

INSTALLATION INSTRUCTIONS

Speed/Temperature Sensor with Valve

U.S. Patents: 4,898,029; 5,186,050. Australian Patent 605,281.
Canadian Patent 1,313,775. Japanese Patent 1851014

Models: S650 and ST650

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

WARNING: NEVER USE SOLVENTS!

Cleaners, gasoline, paint, sealants and other products may contain strong solvents, such as acetone, which can attack many plastics dramatically reducing their strength.

Applications

- **Plastic** housings are recommended for fiberglass or metal hulls only. *Never* mount a plastic thru-hull housing in a wood hull since swelling of the wood may overstress the plastic causing a fracture.
- **Bronze** housings are recommended for fiberglass or wood hulls only. *Never* mount a bronze housing in a metal hull because electrolytic corrosion will occur.
- **Stainless steel** housings are recommended for metal hulls to prevent electrolytic corrosion.
- *Never* install a metal housing on a vessel with a positive ground system.

Tools and Materials Needed

Water-based *or* mineral spirits-based antifouling paint
(**mandatory in salt water**)

Safety goggles

Dust mask

Electric drill

Drill bit: 3 mm *or* 1/8"

Hole saw: 51 mm *or* 2"

Countersink tool for P217 and B119

[Available from Farallon Electronics: tel (415) 331-1924, fax (415) 331-2063]

Mild household detergent *or* weak solvent (alcohol)

Sandpaper

Marine sealant

Additional washer for aluminum hull less than 6 mm (1/4") thick

slip-joint pliers for metal housing

Silicone grease *or* petroleum jelly (Vaseline®)

Zip-ties

For a cored fiberglass hull installation:

Hole saw for interior: 60 mm *or* 2-3/8"

Fiberglass cloth and resin (see page 3, #5)

or Cylinder, wax, tape, and casting epoxy (see page 3, #5)

Preparation

Pre-test

Connect the sensor to the instrument and spin the paddlewheel. Check for a speed reading and the approximate air temperature.

Antifouling Paint

Marine 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 **water-based** or **mineral spirits-based** antifouling paint only. *Never* use ketone-based paint, since ketones can attack many types of plastic possibly damaging the sensor.

It is easiest to apply antifouling paint before installing the sensor, but allow sufficient drying time. Reapply paint every 6 months or at the beginning of each boating season. Paint the following surfaces (see Figure 1):

- Outside wall below the lower O-ring of the paddlewheel insert
- Paddlewheel cavity
- Paddlewheel
- Exterior lip of the housing and valve assembly
- Inside wall of the valve assembly up 30 mm (1-1/4")
- Blanking plug below the lower O-ring and the exposed end

Mounting Location

Turbulence-free water *must* flow over the paddlewheel at all boat speeds.

Choose an accessible spot with a minimum deadrise angle.

Allow a minimum of 28 cm (11") of headroom inside the vessel for the height of the housing, tightening the nuts, and removing the insert.

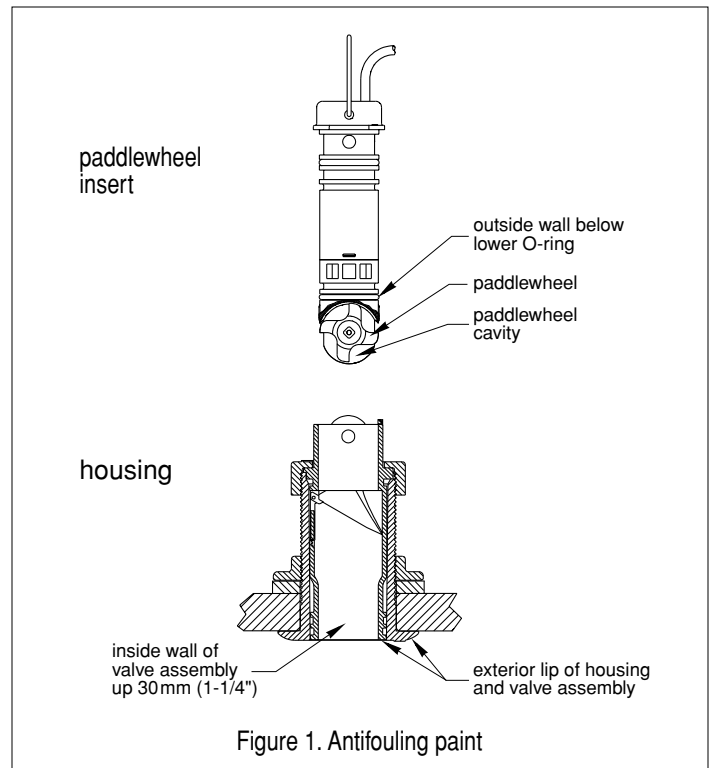


Figure 1. Antifouling paint

- **Displacement hull powerboats**—Locate the sensor amidships near the centerline.
- **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 the sensor on or as close as possible to the centerline and forward of the fin keel 30–60 cm (1–2').
- **Full keel sailboats**—Locate the sensor amidships and away from the keel but still in the water when the boat is heeled.

Caution: Do not mount the sensor in a turbulent area: near water intake or discharge openings; behind strakes, fittings or hull irregularities; or behind eroding paint (an indication of turbulence).

Caution: Never mount the sensor directly ahead of a depth transducer, since turbulence generated by the paddlewheel's rotation will adversely affect the transducer's performance, especially at high speeds.

Installation

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

Hole Drilling

Warning: Always wear safety goggles and a dust mask.

1. Drill a 3 mm 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 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 51 mm or 2" hole saw, cut the hole from outside the hull.
3. 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 mild household detergent or a weak solvent (alcohol) before sanding.

Bedding

1. Remove one safety ring and the retaining pin from the sensor. Grasp the paddlewheel insert by the pull ring and pull slowly upward. Next, remove the cap nut, hull nut, and washer (see Figure 2).
2. Apply a 2 mm (1/16") thick layer of marine sealant around the lip of the housing that contacts the hull and up the sidewalls of the housing, 6 mm (1/4") higher than the combined thickness of the hull, washer, and hull nut. This will ensure there is sealant in the threads to seal the hull and hold the hull nut securely in place.

Installing

Caution: Never pull, carry or hold the sensor by the cable as this may sever internal connections.

1. From outside the hull, push the housing into the mounting hole using a twisting motion to squeeze out excess sealant (see Figure 2).
2. Align the arrow on the lip of the housing pointing forward toward the bow and parallel to the centerline of the boat.
3. From inside the hull, slide the washer onto the housing.
Aluminum hulls less than 6 mm (1/4") thick—Use an additional washer. Never use bronze, since electrolytic corrosion will occur.
Plastic housing—Use a fiberglass, plastic or rubber washer. Never use a wood backing block with a plastic housing, since swelling of the wood can overstress the plastic causing a fracture.
4. Screw the hull nut in place being sure the notch on the upper rim of the housing is still positioned forward toward the bow.
Metal hull nut—Tighten the hull nut with an slip-joint pliers.
Plastic hull nut—**Hand-tighten** only. Do not over-tighten.
5. Screw the plastic cap nut in place and **hand-tighten** only. Do not over-tighten.
6. Remove any excess sealant on the outside of the hull to ensure smooth water flow over the paddlewheel.
7. After the sealant cures, inspect and lubricate the O-rings on the paddlewheel insert with silicone grease or petroleum jelly (see Figure 4).
8. Slide the insert into the valve assembly with the arrows on the top pointing forward toward the bow. Seat it into place with a twisting motion until the keys fit into the notches. Be careful not to rotate the outer housing and disturb the sealant.
9. Insert the retaining pin and reattach the safety ring (see Figure 2).
Warning: 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.
10. **Metal housing**—Wrap one end of the safety wire tightly around the housing and twist it together with the long end. Thread the **short** emergency plug onto the wire. Lead the wire straight up and through one eye in the cap nut. Loop the wire through the pull ring and twist it securely to itself.
Plastic housing—Attach the safety wire to one eye in the hull nut. Thread the **short** emergency plug onto the wire. 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 pull ring and the second eye in the cap nut. Twist the wire securely to itself.

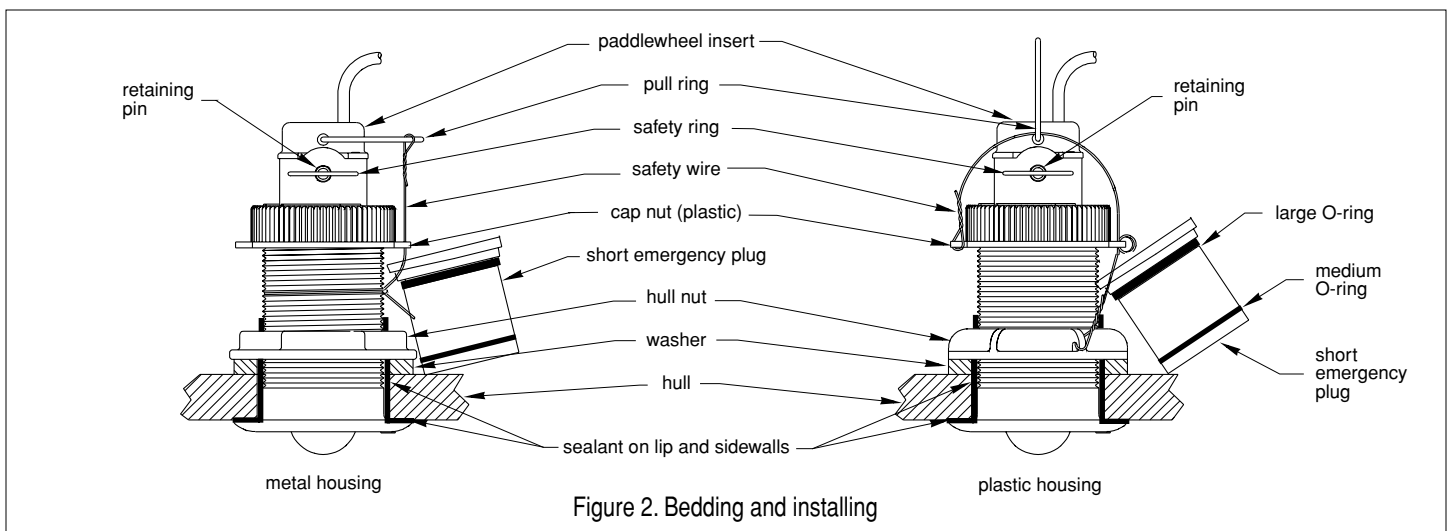


Figure 2. Bedding and installing

Caution: 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 33-035 and follow the instructions provided. Cutting the cable or removing the connector, except when using Airmar's junction box, will void the warranty.

- 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 the engine. Coil any excess cable and secure it in place with zip-ties to prevent damage.
- Refer to the instrument owner's manual to connect the sensor to the instrument.

Checking for Leaks

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

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 bilge water accumulation after 24 hours (probably not enough to cause water damage). If a leak is observed, repeat "Bedding" and "Installing" on page 2 immediately.

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.

Warning: Always wear safety goggles and a dust mask.

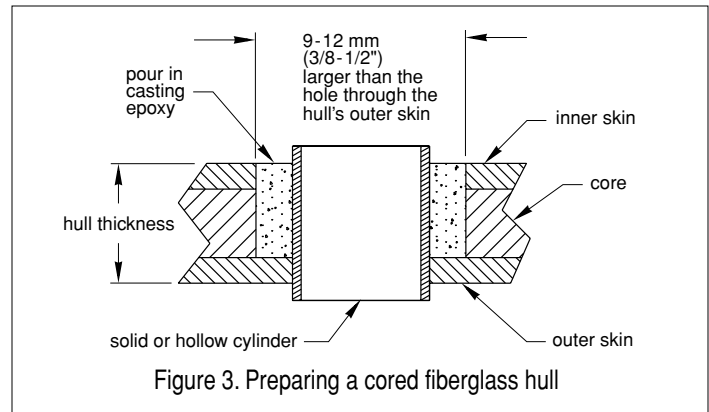
- Drill a 3 mm or 1/8" pilot hole from inside the hull. If there is a rib, strut or other hull irregularity near the selected mounting location, drill from the outside. (If the hole is drilled in the wrong location, drill a second hole in a better location. Apply masking tape to the outside of the hull over the incorrect hole and fill it with epoxy.)
- Using the 51 mm or 2" hole saw, cut the hole from outside the hull through the **outer** skin only (see Figure 3).
- From inside the hull, use the 60 mm 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.
- Remove the plug of core material so the inner core of the hull is fully exposed. Clean and/or sand the inner skin, core, and the outer skin around the hole.

Caution: Always completely seal the hull to prevent water seepage into the core.

- 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 (see Figure 3).

- 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 mild household detergent or a weak solvent (alcohol) before sanding.
- Proceed with the "Bedding" and "Installing" instructions on page 2.



Maintenance, Repair, and Replacement

Blanking Plug

To protect the paddlewheel insert, use the **long** blanking plug when the boat will be moored in salt water for more than a week, the boat will be removed from the water or aquatic growth build-up on the paddlewheel is suspected due to inaccurate readings from the instrument.

The sensor incorporates a self-closing valve which minimizes the flow of water into the vessel when the paddlewheel insert is removed. The curved flap valve in the valve assembly 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.

Warning: THIS IS NOT A WATERTIGHT SEAL!

Always use the **long** blanking plug secured with the retaining pin, safety rings, and safety wire to provide a watertight seal when the paddlewheel insert is removed.

- Inspect and lubricate the O-rings on the **long** blanking plug with silicone grease or petroleum jelly.
- Remove the paddlewheel insert from the housing by first removing the safety wire, one safety ring, and the retaining pin.
Do not remove the cap nut (see Figure 2).
- Grasp the pull ring and remove the paddlewheel insert with a slow pulling motion (see Figure 4).
Note: In the unlikely event that the paddlewheel insert cannot be removed, see "Servicing the Valve Assembly" on page 4.
- With the arrows pointing forward toward the bow, insert the **long** blanking plug. Secure it with the retaining pin, safety rings, and safety wire (see Figure 2).

Servicing the Paddlewheel Insert

Aquatic growth can impede or freeze the paddlewheel's rotation and *must* be removed. Use a stiff brush or putty knife to remove the growth and clean the surface with mild household detergent. If fouling is severe, push the paddlewheel shaft out using a spare shaft or a 4D finish nail with a flattened point. Then, lightly wet sand the surface with fine grade wet/dry paper.

The water lubricated paddlewheel bearings have a life of up to 5 years on low-speed boats [less than 10kn (11 MPH)] and 1 year on high-speed vessels. Paddlewheels can fracture and shafts can bend due to impact with water borne objects and mishandling in boat yards. O-rings *must* be free of abrasions and cuts to ensure a watertight seal. A replacement Paddlewheel Kit 33-113 is available (see Figure 5).

- Using the new paddlewheel shaft, push the old shaft out about 6 mm (1/4"). With pliers, remove the old shaft (see Figure 4).
- Place the new paddlewheel in the cavity with the flat side of the blade facing the same direction as the arrows on the insert top.

- Tap the new shaft into place until the ends are flush with the insert.
- Install two of the small O-rings.
- Place the remaining three small O-rings on the **long** blanking plug.

Servicing the Valve Assembly

Should the valve fail, remove it for servicing. A replacement Paddlewheel & Valve Kit 33-415 is available (see Figure 6).

Warning: When the valve assembly is removed, always insert the **short** emergency plug with the cap nut and safety wire for a watertight seal.

- Remove the safety wire from the cap nut. Remove the **short** emergency plug (see Figure 2). Inspect (replace if necessary) and lubricate the O-rings with silicone grease or petroleum jelly.
- Unscrew the cap nut. With the **short** plug ready in one hand, remove the valve assembly by grasping the pull ring and pulling upward. Rapidly install the **short** emergency plug to minimize the flow of water into the boat.
- Secure the **short** emergency plug with the cap nut and safety wire.
- Remove the paddlewheel insert from the valve assembly by removing one safety ring and the retaining pin. Grasp the insert by the pull ring and pull slowly upward.

Warning: If the insert is caught in the valve assembly trapping the cap nut, **TEMPORARILY** hold the **short** emergency plug in place with the safety wire. Then, separate the insert from the valve assembly. In the unlikely event that they cannot be separated and the sensor must be left unattended, cut the cable [a minimum of 1 m (3') from the insert] to free the cap nut. Use the cap nut and safety wire to secure the **short** emergency plug. Later, splice the cable with Airmar's Junction Box 33-035.

- Clean, repair or replace the valve assembly so that the flap valve moves freely and seats against the valve housing (see Figure 4).
- To reinstall the valve assembly, inspect (replace if necessary) and lubricate the O-rings.
- Slide the valve assembly into the housing being sure to engage the key in the notch. Screw the cap nut in place **hand-tightening** only. Do not over-tighten.

Warning: 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.

- After inspecting and lubricating the O-rings, reinsert the **long** blanking plug or paddlewheel insert and secure it with the retaining pin and safety rings. Thread the short emergency plug onto the safety wire and twist it in place for a watertight seal (see Figure 2).

Replacement Parts

If you have purchased a plastic housing and have a wood hull or desire greater strength, purchase an Airmar metal housing. Obtain the following parts from your marine dealer or instrument manufacturer.

Part	Airmar Part Number
Blanking Plug	20-602
Paddlewheel Kit (see Figure 5)	33-113
Paddlewheel & Valve Kit (see Figure 6)	33-415
Cap Nut	04-011 (plastic)
	02-029 (bronze)
Hull Nut	04-004 (plastic)
	02-030 (bronze)
	02-530 (stainless steel)
Housing, Nut & Washer	33-100 (bronze)
	33-101 (stainless steel)

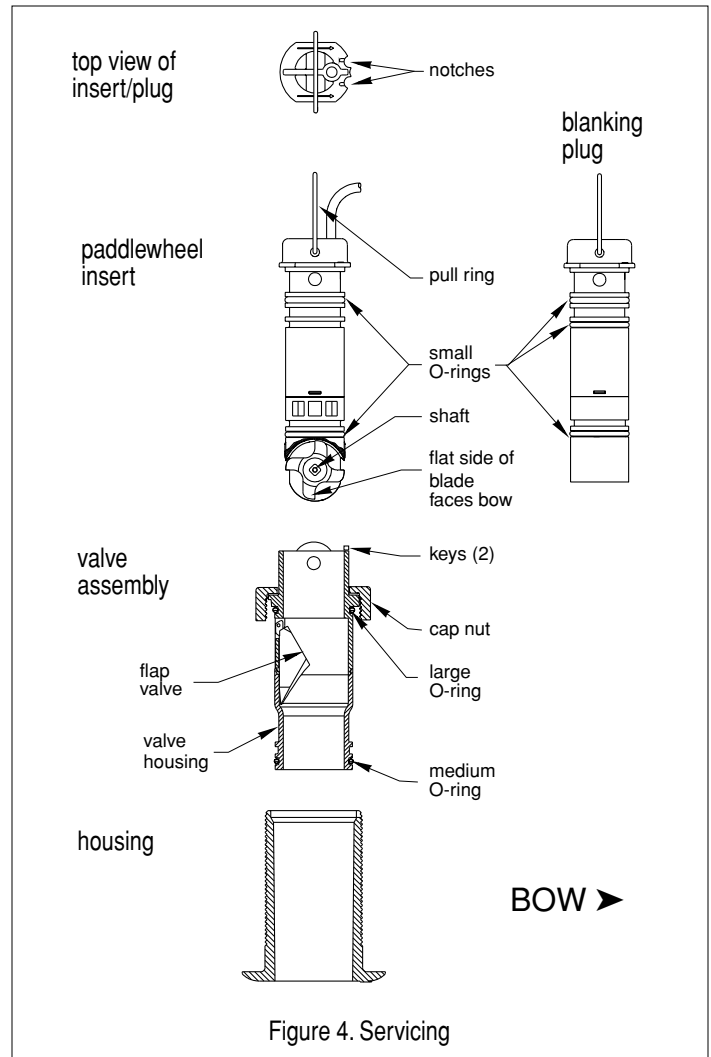


Figure 4. Servicing



Figure 5. (33-113)
Paddlewheel Kit

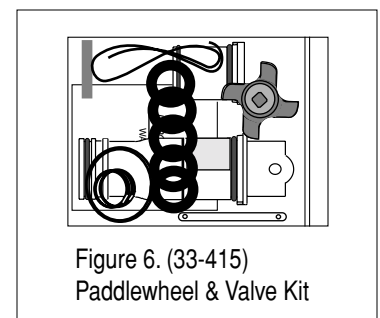


Figure 6. (33-415)
Paddlewheel & Valve Kit

Sensor Replacement

The information needed to order a replacement Airmar sensor is printed on the **vinyl** tag affixed to the cable near the connector end. Do not abrade the marking or remove this tag. When ordering, specify the date code and part number.

