

## **Fabrication of the PVDF Hydrophone Design**

### **1. Overview**

This technical article covers the fabrication of the hydrophone design described in the article [A Low-Cost Hydrophone Design Using PVDF Film](#). It is intended as a guide to fabricating a functional hydrophone for marine acoustic work. Although this article covers one design approach, the techniques described herein can be used to fabricate other configurations, including the molding of the PVDF design into structures such as instrument cases on the back of animals under observation.

### **2. Preamp Fabrication**

The Preamplifier for the hydrophone is fabricated per the schematic and parts list found in the appendices. The optional capacitor C-2 can be included as necessary for applications where a DC level is not desired on the signal line. Ensure the board is thoroughly cleaned after soldering to ensure proper epoxy adhesion.

### **3. Cable Preparation**

Cable selection should include the number of conductors and how the cable is constructed. The cable must be of water-tight construction and the space between conductors should be filled with a noiseless and resilient water-blocking compound. Ideally, the cable should be ~1/2" in diameter in order to wrap the transducer most efficiently. Alternatively, a plastic tube can be slid over the cable and used for the transducer mount. The power and ground conductors should be 18AWG or so. Signal conductors can be 22AWG.

Prepare the cable by first marking the point where you want to build the hydrophone element. In this area, remove 2 to 2-1/4" of the cable's jacket, thereby exposing the conductors. This area will be used to mount and connect the preamplifier.

Splice the preamplifier circuit into the cable, connecting the ground, power and signal wires to the appropriate leads of the circuit board. Do so such that the preamplifier circuit board fits snugly in the area where the cable jacket was removed. If desired, a small amount of silicon adhesive may be used to secure the board in its position.

#### 4. Transducer Fabrication

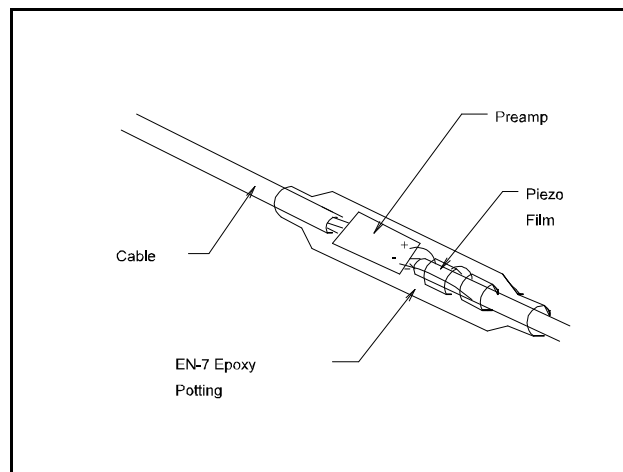
The transducer for this design will consist of 2 sets of 2 films in parallel, wired in series. When looking at the film you will notice that the red lead will correspond to one side of the film, and the black to the other. In fabricating the transducer, the film will be wrapped onto the cable with the side connected to the black lead facing outward.

Begin the fabrication by taking one film and placing a piece of clear double-sided tape over its length. Ensure that it is centered over the silver paint and covers the length of the film. Take a second piece of film, orientating the leads in the same order (red on the same side as the other's red lead), carefully match the two films together and press them firmly to remove any air bubbles. Do this to 2 sets so that we now have our parallel film groups. Before moving on, cut a small piece of electrical tape to fit between the lead rivets to insulate them from each other (they will be wired together later).

The transducer will be mounted on the cable directly below the preamplifier on the end where the terminals for the piezos lie. Prepare the cable by cleaning it with isopropyl alcohol and wiping it dry.

Take each set of the films we taped together. Apply another piece of double-sided to the positive side of the film group such that extends a half inch or so past the non-leaded end. Again, apply the tape so that no air bubbles exist. Starting with the end that has the 1/2" or so extra tape, orientate the tape so that the red lead is closest to the preamplifier and wrap the film group *tightly* and evenly around the cable. Repeat this with the second film about 1/4" away.

Take the red leads from the first group and trim and strip the lead set so that it just reaches the preamplifier's positive piezo lead terminal, then solder the leads in place. Do the



**Figure 1.** Hydrophone Element Construction (one possible approach).

same with the second group's black lead set (this time to the preamplifier's negative piezo lead terminal).

With the middle set of leads, trim and strip them as close as possible so that they can be connected to each other (red set to black set). Make a tight connection of this lead group and solder them together, using heat shrink tubing to insulate the group when complete.

Add tie wraps as desired to secure loose wires, but ensure you do not add to the finished diameter of the assembly.

Test the unit by hooking power to the cable's power leads and, using an oscilloscope, tap gently on the piezo elements. A response on the scope should be seen for each film grouped tapped on.

## **5. Potting Hydrophones**

Please refer to the document entitled [Potting Hydrophones](#) for this information.

## **6. Calibration and Usage**

Please refer to the document entitled [Hydrophone Usage and Deployment](#) for this information.

## Appendix A. Sources

Cable; Custom Design & Fabrication Cortland Cable Company, Cortland NY (Doug Bentley)	607-753-8276
Cable; Standard Newark Electronics supplies Belden cable. -- We use Belden Brilliance Microphone cable, type 8406 for single hydrophone cables (call for local rep). Unfortunately it is only about 0.2" in diameter and will not work well with this design unless a larger diameter core (e.g. plexiglass tubing) is used over the cable for the PVDF film.	800-462-3153
Electronic Components Newark DigiKey	800-462-3153 800-344-4539
Miscellaneous Hardware McMaster-Carr	908-329-6666
Mold Kits 3-M Electro-Products Division (call for local rep)	800-245-3573
Piezo Film Amp Sensors	215-666-3545
Potting Epoxies Conap	716-372-9650

## Appendix B. Parts List

### Hardware

- Conap EN-7 Epoxy
- Cable (per application, ~1/2" diameter ideal)
- Double-sided tape, Scotch #137
- (1) PreAmp PCB (Gerber file or actual PCB can be purchased directly from Cornell University-BARP).

### Electrical

DT2-028K PVDF film, w/leads/eyelets (Amp-Sensors p/n 1-1002153-0)

U1 TL071 or TL2071

D1,2 1N914

[all resistors 1/8w or larger, 5% except where noted]

R1 10M

R2 15K, 1%

R3 620K

R4 470K

R5 1M, 1%

C1 1uF/25V, tantulum low-leakage, 10%

C2 optional DC-block, 1uF/25V electrolytic

## Appendix C. Preamp Schematic

[attached]