

# OWNER'S GUIDE & INSTALLATION INSTRUCTIONS

## Thru-Hull Speed & Temperature Sensor with Valve

Model ST600

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

10/01

17-038-01 rev. 03

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

### CAUTION: NEVER USE SOLVENTS

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

### Applications

- **Plastic** housing recommended for 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 causing a fracture.
- **Bronze** housing recommended for wood or fiberglass hulls only. Never install a bronze housing in a metal hull because electrolytic corrosion will occur.
- Never install a metal housing in a vessel with a positive ground system.

### Tools and Materials

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

Safety goggles

Dust mask

Electric drill with 10mm (3/8") or larger chuck capacity

Drill bit: 3mm or 1/8"

Hole saw: 51mm or 2"

Sandpaper

Mild household detergent or weak solvent (alcohol)

Marine sealant

Additional washer (some installations)

Slip-joint pliers for metal housing

Zip-ties

Installation in a cored fiberglass hull (see page 3)

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

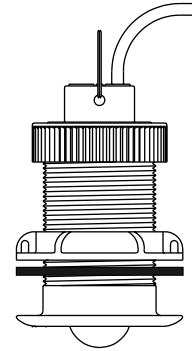
Fiberglass cloth and resin

or Cylinder, wax, tape, and casting epoxy

### Preparation

#### Pre-Installation Test

Connect the sensor to the instrument and spin the paddlewheel. Check for a speed reading and the approximate air temperature. If there is no reading or it is inaccurate, return the instrument to your place of purchase.



### Anti-fouling Paint

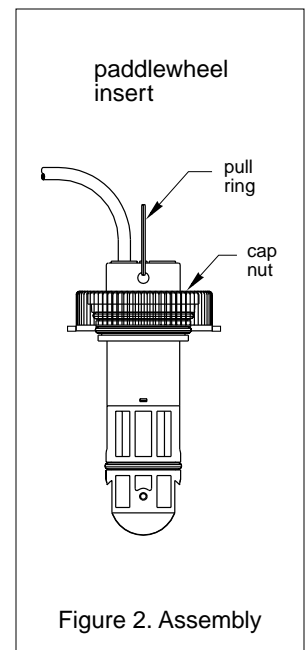
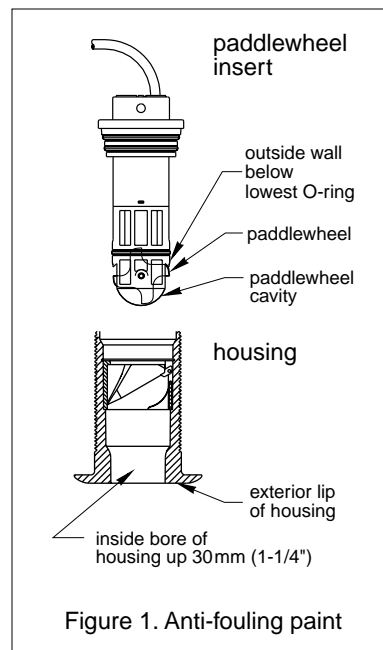
Marine growth can accumulate rapidly on the sensor's surface reducing performance within weeks. Surfaces exposed to salt water *must* be coated with anti-fouling paint. Use **water based or mineral spirits based** anti-fouling paint only. Never use ketone based anti-fouling paint, since ketones attack many plastics possibly damaging the sensor.

It is easiest to apply anti-fouling paint before installation, 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 of paddlewheel insert below lowest O-ring
- Paddlewheel cavity
- Paddlewheel
- Bore of housing up 30mm (1-1/4")
- Exterior lip of housing
- Blanking plug below lowest O-ring including the exposed end

### Assembly

Slide the cap nut along the cable until it rests on the top of the paddlewheel insert. Attach the pull ring to the insert capturing the cap nut (see Figure 2). Similarly attach the pull ring to the blanking plug capturing the cap nut.



## Mounting Location

Turbulence-free water *must* flow over the paddlewheel at all speeds. Choose an accessible spot inside the vessel. Allow a minimum of 200mm (8") of headroom for the height of the housing, tightening the nuts, and removing the insert.

- **Displacement hull powerboats**—Locate amidships near the centerline.
- **Planing hull powerboats**—Mount well aft to insure that it is in contact with the water at high speeds.
- **Fin keel sailboats**—Mount on or as close as possible to the centerline and forward of the fin keel 300–600mm (1–2').
- **Full keel sailboats**—Locate amidships and away from the keel at the point of minimum deadrise.

**Caution:** Do not mount the sensor in an area: of turbulence or bubbles: 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 depth transducer's performance, especially at high speeds.

## Installation

**Cored fiberglass hull**—Follow separate instructions on page 3.

### Hole Drilling

**Warning:** Always wear safety goggles and a dust mask.

1. Drill a 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 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 or 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 mild household detergent or a weak solvent (alcohol) before sanding.

### Bedding

Apply a 2mm (1/16") thick layer of marine sealant around the lip of the housing that contacts the hull. Apply marine sealant to the

sidewall of the housing, 6mm (1/4") higher than the combined thickness of the hull, washer, and hull nut (see Figure 3). This will ensure there is sealant in the threads to seal the hull and to hold the hull nut securely in place.

## Installing

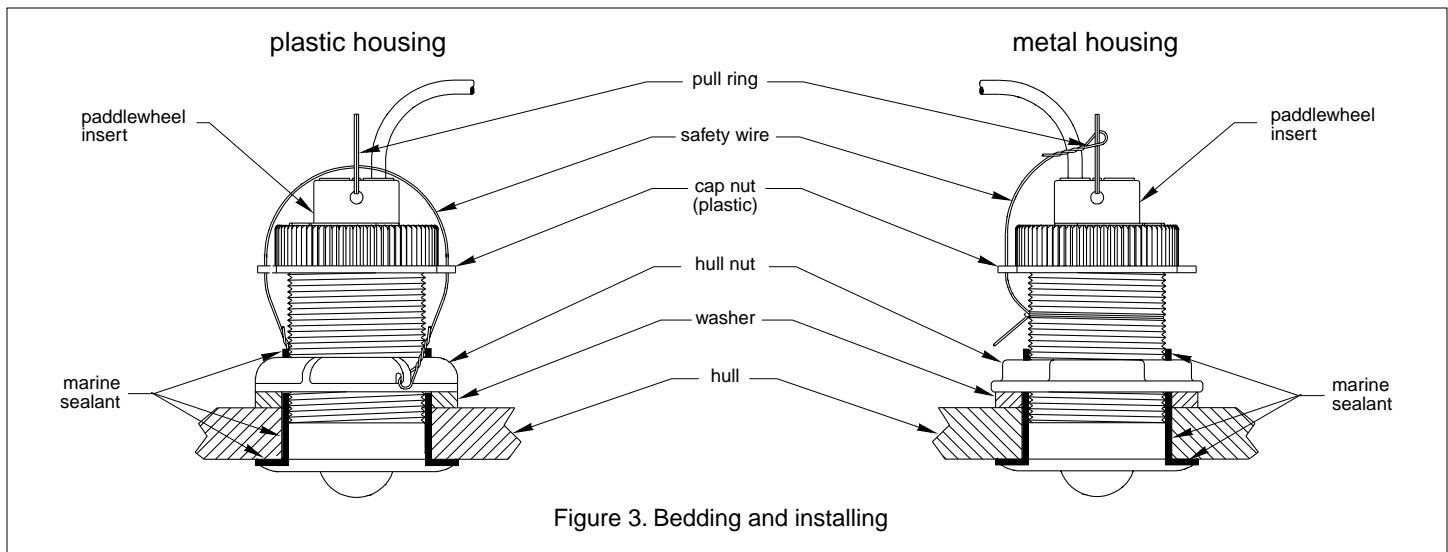
**Caution:** Never pull, carry, or hold the sensor by the cable as this may sever internal connections.

1. From outside the hull, push the housing into the mounting hole using a twisting motion to squeeze out excess sealant (see Figure 3). Align the arrow on the lip of the housing to point forward toward the bow. If the sensor is not installed on the centerline of the boat, angle the housing slightly toward the centerline to align it with the water flow.
2. From inside the hull, slide the washer onto the housing.  
**Aluminum hulls less than 6mm (1/4") thick**—Use an additional rubber, plastic, or fiberglass washer. *Never* use a wood backing block, since swelling of the wood can overstress the plastic housing causing a fracture. *Never* use bronze since electrolytic corrosion will occur.
3. Screw the hull nut in place *being sure* the arrow on the lip and the notch on the upper rim of the housing are still positioned forward toward the bow (see Figure 7).  
**Plastic hull nut**—Hand-tighten only. *Do not* over-tighten.  
**Metal hull nut**—Tighten the hull nut with slip-joint pliers.  
**Wood hull**—Allow for the wood to swell.
4. Remove any excess sealant on the outside of the hull to ensure smooth water flow over the paddlewheel.

**Warning:** The O-rings must be intact and well lubricated to make a watertight seal.

5. After the sealant cures, inspect the O-rings on the paddlewheel insert and lubricate them with the silicone lubricant supplied.
6. Slide the paddlewheel insert into the housing with the arrow on the top pointing forward toward the bow. Seat it into place with a pushing twisting motion until the key fits into the notch. The arrow on the top of the insert, the notch, and the arrow on the lip of the housing will all be aligned. *Be careful* not to rotate the housing and disturb the sealant. Screw the cap nut in place and **hand-tighten** only. *Do not* over tighten (see Figure 3).

**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.



7. **Plastic housing**—Attach the safety wire to one eye in the hull nut. Lead the wire in a counterclockwise direction and thread it through one eye in the cap nut, the pull ring, the second eye in the cap nut, and the second eye in the hull nut. 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. Lead the wire straight up and through the eye in the cap nut. Loop the wire through the pull ring and twist it securely to itself.

**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 splash-proof 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.

8. 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 using zip-ties to prevent damage.
9. 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. *Do not* 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" 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.

1. Drill a 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 the 51 mm or 2" hole saw, cut the hole from outside the hull through the *outer skin* only (see Figure 4).
3. From inside the hull, use the 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. Clean and sand the inner skin, core, and the outer skin around the hole.

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

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.

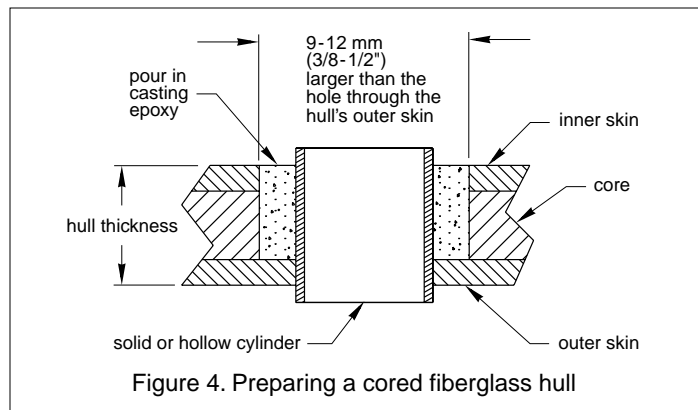


Figure 4. Preparing a cored fiberglass hull

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 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 the "Bedding" and "Installing" on page 2.

## Operation, Maintenance, Repair, & Parts

### How the Valve Works

The sensor incorporates a self-closing valve which minimizes the flow of water into the boat when the paddlewheel 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.

**WARNING: THE VALVE IS NOT A WATERTIGHT SEAL.**

Always use the paddlewheel insert or the blanking plug secured with the safety wire for a watertight seal.

### Using the Blanking Plug

To protect the paddlewheel, use the blanking plug when:

- The boat will be kept in salt water for more than a week.
- The boat will be removed from the water.
- Aquatic growth build-up on the paddlewheel is suspected due to inaccurate readings from the instrument.

**Warning: The O-rings must be intact and well lubricated to make a watertight seal.**

1. Inspect (and replace if necessary) the O-rings on the blanking plug and lubricate them with the silicone lubricant supplied or petroleum jelly (Vaseline®).
2. Remove the paddlewheel insert from the housing by removing the safety wire and unscrewing the cap nut (see Figure 3).
3. Grasp the pull ring and remove the paddlewheel insert with a slow pulling motion.

**Note:** In the unlikely event that the paddlewheel insert cannot be removed, see "Servicing the Valve Assembly" on page 4.

4. Slide the blanking plug into the housing with the arrow on the top pointing forward toward the bow. Seat it into place with a pushing twisting motion until the key fits into the notch. Screw the cap nut in place and **hand-tighten** only. *Do not* over-tighten. Reattach the safety wire.



Figure 5. Paddlewheel & Valve Kit 33-250

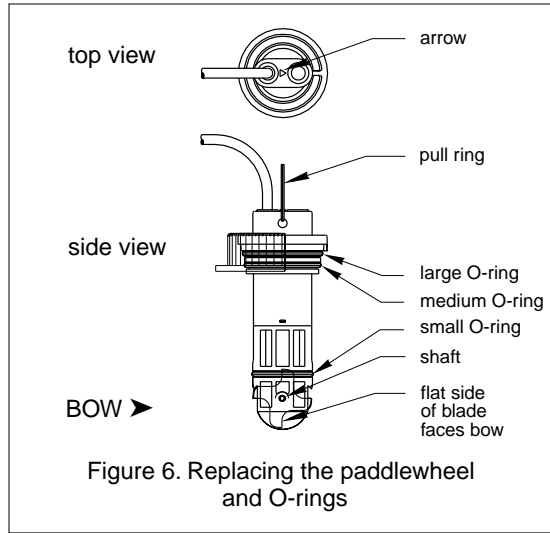


Figure 6. Replacing the paddlewheel and O-rings

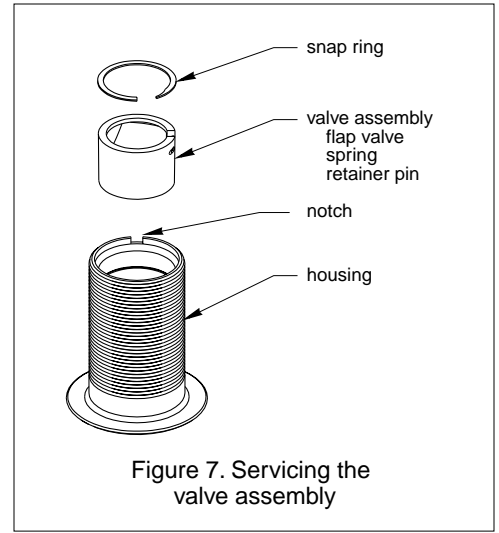


Figure 7. Servicing the valve assembly

### Cleaning the Paddlewheel

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 out the paddlewheel shaft 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.

### Replacing the Paddlewheel and O-rings

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 & Valve Kit 33-250 is available (see Figure 5).

1. Using the new paddlewheel shaft, push the old shaft out about 6mm (1/4"). 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 insert top.
3. Tap the new shaft into place until the ends are flush with the insert.
4. Install the **large** O-ring near the pull ring, the **medium** O-ring below it, and the **small** O-ring near the paddlewheel.
5. Place the three remaining O-rings in similar positions on the blanking plug.

### Servicing the Valve Assembly

Should the valve fail, remove it for servicing. A Paddlewheel & Valve Kit 33-250 is available (see Figure 5).

**Warning:** The O-rings must be intact and well lubricated to make a watertight seal.

1. Inspect (replace if necessary) the O-rings on the blanking plug and lubricate them with silicone lubricant or petroleum jelly (Vaseline®).
2. Remove the paddlewheel insert from the housing (see Figure 3).
3. Remove the snap ring from the valve assembly using a screwdriver to pry the end of the ring free. Lift the ring out (see Figure 7).
4. Slide the valve assembly upward and out of the housing slowly.

**Note:** The flap valve retainer pin is a loose slip-fit and may slide out when the assembly is removed.

5. Hold the cap nut on the blanking plug while sliding it into the housing with the arrow on the top pointing forward toward the bow. Seat the plug with a pushing twisting motion until the key fits into the notch. Screw the cap nut in place and **hand-tighten** only. Do not over-tighten. Reattach the safety wire (see Figure 3).
6. Clean, repair, or replace the valve assembly so the flap valve moves freely and seats against the valve housing.
7. To reinstall the valve assembly, first reassemble the flap valve in the valve housing with the retainer pin and spring in place (see Figure 7).
8. Remove the blanking plug. Slide the valve assembly into the housing with the flap valve pointing downward. Insert the snap ring *being certain* that it **locks into the groove** in the housing wall.
9. Hold the cap nut on the blanking plug or paddlewheel insert while sliding it into the housing. *Be sure* the arrow on the top is pointing forward toward the bow. Seat it into place with a pushing twisting motion until the key fits into the notch. Screw the cap nut in place and **hand-tighten** only. Do not over-tighten. Reattach the safety wire (see Figure 3).

**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.

### Replacement Parts

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

Blanking Plug Kit	Cap Nut	Hull Nut	Housing & Hull Nut Kit	Paddlewheel & Valve Kit
20-600	04-011	04-004 (plastic) 02-030 (bronze)	33-340-02 (plastic) 33-340-01 (bronze)	33-250

### Sensor Replacement

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