

**FISH AND WILDLIFE SERVICE  
OCCUPATIONAL SAFETY AND HEALTH**

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## OVERVIEW

**6.1 What is the purpose of this chapter?** This chapter:

- A. Establishes U.S. Fish and Wildlife (Service) requirements for electrofishing safety, and
- B. Provides guidelines for the safe and effective operation, construction, and modification of electrofishing equipment.

**6.2 What is electrofishing?** Electrofishing means using electricity in aquatic habitats to sample or control fish and other organisms.

**6.3 What is the scope of this chapter?** This chapter applies to all Service personnel and volunteers who use electricity to sample or control animals in aquatic habitats or to work on captive fish (i.e., electrosedation and lab experiments).

A. An electrofishing team comprised in whole or in part by Service employees, must have a team leader who holds a current *Certification in Electrofishing*.

B. All team members must comply with the training requirements in [section 6.7](#).

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**6.4 What are the authorities for this chapter?**

- A. Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters ([29 CFR 1960](#)).
- B. [Executive Order 12196](#), Occupational Safety and Health Programs for Federal Employees.
- C. Federal Agency Safety Programs and Responsibilities ([P.L. 91-596, Section 19](#)).
- D. National Fire Protection Association (NFPA) 70, National Electric Code, Current Edition.
- E. Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standards ([29 CFR 1910](#)).
- F. [485 Departmental Manual \(DM\) 22](#), Watercraft Safety.

**6.5 What terms do you need to know to understand this chapter?** See Exhibit 1 for a glossary of terms we use in this chapter.

**RESPONSIBILITIES**

**6.6 Who is responsible for ensuring compliance with the electrofishing policy?** See Table 6-1.

<b>Table 6-1 Responsibilities for the Service's Electrofishing Program</b>	
<b>This official...</b>	<b>Is responsible for...</b>
<b>A. The Director</b>	<p><b>(1)</b> Ensuring the Service maintains an effective and comprehensive occupational safety and health program, and</p> <p><b>(2)</b> Approving or declining to approve our electrofishing safety policy.</p>
<b>B. The Assistant Director – Business Management and Operations</b>	<p><b>(1)</b> Ensuring we have an effective electrofishing safety program, and</p> <p><b>(2)</b> Providing sufficient support and resources to the Chief, Division of Safety and Health, to ensure that the Chief can effectively accomplish program goals.</p>
<b>C. The Assistant Director – Fish and Aquatic Conservation</b>	Working with the Chief, Division of Safety and Health to ensure this chapter is up-to-date.
<b>D. Regional Directors</b>	<p><b>(1)</b> Ensuring employees conduct electrofishing operations safely, and</p> <p><b>(2)</b> Ensuring that sufficient resources are allocated to accomplish tasks involving electrofishing in a safe manner.</p>

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<b>Table 6-1 Responsibilities for the Service's Electrofishing Program</b>	
<b>This official...</b>	<b>Is responsible for...</b>
<b>E. The Chief, Division of Safety and Health</b>	<p>(1) Revising and updating this chapter, as necessary, in coordination with the Assistant Director - Fish and Aquatic Conservation, and</p> <p>(2) Interpreting this chapter's requirements and serving as a consultant to resolve Servicewide issues or questions.</p>
<b>F. Regional Safety Managers</b>	<p>(1) Interpreting the requirements in this chapter and serving as advisors to resolve Regionwide issues and questions, and</p> <p>(2) Evaluating implementation of these requirements during Regional field station safety program evaluations.</p>
<b>G. The Director, National Conservation Training Center (NCTC)</b>	<p>(1) Scheduling the <i>Principles &amp; Techniques of Electrofishing</i> course (CSP2201), and the <i>Electrofishing Sampling Advanced Practicum</i> (CSP2203) often enough to meet Service needs. The courses should be conducted at least once annually;</p> <p>(2) Offering distance learning versions of the following two courses:</p> <p style="padding-left: 40px;">(a) <i>Principles &amp; Techniques of Electrofishing</i> (CSP2c01), and</p> <p style="padding-left: 40px;">(b) <i>Electrofishing Safety</i> (CSP2202);</p> <p>(3) Preparing electrofishing examinations so employees can demonstrate knowledge of the principles and techniques of electrofishing;</p> <p>(4) Issuing course completion certificates for people achieving a score of at least 80% on the course exams; and</p> <p>(5) Maintaining records of participants who have successfully completed the electrofishing courses.</p>
<b>H. Project Leaders</b>	<p>(1) Providing adequate staff and resources to ensure that staff can accomplish assigned tasks in a safe and effective manner in accordance with this chapter, at a minimum;</p> <p>(2) Ensuring that all team members are adequately trained, properly equipped, and physically able to perform their duties;</p> <p>(3) Ensuring that safety considerations are part of electrofishing project planning and that staff follow manufacturers' equipment operating guidelines; and</p>

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**Table 6-1 Responsibilities for the Service's Electrofishing Program**

<b>This official...</b>	<b>Is responsible for...</b>
	<p><b>(4)</b> Ensuring that Hazard Analysis and Critical Control Point (HACCP) plans are in place to prevent the spread of aquatic invasive species by electrofishing operations.</p>
<p><b>I. Electrofishing Team Leader</b></p>	<p><b>(1)</b> Serving as the person onsite who is in charge of electrofishing operations;</p> <p><b>(2)</b> Identifying hazardous conditions associated with proposed electrofishing operations, determining measures to protect electrofishing crew members, and briefing crew members (see <a href="#">section 6.7C</a>);</p> <p><b>(3)</b> Maintaining electrofishing equipment for his/her site in a safe condition. This includes:</p> <p style="padding-left: 40px;"><b>(a)</b> Visually inspecting all external wiring, cables, and connectors for physical damage before each use; and</p> <p style="padding-left: 40px;"><b>(b)</b> Making sure that any equipment deficiency that may present a safety hazard is corrected before each field operation or when equipment damage occurs during use;</p> <p><b>(4)</b> Ensuring that employees follow proper safety procedures and use the proper safety equipment;</p> <p><b>(5)</b> Ensuring that the team warns the public to avoid exposure to the potential hazards of electrofishing operations;</p> <p><b>(6)</b> Shutting down electrical power if a member of the public approaches closer than 30 feet to backpack electrofishing and 100 feet to all other electrofishing operations;</p> <p><b>(7)</b> Ensuring that the team takes precautions to avoid harm to domestic animals or wildlife;</p> <p><b>(8)</b> Ensuring that all electrofishing operations stop and all team members go ashore in dangerous weather conditions;</p> <p><b>(9)</b> Limiting participation in electrofishing to only those trained people necessary to conduct a safe and efficient operation;</p> <p><b>(10)</b> Holding a certification in cardiopulmonary resuscitation (CPR) and first aid;</p> <p><b>(11)</b> Ensuring that at least one other member of the crew is</p>

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**Table 6-1 Responsibilities for the Service's Electrofishing Program**

<b>This official...</b>	<b>Is responsible for...</b>
	<p>certified in CPR and first aid;</p> <p><b>(12)</b> Ensuring that all crew members undergo a safety orientation. The safety orientation must be provided at least once per season before the start of electrofishing or experimental activities (see section <a href="#">6.7C</a>);</p> <p><b>(13)</b> Providing periodic safety briefings to crew members as appropriate. Briefings:</p> <p style="padding-left: 40px;"><b>(a)</b> Must be provided when there are, for example:</p> <p style="padding-left: 80px;"><b>(i)</b> Changes in sampling/experimental protocols or equipment,</p> <p style="padding-left: 80px;"><b>(ii)</b> A move to a new sampling site,</p> <p style="padding-left: 80px;"><b>(iii)</b> A significant change in environmental conditions or hazards,</p> <p style="padding-left: 80px;"><b>(iv)</b> A recent occurrence of a close call or risky work practice,</p> <p style="padding-left: 80px;"><b>(v)</b> Introduction of new personnel,</p> <p style="padding-left: 80px;"><b>(vi)</b> Availability of new safety information, or</p> <p style="padding-left: 80px;"><b>(vii)</b> Reactivation of an electrofishing crew;</p> <p><b>(b)</b> May include, among other things, reminders of safe electrofishing, vehicle, and boating practices; information on equipment design and operation, new equipment, or new processes; discussion of crew member roles; and details of upcoming operations; and</p> <p><b>(c)</b> Must include how to summon emergency help to that location and the identification of sample site hazards;</p> <p><b>(14)</b> Fostering an environment where employees feel free to voice safety concerns without fear of reprisal;</p> <p><b>(15)</b> Ensuring that the project HACCP plan(s) is/are implemented by the team; and</p>

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<b>Table 6-1 Responsibilities for the Service's Electrofishing Program</b>	
<b>This official...</b>	<b>Is responsible for...</b>
	<b>(16)</b> When conducting operations by boat, ensuring that the operator has provided a float plan and the craft is equipped with proper safety and survival gear in accordance with <a href="#">241 FW 1</a> .
<b>J. Crew Members</b>	<p><b>(1)</b> Adhering to electrofishing safe practices as outlined by the team leader and Service and station policy;</p> <p><b>(2)</b> Reporting potential work hazards, accidents, incidents, and job-related illnesses or injuries to their team leader or supervisor immediately; and</p> <p><b>(3)</b> Immediately voicing safety concerns to the Electrofishing Team Leader.</p>

## TRAINING

### **6.7 What are the training requirements for team leaders, other crew members, motorboat operators, and those using electrosedation?**

**A.** Team leaders must have a current *Certification in Electrofishing*.

**(1)** Anyone who obtained a *Certification in Electrofishing* prior to December 31, 2016, need only adhere to the recertification requirements in Table 6-2.

**(2)** For all others, to obtain a *Certification in Electrofishing*, you must successfully complete the training described in Table 6-2.

<b>Table 6-2: Training Required to Obtain a <i>Certification in Electrofishing</i></b>	
<b>You must take one of the following three training options AND the CPR/First Aid training if you do not have a certificate by December 31, 2016:</b>	
<b>(1)</b> <i>Principles &amp; Techniques of Electrofishing</i> on-site, instructor-led course (CSP2201).	<p>Course topics for CSP2201 include:</p> <ul style="list-style-type: none"> <li>• Basic principles of electricity and the generation of electric fields in water;</li> <li>• Basic concept and design guidelines for electrofishing equipment;</li> <li>• Types of electrofishing equipment and capabilities, limitations, safety features, and maintenance;</li> <li>• Safety precautions and personal protective equipment to employ while using electrofishing equipment;</li> <li>• Awareness of and methods to reduce fish trauma due to electrofishing; and</li> <li>• Principles of sampling standardization and</li> </ul>

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**Table 6-2: Training Required to Obtain a *Certification in Electrofishing***

	<p>efficiency.</p> <p>You can get a completion certificate for the <i>Principles &amp; Techniques of Electrofishing</i> course by scoring an 80% or above on the exam.</p>
<p><b>(2)</b> <i>Principles &amp; Techniques of Electrofishing</i> online course (CSP2c01), plus participation in two practical sessions where you perform gear setup, safety checks, sampling, and gear dismantling under the supervision of someone certified in electrofishing.</p>	<p>Course topics are the same as for CSP2201 above.</p> <p>You can get a completion certificate for the <i>Principles &amp; Techniques of Electrofishing</i> online course by scoring an 80% or above on the exam. (Staff may prepare for the exam by taking any electrofishing course at their discretion.)</p>
<p><b>(3)</b> <i>Principles &amp; Techniques of Electrofishing</i> online course (CSP2c01), plus participation in the <i>Electrofishing Sampling Advanced Practicum</i> on-site, instructor-led course (CSP2203).</p>	<p>Course topics for CSP2203 include:</p> <ul style="list-style-type: none"> <li>• Lab threshold experiments and identification of effective waveforms;</li> <li>• Electrode design and resistance;</li> <li>• Electric field mapping;</li> <li>• Field trials to evaluate identified waveforms and determine threshold settings;</li> <li>• Voltage, amperage, and power goal table development; and</li> <li>• Operating capacity of electrofishing gear.</li> </ul>
<b>CPR/First Aid Training</b>	
<p>Successful completion of a course in adult CPR and first aid offered by the Red Cross, American Heart Association, or other organization that follows OSHA guidelines for first aid programs (<a href="#">OSHA 3317-06N 2006</a>). The course must include an instructor-led skills training session.</p>	
<b>Recertification</b>	
<p>A <i>Certificate in Electrofishing</i> lasts 5 years. To maintain your <i>Certificate in Electrofishing</i>, you must re-certify every 5 years. You may re-certify by successfully completing <i>Principles &amp; Techniques of Electrofishing</i> (CSP2201), <i>Principles &amp; Techniques of Electrofishing</i> online (CSP2c01), or <i>Electrofishing Sampling Advanced Practicum</i> (CSP2203). You must also hold current CPR and first aid certificates.</p>	

**B.** In addition to the team leader, at least one other crew member on an electrofishing team must have a current certificate in CPR and in first aid. If an Automated External Defibrillator (AED) is part of the crew safety equipment, then a minimum of one crew member in addition to

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the team leader must have current certification in a CPR class that covered AED use (see [section 6.11G](#)).

**C.** All crew members on the electrofishing team must receive an electrofishing safety orientation prior to the field season, or when they join the team during the field season, and a briefing prior to the start of each electrofishing sampling event.

**(1)** The safety orientation must include the NCTC *Electrofishing Safety* online course (CSP2202). This course includes the following information:

- (a)** Overview of electrofishing equipment components and procedures,
- (b)** Hazards involved in electrofishing,
- (c)** Safe operation and emergency shutdown of electrofishing equipment,
- (d)** Proper use and maintenance of personal protective equipment, and
- (e)** How to report safety issues and any injuries.

**(2)** Crew members must give a copy of the *Electrofishing Safety* course completion certificate to their team leader to document that they have completed the course.

**(3)** The team leader may add site- and equipment-specific topics to the orientation.

**D.** Personnel operating motorized watercraft in the line of duty must complete the U.S. Department of the Interior Motorboat Operators Certification Course (see [241 FW 1](#)). Also see additional requirements in [section 6.13](#).

**E.** Personnel using electroseparation or conducting lab experiments must successfully complete the NCTC *Electrofishing Safety* course (CSP2202) or one of the *Principles & Techniques of Electrofishing* classes (CSP2201 or CSP2c01).

**F.** Crew members are responsible for maintaining their records of course completion (e.g., hard copies of certificates in a personal folder and electronic copies on a computer). We encourage crew members to maintain records in the U.S. Department of the Interior's learning management system (i.e., DOI Learn).

**G.** If circumstances for a volunteer or employee are such that taking an online electrofishing course through the learning management system (i.e., DOI Learn) is problematic, contact NCTC for assistance.



## DESIGN SPECIFICATIONS

### 6.8 What design specifications are applicable to all electrofishing operations?

#### A. Neutral Connection Removal in the Generator.

(1) To avoid malfunctions in certain models of pulsators that occur when current output from the generator is not isolated from the ground, current output from generators used for electrofishing must be isolated from the ground by:

- (a) Removing the neutral connection from within the generator (i.e., “floating the neutral”),
- (b) Purchasing a generator without a neutral connection (“floating neutral generator”), or
- (c) Incorporating an isolation transformer.

(2) You must verify that there is no neutral connection to ground unless an isolation transformer is used. This can be accomplished by performing a continuity test between the neutral and ground of the 240 volt receptacle and of each 120 volt receptacle. The pulsator manufacturer should be consulted for additional guidance.

(3) A generator that came new with a neutral connection that was subsequently modified to float the neutral for electrofishing must have a sticker indicating that the neutral is floating. Place the sticker over any text printed on the generator that states the neutral is bonded to the ground. If you plan to use the generator for non-electrofishing activities on land, then it must be returned to its original condition.

**B. Inverter Generators.** Inverter generators are much quieter (some models have an advertised 50 - 60 decibel noise level), but they may not work well with some pulsator models unless they are modified by adding a stabilizer.

#### C. Wiring.

(1) *Conductor Type:* Only copper wire is acceptable in electrofishing units. This applies to the branch circuits, not the generator.

- (a) Wires enclosed in conduit, conduit/junction boxes, and connectors must meet National Electric Code (NEC)-designated types for damp locations. We recommend type THHN.
- (b) Where conductors must run outside conduit and conduit/junction boxes, use SOOW (600 volt) or SJOOW (300 volt) cables. (See Exhibit 1 for an explanation of SOOW and SJOOW.)

(2) *Conductor Voltage:* The insulation value for all wiring in electrofishing units must meet or exceed the maximum voltages that the power source or pulsator generates. Insulated wires are

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specified with an Alternating Current (AC) voltage Root Mean Square (RMS) rating. AC RMS voltage is equivalent to Direct Current (DC)/Pulsed Direct Current (PDC) average voltage.

**(a)** You can compare maximum AC voltage expected directly to the conductor voltage rating.

**(b)** You can compare the highest expected peak DC or PDC voltage to the conductor rating by accounting for duty cycle. For example, a 600 volt RMS conductor rating can handle 2,400 peak volts PDC at a 25% duty cycle.

**(3) Conductor Amperage:** Table 6-3 shows the minimum conductor size (i.e., for copper wire) for rated RMS amperage of equipment. Always check the manufacturer's specifications for conductors. You can compare maximum expected AC RMS amperage or DC/PDC peak amperage with conductor capacity in the same manner as with conductor voltage.

<b>Table 6-3 Minimum Conductor Sizes</b>	
<b>Maximum Amperage</b>	<b>Minimum Conductor Size</b>
11	20 American Wire Gauge (AWG)
16	18 AWG
22	16 AWG
32	14 AWG
55	10 AWG
64	9 AWG
73	8 AWG
158	3 AWG
181	2 AWG

**(4) Conductor Placement:** All conductors outside of the pulsator must be enclosed in conduit, conduit/box, junction boxes, connectors, or cables.

**D. Conduit.** Conduit must be liquid-tight. We recommend non-metallic liquid-tight (NMLT) conduit.

**E. Conduit/Junction Box.** Condulets or junction boxes must be designed for wet locations, and meet the National Electrical Manufacturers Association (NEMA) 4 standard at a minimum.

**F. Connections.**

**(1)** When using conduit, wiring may only be spliced inside condulets or junction boxes. If connections are necessary, the rating of the connector must be the same or greater than the wire.

**(2)** Connector plugs and sockets used with flexible cables must be watertight and meet the NEMA 4 or Ingress Protection (IP) 65 standard, at a minimum. You should use a splash cover (e.g., a rubber hood) to protect the connection to the generator.

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**G. Circuit Breakers.**

- (1) The electrofishing system (e.g., generator, pulsator, or console) must include circuit breakers or fuses to provide circuit protection.
- (2) If external to the generator or pulsator, circuit breakers or fuses must be labeled to show their purpose.

**H. Controls for Electrical Equipment.**

- (1) An on-off switch on the generator power source and pulsator must be readily accessible to the operator. We recommend that the pulsator or generator be equipped with a mushroom, push-button, or slap-style emergency stop switch to quickly shut down the system. The on-off switch or emergency stop switch must be clearly labeled and colored red.
- (2) A voltage meter must be installed to monitor the voltage level applied to the electrodes. An amperage meter, which can be useful for electrofishing standardization, is recommended, but not required.
- (3) Safety circuits (switches and relays designed to interrupt the high voltage circuits) must not exceed 24 volts.

**6.9 What design specifications are applicable to portable electrofishing equipment (backpack, tow-barge, shore-based, prepositioned area shocker, etc.)?**

**A. Portable Electrofishing Units (General).**

(1) *Electrodes:*

- (a) Electrode handles must be made of a nonconductive material and be long enough to avoid hand contact with the water.
- (b) The hand-held electrode (anode with DC or PDC) used with portable electroshockers must be equipped with a manual safety switch that breaks the electric current. Gear with more than one hand-held electrode must have manual safety switches wired in series. Disabling the manual switch in any way is prohibited. Do not bypass the manual switches with anything that holds them down (e.g., tape).
- (c) You may use a throwable anode with a tow barge, canoe, or boat that has a non-conductive hull and a cathode located in an isolated position (e.g., a metal plate attached to the bottom of the hull). An electrofishing crew may operate in a watercraft with a metal hull only if the throwable anodes are operated away from the watercraft (i.e., thrown from a wading position and not from inside the watercraft).
- (d) Do not use netting on hand-held electrodes except when sampling for lamprey ammocetes. This helps ensure safety, avoids fish trauma, and allows removal of deposits. Gear equipped with automatic cut-off circuitry for anodes exiting the water (“anode out-of-water switch”) are not constructed to allow for netted anodes. Anode out-

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of-water switches may have a minimum amperage cut-off threshold that is above the level that has no effect on humans.

**(2) Grounding:** For electrofishing methods that employ a generator stationed on land (e.g., shore-based, electric seine), we strongly recommend you ground the generator frame to the earth using a driven ground rod. We also strongly recommend that you ground the pulsator in a shore-based operation to the earth either through the generator or by a separate driven ground rod. Backpack electrofishing units cannot be grounded to the earth.

**B. Backpack Electrofishing Units.**

**(1)** If battery powered, you must use a lithium ion phosphate or a valve-regulated lead-acid sealed gel cell battery.

**(2)** Backpacks must have a quick release belt (hip) and shoulder straps.

**(3)** All equipment must have a tilt switch and an immersion switch that opens the circuit if the operator falls. The tilt or immersion switch must require a manual reset after regaining footing.

**(4)** The backpack must be equipped with a light or audible signal that indicates when the unit is operating.

**C. Shore-based Electrofishing Units.** Each electrode operator must have an individual safety switch on the electrode handle.

**D. Tow-barge Electrofishing Units.**

**(1)** Each electrode operator must have an individual safety switch on the electrode handle.

**(2)** The barge hull must be made of nonconductive material with an electrode attached to the hull bottom.

**E. Electric Seine Electrofishing Units.** Each braille (seine pole) must have an individual safety switch to control the power applied to the electrodes.

**6.10 What design specifications are applicable to electrofishing boats and rafts?**

**A. Design.**

**(1)** Boat design and equipment must be in compliance with U.S. Coast Guard and State regulations and U.S. Department of the Interior policy (also see [241 FW 1](#)). The boat or raft crew must follow the additional guidelines in this electrofishing safety policy.

**(2)** The netting area must have substantial safety rails to help prevent netters from falling overboard. Safety rails must withstand netters leaning on them without collapsing.

**(a)** On solid-hulled boats, safety rails should be at least 42 inches from the top of the rail to the deck. The top of the rail should be at or above the waistline of netters.

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- (b) Safety rails on rafts may be lower, but netters must kneel to keep the top of the rail at or above their waistline.
- (3) The team leader must ensure the boat bow deck is equipped with a nonslip or skid-resistant material or roughened in some manner to decrease the chance of slipping.
- (4) Electrode booms (anodes with DC) must be mounted in a stationary position on a metal-hulled boat. Moveable anodes (prod poles) may be used on metal-hulled boats with non-conductive deck surfaces and railings.
- (5) All metal surfaces on a boat or raft must be electrically connected (in electrical continuity) to eliminate differences in electrical potential that may cause electric shock. Ground the generator case to the hull or rowing frame (raft) by a direct attachment, with a ground strap, or 8 AWG sized wire. We recommend that you connect a ground wire from the pulsator to the hull or rowing frame. You may use a metal boat hull as a cathode.
- (6) An acid proof, nonmetallic enclosure and holder must be provided for wet cell batteries.
- (7) For typical power sources, the recommended conductor voltage capacity is 600 volts RMS minimum for the main circuit and 300 volts RMS maximum for the safety circuit.
- (8) For typical power sources, the recommended conductor size is 10 AWG for the generator power cord and main circuit. The suggested safety circuit size is 14 – 16 AWG.
- (9) For typical power sources, the recommended connector plug and socket rating is 600 volts/32 amps minimum for the main circuit and 250 volts/30 amps for the plug to the generator.
- (10) All conductors must be enclosed in liquid-tight conduits. Where external connections are necessary (e.g., to the booms, pulsator, or foot safety switch), use appropriately rated SOOW and SJOOW cables, watertight conduit/junction boxes, and connector plugs and sockets (meeting the NEMA 4 and IP65 standards or greater). All conductors installed in a common raceway (conduit) must be continuous (without connectors, breaks, or splicing) and independently and correctly insulated. High and low voltage (safety circuit) conductors do not need to be placed in separate conduits.
- (11) Mount fire extinguishers away from gas cans, generators, or other fire sources.
- (12) Mark watercraft with “Danger Electricity” signage.

**B. Controls for Electrical Equipment.**

- (1) The boat/raft operator must have ready access to a generator or pulsator on/off, emergency stop, or safety switch to cut the power in case of an accident.
- (2) At least one netter on the bow work deck must have a safety switch connected to the power control circuit.

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**C. Lighting.**

- (1) When operating at night, you must have adequate lighting for working areas. Lighting may include fixed lights (12-24 volts) or head-lamps.
- (2) You must use adequate lighting outside the watercraft to avoid safety hazards, such as striking logs, rocks, and overhead tree branches.
- (3) Lighting and other auxiliary circuits should not exceed 24 volts. Light emitting diode (LED) lamps can provide effective lighting with low amperage draw, usually requiring 12 volts. If shielded with a protective housing, you may use 120 volt lamps.

## **PERSONAL PROTECTIVE EQUIPMENT AND SAFETY PRACTICES**

### **6.11 What personal protective equipment and safety practices are applicable to all electrofishing operations?**

**A. Gloves.**

- (1) All team members must wear rubber gloves that are long enough to isolate hands from touching external surfaces. Common glove materials include neoprene, polyurethane, butyl, silicone, natural rubber, and PVC. Rubber insulating (“lineman’s”) gloves are not required. Class 0 rubber insulating gloves (maximum use voltage = 1,000 V RMS) with leather glove protectors are a practical glove system and allow for dexterity.
- (2) Team members must visually inspect gloves for punctures before each use and replace them immediately if they are torn or punctured.

**B. Net Handles.** Net handles must be constructed of a nonconductive material and be long enough to avoid hand contact with the water.

**C. Polarized Sunglasses.** Team members should wear polarized sunglasses when there is glare.

**D. Noise.**

- (1) If using a generator, a noise survey to document Sound Pressure Level (SPL) exposures to electrofishing crew members must be performed. When subjected to sound levels at or above 85 decibels (dBA), regardless of time exposed, crew members must wear hearing protection to reduce sound levels (see [242 FW 3](#)). Also, whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level of 85 dBA, a continuing effective hearing loss prevention program, in accordance with [242 FW 3](#), must be administered. The team leader should ensure that any time a generator is used, hearing protection is available for anyone who wants to wear it, whether or not it is required. Inverter generators are substantially quieter than traditional generators, but require a special stabilizer sold by electrofishing equipment manufacturers.

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(2) More information about personal protective measures for preventing hearing loss, such as using earplugs, is available in [242 FW 3](#).

(3) Project Leaders may buy 2-way communication headphones using duty station funds. If you use 2-way communication headphones, you should do so in accordance with 242 FW 3. To be effective, headphones should provide clear communication among personnel.

**E. Gloves and Wader Repair or Replacement.** Electrofishing operations should be discontinued if a crew member feels electroshock through gloves or waders. Replace or repair gloves or waders to eliminate electroshock.

**F. First Aid Kit.** Maintain and have available a well-equipped first aid kit (see [243 FW 1, Exhibit 1](#)).

**G. Automated External Defibrillators (AED).** We recommend, but do not require, that all electrofishing crews be equipped with an AED. If AEDs are provided, then a minimum of two team members must be AED-certified and a formal written program established at the local level. A medical director must oversee the program.

**H. Exhaust From Power Source.** The exhaust from gasoline powered engines must be directed away from the equipment operator. Enclose any added exposed hot pipes in a protective covering (e.g., screening) that you may paint with high temperature yellow paint, or position them so that crew members will not be burned. Do not use plastic or galvanized pipe for exhaust because it may release toxic gases when extremely hot.

**I. Fuel Storage.**

(1) Store and transport gasoline and other fuels in approved safety cans. Unless specifically designed as a fuel tank for a generator, pump, or outboard motor, safety cans that meet OSHA standards are required ([29 CFR 1926.152\(a\)](#), [155\(a\)](#), [155\(l\)](#)). OSHA recognizes safety cans approved by testing laboratories as Factory Mutual (FM) or United Underwriters Laboratory (UL). We recommend that you use approved plastic containers with stainless steel fittings to reduce corrosion issues. Screw-cap type containers that do not meet safety standards are not permissible for such flammable liquids as gasoline.

(2) If rough transport could result in spillage from an approved safety can, then the team must use U.S. Department of Transportation (DOT)-compliant transport and dispensing safety cans. These are commonly referred to as DOT/OSHA cans and have filler caps you can lock down to avoid leaks during transport. You can also release the locking mechanism so that the container will function as a safety cap during fueling operations.

**J. Refueling.**

(1) Turn off all equipment before refueling the generator and allow hot surfaces to cool. We recommend that you fill all tanks before each operation to avoid the potential for explosion or fire while refueling.

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(2) Only fuel away from any open flame or a flame-generating device. You should use a properly sized flexible filling spout or funnel during refueling to avoid spills.

(3) Place portable fuel tanks on a dock or pavement for refueling. Do not refuel portable fuel containers on a plastic surface (e.g., a plastic lined pickup truck bed). We recommend that you use a bonding wire between metal tanks/containers.

**K. Handling Electrodes.**

(1) After operation of an electrofishing unit, before handling electrodes, disconnect the electrodes from the rest of the system (e.g., with backpack shockers, unplug handheld electrode from the pulsator; with boats, unplug the power output cable from the pulsator). Capacitors in the pulsator hold a charge for a period of time after the power is turned off. Capacitors self-discharge, often in less than 5 minutes. Check with the equipment manufacturer to determine capacitor discharge times for your pulsator model.

(2) Never touch both electrodes simultaneously while the power source is running, when both electrodes are connected to the equipment circuit, or prior to capacitor discharge time after power shutdown.

**L. Servicing Pulsator.** Before opening a pulsator to service it (e.g., changing fuses), capacitors must be in a discharged state. Do not service the pulsator unit until the capacitor self-discharge time has elapsed, typically within 5 minutes (contact manufacturer for the discharge time). We recommend that you label pulsators with their capacitor discharge time.

**M. Making Connections or Repairs.** Prior to adjusting connections or making repairs, disconnect the power source.

**N. Startup of Electrofishing Unit.** Before turning on the electrofishing unit, warn all team members and check to be sure they are aware electrofishing is about to begin.

**O. Equipment Inspection.** Maintain all electrofishing equipment in a safe condition. Visually inspect external wiring, cables, and connectors for physical damage before each use and periodically during use. Test safety switch operation with a multimeter. Any equipment deficiency that may present a safety hazard must be corrected before beginning or resuming electrofishing activities.

**P. Protecting Others.** Discontinue electrofishing if anyone outside of the electrofishing team approaches within 30 feet (for backpack operations) or 100 feet (for all other electrofishing operations).

**Q. Weather.** Discontinue electrofishing during dangerous weather conditions.



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**6.12 What additional personal protective equipment and safety practices are applicable to portable electrofishing units (backpack, tow barge, shore-based, prepositioned, etc.)?**

**A. Portable Electrofishing Units.** The standard safety equipment includes:

(1) *Waders.* All crew members must wear chest or hip waders to insulate them from electrical shock. Suitable waders are generally constructed of neoprene, PVC, silicon, etc. Soles must be non-slip. Breathable waders may not have adequate electrical insulating properties, so they may only be used with backpack electrofishing operations. Crew members must wear long pants under breathable waders.

(2) *Footwear.* All footwear must have non-slip soles.

**B. Backpack Electrofishing Units.** The person operating a backpack electrofishing unit must wear a raincoat that also covers the backpack unit when there is moderate precipitation. Discontinue electrofishing operations when there is heavy precipitation.

**C. Shore-based Electrofishing Units.** A crew member must continuously man the generator so it can be immediately shut down in an emergency.

**D. Tow-barge Electrofishing Units.**

(1) The tow-barge operator must continuously man the generator so it can be immediately shut down in an emergency.

(2) The tow-barge operator must be tethered to an emergency stop switch or operate a safety switch that interrupts the electrical power if he/she falls.

(3) The tow-barge operator should always watch the crew while the electricity is on. Electrode operators must keep the netter within their view as much as possible.

**E. Electric Seine Electrofishing Units.** A crew member must continuously man the generator so it can be immediately shut down in an emergency.

**F. Prepositioned Area Electrofishing Units.** A crew member must continuously man the generator so it can be immediately shut down in an emergency.

**6.13 What additional personal protective equipment and safety practices are applicable to electrofishing boats and rafts?**

**A. Standard Safety Equipment.**

(1) All watercraft occupants must wear U.S. Coast Guard-approved personal flotation devices at all times in accordance with the U.S. Department of the Interior and Service watercraft safety policy (see [485 DM 22](#) and [241 FW 1](#)).

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**(2)** Boat crew members must wear, at a minimum, rubber-soled boots or other boots rated for electrical hazard protection (e.g., those meeting standards in ASTM F2412-11, ASTM F2413-11, and ASTM F2892-11).

**(3)** Netters in rafts that have a non-conductive work-deck surface must wear hip waders to prevent contact with wet surfaces.

**(4)** Motorized electrofishing boats must be outfitted with required safety equipment (also see [241 FW 1](#), Watercraft Safety).

**B. Clear Working Space.** There must be adequate working space to conduct safe operations. The team leader and all crew members must be careful to prevent clutter that may cause safety hazards.

/sgd/ Teresa Christopher  
ACTING DIRECTOR

Date: December 29, 2016