HOW TO INSTAL AN ECHO SOUNDER IN A SMALL FIBERGLASS BOAT

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The standard technique for installing an echo sounder on a vessel is to mount the transmitting/receiving transducer on the exterior of the hull. For large displacement vessels, this method of installation does not create many problems because the boats operate in deep water at relatively slow speed. However, the externally mounted transducer generates several problems on smaller boats. The most significant problems are the tranducer's vulnerability to damage when operating in shallow water or placing the boat on a trailer, and reduced performance of the boat hull.

In small boats, a more practical place to mount the transducer is inside the hull. Many smaller boats are constructed of reinforced fiberglass plastic; therefore it may be possible to transmit and receive acoustic signals through the hull's bottom. An internal transducer mounting would offer several advantages over external mounting by solving the abovementioned problems--and allowing easy access to the transducer for maintenance and repair. However, boat hulls with air bubbles or filler materials in the fiberglass could present a problem by reducing the echo sounder's performance.

This paper reports the results of the installation of an echo sounder in a fiberglass boat. The transducer was mounted inside the hull in a watertight well.

THE BOAT AND ECHO SOUNDER

The boat, a Thunderbird[1/] (model Iroquois), is 23 feet 9 inches long at the center line, and 8 feet wide across the beam. It has a cathedral-style hull with a small enclosed cabin forward. It is powered by an inboard/outboard drive unit with a 200-horsepower engine.

The boat is constructed from reinforced fiberglass plastic with wood structural members. The manufacturer says the hull was constructed from a combination of polyester-type resin and glass fiber that was relatively free of air bubbles and filler materials.

The echo sounder was a Ross Fineline Model No. 200 operating at a frequency of 105 kHz. Maximum range of the system was 200 fathoms. Power at 12 v.d.c. was supplied to the transmitter/receiver from the boat batteries. The readout was of the dry-paper type.

The piezoelectric transducer was constructed from barium titanate. It had a diameter of 5 inches and a length of 3 inches. The beam angle was 8 degrees.

ECHO SOUNDER INSTALLATION

A watertight well was designed for mounting the transducer inside the boat (Figure 1). Initially, the well was filled with sea water to conduct tests of sound level measurements; but oil or other viscous incompressible fluids,

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1/Trade names referred to in this publication do not imply endorsement of commercial products.

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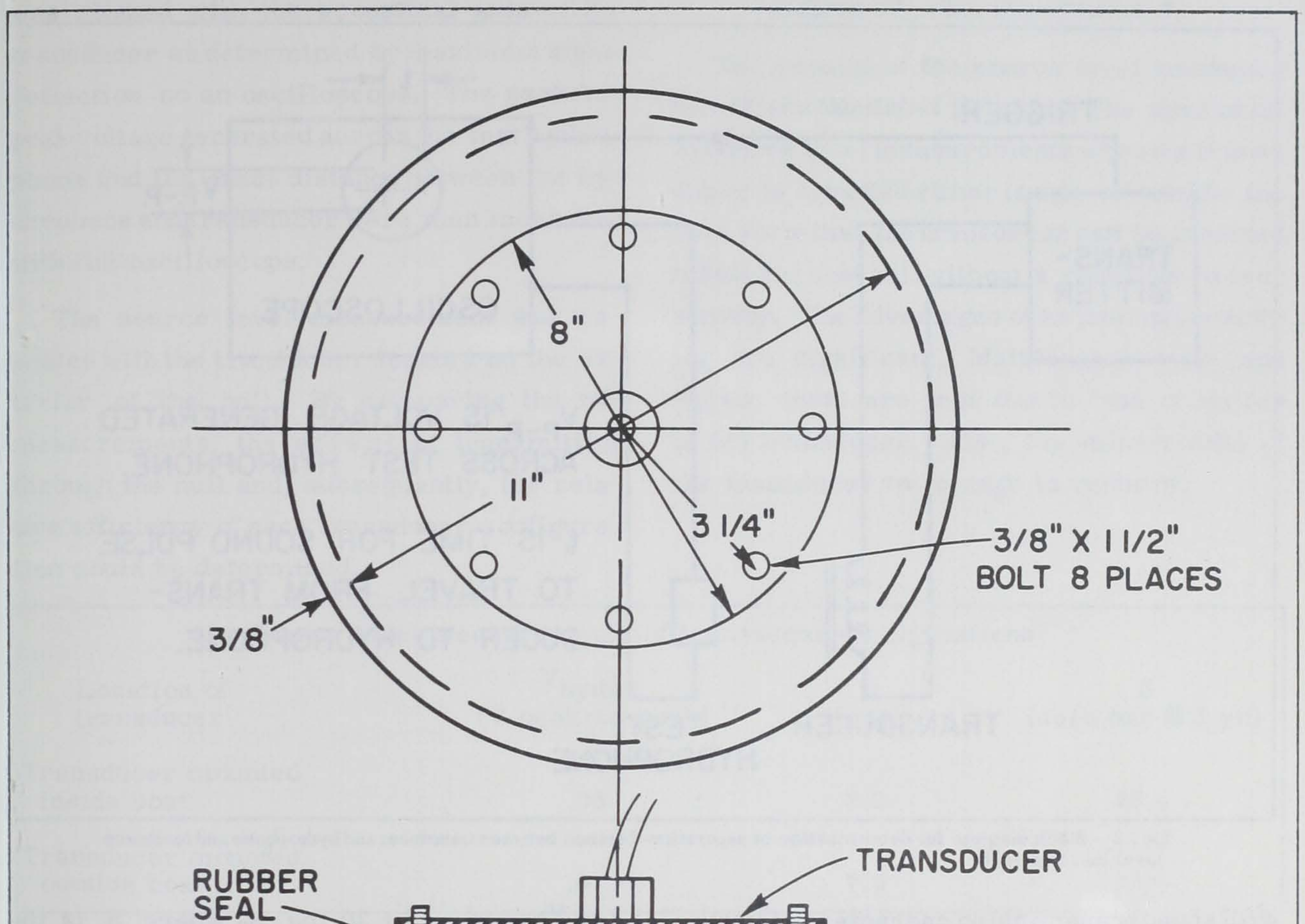

Fig. 1 - Well design for installing transducer inside boat hull.

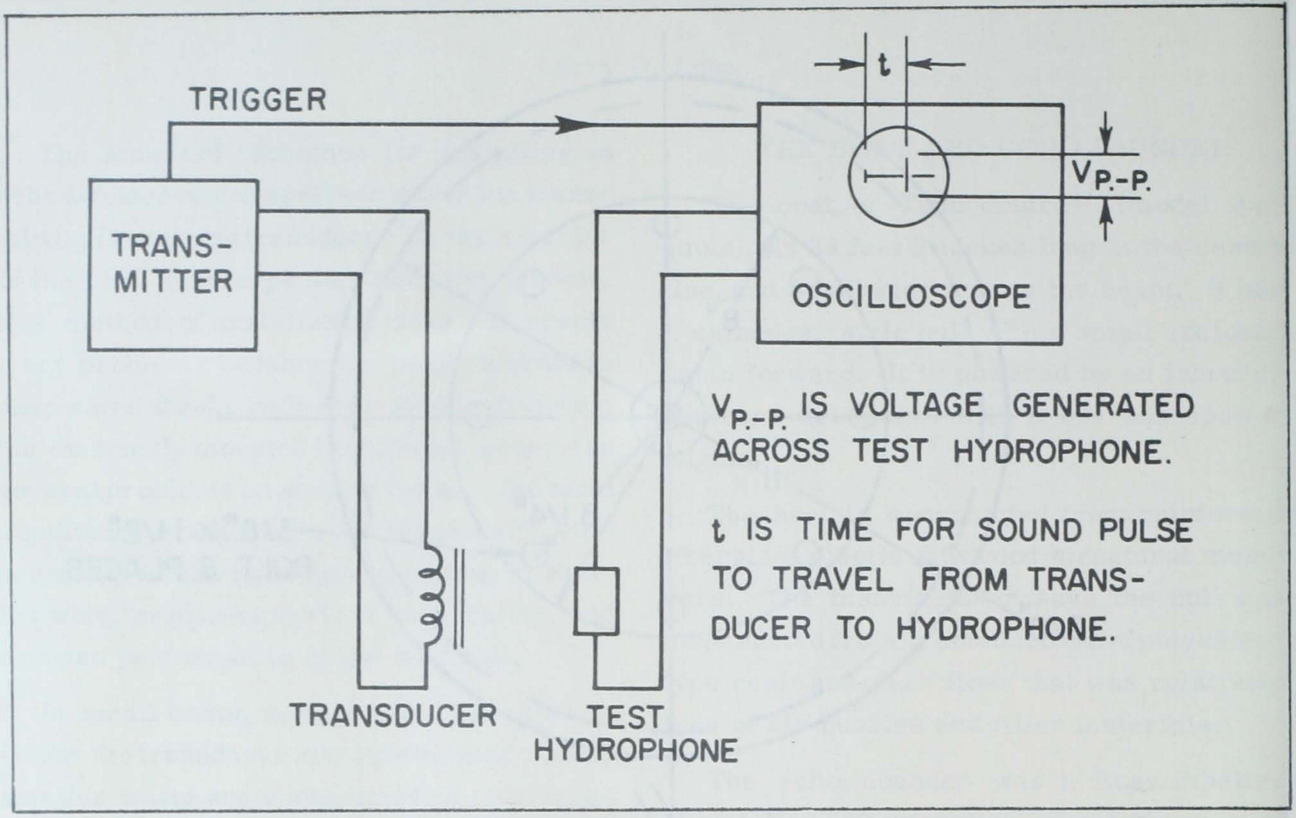

Fig. 2 - Block diagram for determination of separation distance between transducer and hydrophone and for source level measurement.

with sound transmission characteristics similar to sea water, could be used to couple the acoustic energy into the water.

The readout and transmitter/receiver were mounted on the port bulkhead in the cabin of the boat. These units could be installed in weatherproof boxes for external mounting on cabinless boats.

TESTS TO DETERMINE TRANSDUCER EFFICIENCY

Tests were conducted to determine the relative efficiency of an internally mounted versus an externally mounted transducer. The source level at a distance of 1 yard can be calculated from the following equation: $S = 20 \log V_{hydro} - M + 20 \log R$ where S is the source level in db/u bar, V_{hydro} is the rms voltage across the calibrated hydrophone, M is the open circuit receiving sensitivity at one yard for the calibrated hydrophone,2/ and R is the distance in yards between the transducer and calibrated hydrophone3/.

The source level was measured with the circuit shown in Figure 2 with the transducer installed in the boat. The measurements were performed in water that was 30 feet deep with the boat tied to a dock. A calibrated test hydrophone was lowered into the water beneath the echo-sounder transducer. The hydrophone was adjusted until its acoustical axis

2/M = -112.8 db/u bar (calibrated by Applied Physics Laboratory, University of Washington).
3/Kinsler, Lawrence E., and Austin R. Frey, "Fundamentals of Acoustics," John Wiley & Sons, Inc., New York, 1962.

was aligned with the acoustical axis of the transducer as determined by maximum signal deflection on an oscilloscope. The peak-to-peak voltage generated across the test hydrophone and the exact distance between the hydrophone and transducer were then measured with the oscilloscope.

The source level measurement was repeated with the transducer located on the exterior of the hull. By comparing the two measurements, the effect of transmitting through the hull and, subsequently, the relative efficiency of each transducer configuration could be determined.

RESULTS AND CONCLUSION

The results of the source level measurements are tabulated in table. The similarity in source level measurements when the transducer is mounted either inside or outside the boat show that the transducer can be mounted inside the boat hull without a reduction in sensitivity. The advantages of an internal mounting are significant. Maintenance time and repair costs are less due to ease of access to the transducer. Also, the vulnerability of the transducer to damage is reduced.

Source level measurements of transducer configurations

Location of transducer	V_{hydro} (V peak-to-peak)	R (yds)	S (db/u bar @ 1 yd)
Transducer mounted inside boat	.06	8.2	95.9
Transducer mounted outside boat	.07	7.9	95.6