INSTALLATION INSTRUCTIONS

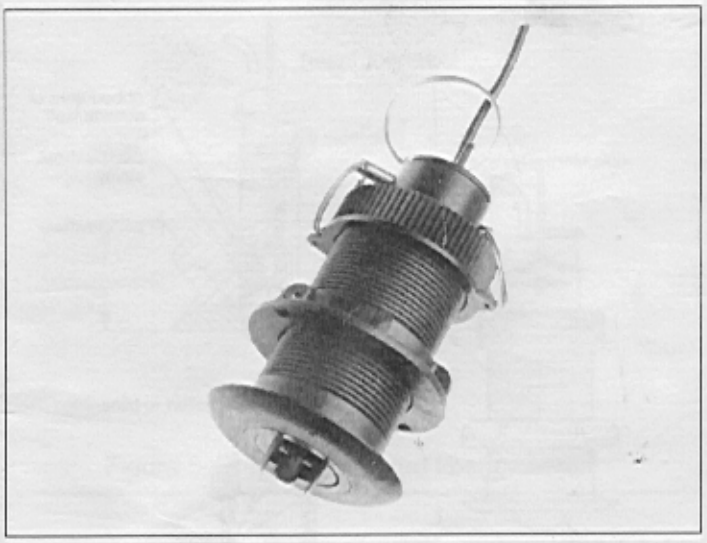
Thru-Hull, Self-Closing, Speed/Temperature Sensors: Models S650 and ST650

***IMPORTANT**: Please read instructions completely before proceeding with installation. These directions supercede instructions in your instrument manual if they differ.*

WARNING: NEVER USE SOLVENTS

Never expose a sensor to solvents. Strong solvents, such as acetone, attack many polymers and dramatically reduce their strength. Clean with a soft cloth and mild household detergent.

EM 17-129 rev 1 5/95



APPLICATION

- Install **plastic** housings in fiberglass or metal hulls only. **Never** install a plastic thru-hull sensor in a wood hull, since swelling of the wood may overstress the plastic housing.
- Install **stainless steel** housings in metal, fiberglass or wood hulls.
- Install **bronze** housings in fiberglass or wood hulls only. **Never** install a bronze housing in an aluminum hull, because electrolytic corrosion will occur.
- **Never** install a metal housing in a vessel with a positive ground system.

MATERIALS NEEDED

Water or mineral spirits based antifouling paint (**mandatory in salt water**)
Safety goggles
Dust mask
Electric drill with a 10mm (3/8") or larger chuck capacity
Drill bit: 3mm or 7/64"
Hole saw: 51mm (2")
Countersink tool for P217 and B119[a]
Household detergent
Sand paper
Marine sealant
Petroleum jelly (Vaseline®)
Wrench or pliers for metal housing
Tie-wraps or lacing twine
For a cored fiberglass hull installation:
- Hole saw: 60mm (2-3/8")
- Fiberglass cloth and resin (see page 3, #5)
- ***or*** cylinder, wax, tape and casting epoxy (see page 3, #5)

SELECTING THE MOUNTING LOCATION

Turbulent free water must flow over the paddlewheel at all boat speeds. Avoid the turbulent water near the keel.

- **Displacement hull powerboats** — Locate the sensor amidships and away from the keel.
- **Planing hull powerboats** — Mount the sensor well aft to insure that it is in contact with the water at high speeds.
- **Fin keel sailboats** — Mount to the side of the keel and forward of the fin keel 300–600mm (12"–24"). If possible, choose an accessible spot with a minimum deadrise angle.
- **Full keel sailboats** — Locate the sensor amidships and away from the keel but still in the water when the boat is heeled.

Never mount the sensor near water intake or discharge openings; or behind strakes, struts, fittings or hull irregularities that may cause aeration, cavitation or turbulence and thus inaccurate readings.

Never mount the sensor directly ahead of a depth transducer, because turbulence generated by the paddlewheel's rotation can adversely effect depth transducer performance, especially at high speeds.

Headroom

There must be adequate access space inside the vessel to allow for the height of the housing, tightening the nuts and removing the insert. Allow 125mm (5") of headroom.

ANTIFOULING PAINT

Sea growth can accumulate rapidly on the sensor's surface reducing performance in weeks. Surfaces exposed to salt water must be coated with antifouling paint. **Use only water or mineral spirits based antifouling paint**. Never use ketone based paint since ketones attack polymers and damage the sensor.

It is easiest to apply paint before installing the sensor, but allow time for it to dry. Paint the following surfaces (see **Figure 1**):

Ribbed area on the outside wall of the insert
Paddlewheel cavity
Paddlewheel
Exposed end of the insert
Exterior lip of the housing and valve
Inside wall of the valve assembly, 30mm (1-1/4") up

INSTALLING THE SENSOR

Note: Follow separate instructions on page 3 for installing a sensor in a cored fiberglass hull.

Hole Drilling

Always wear safety goggles and a dust mask when drilling.

a. Available from Farallon Electronics
Phone (415) 331-1924, Fax (415) 331-2063

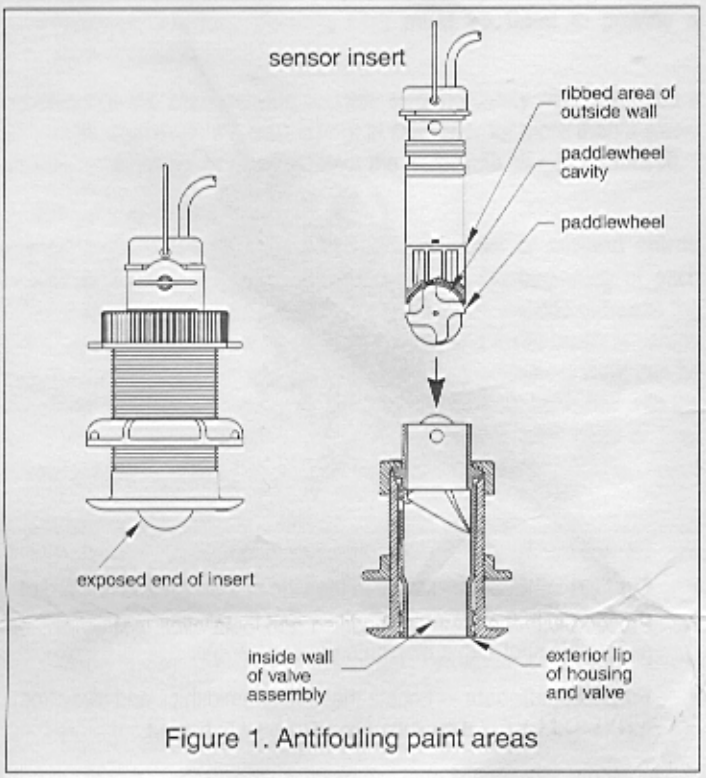


Figure 1. Antifouling paint areas

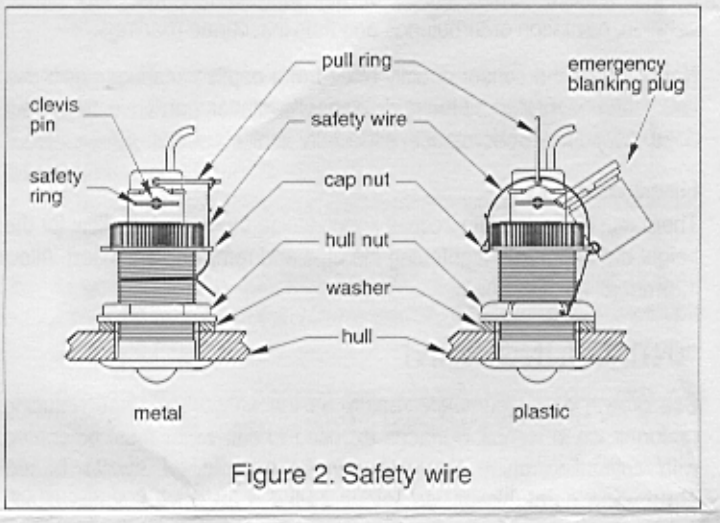


Figure 2. Safety wire

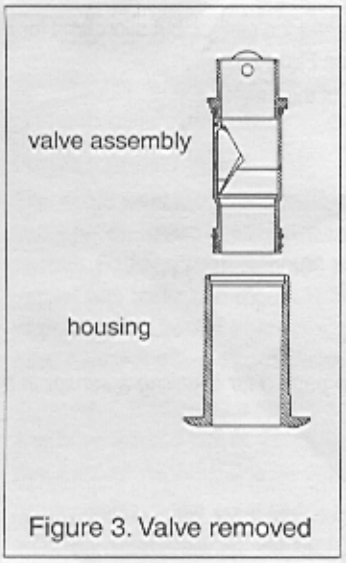


Figure 3. Valve removed


Figure 4. Applying sealant

1. Drill a 3mm (7/64") 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 pilot 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 the 51mm (2") hole saw, cut the hole from outside the hull.
3. 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 household detergent or a weak solvent, such as alcohol, before sanding.

Bedding Procedure

1. Remove one safety ring and the clevis pin (see **Figure 2**), then pull the sensor insert from the housing (see **Figure 1**). Next, remove the cap nut, hull nut (see **Figure 2**) and valve assembly (see **Figure 3**).
2. Apply a 2mm (1/16") thick layer of sealant around the lip of the housing (see **Figure 4**).
3. Apply a 1mm (1/32") thick layer of sealant up the sidewalls of the housing, 6mm (1/4") higher than the thickness of the hull. This will ensure there is sealant in the threads to seal the hull and hold the hull nut securely in place.

Installation

1. From outside the hull, push the housing into the hole using a twisting motion to squeeze out excess sealant.
2. Align the arrow on the lip of the housing to point forward toward the bow and be parallel to the keel.
3. Slide on the washer used to distribute the force from the hull nut and create a flat surface to tighten against (see **Figure 2**). On aluminum hulls less than 5mm (0.2") thick, it is necessary to use a second washer. With a plastic sensor, the washer material must not swell and stress the housing. **Never** use a wood backing block with a plastic housing; use a fiberglass, plastic, brass or rubber washer.
4. Screw on the hull nut (see **Figure 2**). On a metal housing, tighten the hull nut with a wrench or pliers. On a plastic housing, always **hand tighten** the hull nut. **Do not over tighten**. Check to be sure the notch on the upper rim of the housing is aligned forward toward the bow.
5. Remove the excess sealant on the outside of the hull to ensure smooth water flow over the sensor.
6. After the sealant cures, lubricate the O-rings on the sensor insert and valve assembly with petroleum jelly. Slide the valve assembly into the housing being sure to engage the key in the notch (see **Figure 3**). (A pushing, twisting motion will locate the notch.) Secure it in place by **hand tightening** the cap nut. Slide the insert into the valve assembly with the arrows on the top facing forward toward the bow. Be careful not to rotate the outer housing and disturb the sealant.
7. Slide the clevis pin in place and attach the safety ring. Thread the short, large diameter, emergency blanking plug onto one of the safety rings (see **Figure 2**).
8. On a plastic housing, attach the safety wire to one eye in the hull nut. Lead the wire in a counter clockwise 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 pull ring and the second eye in the cap nut. Twist the wire securely to the cap nut (see **Figure 2**).

On metal sensors, wrap one end of the wire tightly around the housing and twist it together with the long end. Lead the wire through one eye in the cap nut. Thread the wire through the eye a second time. Loop the wire through the pull ring and twist it securely to itself (see **Figure 2**).

Always 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.

9. Route the cable to the instrument being careful not to tear the cable jacket when passing it through the bulkhead and other parts of the boat. To reduce electrical interference, separate the sensor cable from other electrical wiring and sources of electrical interference. To prevent damage, coil the excess cable and secure it in place using tie-wraps or lacing twine.

*Note: If your sensor came with a connector, **do not** remove it to ease cable routing. If the cable must be cut and spliced, use AIRMAR's waterproof junction box 33-124. Follow the splicing instructions provided. **Never** cut the cable or remove the connector, except when using AIRMAR's junction box, because this will void the warranty.*

Installation in a Cored Fiberglass Hull

To install a thru-hull sensor in a cored fiberglass hull, the core (balsa or klegecell) must be cut carefully and sealed. The core must be protected from water seepage and the hull must be reinforced to prevent it from crushing under the hull nut thus allowing the thru-hull housing to become loose.

Always wear safety goggles and a dust mask when drilling.

1. Drill a 3mm (7/64") 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 the 51mm (2") hole saw, cut the hole from outside the hull.
3. Using the 60mm (2-3/8") hole saw, cut through the inner skin and most of the core from inside the hull. 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 hull (see **Figure 5**).
4. Remove the plug. Clean and sand the inner hull, core and the gelcoat 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 (see **Figure 5**). After the epoxy has set, remove the cylinder.

   Always completely seal the hull to prevent water from seeping into the core.
6. Clean and sand 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 household detergent or a weak solvent, such as alcohol, before sanding.
7. Proceed with the standard bedding and installation instructions on page 2.

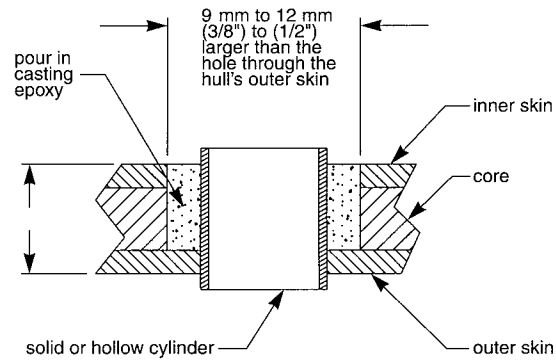


Figure 5. Preparing a cored fiberglass hull

CONNECTING THE SENSOR TO THE INSTRUMENT

Refer to your instrument owner's manual.

CHECKING FOR LEAKS

When the boat is placed in the water, **immediately** check around the thru-hull sensor for leaks. Note that very small leaks may not be readily observed. It is best 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 water accumulation after 24 hours (probably not enough to cause water damage). If a leak is observed, the bedding procedure and installation should be repeated immediately.

Never install a thru-hull sensor and leave the boat in the water unchecked for several days.

MAINTAINING THE SENSOR

Blanking Plug

To protect the paddlewheel, a blanking plug is provided and should be used when the boat is kept in salt water for more than a week, at a slip or mooring, or removed from the water with slings or a fork lift. Also, remove the speed/temperature insert from the housing and replace it with the long blanking plug if marine growth buildup on the paddlewheel is suspected due to inaccurate readings from the instrument.

1. Lubricate the O-rings on the blanking plug with petroleum jelly.
2. Remove the speed/temperature insert from the housing by first removing the safety wire, one safety ring and pulling out the clevis pin.
3. With the arrow facing forward toward the bow, insert the long blanking plug. Secure the blanking plug with the clevis pin, safety ring and safety wire.

   The S/ST650 incorporates a self-closing valve which minimizes the flow of water into the vessel when the speed/temperature insert is removed. The curved flap valve in the valve assembly is activated by both a spring and water pressure, pushing the flap valve upward to seal the opening so there is no plume of water into the boat.

However, the long blanking plug **must be used** to provide a watertight seal.

Always use the blanking plug secured with the safety wire to provide a watertight seal when the boat is kept in salt water for more than a week, at a slip or mooring, or removed from the water with slings or a fork lift.

Antifouling Paint

For sensors exposed to salt water, reapply **water or mineral spirits based** antifouling paint every 6 months or at the beginning of each boating season (see **Figure 1**). Marine growth can impede or freeze the paddlewheel's rotation and must be removed. Use a stiff brush or scrape with a dull edged tool. If fouling is severe, the paddlewheel shaft can be removed by pushing it out using a spare shaft or a 4D finish nail with the point ground flat. Light wet sanding is permissible with #220 or finer grade wet/dry paper. Clean with detergent if necessary.

Changing the Paddlewheel

1. Push out the paddlewheel shaft about 5mm (1/4") using the new shaft. With pliers, remove the old shaft (see **Figure 6**).
2. Place the new paddlewheel in the cavity with the flat side of the blade facing the same direction as the arrow on the top of the insert.
3. Tap the new shaft into place until the ends are flush with the insert being careful that the shaft enters the center hole of the plastic bearing in the paddlewheel. Center the paddlewheel on the shaft or damage to the bearing can result.

Changing the Valve Assembly

Should the valve jam preventing the speed/temperature insert from being installed or removed, the short, large diameter, emergency blanking plug must be used.

1. Remove the short blanking plug from the safety ring and clean the O-ring.
2. Unscrew the cap nut. With the plug ready in one hand, use the clevis pin to pull out the valve assembly. Rapidly replace it with the plug (see **Figure 3**).
3. **Always** secure the blanking plug with the cap nut and safety wire (see **Figure 2**). Repair or replace the valve assembly.

Reinstalling the Speed/Temperature Insert

1. Inspect and lubricate the insert O-rings.
2. Align the arrow on the insert facing forward toward the bow and slide it into the valve assembly.
3. **Always** secure the insert with the clevis pin, safety rings and safety wire (see **Figures 2**).

Replacement Parts

The water lubricated paddlewheel bearings have a finite life of up to 5 years on low speed boats (less than 10 knots) and 1 year on high-speed vessels. Paddlewheel shafts can bend and paddlewheels fracture due to impact with water borne objects and from mishandling in boat yards. O-rings must be free of abrasions, nicks and cuts to ensure a watertight seal. AIRMAR offers a paddlewheel and valve kit 33-415 (see **Figure 7**).

If you have purchased a speed/temperature sensor in a plastic housing and have a wood hull or desire the greater strength of a metal housing, purchase an AIRMAR bronze or stainless steel housing.

Broken, worn and lost parts should be replaced immediately. The following table gives the AIRMAR part numbers for parts which can be obtained through your instrument manufacturer.

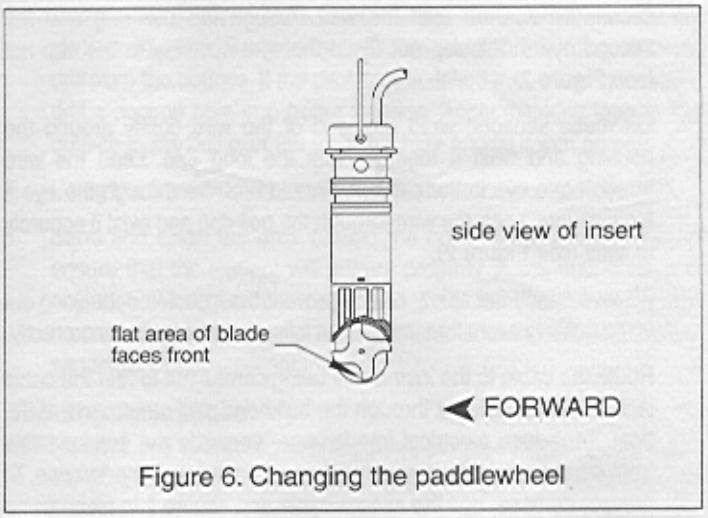


Figure 6. Changing the paddlewheel

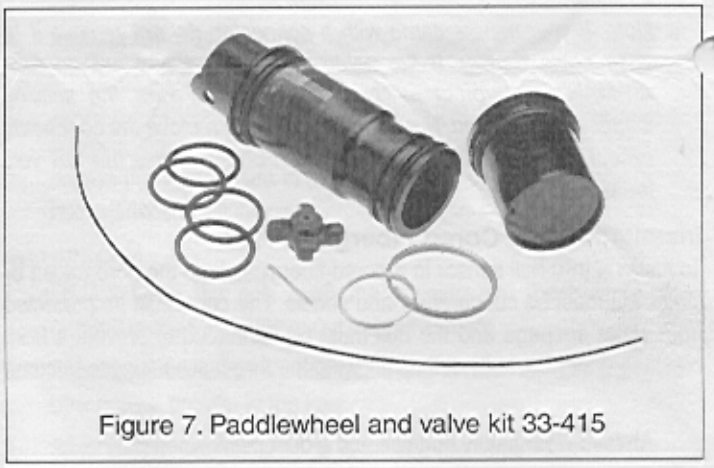


Figure 7. Paddlewheel and valve kit 33-415

Model	Blanking Plug	Cap Nut	Hull Nut	Housing & Hull Nut	Pdlwhl & Valve Kit
S/ ST650	33-414	04-011 (P) 02-029 (B)	04-004 (P) 02-030 (B) 02-530 (SS)	33-100 (B) 33-101 (SS)	33-415

IDENTIFYING AND REPLACING THE SENSOR

The AIRMAR part number is printed on the mylar tag on the cable near the connector end. **Do not** abrade the marking or remove the label since this identifies the sensor. Should you need a replacement, specify the frequency, date code and part number found on this tag (see **Figure 8**).

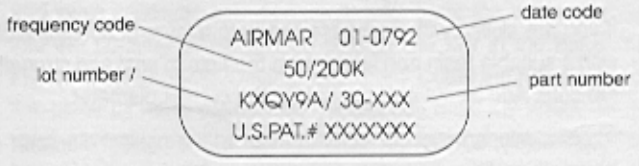


Figure 8. Mylar tag

AIRMAR
TECHNOLOGY CORP
69 Meadowbrook Drive, Milford, New Hampshire 03055–4618 USA
Phone (603) 673-9570 ■ Fax (603) 673-4624