



# Installed Sound Technical Guide

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## Designing and Specifying Outdoor and Underwater Speaker Systems

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You've been asked to install a music system next to an outdoor swimming pool. Should you select an underwater, weatherproof, or submergence-proof loudspeaker system? Ah... you begin to get the idea. The definition of the term is very specific.

Electro-Voice sells a number of special-purpose products, and products with special attributes. This article will clarify what they are so that you can specify, bid and install systems that are optimized for the intended application.

### Weatherproof vs. Submergence Proof vs. Underwater

A weatherproof loudspeaker or compression driver is one which is designed to survive repeated exposure to rain, dew, direct sun, and extreme cold. The finish is typically a durable baked enamel, a plastic or resin clad coating, or the product itself may have a plastic, fiberglass, or resin enclosure. Connections are typically sealed or shielded from direct penetration of falling rain or mist, and the diaphragms and suspensions are either plastic, non-corroding metal, or coated with a protective material which prevents the atmosphere from causing deterioration.

An example of a full-range weatherproof loudspeaker is the Electro-Voice® EVID™ 6.2, which has a dome tweeter coupled to a constant-directivity horn, which is mounted between a pair of 6-inch woofers. These components are mounted in a one-piece, molded ABS cabinet, and all parts of the system are not only weatherproof, but are also fungus-resistant. (Some plastics and other materials are susceptible to attack by fungus, whereas Electro-Voice uses inhibitors and materials, which discourage fungus growth.) This type of loudspeaker is an excellent choice for installation near a swimming pool, on a patio, or an outdoor amusement/recreational facility where it can be found hidden in foliage (i.e., a Disneyland-like jungle setting). All of the EVID models except the 12.1 subwoofer offer these weather-resistant features.

*Read the EVID 6.2  
data sheet.*

*Read more about  
EVID loudspeakers.*

The Electro-Voice SXPI™ Series are similar high-fidelity, two-way loudspeaker systems with an integrated horn, cone-type woofer, and compression driver. They're also designated as weatherproof. Certain Electro-Voice drivers, such as the ID30 and ID60 series, are classified as weather resistant, which means they, too, are able to be used out of doors without concern. They have phenolic diaphragms, which are unaffected by moisture, and plastic cases which won't rust. Of course, the horns to which they are mounted should not be pointed upward, which would allow rain to run into the driver and accumulate.

*Read more about  
SXPI speakers.*

*Read more about  
EV drivers.*

## **Submerged Sound**

Indeed, none of the above products is intended to be immersed in water. Yet certain applications are likely to drench a loudspeaker. The most obvious example is the paging speaker on a Coast Guard patrol boat. Such loudspeakers or drivers are classified as submergence proof, and will withstand repeated splashing—from ocean waves (when mounted on ships or piers) or from passing trains or motor vehicles (when mounted on bridges or in switching yards, or on the vehicle itself).

The Electro-Voice MM-2, MM-2F and MM-2TC speakers are not only submergence proof (per U.S. Navy specs), they also withstand exposure to live steam, making them suitable for use in boiler rooms or near steam-operated equipment. They can withstand repeated exposure to salt water, and other harsh environments. They use plastic-impregnated diaphragms, which are readily accessible for cleaning (to remove any dried salt or other contaminants which accumulate). The MM-2 design has sufficiently wide bandwidth to be used for general paging, yet is rugged enough to be used for high-level siren duty.

*Read more about  
MM-2 Series speakers.*

We have established that submergence proof products can handle more water than weatherproof products, but none of these are intended to be operated under water. For that job, Electro-Voice makes the UW30, an underwater loudspeaker.

*Read more about  
the UW30 speaker.*

The UW30 is designed specifically for mounting and operation below the water line. It has been used in swimming pools (for synchronized swimming and PA), in aquariums, and even for research and on certain naval vessel hulls. The high-impact ABS outer structural enclosure is the sound transducer, so no metal parts are exposed. Inner metal parts are "hot melt" encapsulated to protect them against residual moisture. One concern about underwater operation is the pressure of the water itself. The UW30 can operated in depths to a few feet without concern. However, it can be modified with a pressure fitting, enabling the internal air pressure to be

pumped up to counteract water pressure at depths below 10 feet with continuous pressurization. These speakers are made to efficiently couple sound energy directly to water, and are not for use in the air.

## Using the UW30 at Extended Depths

The UW30 is a sealed loudspeaker designed for use underwater. Water pressure increases rapidly with increasing depth, however, so when the UW30 is used much below 4 feet, the water pressure on the case begins to bias the diaphragm away from its normal position, increasing distortion and decreasing efficiency. Ultimately, the speaker will cease to function at very low depths, and will eventually collapse at extreme depths. There is a modification that enables the UW30 to be used to depths greater than 10 feet (to 60 feet or more). Simply stated, the speaker must be provided internal air pressure to counteract the water pressure at a given depth.

The side of the UW30 case must be drilled to accommodate a pressure fitting. Position the hole as close as possible to the mounting flange, and use a vacuum to capture any particles during the drilling so that they do not migrate to the speaker's internal magnetic structure. Seal the fitting with epoxy. When the UW30 is installed, attach an air hose to the fitting and attach the other end to a small air tank which you may either charge periodically or keep connected to an air pump. The tank must be fitted with an air regulator, a de-humidifier to dry the air, and air pressure gauges before and after the regulator.

Water pressure increases at the rate of one atmosphere (14.7 lb/in<sup>2</sup> or 1.034 kg/cm<sup>2</sup> or 1.014 x 10<sup>5</sup> Pascals) for each 33 feet of water depth. Thus, for a UW30 mounted 33 feet below the surface, in order for its internal air pressure to equal the water pressure, it should be one atmosphere or 14.7 lb/in<sup>2</sup> (1.014 x 10<sup>5</sup> Pa) above the normal atmospheric pressure. Since normal, sea-level air pressure (one atmosphere) at 59°F (15°C) is 14.7 lb/in<sup>2</sup>, the internal air pressure at 33 feet would therefore be 29.4 lb/in<sup>2</sup>. For a UW30 mounted 66 feet below the surface, the internal air pressure should be two atmospheres or UW30's with  $2 \times 14.7 \text{ lb/in}^2 = 29.4 \text{ lb/in}^2$  above normal pressure—a total of 44.1 lb/in<sup>2</sup>. For a shallower depth of 10 feet, the internal pressure will equal the water pressure if it is  $10 \div 33 \times 14.7 \text{ lb/in}^2 = 4.5 \text{ lb/in}^2$  (about 1/3 of an atmosphere) above normal pressure (or  $14.7 + 4.5 = 19.2 \text{ lb/in}^2$  total internal pressure).