

Potting Hydrophones

The primary concern in encapsulating the hydrophone elements is to isolate the element from the environment. This includes the expected pressure-at-depth, and thus the potting (and element construction) must be void-free.

For potting, an urethane-based epoxy with an acoustical impedance close to water is used. Currently, Conap EN-7 is used which also provides a near-neutral specific gravity ratio to water. When ordering, order pre-measured quart quantities and make sure you request the applicable bulletins (e.g. for EN-7, request bul. #P-139).

- ☞ Molds can be fabricated from plastic film or bottles, or in the case of in-line cable hydrophones, using 3-M's 82 series standard molds. [hint: use binder clips to hold 3-M molds together]
- ☞ Cables containing paper, twine, or similar water-holding fibers *must* be sealed before potting. This is due to the manner in which urethane-based epoxies react with water (foaming).
- ☞ If the hydrophone element being fabricated is in-line to a cable, the cable should be stressed during potting to prevent tearing of the epoxy later during deployment.

The potting procedure is as follows.

Items needed:

Weighing scale, mold release compound (e.g., Conap MR-5002 or Vaseline), stopwatch, vacuum chamber & vacuum source¹, drying oven (e.g., modified dehydrator), power drill with mixer attachment, molds, Conap EN-7 epoxy, Conap Dri-purge compound, epoxy primer -- as required (e.g. Conap PR-1167).

1) Mold Preparation:

- * If required, apply epoxy primer to the element to be cast.

¹ An inexpensive vacuum setup can be had by using a 6 gallon galvanized garbage can and a shop vacuum attached to a fitting on the side. However, not all air bubbles will be removed with this method. Ideally a lab-quality vacuum pump should be used, connected to a bell jar or similar high-vacuum capable chamber.

- * Coat the molds to be used with Vaseline or a commercial mold-release compound and put them in place around the element to be potted.
- * Preheat the molds to approximately 80 deg. F (at least 10 deg. F above the epoxy mix temperature). Note that the epoxy mix components should be at 70 deg. F or higher before starting. Work in a low humidity environment to prevent introducing moisture into the mix.

2) Mix Preparation:

- * The mix containers must be plastic, metal, or glass -- paper or wood introduces moisture into the system which causes bubbles (thus voids) in the final cured cast. **The container should also be twice the size of the mixed amount of epoxy due to expansion during degassing.** I use plastic paint mixing containers available at the hardware store in various graduated sizes.
- * Make sure you are using fresh epoxy components. Old epoxy may have a moisture content that will preclude void-free castings!
- * To mix the compounds, a plastic and/or metal paint stirrer attached to a power drill is used. Have a drip container setup to place the drill/stirrer in after mixing.
- * The mix ratio for the EN-7 is by weight: 100g part A to 17.5g part B. A scale is necessary to do this process (An inexpensive digital postal scale or hanging scale is quite satisfactory).
- * A vacuum container and vacuum source is necessary -- have it ready and hooked up.
- * **Note: with EN-7 compound you have approximately 12 minutes to work with the compound once mixed (EN-8 has only 5 minutes).**

3) Mixing & Pouring the Epoxy:

- * Open the epoxy containers and pour the components into the containers on the scale. Once the proper amount has been poured and measured, re-seal the containers -- using nitrogen (Conap Dri-Purge) if available.
- * Mix with the power stirrer on low for approximately 30 seconds. Move the stirrer up and down, throughout the mix. Ensure the components are thoroughly mixed and have a uniform color.
- * Immediately place the container containing the mix into the vacuum chamber and turn on full vacuum (1-5mm Hg). Leave it running until the epoxy has frothed up and then collapsed (approximately 3 minutes) -- do not exceed 5 minutes or boiling of the epoxy solvents may result. This de-gasses the mixture. When the time has expired, slowly release the vacuum.
- * Remove the mix container and once the epoxy has settled (approximately 2 minutes), pour it into the molds. When pouring the epoxy, pour it down the side of the mold inlet to reduce the possibility of introducing bubbles into the cast by the epoxy folding over itself. Overfill the mold by at least

1/2" to allow for loss when air trapped works its way out. Should the mold leak, add additional epoxy **but NOT after 15' elapsed time**.

4) Curing:

- * Optional: allow the filled molds to sit at room temperature for approximately 1 hour to allow any residual bubbles to migrate out.
- * Place the molds into the curing oven and set the temperature between 150 and 180 deg. F (80 deg. C MAX²).
- * For Conap EN-7 epoxy mixtures, leave the molds in the oven at full temperature for 16-20 hours.
- * After the cure time has elapsed, turn the oven temperature off and allow the molds to come down to room temperature before removing them. The epoxy should be tack-free. If not, the mixture was improper and the mold unit will have to be discarded.

5) De-Molding the Elements:

- * Remove the mold shells from the casts by gently prying it off. Wipe off any excess mold-release agent (e.g., Vaseline) and, if necessary, set the de-molded cast on wax paper for a couple more hours before using them

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²The 80 deg. C figure is to protect the piezo film from aging and sensitivity losses.