40mm (1.6 in) clearance behind the dashboard for the shaft and cable.

Mark the centres of the two holes where the control unit is to be positioned with a centre punch, one 38mm (1.5in) vertically above the other. Drill a 25mm (1.0 in) hole at the top mark, and a 5mm (0.2in) hole at the lower mark.

- If drilling into glassfibre (GRP), use a low speed setting on the drill and countersink the holes afterward to avoid cracking or splitting the gelcoat.

Pass the cable through the larger hole and through the fixing nut. Tighten the nut to fix the control unit into place (**do not overtighten**), making sure that the locating peg fits correctly into the smaller hole (Fig 5.8). Check that the cable is not obstructed or kinked before connecting up.

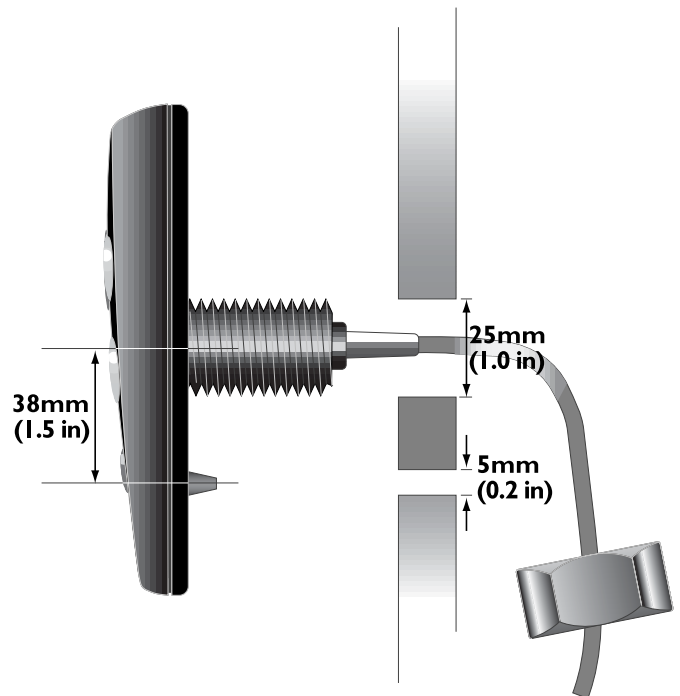


Fig 5.8 - Mounting control unit

5.6 Fitting Compass Unit SHS12

The compass should be positioned as close to the centreline of the boat as possible (Fig 5.9), in one of four possible orientations (see section 6.2). If the boat is GRP or wooden, the compass can be mounted below deck, but must be at least 1m (3 ft) away from any metallic objects such as stereo speakers, heating units etc.

- If the boat has a metal hull (this includes ferrocement), the compass must be mounted above decks on a mast or pole between one and two metres (3 to 7 feet) above deck.

When mounting, make sure that the compass is the right way up and is level. The compass unit can be screwed to a vertical bulkhead using the two No.6 x ³/₄in self tapping screws provided. If screwing into GRP, drill pilot holes and countersink them properly, which will stop the gel-coat splitting when the screws are tightened.

5.7 Electrical Installation

- The AP12R should be connected to the boat's battery via the main switch panel with a properly rated breaker or fuse and switch.

- The AP12R operates from a 12v DC supply. Power is supplied to the system via the two core cable from the SRD12 drive unit. **Brown is 12v+, Blue is 0v.**

- If the power cable needs to be extended, the correct diameter cable should be used, depending on the length of run (Fig 5.10). For this reason, it is recommended that any additional cable runs be as short as possible.

The SFC12 control unit, SHS12 compass and SRD12 drive unit are wired together using the SJB12 junction box supplied. All three cables have the same core colours - Red, Black and White, and the terminals in the junction box are clearly marked (Fig 5.11).

- For good connections, all wire ends should be tinned if the cables are shortened. Poor connections will impair the performance of the pilot.

- The cables should be kept away from cables which carry radio or pulsed signals (1m / 3 Ft minimum distance is recommended).

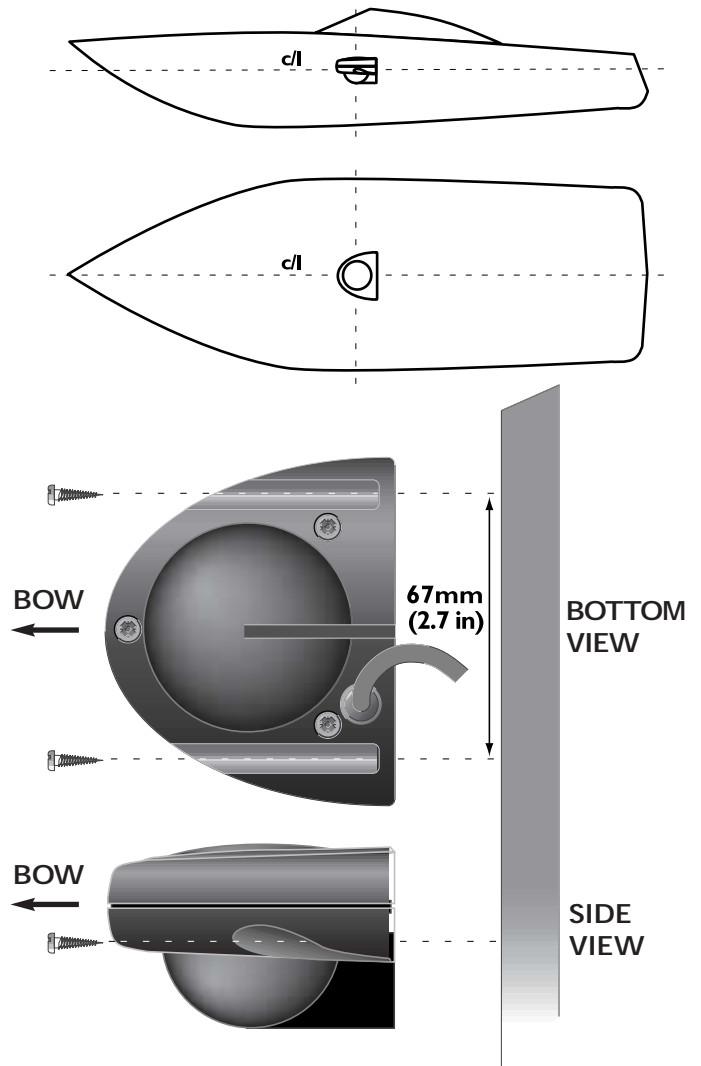


Fig 5.9 - Mounting compass unit

Length of Cable Run	Cross Section Area	Conductor Type	AWG
Under 5M (16.6Ft)	2.5mm ²	50/0.25	13
5-10M (33.3Ft)	4mm ²	56/0.3	12

Fig 5.10 - Cable selection table

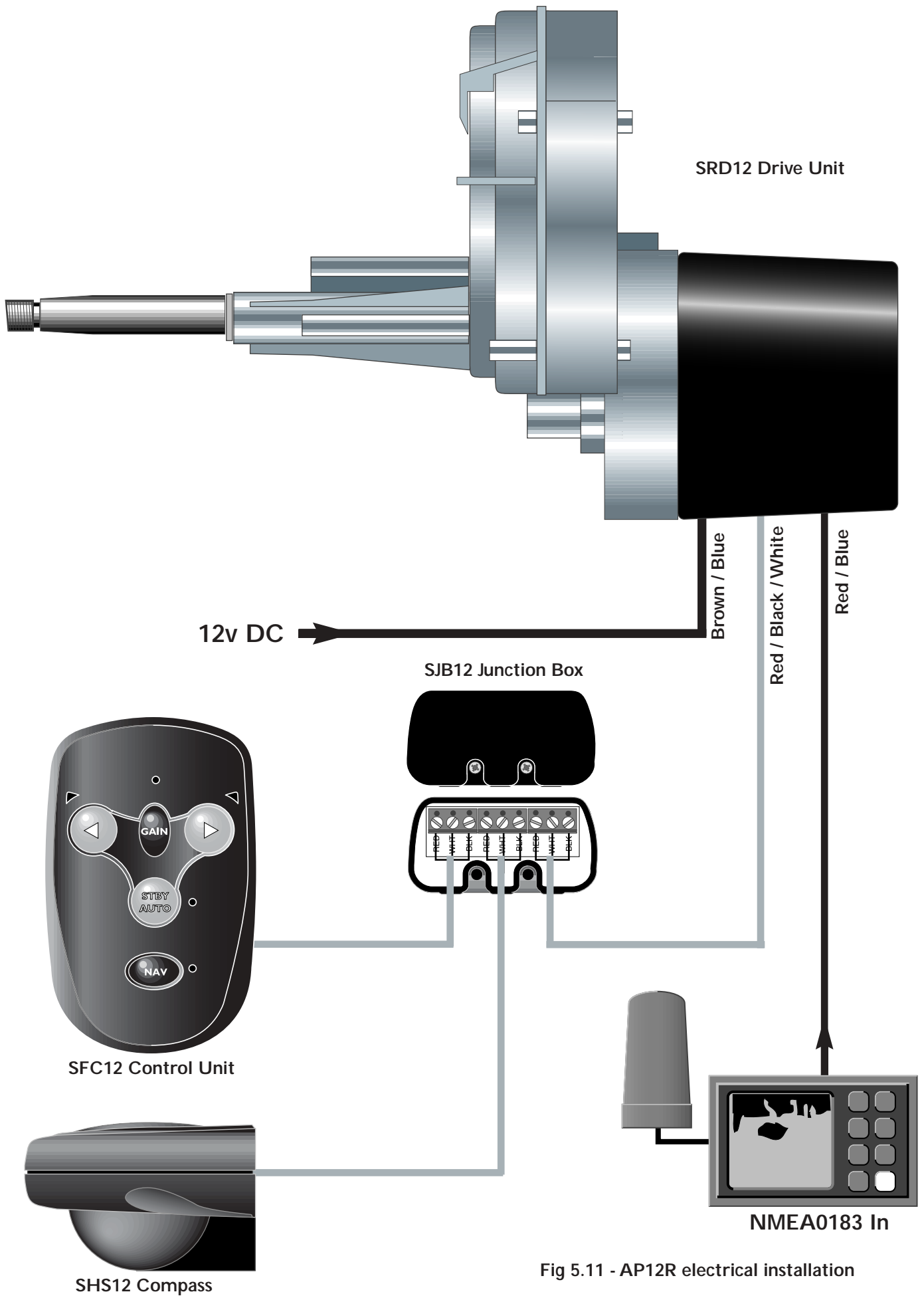


Fig 5.11 - AP12R electrical installation

5.8 Interfacing via NMEA

The AP12 includes an inbuilt NMEA0183 interface so GPS, Loran and Chart Plotters can be connected directly to it. This allows the Nav Mode (Steer to GPS) function to be used.

To interface with the AP12, the **NMEA OUT** connections of the equipment should be wired to the respective NMEA IN Data and Common (COM) cores of the NMEA wire from the SRD12 drive unit (Fig 5.12).

NMEA Data - RED
NMEA Common - BLUE

- Some manufacturers may refer to the connections as NMEA OUT + and - instead of NMEA Data and Common.
- Certain equipment may have connections marked NMEA IN. Do not use these.
- If the equipment does not have a NMEA Common (or -) connection, the NMEA Common terminal of the SCP12 course computer should be connected to ground by linking it to the BATT - terminal (Fig 5.13).
- If the vessel has more than one battery bank, when connecting the AP12 to the power supply always check that the pilot and the receiver are not connected to a different battery bank. This is to avoid a possible voltage drop between the interfaced equipment which would render the equipment inoperative.
- The receiver must be running an active route or waypoint for the Nav Mode function to operate.
- While any NMEA0183 compatible receivers should interface with the AP12, Simrad cannot guarantee operation with other manufacturer's equipment, as the Nav Mode function is dependant on specific NMEA0183 sentences of the correct format being available (see section 7.3). Read the relevant section in the receiver's manual before attempting to interface the AP12 with this equipment. If necessary, contact the manufacturer's technical support department or speak to a qualified technical dealer.

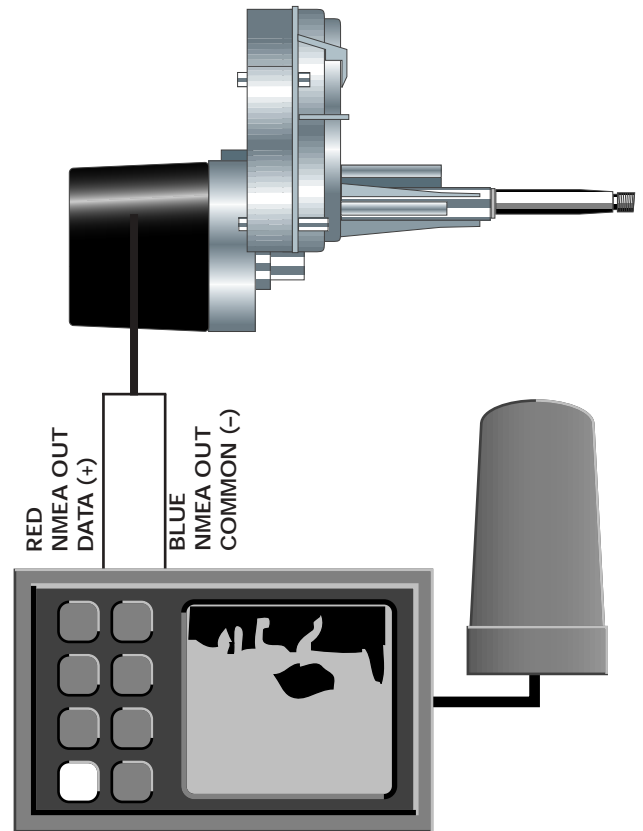


Fig 5.12 - Connecting using NMEA interface

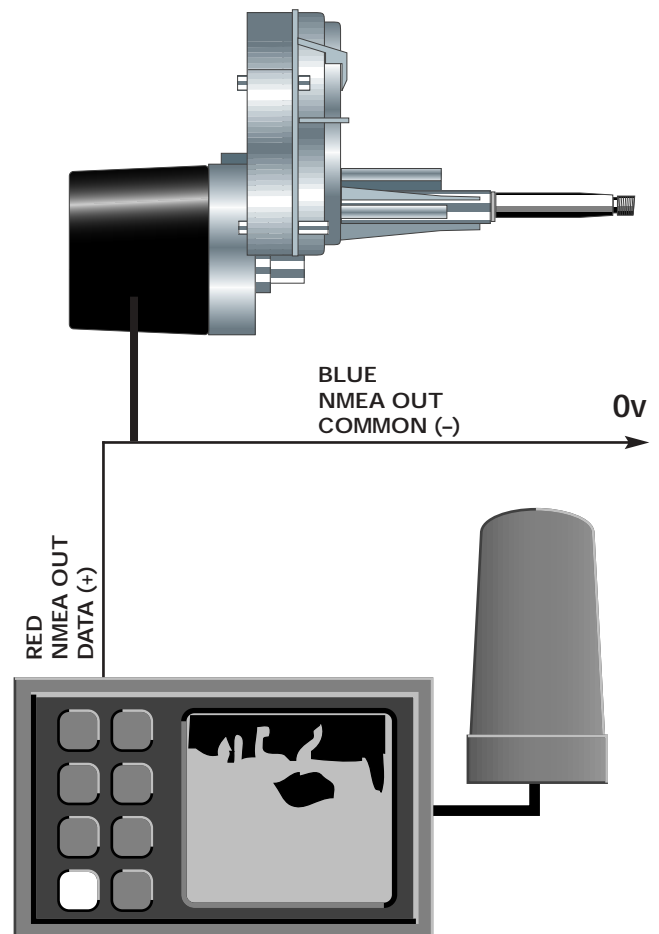


Fig 5.13 - Connecting using NMEA interface : no Common (-) wire

6 Commissioning

6.1 Commissioning Checks

After installation has been completed, the following checks should be made before use -

1. **Installation check** - ensuring that the installation of all the components in the system is mechanically and electrically correct.
2. **Seatrial** - Auto compass calibration. The pilot should be set up for optimum course keeping ability. If a navigational receiver is interfaced with the pilot, Nav Mode should also be tested.

6.1.1 Installation Check

CABLING

1. Are all the connections secure?
2. Does all wiring meet recommended lengths and sizes for the current/voltage?
3. Does the input power line have the correctly rated fuse or circuit breaker?
4. Where possible, are the cables run away from existing cables which carry radio frequency or pulsed signals? (1m / 3 Ft distance is recommended).
5. Are cables neatly tied or clamped to prevent friction damage? (Ties every 0.5m / 1.5 Ft intervals recommended minimum).
6. Are all wire ends tinned?

COURSE COMPUTER SCP12 (AP12H ONLY)

1. Is the Course Computer in a dry location away from excessive heat and vibration?
2. Is the Course Computer mounted on a vertical surface, with the cooling fin uppermost?
3. Is the Course Computer securely attached to a permanent structure?
4. Are all the cables properly fed through the cable clamp channels?

LINEAR FEEDBACK UNIT SLF12 (AP12H ONLY)

1. Has the unit been securely attached to the hydraulic ram of the boat using the supplied mounting saddles?
2. Is the full stroke of the SLF12 between 150mm and 300mm (6.0in to 12.0in)?
3. Is the SLF12 correctly aligned with the rudder arm?
4. Has it been fitted so that the rod does not bend or distort at any point of steering?
5. When driven hard over from lock to lock, is the SLF12 free from any obstructions?

COMPASS SHS12

1. Has the compass been mounted the correct way up and is it level?
2. Has the compass been mounted in a position away from ferrous materials, loudspeakers, heavy current carrying cables or other magnetic/electronic equipment to avoid deviation?
3. Has the compass been mounted as near as possible to the centrepoint of the boat to minimise heel angle?

HYDRAULIC PUMP (AP12H ONLY)

1. Have the correct fittings been used?
2. Has return line (R) been fitted from the pilot pump ?
3. Are check valves fitted if needed ?
4. Has the system been correctly bled of air ?
5. Is the tubing to the pump high pressure flexible material to reduce vibration?

6.2 Compass Orientation

The SHS12 compass can be mounted pointing four different ways - 0°, 90°, 180° or 270° to the bow (Fig 6.1).

- The factory preset is 0° (pointing forward). If the compass is mounted pointing any other way, this must be programmed in before using the pilot.

With the power switched off, press and hold **Nav** while turning the power on. Both the **Stby/Auto** and **Nav** LEDs will light and the **Gain** LED will flash and beep, indicating the current compass orientation setting -

Beeps/Flashes	Compass Pointing
0	0° (To Bow)
1	270° (To Port)
2	180° (To Stern)
3	90° (To Starboard)

- Note bow mounting (0°) will give no flash or beep

- Use the ◀ or ▶ keys to set the correct compass orientation (▶ to rotate setting clockwise, ◀ anticlockwise - Fig 6.2).

Press **Stby Auto** to accept the entered setting and return to Standby mode.

6.3 Setting Rudder Limits (AP12H only)

This two-stage procedure is used to -

- Define the maximum limits of the SLF12 pushrod stroke.
- Define the endstop and midstroke positions of the rudder.

This data is permanently stored, so it will only be necessary to repeat this procedure if the SCP12 is replaced or the SLF12 is replaced/repositioned.

1. Turn the power to the pilot off at the breaker (or switch). Press and hold the ◀ and ▶ keys while switching the power on.

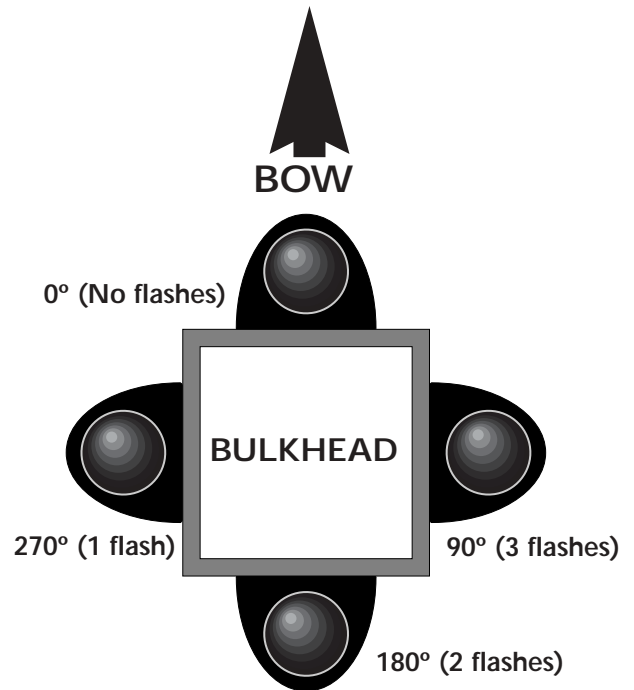


Fig 6.1 - Compass orientation

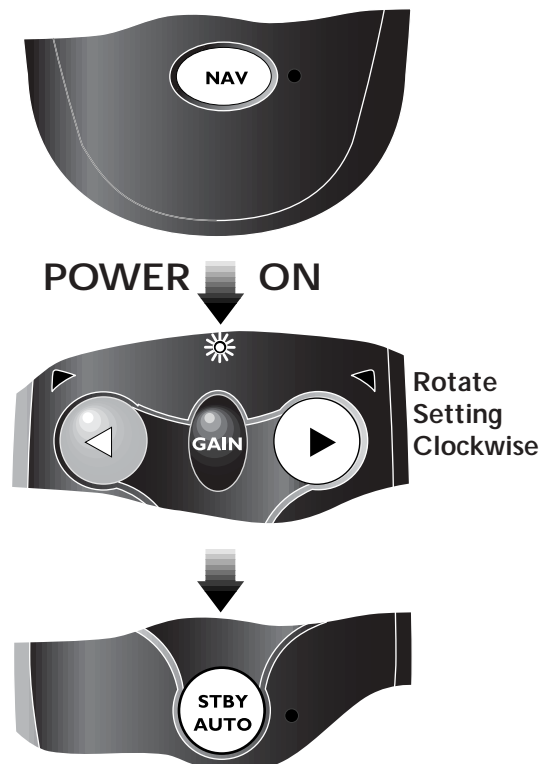


Fig 6.2 - Setting compass orientation

2. The Port LED will flash and the Starboard LED will light. If this light sequence is not shown, repeat step 1, holding the ◀ and ▶ buttons down firmly.

3. Disconnect the SLF12 rod from the ram and pull it fully from the feedback body (the rod is not physically attached to the SLF12 and can be removed easily).

4. Slide the rod all the way into the feedback body as far as it will go, then reattach the rod to the rudder. This sets the maximum limits of the SLF12

5. Turn the helm hard over to Port, then back it off 1/8th of a turn. Push the ◀ key once, and the Starboard LED will flash and the Port LED will light.

6. Turn the helm hard over to Starboard, then back it off 1/8th of a turn. Push ▶ once - the Gain LED will flash and the Port and Starboard LEDs will light.

7. Turn the helm to the midships position and press Gain. The pump will drive the rudder briefly to test the limits entered. If the rudder limits are accepted, a double beep will sound and the Stby/Auto LED will flash. If all the LEDs flash and an alarm sounds, then the calibration has failed - repeat the above steps carefully.

- If the calibration still fails, this may indicate that the hard over rudder position is beyond the sensing range of the SLF12 or the system has not been bled properly and the pump is air-locked. Try repositioning the SLF12 so that the stroke is within the defined parameters (see section 4.3), bleed the system if necessary and repeat the above procedure.

Note that the pilot will not enter Auto mode until the rudder limits have been set.



Fig 6.3 - Setting rudder limits

6.4 Seatrial / Compass Calibration

Before using the AP12, the compass must be calibrated to compensate for any magnetic deviation caused by ferrous or magnetic objects surrounding it on the boat, such as cockpit speakers etc.

1. With the boat motoring along slowly (2-3 knots) in calm conditions press the ► key a number of times (or manually steer) to induce a slow clockwise rotation of the boat (approx 3°/sec).

2. Press and hold **Gain**, followed by the ◀ and ► keys simultaneously to enter Auto Compass Calibration Mode (Fig 6.4).

3. Allow the boat to turn through a minimum of 1¼ turns (450°) in approximately 2½ minutes, during which time the fluxgate compass will automatically calibrate itself.

4. If the rate of turn is too high, the Port LED will flash indicating that it is necessary to decrease the rate of turn - press ◀. If the rate of turn is too slow the Starboard LED will flash, indicating increase the angle of turn - press ►.

- It is recommended that the calibration is restarted if the Port LED flashes more than twice.

A double beep indicates the calibration was successful and the AP12 will return to Standby Mode.

• If after about four minutes the compass has not calibrated, an alarm will sound. Repeat the above procedure, following the directions carefully. If the compass will still not calibrate then it is usually because the deviation being detected is too great, which may be due to the compass being too close to a metallic or magnetic object (minimum safe distance - 1m [3 Ft]). Move the compass to a position as close to the ideal centreline location as possible, but away from speakers, metallic superstructure etc. Repeat the above procedure.

• This should only need to be done once when the autopilot is first commissioned, unless the compass is changed, repaired, relocated or if any metallic objects have been installed or removed near to the compass since it was calibrated. In the interests of accurate performance, always bear in mind the location of the compass when installing any metallic objects on the boat. If in any doubt, recalibrate the compass as shown above.

After calibrating the compass perform the following procedure -

1. Hold the course steady for 5-10 seconds.
2. Press **Auto** to engage the autopilot and lock onto the heading - in calm conditions a constant heading should be held.
3. Alter course to Port and Starboard - the course change should be smooth without any sign of overshooting.
4. Look back at the wake of the boat to get an indication of the steering performance over a distance of at least 3km (2 Miles). If there is any evidence of snaking or "S-ing", try decreasing the Gain setting (see section 3.1).
5. If a GPS is connected, the Nav Mode function should be tested over a longer distance.



Fig 6.4 - Auto Compass Calibration

7 Appendix

7.1 Advice On Operation

- When making course changes, be aware of the effect of a large course change on the boat, especially when travelling at high speed - the AP12 will respond very quickly to any instructions, so it is advisable to reduce speed before changing course. This should particularly be remembered when approaching a waypoint in Nav Mode - pressing **Nav** to head for the next waypoint could result in a sudden and severe course change. This is one of the reasons that a constant vigil and awareness of the situation must be maintained (see warning below).
- The Gain setting is critical on a high speed vessel like a power boat, because it affects the reaction speed of the autopilot. As you become more familiar with the operation of the AP12 and how your own boat handles, it should be possible to tailor the Gain settings to suit the speed of the boat and the conditions it is cruising under.

7.2 Warning

The AP12 is a highly advanced autopilot, and a valuable aid to enjoyable cruising. However, it would be a mistake to become complacent. Like all electronic navigational equipment, it is an aid to navigation and should not be used as a substitute for conventional navigational practice. **Remember - Maritime Law* requires that you keep a good look out at all times.**

7.3 NMEA Sentences Received

The NMEA0183 information required for full functionality while in Nav Mode is as follows -

Cross track error
Bearing to destination waypoint
Arrival at waypoint indication

This information is extracted from the following NMEA0183 sentences -

XTE	Cross Track Error
BWC	Bearing & Distance To Destination Waypoint (Great Circle)
BWR	Bearing & Distance To Destination Waypoint (Rhumb Line)
APA	Cross Track Error, Bearing To Destination Waypoint and Arrival At Waypoint
APB	Cross Track Error, Bearing To Destination Waypoint and Arrival At Waypoint
RMA	Boat Speed
RMB	Cross Track Error, Bearing, Distance and Arrival At Arrival Waypoint
RMC	Boat Speed

NOTE - The Cross Track Error (XTE) information has a maximum value of 1.27 Nautical Miles. If the XTE exceeds this while using Nav Mode, the AP12 will sound an alarm, exit Nav Mode and return to Compass Auto Mode.

7.4 Fault Finding

Symptom	Probable Cause	Remedy
Pilot will not enter Auto mode.	Rudder limits not entered*. Rudder limits configuration failed*. Faulty connection to SLF12* Faulty connection to SHS12. Fault with SCP12* / SRD12†.	Enter rudder limits* (see 6.3) Check all connections. Replace fuse.
Autopilot drops back into Standby Mode.	Low supply voltage to Drive Unit or Course Computer*.	Check battery charge. Check all electrical connections and supply cables.
Cannot select Nav Mode	Navigational data not available. Incorrect NMEA format or sentences are being transmitted. Destination not programmed in navigator.	Check NMEA connections. Refer to section 7.3 for correct NMEA0183 sentence formats.
Autopilot will not allow rudder travel limits to be set*.	Power cable gauge too small. SLF12 incorrectly wired or installed. Pump not primed or airlocked Buttons not pressed properly	Check recommended cable sizes (Fig 4.17) Check SRP12 & SLF12 wiring and installation. Prime pump & bleed system.
Autopilot does not maintain an accurate course in Auto Mode.	SHS12 compass has not been calibrated. SHS12 compass is encountering magnetic interference. • If the boat's magnetic compass is being used as a reference, it is more likely that this is inaccurate unless it has been recently swung.	Refer to section 6.4 to calibrate the compass to compensate for magnetic deviation. Check area around SHS12 for magnetic objects (loudspeakers, heavy current carrying cables etc). Minimum compass safe distance is 1m (3 Ft). Check course against other reference (handbearing compass etc) and swing boat's compass if necessary.
Compass will not auto calibrate	Turn rate too fast/slow Conditions too rough Deviation detected is too large	Flashing LEDs above Port/Starboard keys indicate if turn rate is too fast or slow. Calibration should be attempted in calm conditions Check area around compass for metallic objects/speakers etc (min safe distance - 1m/3ft)
Boat's course is unstable when in Auto mode.	Gain setting is incorrect for boat's speed or type.	Adjust Gain to suit boat's speed: Low Speed=High Gain High Speed=Low Gain

In the event of the **AP12H** failing, the LED located under the terminal bay cover of the SCP12 Course Computer can be used to identify the potential source of the problem -

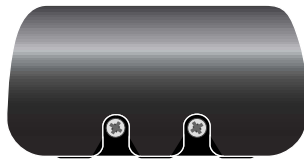
Flashes	Diagnosis	Fault Location
2	Invalid rudder feedback reading from SLF12	SLF12
4	Current limit exceeded	SRP12, SCP12
5	Control unit not connected	SFC12
6	No compass data received	SHS12
7	No compass/controls detected	SFC12, SHS12, SCP12
8	Rudder limits not set / calibration failed	SLF12, SCP12

In the event of the **AP12R** failing, the LED located on the circuit board under the black cover of the SRD12 Drive Unit can be used to identify the potential source of the problem -

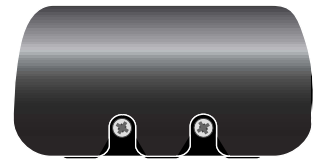
Flashes	Diagnosis	Fault Location
5	Control unit not connected	SFC12
6	No compass data received	SHS12
7	No compass/controls detected	SFC12, SHS12, SRD12
8	Compass calibration failed	SRD12

7.5 Optional Accessories

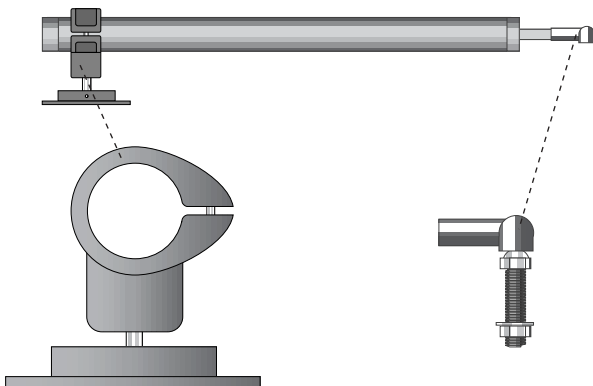
The following optional accessories for the AP12H and AP12R are available from your Simrad dealer. Please quote the correct part number when ordering.



SCJ12
Additional Control
Unit +
Junction Box



SCJ14
Hand Controller +
Junction Box



LFK500

SLF12 Feedback Mounting Accessory Kit - balljoint & universal joint mounting foot. (for AP12H hydraulic drive option only)

LFKSeastar
Kit for mounting SLF12 (AP12H only) to Teleflex HC5345 cylinders

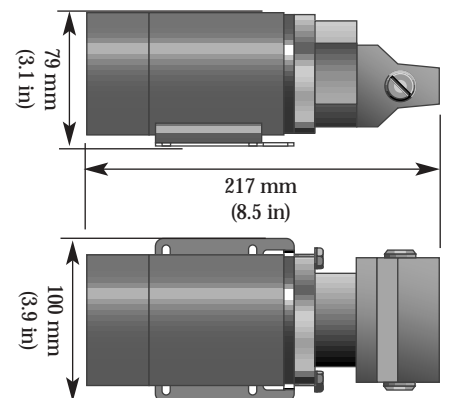
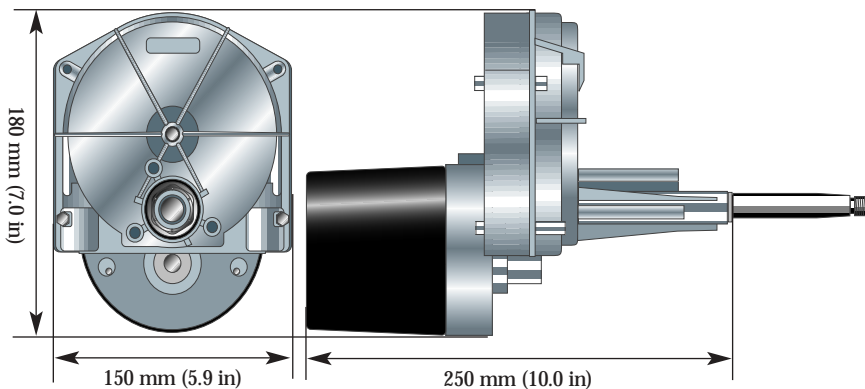
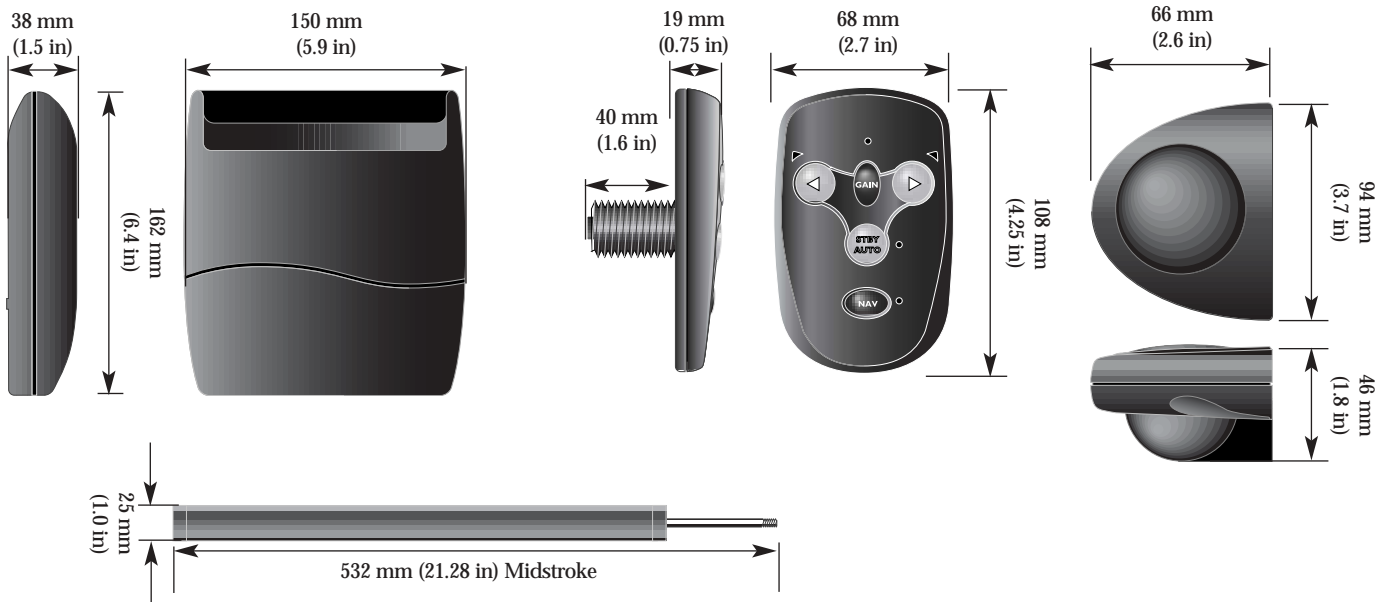
7.6 Specification & Dimensions

AP12H SPECIFICATIONS

Supply Voltage	12v DC (10.8v-16v)
Average Power Consumption	3 Amps typically
Drive Output	15 Amps Max
Peak Flow Rate	1,000 cc/min (64 in ³ /min)
Peak Pressure	28 kg/cm ² (1,000 psi, 67 bar)
Ram Capacity Min	90cc (5.4 in ³)
Ram Capacity Max	250cc (15.25 in ³)

AP12R SPECIFICATIONS

Supply Voltage	12v DC (10.8v-16v)
Average Power Consumption	0.7 Amps typically
Linear Thrust	175kg (385 lbs)
Max Torque	19.5Nm (170 lb/in)
Speed	15 rpm



7.7 Service & Warranty

Your equipment should seldom need servicing, although it will benefit from an application of silicone or Teflon grease to the contacts each season.

If it is necessary to have the unit repaired, return it carriage prepaid to the agent in the country of purchase with a copy of the receipted invoice showing the date of purchase. Where possible, return all the components unless you are certain that you have located the source of the fault. If the original box is not available, ensure that it is well cushioned in packing; the rigours of freight handling can be very different from the loads encountered in the marine environment for which the unit is designed.

For Worldwide Warranty details, please refer to the Warranty Card supplied with this unit.



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