

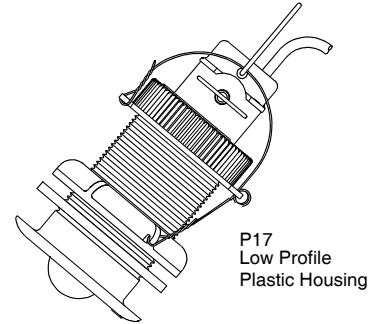
OWNER'S GUIDE & INSTALLATION INSTRUCTIONS

Thru-Hull, Retractable *with* Valve Speed & Temperature Sensor

Models: S650, ST650

Record the information found on the cable tag for future reference.

Part No. _____ Date _____



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 goggles and a dust mask when installing.

WARNING: The valve is not a watertight seal! Always use the insert or long blanking plug secured with the retaining pin, safety rings, and safety wire for a watertight seal.

WARNING: The o-rings must be intact and well lubricated 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: Stainless steel housing in 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. If necessary, sand the isolation bushing until the washer rests against the hull.

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

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

CAUTION: Never install a metal housing on a vessel with a positive ground system.

CAUTION: A stainless steel housing must be isolated from a metal hull to prevent electrolytic corrosion. Use the isolation bushing supplied.

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

CAUTION: Never use solvents. Cleaners, fuel, sealants, paint, and other products may contain strong solvents, such as acetone, which attack many plastics, greatly reducing their strength.

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

Applications

- **Plastic** housing recommended for fiberglass or metal hull only. *Never install a plastic housing in a wood hull, since swelling of the wood may fracture the plastic.*
- **Bronze** housing recommended for fiberglass or wood hull. *Never mount a bronze housing in a metal hull because electrolytic corrosion will occur.*
- **Stainless steel** housing compatible with all hull materials. *Recommended for aluminum hulls to prevent electrolytic corrosion provided the stainless steel housing is isolated from the metal hull.*

Tools & Materials

Safety goggles
Dust mask
Water-based anti-fouling paint (**mandatory in salt water**)
Electric drill with 10mm (3/8") or larger chuck capacity
Drill bit: 3mm or 1/8"
Hole saw: 51 mm or 2" (plastic or bronze housing)
57 mm or 2-1/4" (stainless steel housing in a metal hull)
Countersink tool (installing a flush housing)
Sandpaper
Mild household detergent or weak solvent (such as alcohol)
File (installation in a metal hull)
Marine sealant (suitable for below waterline)
Additional washer [for aluminum hull less than 6mm (1/4") thick]
Slip-joint pliers (installing a metal housing)
Grommet(s) (some installations)
Cable 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

Pretest

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

Mounting Location

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

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. Mount side by side.

CAUTION: Do not mount in line with trailer rollers or bunks that may damage the transducer's face.

Turbulence-free water must flow under the paddlewheel at all boat speeds. Choose an accessible spot inside the vessel. Allow a minimum of 280mm (11") 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 ensure the sensor is in contact with the water at high speeds.
- **Fin keel sailboats**—Mount on or near 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.

Anti-fouling Paint

Aquatic 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 anti-fouling paint only.* Never use ketone based paint, since ketones can attack many plastics possibly damaging the sensor.

It is easier to apply anti-fouling 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 of the paddlewheel insert below the lower o-ring
- Paddlewheel cavity
- Paddlewheel
- Exterior flange of the housing and valve assembly
- Bore of the valve assembly up 30mm (1-1/4")
- Blanking plug below the lower o-ring including the exposed end

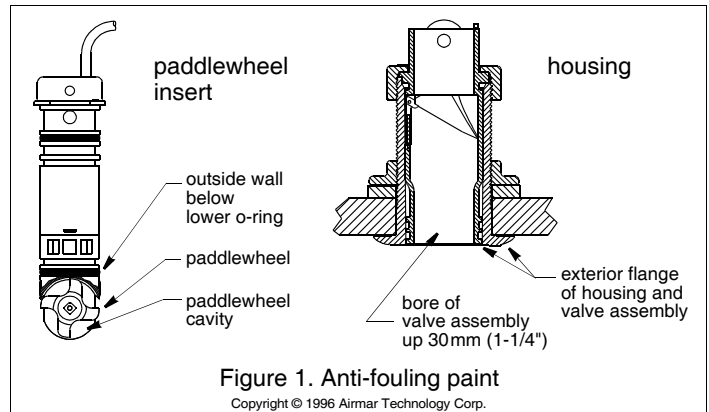
Installation

Hole Drilling

Cored fiberglass hull—Follow separate instructions on page 3.

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.
2. Using the appropriate size hole saw, cut a hole perpendicular to the hull from outside.

Flush housing—Use a countersink tool to create a 'seat' in 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. **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 (see Figure 2). *The sealant must extend 6mm (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 to hold the hull nut securely in place.

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

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 splash-proof Junction Box 33-035 and follow the instructions provided. Removing the waterproof connector or cutting the cable, except when using a watertight junction box, will void the sensor's warranty.

1. From outside the hull, push the housing into the mounting hole using a twisting motion to squeeze out excess sealant (see

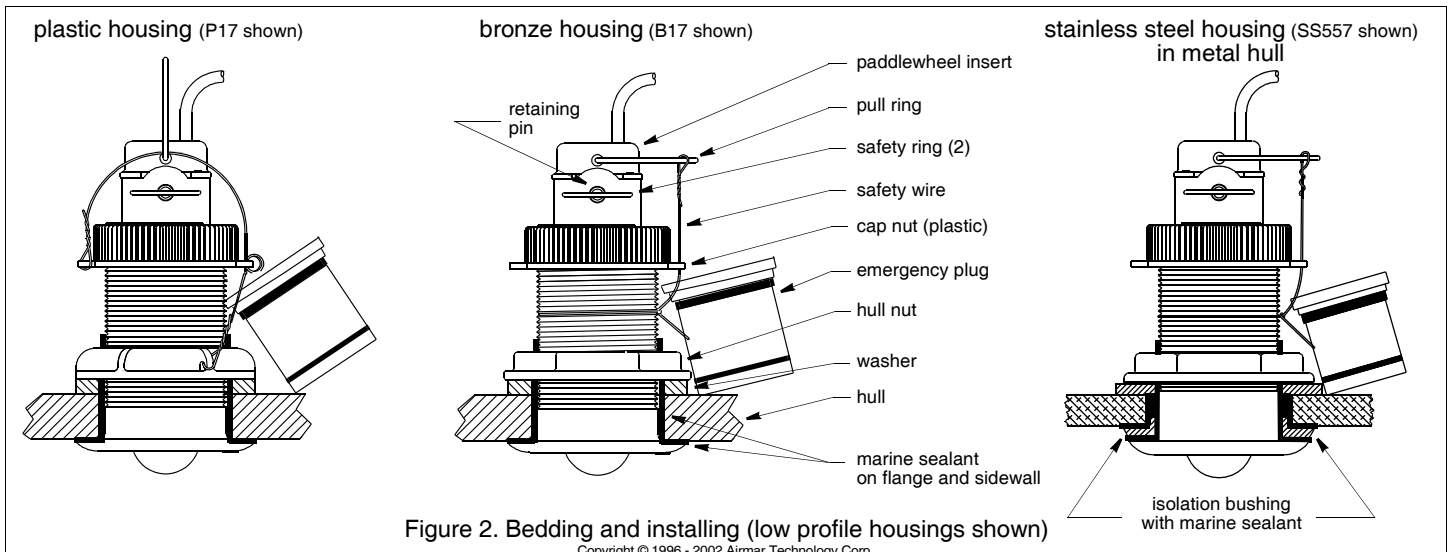


Figure 2). Align the arrow on the flange of the housing to point forward toward the bow. If the sensor is not installed on the centerline, angle the housing slightly toward the centerline to align it with the water flow.

- From inside the hull, slide the washer onto the housing.

Aluminum hull less than 6mm (1/4") thick—Use an additional rubbery, fiberglass, or plastic washer. Never use wood since it will swell, possibly fracturing the plastic housing. Never use bronze since electrolytic corrosion will occur.

Stainless steel transducer in 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. If necessary, sand the isolation bushing until the washer rests against the hull.

- Screw the hull nut in place being sure the notch on the upper rim of the housing and the corresponding arrow on the flange are still pointing forward toward the bow.

Plastic housing—Do not clamp tightly on the wrenching flats, causing the housing to fracture.

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 hull nut.

- Remove any excess sealant on the outside of the hull to ensure smooth water flow under the paddlewheel.
- After the sealant cures, inspect the o-rings on the valve assembly (replace if necessary) and lubricate them with the silicone lubricant supplied (see Figure 4). The o-rings must be intact and well lubricated to make a watertight seal.
- Slide the valve assembly into the housing *being sure to engage the key in the notch*. Screw the plastic cap nut in place and **hand tighten** only. Do not over tighten.
- Attach one pull ring to the paddlewheel insert. Similarly, attach a pull ring to the blanking plug.
- Inspect the o-rings on the paddlewheel insert (replace if necessary) and lubricate them with the silicone lubricant supplied.
- Slide the paddlewheel insert into the housing with the arrows on the top pointing forward toward the bow. Seat it into place with a pushing twisting motion until the keys fit into the notches. *The arrows on the top of the insert, the notch in the housing, and the arrow on the flange will be aligned*. Be careful not to rotate the housing and disturb the sealant.
- Attach one safety ring to one end of the retaining pin. Slide the retaining pin through the valve assembly and paddlewheel insert. Attach the second safety ring to the retaining pin (see Figure 2).
- 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. Thread the short emergency plug onto the wire. 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 pull ring and the second eye in the cap 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. Thread the *short* emergency plug onto the wire. Keeping the wire taut throughout, 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.

- Route the cable to the instrument being careful not to tear the cable jacket when passing it through the bulkhead(s) and other parts of the boat. Use grommets to prevent chafing. 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 cable ties to prevent damage.
- Refer to the instrument owner's manual to connect the sensor to the instrument.

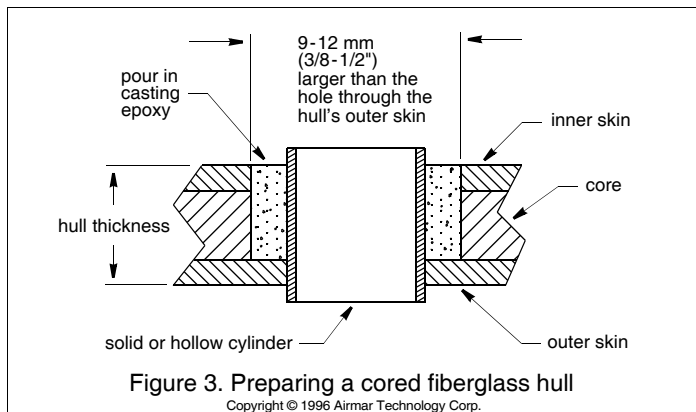


Figure 3. Preparing a cored fiberglass hull

Copyright © 1996 Airmar Technology Corp.

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. Do not leave the boat in the water unchecked for more than 3 hours. If there is a small leak, there may be considerable bilge water accumulation after 24 hour. If a leak is observed, repeat "Bedding" and "Installing" **immediately** (see on page 2).

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.

- 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.)
- 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 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.
- 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.
- 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.
- 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.
- Proceed with "Bedding" and "Installing" on page 2.

Operation, Maintenance, Repair & Parts

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 vessel 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. Always install the paddlewheel insert or the *long* blanking plug secured with the retaining pin, safety rings, and safety wire for a watertight seal.

Using the Long Blanking Plug

To protect the paddlewheel, use the *long* blanking plug when the boat will be kept 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.

1. Inspect the o-rings on the *long* blanking plug (replace if necessary) and lubricate them with the silicone lubricant supplied or petroleum jelly (Vaseline®) (see Figure 4). The o-rings must be intact and well lubricated to make a watertight seal.
2. Remove the paddlewheel insert from the housing by removing the safety wire, one safety ring, and the retaining pin.
Do not remove the cap nut (see Figure 2).

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 *long* blanking plug into the housing with the arrows on the top pointing forward toward the bow. Seat it into place with a pushing twisting motion until the keys fit into the notches (see Figure 4). 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. Clean the surface using a Scotch-Brite® scour pad and 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.

1. Using the new paddlewheel shaft, push the old shaft out about 6mm (1/4"). With pliers, remove the old shaft (see Figure 4).
2. Place the new paddlewheel in the cavity with the flat side of the blade facing the same direction as the arrows on the top of the insert.
3. Tap the new shaft into place until the ends are flush with the insert.
4. Install two of the small o-rings.
5. Place the remaining two small o-rings on the *long* blanking plug.

Servicing the Valve Assembly

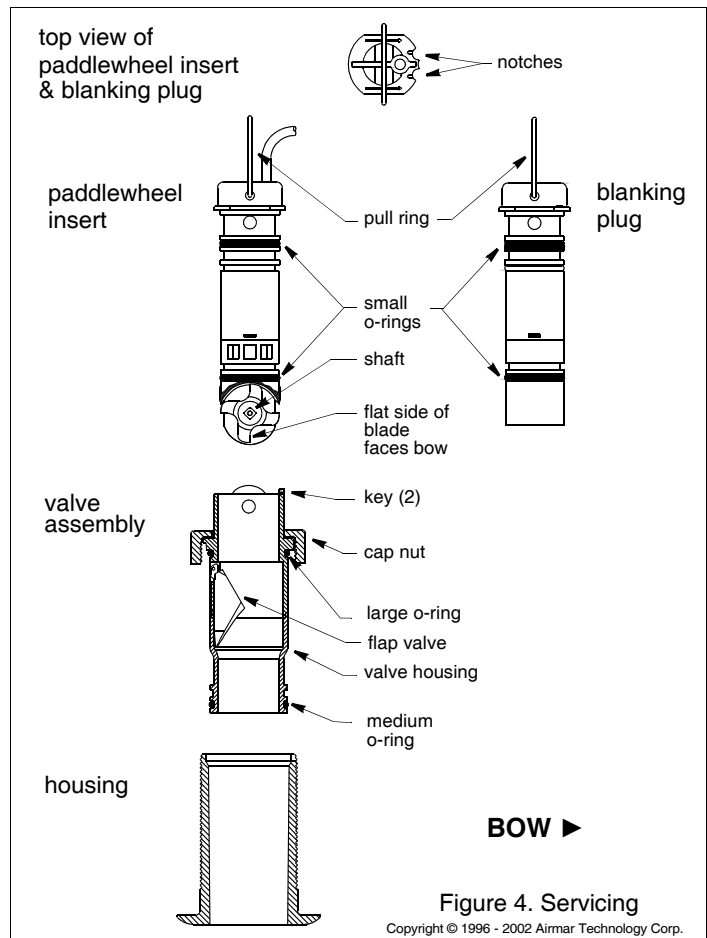
Should the valve fail, remove it for servicing. A replacement Paddlewheel & Valve Kit 33-415 is available.

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. If they cannot be separated and the sensor must be left unattended, cut the cable to free the cap nut [a minimum of 1 m (3') from the insert]. Later, splice the cable using Airmar's Junction Box 33-035.

1. Remove the *short* emergency plug from the safety wire (see Figure 2).
2. Inspect (replace if necessary) and lubricate the o-ring with silicone lubricant or petroleum jelly (Vaseline®). The o-ring must be intact and well lubricated to make a watertight seal.
3. Unscrew the cap nut. With the *short* emergency plug ready in one hand, remove the paddlewheel insert and valve assembly as one unit by pulling upward on the pull ring. Rapidly insert the *short* emergency plug to minimize the flow of water into the boat.

NOTE: The plug is not secure until the cap nut is in place.

4. To free the cap nut, 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.
5. Secure the *short* emergency plug with the cap nut. **Hand-tighten** only. Do not overtighten. Reattach the safety wire.
6. Clean, repair, or replace the valve assembly, so the flap valve moves freely and seats against the valve housing (see Figure 4).
7. To reinstall the valve assembly and paddlewheel insert, inspect (replace if necessary) and lubricate all the o-rings with silicone lubricant or petroleum jelly. The o-rings must be intact and well lubricated to make a watertight seal.



8. Remove the safety wire and cap nut from the *short* emergency plug. With the valve assembly ready in one hand, remove the emergency plug. Rapidly slide the valve assembly being sure to engage the key in the notch of the housing. Then slide the paddlewheel insert into the valve assembly with the arrows on the top pointing forward toward the bow. Seat it into place with a pushing twisting motion until the keys fit into the notches. Screw the cap nut in place and **hand-tighten** only. Do not over tighten. Reattach the safety wire.

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 and possibly cracking it.

Replacement Sensor & Parts

The information needed to order a replacement Airmar transducer 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 top of page one.

Part	Airmar Part Number	
Blanking Plug	33-376-01	
Paddlewheel Kit	33-113	
Paddlewheel & Valve Kit	33-415	
Cap Nut	04-234-1	(plastic)
	02-131-01	(bronze)
Hull Nut	04-004	(plastic)
	02-030	(bronze)
Isolation Bushing	04-186-1	
Housing, Nut & Washer	33-100	(bronze, low profile, B17)
	33-224-01	(bronze, flush, B21)
	33-094-01	(stainless steel, SS557)
	33-217	(plastic, flush, P217)

Obtain parts from your instrument manufacturer or marine dealer.

Gemeco
(USA)
Tel: 803-693-0777
Fax: 803-693-0477
email: sales@gemeco.com

Airmar EMEA
(Europe, Middle East, Africa)
Tel: +33.(0)2.23.52.06.48
Fax: +33.(0)2.23.52.06.49
email: sales@airmar-emea.com

AIRMAR Technology Corporation www.airmar.com