

## APPENDIX: ERAC-2016-B2



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## Electric Shock Drowning (ESD) Resources

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**WHAT IS ELECTRIC SHOCK DROWNING or ESD?** ESD has become the catch-all phrase to encompass all in-water shock casualties and fatalities, but it is defined as:

*The result of the passage of a typically low level AC current through the body with sufficient force to cause skeletal muscular paralysis, rendering the victim unable to help him/herself, while immersed in fresh water, with drowning the eventual result. (Source: [ESD Prevention Association](#), 2014).*

Higher levels of AC current can result in electrocution.

**HOW COMMON IS IT?** Ten to 20 **documented** electric shock drownings occur each year, nationally. However, an unknown quantity of ESDs may be misdiagnosed as drowning due to fatigue, alcohol consumption, cramping, or other factors.

**WHERE DOES IT HAPPEN:**

- Usually fresh water (lakes, ponds, streams, rivers). The human body is a better electrical conductor than fresh water and electricity will always follow the path of least resistance. *While conditions can exist in **any** type of water, more conductive salt water generally reduces the risk.*

### RESOURCES

--**ESD Response and Investigation Checklist** ([PDF](#) / [Word](#)): developed by NASBLA [ERAC](#) to assist officers, investigators, and other first responders in the accurate recognition and reporting of ESD events

--**ESD: Legislative Considerations for the State Boating Law Administrator** ([PDF](#) / [Word](#)): developed by NASBLA [ERAC](#) as general guidance for BLAs addressing ESD-related legislative proposals

### Featured organizations

Docks that have AC power provided to them and that provide power to boats, boat lifts, lighting or other applications.

- Boats that are plugged into AC power.

#### WHAT CONDITIONS MUST BE MET FOR ESD TO HAPPEN?

- There must be a fault in the AC electrical system onboard a boat or on a dock. *When wired correctly, faults are uncommon. But do-it-yourselfers or residential electricians unfamiliar with boat or dock wiring can make mistakes that lead to faults.*
- There must be a lack of or failure of the AC grounding system. *The grounding system is also known as the safety ground, the sole purpose of which is to give fault current a place to go and “trip” a breaker or blow a fuse.*

When the two scenarios above are met, the current has no way to complete the circuit other than through the water.

**WHAT DOES ESD DO TO THE HUMAN BODY?** Keeping in mind that a 100 watt light bulb uses 833 milliamps of electricity, it can take as little as 10-20 milliamps passed through the human body to cause the muscles to seize, leaving the victim conscious and aware that something is wrong, but unable to react or swim effectively. Higher levels of current lead to more severe effects including heart fibrillation and cardiac immobilization.

**HOW IS ESD IDENTIFIED?** No physical evidence is left on the body of an ESD victim, unlike the burns that someone would receive when they are electrocuted. Electric shock drownings are identified when a source of AC leakage is discovered within a given range of the swimmer’s location at the time the swimmer is present.

#### APPLICABLE STANDARDS FOR ESD PREVENTION:

- **Boats:** [ABYC E-11](#), *AC and DC Electrical Systems on Boats*
- **Shore Facilities and Docks:** [NFPA 70](#), *National Electric Code Article 555 and [NFPA 303](#), *Fire Protection Standard for Marinas and Boatyards**

[The American Boat & Yacht Council](#)

[Electric Shock Drowning Prevention Association](#)

[BoatUS Electric Shock Drowning Resource Center](#)

[Energy Education Council](#)

**Go to the [Lighthouse Library](#) for more ESD resources (under construction)**

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With appreciation to [The American Boat & Yacht Council \(ABYC\)](#)  
for supplying source material for this summary.

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## Human Performance Investigation In Accidents



Investigations into aviation, commercial shipping, rail, and highway accidents indicate the majority of causes or contributing factors are related to human failures. **Can the same be said for recreational boating accidents?**

There's a *strong likelihood*. But getting beyond *likelihood* to *more conclusive evidence* on their contribution requires consistently-collected data and information that not only identify factors that contributed to the accident, but also get at **how** and **why** failures occurred.

In 2012, NASBLA **ERAC began its trek toward understanding human error** and the factors that might be associated with performance failures in recreational boating accidents.

Since then, it's **adopted a "lite" version** of the **Department of Defense's Human Factors Analysis and Classification (HFACS)** for analyzing accident cases, and used human performance investigation tools developed by the **National Transportation Safety Board (NTSB)** to determine whether more human factors information could reasonably be gathered in the context of recreational boating accident investigations.

### RESOURCES

[Human Performance Investigation in Recreational Boating Accidents: Best practices for gathering and examining human factors data](#). Issued by NASBLA ERAC, October 2014.

[2016 Guidance Update](#)  
[2016 Form Update](#)

**Go to the Lighthouse Library for more resources on Human Factors (under construction)**

The result was ERAC's **2014 release of guidance and a supplemental report form** for officers and investigators in states wishing to augment their recreational boating accident investigations, add to the knowledge about human factors, and use it to evaluate their own safety programs and strategies.

But the package needed some real world testing to determine if the guidance and form enhanced the investigations and gave more depth and meaning to the accident analyses. Tennessee took up the challenge and applied it to their investigation of recreational boating fatalities in 2015. The **analysis of results** led to **2016 updates** to the **investigative guidance** and **report form**. The modified package will be used by two other pilot states for the 2016 boating season. Watch this site for further developments.

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