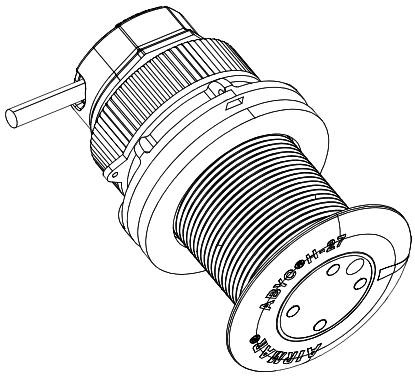
AIRMAR® TECHNOLOGY CORPORATION

Owner's Guide & Installation Instructions

Electromagnetic
Multilog Sensor
Smart™ Sensor

Model **DX900+**

Patent http://www.airmar.com/patent.html



Record the information found on the cable tag for future reference.
Part No._____Serial No._____Date_____

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Introduction

Thank you for purchasing Airmar's Electromagnetic MultiLog Sensor. The DX900+ is the industry's first Bluetooth®-enabled, multi-functional unit. It is actually several sensors in a single housing. And it is the only sensor that truly measures leeway instantaneously—not derived from a calculation. Data is output in NMEA 0183 or NMEA 2000® format.

Functions & Outputs	DX900+
Speed	✔
Leeway	✔
Reverse speed	✔
Temperature of water	✔
Heel & Trim	Optional
NMEA 0183: RS-422	Optional
NMEA 2000: CAN	Optional

Features & Options

- Bluetooth-enabled to connect your boat display and smart devices
- Supports both iOS and Android platforms
- Performs speed calibration and more through the Airmar CAST™ app
- Configurable data update rate: up to 10 Hz
- Diagnostic information for troubleshooting
- Interface to update firmware
- Dual-axis, electromagnetic, speed sensor
- Fast-response water temperature
- Three-axis accelerometer
- Three-axis rate gyroscope
- Retrofits most existing Ø 51 mm (2") thru-hull housings

About the Airmar CAST™ App

Download the Airmar CAST app to view, analyze, and share sensor data and evaluate your sailing performance. Simply install the CAST app on your iOS or Android device to view available NMEA data over a Bluetooth or network connection. Create custom gauges and page views to see only the data that is important to you. With the CAST app you can perform speed, temperature, and attitude calibrations without extra converters or cables. In addition to firmware updates, the app logs all of the NMEA sensor data over a customized time period for analysis. Smart devices can be used to view the data, creating a mobile powerhouse.

Downloading the Airmar CAST App

1. Go to the Apple App Store or Google Play Store.
2. Search on the word ‘Airmar.
3. Download the free Airmar CAST app (Figure 1).

Figure 1. Airmar CAST app icon

Applications

- High-speed racing sailboats
- Not recommended for boats designed to pull air under the hull.
- **Plastic** housing recommended for fiberglass or metal hull only.
  Never install a plastic housing in a wood hull, since swelling of the wood can possibly fracture the plastic.
- **Stainless steel** housing compatible with all hull materials.
  Recommended for a metal hull to prevent electrolytic corrosion *provided the stainless steel housing is isolated from the metal hull.*

Tools & Materials

Safety glasses
Dust mask
Ear protection
Water-based anti-fouling coating (**mandatory in saltwater**)
Electric drill [Ø 10 mm (3/8") or larger chuck capacity]
Drill bit: Ø 3 mm *or* 1/8"
Hole saw:
  Plastic/metal housing in non-metal hull Ø 51 mm *or* 2"
  Stainless steel housing in metal hull Ø 57 mm *or* 2-1/4"
Sandpaper
Mild household detergent *or* weak solvent (such as alcohol)
File (installation in a metal hull)
Marine sealant (suitable for below waterline)
Measuring tape
Chalk line
Slip-joint pliers (installing a metal housing)
Installation in a cored fiberglass hull (page 17):
  Hole saw for hull interior: Ø 60 mm *or* 2-3/8"
  Fiberglass cloth and resin
  or Cylinder, wax, tape, and casting epoxy
DeviceNet cable [maximum 2 m (6')] (NMEA 2000)
Pencil
Cutting pliers
Phillips screwdriver
Wire strippers
Heat-shrink tubing
Heat gun
Blade screwdrivers

CAUTION!

Interference From Electronic Devices

Install the DX900+ sensor and the Processor a minimum of 1 m (3') from other electronic equipment and cables. The sensor may be susceptible to interference from strong electromagnetic fields caused by devices such as AC inverters, power supplies, or other onboard equipment. Interference may cause inaccurate speed readings.

Follow the precautions below for optimal product performance and to reduce the risk of property damage, personal injury, and/or death.

WARNING: Always wear safety glasses, a dust mask, and ear protection when installing.

WARNING: **The valve is not a watertight seal!** Be sure the insert or blanking plug is fully inserted into the housing, and the cap nut is screwed on completely.

WARNING: All the O-rings must be intact and well lubricated to make a watertight seal. Do not dry fit the insert in the housing. Attempting to install the insert without lubricating all the O-rings may damage them, possibly preventing full insertion and a watertight seal.

WARNING: The **YELLOW** O-ring must be in place near the top of the insert to make a watertight seal.

WARNING: Always attach the safety wire to prevent the insert or blanking plug from backing out in the unlikely event that the cap nut fails or is screwed on incorrectly.

WARNING: Immediately check for leaks when the boat is placed in the water. Do not leave the boat unchecked for more than three hours. Even a small leak may allow considerable water to accumulate.

WARNING: **Stainless steel housing in a metal hull**—Be sure the washer contacts the hull. Do not tighten the hull nut with the washer against the isolation bushing, as the housing will not be firmly installed.

WARNING: The power supply must be OFF before making electrical connections.

WARNING: A safe installation requires a 0.5 amp fast-blow fuse or circuit breaker.

WARNING: The power supply voltage must be 9 to 16 VDC.

CAUTION: The sensor is NOT compatible with a bronze housing, because bronze may cause interference resulting in incorrect readings.

CAUTION: Never pull, carry, or hold the sensor by its cable; this may sever internal connections.

CAUTION: The sensor must be aligned within 1° of parallel to the centerline/keel of the boat.

CAUTION: The arrow on the top of the insert must point forward toward the bow area to align with the water flow.

CAUTION: The bottom of the insert must be flush with the bottom of the housing. Note that the electrodes will protrude into the water.

CAUTION: Do not coat the face of the insert with the electrodes.

CAUTION: The sensor must be in good contact with the water at all times.

CAUTION: **Plastic housing**—Never use a fairing with a plastic housing; the protruding sensor would be vulnerable to damage from impact.

CAUTION: **Metal housing**—Never install a metal housing in a vessel with a positive ground system.

CAUTION: **Stainless steel housing in a metal hull**—Stainless steel housing must be isolated from a metal hull to prevent electrolytic corrosion. Use the isolation bushing supplied.

CAUTION: Never use solvents. Cleaner, fuel, sealant, paint, and other products may contain solvents that can damage plastic parts, especially the insert's face.

CAUTION: Never power sand or pressure wash the transducer. It may weaken the structure or damage the internal components.

IMPORTANT: Please read the Owner's Guide completely before proceeding. These instructions supersede any other instructions in your instrument manual if they differ.

Choosing the Mounting Location

CAUTION: Do not mount the sensor in line with or near water intake or discharge openings, or behind strakes, fittings, or hull irregularities that will disturb the water flow.

CAUTION: Do not mount the sensor directly ahead of a depth transducer, since turbulence generated by the housing will adversely affect the depth transducer's performance, especially at high speeds. Mount side-by-side.

- The sensor must be continuously immersed in water at all speeds.
- The water flowing under the hull must be smooth with a minimum of bubbles and turbulence, especially at high speeds.
- Choose an accessible spot inside the vessel with adequate space for the height of the housing, tightening the nuts, and installing the insert. Allow a minimum of 280 mm (11").

Boat Types (Figure 2)

- **Fin keel sailboats**—Mount on or near the centerline and forward of the fin keel 300 to 600 mm (1–2').
- **Full keel sailboats**—Locate amidships and away from the keel at the point of minimum deadrise.
- **Displacement hull powerboats**—Locate amidships near the centerline. The starboard side of the hull where the propeller blades are moving downward is preferred.
- **Planing hull powerboats**—Mount well aft, on or near the centerline, and *well inboard of the first set of lifting strakes* to insure that the sensor will be in contact with the water at high speeds. The starboard side of the hull where the propeller blades are moving downward is preferred.

  Outboard and I/O—Mount just forward of the engine(s).

  Inboard—Mount well ahead of the propeller(s) and shaft(s).

  Stepped hull—Mount just ahead of the first step.

  Boat capable of speeds above 25 kn (29 MPH)—Review the installation location and operating results of similar boats before proceeding.

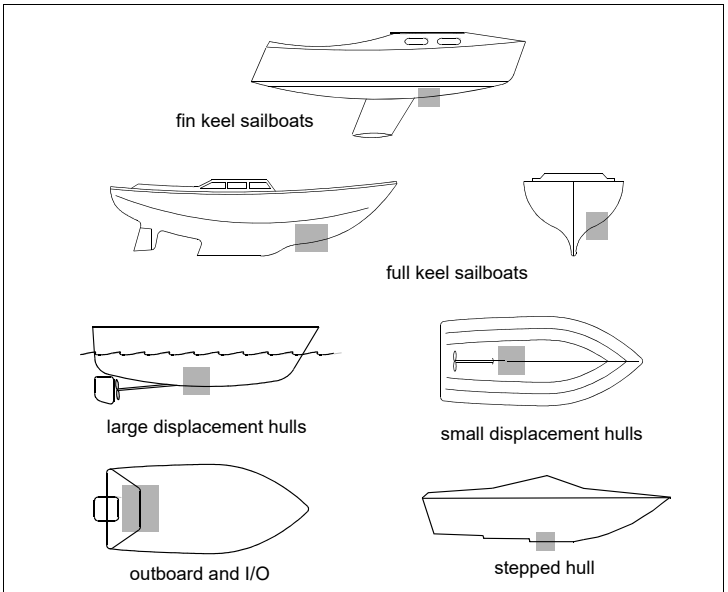

Figure 2. Best location for sensor

Anti-fouling Coating

CAUTION: Do NOT coat the face of the insert with the electrodes. This is different from the instructions given with many similar products. Coating will greatly reduce or prevent the electrodes from functioning.

Marine growth can accumulate rapidly on the sensor's surface reducing performance within weeks. Surfaces exposed to saltwater, *except the face of the transducer with the electrodes*, must be covered with an anti-fouling coating. Use a *water-based* anti-fouling coating made for transducers only. Never use ketone based paint, since ketones can attack many plastics, possibly damaging the transducer.

It is easier to brush on anti-fouling coating before installation, but allow sufficient drying time. Re-coat every 6 months or at the beginning of each boating season. Coat the following surfaces (Figure 3):

- Outside wall of the insert below the lower O-ring
- Bore of the housing up 30 mm (1-1/4")
- Exterior flange of the housing
- Exposed end of the blanking plug

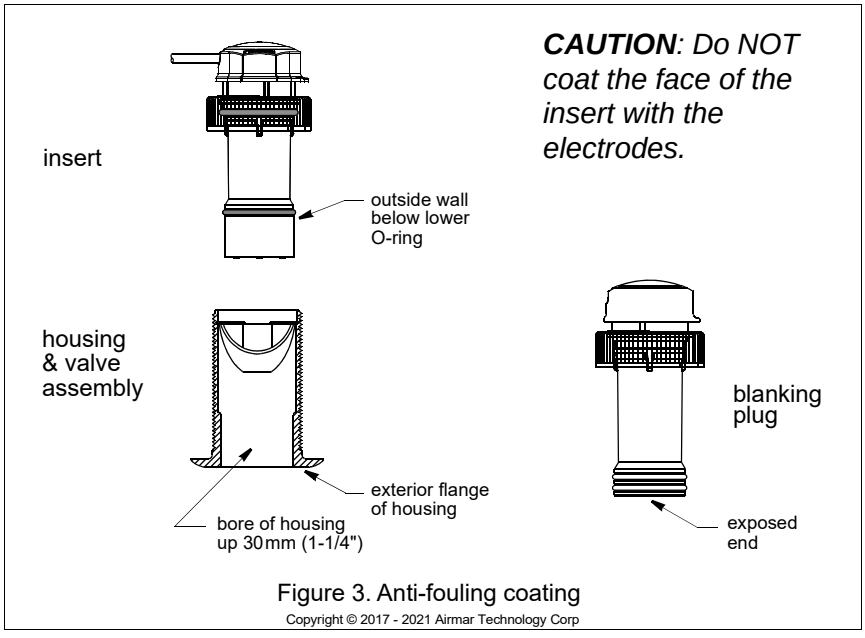

Figure 3. Anti-fouling coating

Installation

Hole Drilling

***Cored fiberglass hull**—Follow separate instructions on page 17*

4. Drill a Ø 3mm or 1/8" pilot hole from inside the hull. If there is a rib, strut or other hull irregularity near the selected mounting location, drill from the outside.
5. Using the appropriate size hole saw, cut a hole perpendicular to the hull from outside the hull.
6. Sand and clean the area around the hole, inside and outside, to ensure that the sealant will adhere properly to the hull. If there is any petroleum residue inside the hull, remove it with either mild household detergent or a weak solvent (alcohol) before sanding.
   Metal hull—Remove all burrs with a file and sandpaper.

Bedding

CAUTION: Be sure the surfaces to be bedded are clean and dry.

Apply a 2mm (1/16") thick layer of marine sealant around the flange of the housing that contacts the hull and up the sidewall of the housing. *The sealant must extend 6mm (1/4") higher than the combined thickness of the hull, the washer, and the hull nut* (Figure 4). This will ensure there is sealant in the threads to seal the hull and to hold the hull nut securely in place.

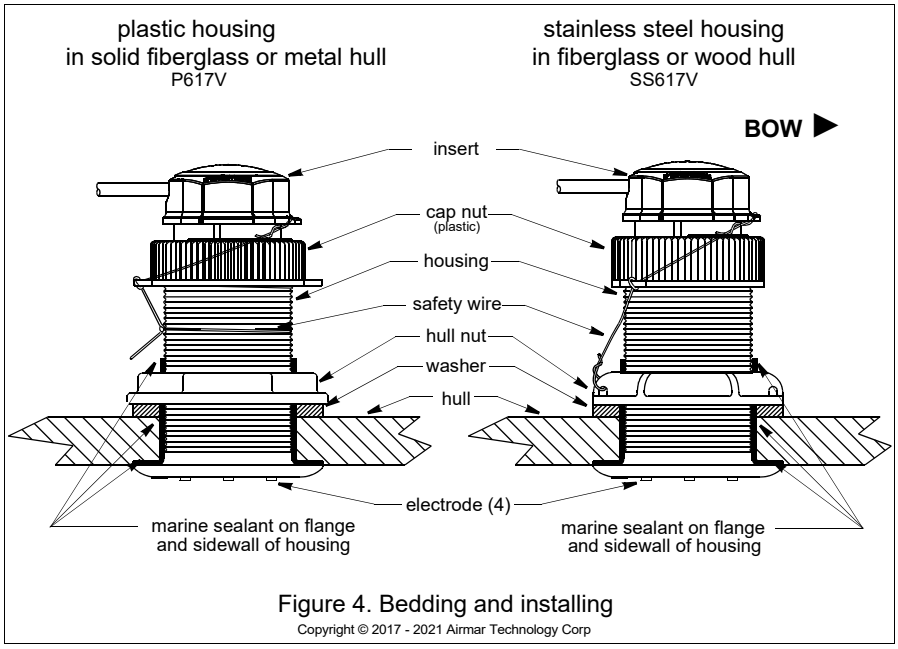

Figure 4. Bedding and installing

Stainless steel housing in a metal hull—A stainless steel housing must be isolated from a metal hull to prevent electrolytic corrosion. Slide the isolation bushing onto the housing (Figure 5). Apply *additional* sealant to the surfaces of the bushing that will contact the hull, filling any cavities in and around the bushing.

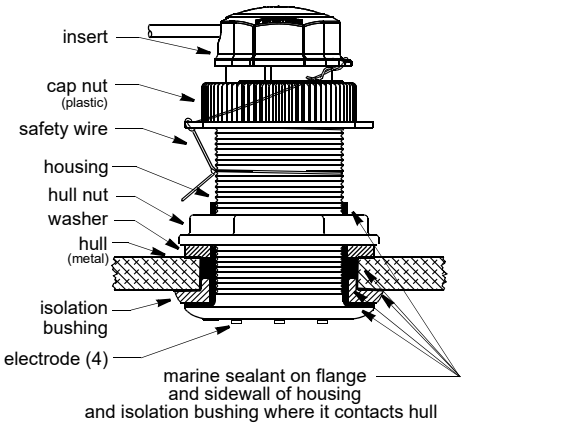

Figure 5. Bedding and installing an SS617V in a metal hull

Installing

CAUTION: The arrow on the flange of the housing must point forward toward the bow area.

CAUTION: The bottom of the insert must be flush with the bottom of the housing for the sensor to work properly. Note that the four electrodes will protrude into the water.

1. The sensor must be aligned within 1° of parallel to the centerline/keel of the boat. At the center of the hole, snap a chalk line parallel to the keel/centerline (Figure 6).

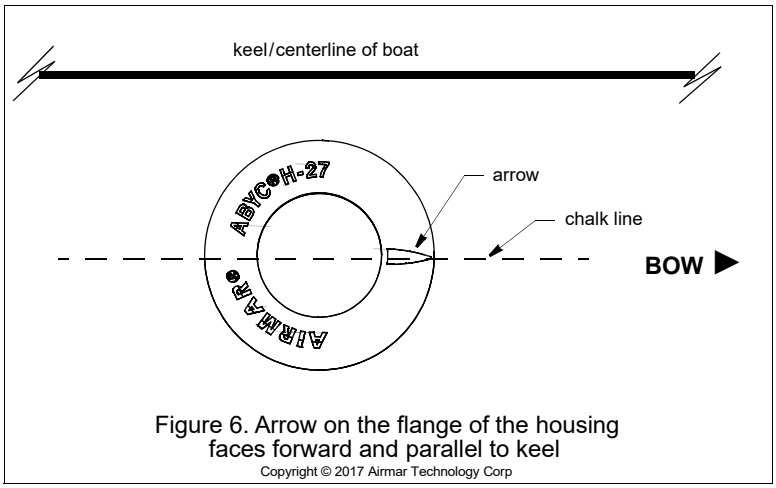

Figure 6. Arrow on the flange of the housing faces forward and parallel to keel

2. From outside the hull, push the housing into the mounting hole using a twisting motion to squeeze out excess sealant. *Align the arrow on the flange of the housing pointing forward toward the bow area.* Be sure the arrow is aligned PARALLEL to the centerline/keel of the boat.

3. From inside the hull, check to be sure the notch in the housing is pointing forward toward the bow area (Figure 7). Slide the washer onto the housing (Figure 4).

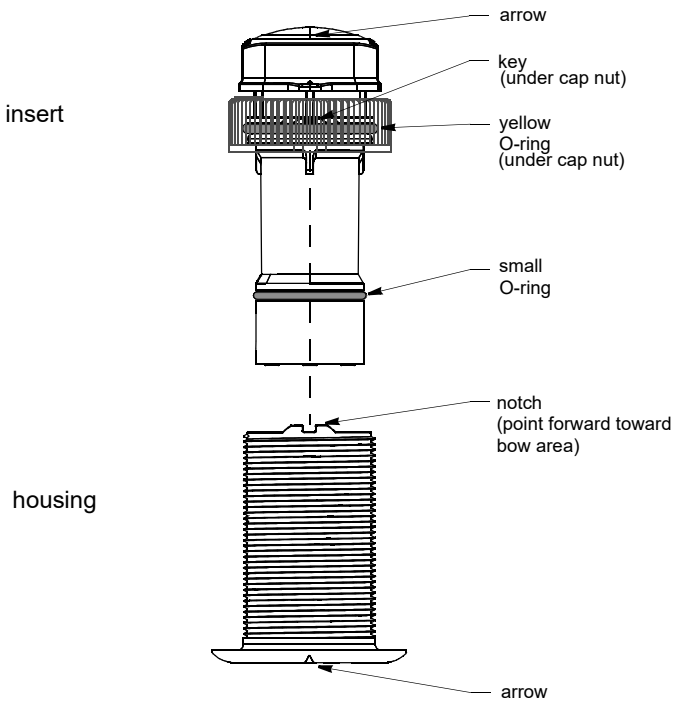

Figure 7. Align arrow on insert cap, key on insert, notch in housing, and arrow on flange to face forward toward bow area

Stainless steel housing in a metal hull—Be sure the washer contacts the hull (Figure 5). *Do not tighten the hull nut with the washer against the isolation bushing, as the housing will not be firmly installed*. If necessary, sand the isolation bushing until the washer rests against the hull.

4. Screw the hull nut in place.
   Plastic housing—Do not clamp tightly on the wrench flats, fracturing the housing.
   Plastic hull nut—**Hand tighten** only. Do not over tighten.
   Metal hull nut—Tighten with slip-joint pliers.
   Cored fiberglass hull—Do not over tighten, crushing the hull.
   Wood hull—Allow the wood to swell before tightening the nut.
5. Remove any excess marine sealant on the outside of the hull to ensure smooth water flow under the sensor.

6. *All the O-rings must be intact and well lubricated to make a watertight seal.* After the marine sealant cures, inspect the O-rings, including the **YELLOW** O-ring, on the insert (replace if necessary) and lubricate them with the silicone lubricant supplied (Figure 7). Also lubricate the bore of the housing above the valve.
7. The insert must be fully inserted into the housing and the cap nut screwed on completely to make a watertight seal. Slide the insert into the housing with the *arrow on the top pointing forward toward the bow area* (Figure 8). Being sure the cable exit is pointing backward toward the stern, seat the insert into place with a *firm,* pushing twisting motion until the key fits into the notch. When this happens, you may hear a snap and the insert will no longer move. Be careful not to rotate the housing and disturb the sealant.

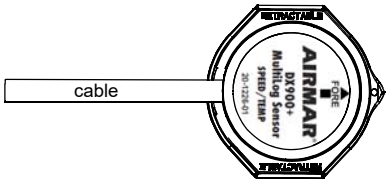

Figure 8. Insert: top view with arrow facing forward toward the bow area

Screw the cap nut several turns until the threads are engaged. Being sure the cable exit is still pointing backward toward the stern, continue to tighten the cap nut completely. The arrow on the top of the insert, the key on the insert, the notch in the housing, and the arrow on the flange will be aligned facing forward toward the bow. **Hand tighten** only. Do not over tighten.

***NOTE**: The electrodes will protrude into the water*.

8. Attach the safety wire to prevent the insert from backing out in the unlikely event that the cap nut fails or is screwed on incorrectly.
   Plastic housing—Attach the safety wire to one eye in the hull nut (Figure 4). Keeping the wire taut throughout, lead the wire in a counterclockwise direction and thread it through one eye in the cap nut. Thread the wire through the eye a second time. Then lead the wire through the eye in the insert. Twist the wire securely to itself.
   Metal housing—Wrap one end of the safety wire tightly around the housing and twist it together with the long end (Figure 4 or 5). Keeping the wire taut throughout, lead the wire straight up and through one eye in the cap nut. Thread the wire through the eye a second time. Then lead the wire counterclockwise and through the eye in the insert. Twist the wire securely to itself.

Installation in a Cored Fiberglass Hull

The core (wood or foam) must be cut and sealed carefully. The core must be protected from water seepage, and the hull must be reinforced to prevent it from crushing under the hull nut allowing the housing to become loose.

CAUTION: Completely seal the hull to prevent water seepage into the core.

1. Drill a Ø 3mm or 1/8" pilot hole from inside the hull. If there is a rib, strut, or other hull irregularity near the selected mounting location, drill from the outside. (If the hole is drilled in the wrong location, drill a second hole in a better location. Apply masking tape to the outside of the hull over the incorrect hole and fill it with epoxy.)
2. Using a Ø 51mm or 2" hole saw, cut the hole from outside the hull through the *outer* skin only (Figure 9).
3. From inside the hull, use a Ø 60mm or 2-3/8" hole saw to cut through the *inner* skin and most of the core. The core material can be very soft. Apply only light pressure to the hole saw after cutting through the inner skin to avoid accidentally cutting the *outer* skin.
4. Remove the plug of core material so the *inside* of the outer skin and the inner core of the hull are fully exposed. Sand and clean the inner skin, core, and the outer skin around the hole.
5. If you are skilled with fiberglass, saturate a layer of fiberglass cloth with a suitable resin and lay it inside the hole to seal and strengthen the core. Add layers until the hole is the correct diameter.

   Alternatively, a hollow or solid cylinder of the correct diameter can be coated with wax and taped in place. Fill the gap between the cylinder and hull with casting epoxy. After the epoxy has set, remove the cylinder.
6. Sand and clean the area around the hole, inside and outside, to ensure that the marine sealant will adhere properly to the hull. If there is any petroleum residue inside the hull, remove it with either mild household detergent or a weak solvent (alcohol) before sanding.
7. Proceed with “Bedding” (page 12).

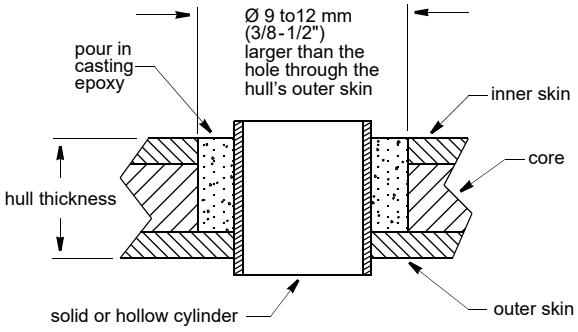

Figure 9. Preparing a cored fiberglass hull

Cable Routing & Connecting

CAUTION: Do not remove the waterproof connector(s) to ease cable routing.

CAUTION: Be careful not to tear the cable jacket(s) when passing it through bulkheads and other parts of the boat. Use grommets to prevent chafing.

CAUTION: Coil any excess cable(s) and secure it with cable ties to prevent damage.

Speed & Temperature: NMEA 0183

Wire the sensor directly to the NMEA 0183 instrument. There is NO processor in this application.

1. If the power is connected to the instrument, disconnect it.
2. Route the sensor cable to the instrument. Do not fasten the cable in place at this time.
3. Being sure the power is OFF, connect the speed and temperature sensor cable to the instrument. Follow the instructions in your instrument owner's manual and refer to the wire colors and functions below:

Red	VDC+	
Black	VDC-	
White	A+	NMEA bi-directional
Blue	B-	NMEA bi-directional
Bare	Shield	

Speed & Temperature: NMEA 2000

The sensor must be connected to the network or instrument through an NMEA2000 processor.

Installing the Processor

1. Select a convenient, dry, mounting location for the water-resistant processor, a minimum of 1m (3') from other cables and electronic equipment (Figure 10).
2. Route the DeviceNet/instrument cable from the processor location to the network backbone/instrument. Do not fasten the cable in place at this time.
3. Route the sensor cable to the processor location. Do not fasten the cable in place at this time.
4. Hold the processor at the selected location and mark the position of the four screw holes with a pencil.

   ***NOTE**: If the processor will be mounted on a vertical surface, position the connectors downward to avoid water seeping into the box.*
5. At the marked locations, drill four Ø 3mm or 1/8" holes approximately 10mm (3/8") deep.
6. Fasten the processor to the selected mounting surface at the previously-drilled holes, using the screws supplied.
7. Connect the DeviceNet cable to the network. Plug the DeviceNet cable into the port on the processor labeled NMEA 2000.
8. Plug the sensor into the port on the processor labeled Sensor.
9. Fasten all the cables in place. Coil any excess cable(s) and secure it with cable ties to prevent damage.

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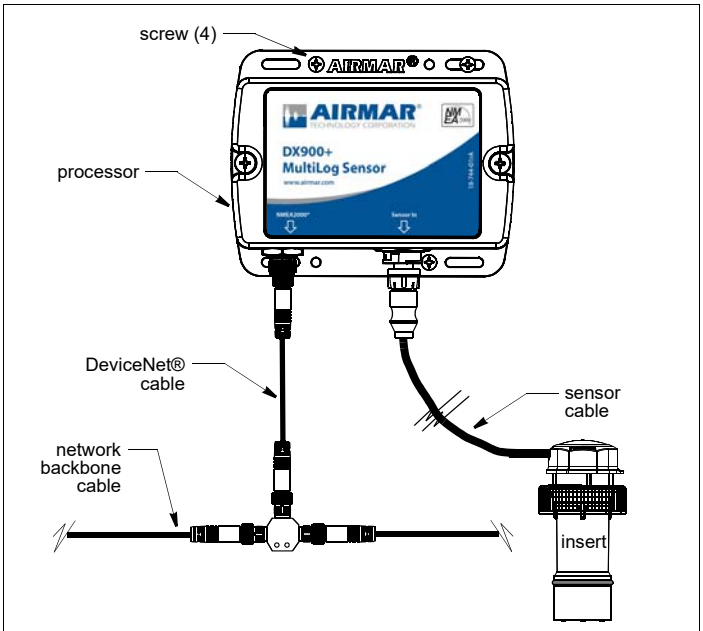

Figure 10. NMEA 2000 cable layout (not to scale)

Checking for Leaks

When the boat is placed in the water, immediately check around the sensor for leaks. Note that very small leaks may not be readily observed. Do not to leave the boat in the water for more than 3 hours before checking it again. If there is a small leak, there may be considerable bilge water accumulation after 24 hours. If a leak is observed, repeat “Bedding” and “Installing” immediately (pages 12 and 13).

Operation, Maintenance, & Replacement

How the Valve Works

THE VALVE IS NOT A WATERTIGHT SEAL! The sensor incorporates a self-closing valve which minimizes the flow of water into the boat when the insert is removed. The curved flap valve is activated by both a spring and water pressure. Water pushes the flap valve upward to block the opening, so there is no gush of water into the boat. Always install the insert or the blanking plug secured with the cap nut and safety wire for a watertight seal.

Using the Blanking Plug

To protect the insert, use the blanking plug:

- When the boat will be kept in saltwater for more than a week.
- When the boat will be removed from the water.
- When aquatic growth buildup on the insert is suspected due to inaccurate readings from the instrument.

1. *All the O-rings must be intact and well lubricated to make a watertight seal.* On the blanking plug, inspect the O-rings (replace if necessary) and lubricate them with the silicone lubricant supplied or petroleum jelly (Figure 11).
2. Remove the insert from the housing by removing the safety wire and unscrewing the cap nut (Figure 4 or 5). This will jack up the insert. Remove the insert with a slow pulling motion. Replace it by sliding the blanking plug into the housing.

   ***NOTE**: In the very unlikely event that the valve breaks, replace the housing the next time the boat is hauled.*
3. With the blanking plug fully inserted, screw the cap nut several turns until the threads are engaged. Continue to tighten the cap nut completely. **Hand tighten** only. Do not over tighten.

   ***NOTE:** The blanking plug must be fully inserted in the housing and the cap nut screwed on completely for a watertight seal.*
4. Reattach the safety wire to prevent the blanking plug from backing out in the unlikely event that the cap nut fails or is screwed on incorrectly.

Winterizing

After the boat has been hauled for winter storage, remove the blanking plug to let the water drain away before reinserting it. This will prevent any water from freezing around the blanking plug, possibly cracking the plastic.

Servicing the Insert

CAUTION: The electrodes on the insert's face are easily damaged. Do not scratch, gouge, or sand them with coarse sandpaper.

Cleaning the Electrodes

Aquatic growth can accumulate rapidly on the four electrodes reducing performance within weeks. Clean the electrodes with fine-grit wet-dry sandpaper, being careful to avoid making scratches.

Replacing the O-rings

All the O-rings must be intact and well lubricated to make a watertight seal.

1. Install the yellow O-ring near the top of the insert (Figure 11). Install a small O-ring near the bottom.
2. Place the remaining two small O-rings near the bottom of the blanking plug.

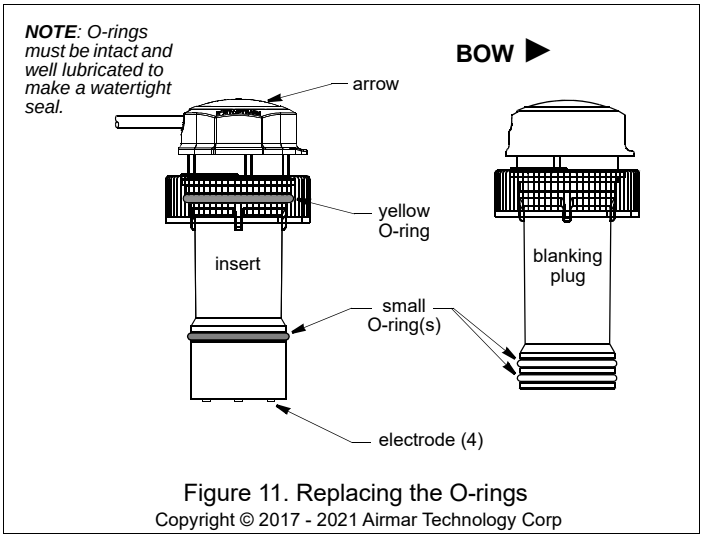

Figure 11. Replacing the O-rings

Replacement Sensor & Parts

The information needed to order a replacement Airmar sensor is printed on the cable tag. Do not remove this tag. When ordering, specify the part number and date. For convenient reference, record this information on the bottom of page one.

Lost, broken, or worn parts should be replaced immediately. If you have purchased a plastic housing and have a wood hull or desire greater strength, purchase an Airmar metal housing. Obtain parts from your instrument manufacturer or marine dealer.

Gemeco	USA
	Tel: 803-693-0777
	Email: sales@gemeco.com
Airmar EMEA	Europe, Middle East, Africa
	Tel: +33.(0)2.23.52.06.48
	Email: sales@airmar-emea.com

Troubleshooting

No Speed Reading

- Is the insert installed in the housing and connected to the instrument/ Processor?
- Is the insert oriented with the arrow on the top pointing forward toward the bow area and the cable exiting toward the stern? If the insert cannot be seated in the housing with the arrow pointing forward, check that the arrow on the flange of the housing is pointing forward. If this is not the case, the housing needs to be reinstalled with the correct orientation.
- Is power being supplied to the instrument/processor? The power must be 9 to 16 VDC. If there is no voltage, check the wiring.
- NMEA 0183 Speed & Temperature: Is the sensor wired to the instrument correctly?

Inaccurate Speed Readings

- If the speed sensor is ON when the boat is stationary, you may see a speed readout of a fraction of a knot because of water movement under the hull.
- If the speed reading is consistently the same percentage higher or lower than the true speed, it may be due to the speed function within the instrument. Refer to your instrument owner's manual.
- If speed readings are inaccurate above about 10 knots:
  - The sensor is installed in turbulent water. The cause may be water intake or discharge openings, strakes, fittings, hull irregularities upstream of the sensor, or the shape of the hull in that area. The sensor must be reinstalled in another location.
  - The insert is covered with aquatic growth. See "Servicing the Insert" on page 21.
  - Aerated water is flowing under the sensor because the boat is designed to pull air under the hull. The sensor will not work on this type of boat.

AIRMAR®
TECHNOLOGY CORPORATION

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