Model 12-B Battery Powered Backpack Electrofisher

For over thirty years the leader in effective, safe, and reliable products for fisheries conservation. Knowledgeable field biologists depend upon Smith-Root equipment.

14014 NE Salmon Creel
Vancouver, WA 98686
Phone: (360)573-0202 Fax: (50
## Contents

### BACKPACK ELECTROFISHERS
- Introductions ................................................................. A-3  
- Controls and Features .................................................... A-3  
- Using the Electrofisher .................................................. A-5  
- In Case of Difficulty ...................................................... A-5  
- Battery Charger ............................................................. A-6  
- Battery ............................................................................... A-7

### PROGRAMMABLE OUTPUT WAVEFORMS (POW)
- Introduction ................................................................ B-3  
- What is POW and why do I need it? ................................. B-3  
- Programmable Output Waveforms .................................... B-3  
- Setting the mode switches ............................................... B-5  
- Waveform tables ............................................................... B-6

### ELECTROFISHING
- Electrofishing Safely  
  - Safe fishing ................................................................... C-3  
  - Preventing electrical shock ............................................ C-4  
  - Planning for safety ......................................................... C-4  
  - Backpack safety ............................................................ C-5  
  - Boat safety ....................................................................... C-5  
  - Do's & Don'ts .................................................................. C-5  
- Electrofishing Principles  
  - Introduction to electrofishing ........................................ C-6  
  - Types of current .............................................................. C-8  
  - Electrode design .............................................................. C-9  
  - Field techniques ............................................................. C-13  
  - References ....................................................................... C-13

### PARTS IDENTIFICATION
- Replacement parts ......................................................... D-3 - D-5  
- Accessory and additional items ....................................... D-6 - D-12

---

All Smith-Root, Inc. manufactured products are covered by a one year warranty. Items manufactured by companies other than Smith-Root carry the original manufacturer's warranty.

Due to increased handling costs a minimum order amount of $25.00 is required.

Smith-Root, Inc. Electrical Field Fish Barrier systems are protected by patent. Ideas, arrangements, drawings, and specifications are the sole property of Smith-Root, Inc. and are intended for this specific catalog and shall not be used for any other purpose, without written consent of Smith-Root, Inc.

U.S. - 4,750,451  Canada - 1,304,442

Credit & Refund Policy: Customers returning equipment, in new condition, will be given credit to the applicable VISA/Master Card account within five days from the date of the return. A return authorization must accompany returns. Valid equipment returns include, but are not limited to, ordering incorrect equipment, funding deficits, and defective equipment returned for reimbursement. All returns are subject to a restocking fee and applicable shipping charges. The restocking fee is figured at 10% of the purchase price but not less than $20.00. Customers receiving equipment in damaged condition will be referred to the shipping company for insurance reimbursement.
INTRODUCTION

The Model 12-B Electrofisher is a rugged 24 volt battery powered unit for use in small to medium sized rivers and streams. This unit is suitable for extensive field work in even the most extreme conditions. Inside, the model 12-B uses premium electronic components and circuitry which insures very capable and reliable operations. Outside, the electronics are enclosed in a heavy gauge aluminum box with welded seams which provides strength, durability, and light weight. The whole unit is mounted on a new injection molded backpack frame designed to be virtually indestructible. Not only strong, this frame’s multiple adjustments make a comfortable fit possible for almost any sized operator.

Standard operational features include an audio “crew alert” tone when shocking. This tone doubles as an indication of battery loading. The model 12-B also has extensive self-testing and condition monitoring with operation feedback on light emitting diodes. Another, and very important, standard feature with all SRI Backpacks of current manufacture is P.O.W.

Programmable Output Waveform (P.O.W.) capacity adds new dimensions to electrofishing. P.O.W. makes complex waveforms and programmable pulse patterns switch-selectable. P.O.W. may reduce the chance of damage to sensitive fish species and will allow electrofishing in areas not previously fishable.

Hardware in current models limit minimum output pulse width to greater than 100 micro seconds, and maximum pulse rates to less than 1000 pps. with no AC waveforms supported. However, within these limitations, your P.O.W. Electrofisher may generate virtually any PCM type wave form. P.O.W.’s wide range of capabilities will meet the demand of changes in electrofishing technology, keeping your electrofisher a useful instrument for years to come.

The Model 12-B POW Electrofisher is a rugged, lightweight, high energy backpack unit designed for medium sized waterways with low to medium conductivity.

CONTROLS AND FEATURES

The main control panel is on the left side of the box.

Voltage Range Switch: This switch is located at the bottom. The switch has 10 ranges. The 100 to 300 volt ranges are for high conductivity waters (400 to 1,600 microSiemens/cc). The 400 to 700 volt ranges are for medium conductivities (200 to 400 microSiemens/cc). The 800 to 1,000 volt ranges are for low conductivities (10 to 200 microSiemens/cc).

Mode Switches: These are located in the middle. One switch is labelled A–P and the other 1–16. Together they select one of the 256 available pulse waveforms from the table affixed to the electrofisher. See Section B of this manual “Programmable Output Waveforms” for more details.

Output Voltage Indicator: The audio indicator provides a strong tone to give positive indication to all crew members that there is an output voltage greater than 30 volts between the anode and cathode. This indicator also serves as an input current indicator. It begins to beep slowly at an input current of 4 Amps, and beeps faster as the input current goes up.
Backpack Model 12-B

Timer: The six-digit timer totals shocking time in seconds. A crystal controlled time base provides precision timing, with a display window located at the top of the left side of the instrument case. The timer can be reset by placing a magnet over the word “Reset” next to the timer. The magnet is found on its keeper on the left side of the shocker near the battery box. Alternately, with the unit turned off and the battery disconnected, use the anode pole switch magnet to reset the counter.

Input Power Connector: The input power connector is a rugged quick-twist positive locking connector, with index tabs for proper polarization of the connector halves.

Input Power Switch: The input power switch is a 25A toggle circuit breaker switch that protects the Model 12-B from excessive input currents.

Self Test Indicator: In normal operation, the SelfTest LED indicates that the control circuit wiring and pole switch are O.K. If this indicator does not turn on when the pole switch is pressed, either the unit is off, the battery is not connected, or there is a problem in the control circuit.

Batt/Gen: This LED only comes on when the battery attached to the unit has been discharged. It can only be cleared by turning off the power switch and replacing the discharged battery with a charged battery.

Average Current Overload: This LED indicator turns on if the voltage and mode switch settings cause the unit to draw too much current from the battery. To clear the problem, turn down the voltage range or select a lower frequency or narrower pulse width or a combination of all three. Release the pole switch and try the new setting.

Peak Current Overload: This condition is indicated by the Overload LED flashing. The SelfTest LED will also be on. This problem is cleared by releasing the pole switch and reducing the voltage setting. Make sure the anode and cathode are not touching as this will also cause a Peak Current Overload.

Tilt: This condition is cleared by standing up straight and releasing the pole switch if pressed. The Tilt switch is set to trip at approximately 15° backward tilt or 30° forward tilt. The sideways tilt is approximately 30°.

Operator Error: This error is caused by one of two conditions. 1. Changing the mode switches with the output on. 2. Having the pole switch pressed when the on/off circuit breaker is turned on. This condition is cleared by releasing the pole switch.

Over Temperature: This indication turns on when the internal temperature of the unit reaches 182°F (83°C). If the unit reaches this temperature it will automatically shutdown. This condition is cleared by allowing the unit to cool with the on/off circuit breaker turned off for at least 15 minutes.

Startup Failure: This condition indicates an internal problem in the electrofisher. Please contact Smith-Root, Inc. for details.

<table>
<thead>
<tr>
<th>Status LED Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
</tr>
<tr>
<td>Normal Off</td>
</tr>
<tr>
<td>Normal On</td>
</tr>
<tr>
<td>Check Batt/Gen</td>
</tr>
<tr>
<td>Ave. Current Overload</td>
</tr>
<tr>
<td>Peak Current Overload</td>
</tr>
<tr>
<td>Tilt</td>
</tr>
<tr>
<td>Operator Error</td>
</tr>
<tr>
<td>Over Temp</td>
</tr>
<tr>
<td>Startup Fail</td>
</tr>
<tr>
<td>Immersion</td>
</tr>
</tbody>
</table>

*Pole On When Pole Switch Pressed. Off Otherwise.*
USING THE ELECTROFISHER

A. Make sure the power switch is in the off position. Place the battery in the battery box, secure with straps, and connect the input power plug to the battery.

B. Plug the anode pole and cathode into their respective connectors on the bottom of the instrument case. Located inside the pole is a scaled, magnetically operated reed switch. The reed switch is activated by a magnet within the rubber flapper. By simply pressing the flapper forward against the pole, the reed switch will close and the output is activated. Release the rubber flapper, and the reed switch will open and the output will be deactivated.

C. Select the desired voltage and frequency ranges. When water conductivity is unknown, set the voltage range to 100V and select mode settings of D and 4. Place both electrodes in the water and press the anode pole switch. The audio tone and the self-test indicator should both come on. Observe the reaction of the fish. If this setting is not satisfactory, then release the anode pole switch and increase the voltage range. Press the anode pole switch, and again observe the reaction. Once a reaction is clearly seen, if you are not holding or stunning fish, increase the pulse width or frequency. If you are stunning fish before drawing them to the anode, decrease the voltage or pulse width or frequency. By carefully adjusting these three controls, you can capture fish without doing damage.

D. Never change voltage range or mode settings while the anode pole switch is pressed; doing so may damage the electrofisher.

E. Caution. If you have been shocking small fish, reduce the voltage range two or three positions before shocking large fish. Large fish are more sensitive to being shocked than small fish. See Section C of this manual for more details.

F. To insure proper operation of your electrofisher, the surface of the anode ring must be conductive. In normal operation it may become anodized and nonconductive, this condition is dependent on electrofisher settings used, type of ions in the water, and length of time exposed.

G. Cleaning: Mechanical removal is the preferred cleaning method. To clean, use the provided Scotch-Brite™ pad and rub the surface of the ring until it shines. It is sometimes helpful to use an abrasive cleaner with the pad. Wire brushes and some chemical cleaning solutions will also work.

IN CASE OF DIFFICULTY

A. Check the input power switch and the battery connector. If the power switch turns off by itself, either the switch is defective or there is a short circuit within the electrofisher.

B. Check the overload indicator. If the overload light comes on when the output is activated, reduce the voltage selector until the overload light no longer comes on. The overload is automatically reset each time the anode pole switch is released.

C. Check the Batt/Gen indicator. If the Batt/Gen indicator is on, the battery is discharged and should be replaced with a fresh battery. The Batt/Gen indicator resets when the power switch is turned off.

D. Check the self-test indicator. The light should turn on when the anode pole switch is activated. If the light fails to turn on, check the anode and cathode connectors on the box to be sure that they are properly seated. If you are sure that the connectors are hooked together properly and the self-test indicator still doesn’t turn on, check the switch circuit on the anode and cathode with an ohm meter. Pin B to Pin C should read approximately zero ohms when the anode pole switch is activated. The rat-tail cathode should measure zero ohms at all times. If it doesn’t measure zero ohms there is either a broken wire or a bad switch in the electrode.

E. A safety switch renders the electrofisher inoperable if the unit is tipped beyond most normal operating positions. The normal operating position for the electrofisher is vertical.

F. A simple test with an ohm meter or continuity tester will tell you if a problem exists. You should be able to lightly touch the ring in any two places and show continuity between them. If poking, rubbing, or pressing hard with the test probes is required, there is a problem and the ring should be cleaned.
BATTERY CHARGER

The Smith-Root BC-24PS is a revolutionary concept in battery charger design. This high technology, compact device offers a number of benefits not found in conventional chargers. The BC-24PS is a truly automatic charger tailored for maintenance-free batteries as well as other types of lead acid batteries.

The BC-24PS has a fully automatic, four stage charge sequence with an electronically timed routine and a desulfation mode.

Stage 1 Desulfation: encourages the breakdown of larger sulfate crystals which form during prolonged periods of deep discharge.

Stage 2 Constant current: applied to achieve the fastest possible return of energy to the battery.

Stage 3 Constant voltage: temperature compensated with adaptive timing to insure maximum charge for each battery, this stage provides the final 20% of the total charger.

Stage 4 Standby float-charge: this stage will replace standing losses and keep the battery in a full charged state. Batteries may be left in this state indefinitely provided that they are in a well vented area and the AC input is not subject to frequent or periodic power outages (switched outlet or bad power). Damage to or failure of the battery may cause the charger to stay in high-rate mode with subsequent battery venting. In these situations consider using a MC-23 charger (not subject to these limitations) for long term battery storage.

Time to recharge will vary depending on state of charger, condition of battery and battery size. The rule of thumb is 2 to 3 hours for Featherweight, 2.5 to 4 hours for Lightweight and 3 to 6 hours for standard batteries.

These charge times are for a battery recently discharged to the low battery cutout on a model 12 electrofisher.

A fully charged battery placed on a BC-24PS charger may not indicate that it is fully charged for as long as 1 1/2 hours due to the timed charger feature.

Specifications

- Input: 120 Volts AC 60Hz, 200 VA
- Output: 5 Amps DC 24 Volts
- Dimensions: 6.5"W x 5.25"H x 6.0"D
- Weight: 9.5 lbs.
- Order Number: 4954

Connectors and Indicators

- Input power cord: The input power plug is a standard 120VAC three-pin with ground.
- Output cord and connector: The connector on the end of the cord is wired to plug directly into the quick-disconnect connector on the battery pack.
- Front panel indicators: The seven front panel indicator lamps are labeled to indicate the battery's state of charge.

Charger Operating Instructions

This charger is suitable for use with all types of lead acid batteries, including the new types of maintenance free and gelled electrolyte batteries.

1. Connect charger to battery.
2. Connect the charger to the AC power supply and switch on. The state of charge is shown by the LED indicators on the battery charger as follows. The red "Charge" LED will light to indicate that the battery is correctly connected and is charging. During charging, the current flowing into the battery is indicated by the LED Amp Meter. This is the vertical group of four red LEDs located directly above the "Charging" LED. At the start of charge, if the battery is in normal condition, all four red LEDs will be on and will gradually go out in sequence as the charge current drops and the battery approaches full charge. When the battery reaches an 80% level of recharge, the red "Charge" LED will go off and
the yellow "80%" LED below it will come on. After a further time interval, the "80%" LED will go off and the green "Ready" LED will come on. The time interval for this final 20% of charge is automatically adjusted by the charger in proportion to the time taken to reach the 80% level.

3. The length of time needed for recharging will depend on the size and depth of discharge of the battery. A minimum of one hour is needed and full charging of a large battery may take up to 12 hours.

4. For best results, the charger should be allowed to complete its full cycle as indicated by the green "Ready" LED, and if possible, the battery should be left connected and on-charge permanently until it is required for immediate use. There is no need to switch off the charger to prevent overcharging.

6. IMPORTANT SAFETY NOTE: When disconnecting the battery from the charger, switch off or unplug the AC supply to the charger first. This precaution will eliminate any risk of gas explosion due to arcing.

Storage Instructions

Fully charge batteries before placing in storage. As these batteries will self discharge, we recommend that they be recharged after 3 or 4 months of storage at 20 degrees centigrade. More frequent charging is required at higher storage temperatures and less at lower temperatures (9 months at 0 degrees). Batteries removed from storage should be recharged for at least 48 hours prior to placing back in service. If batteries are stored on a maintenance charger (MC-24), they are always ready for use.

1. When not in use, store the charger indoors in a cool dry place, preferably with its original packing and carton.
2. Place these instructions with the charger during storage.

Maintenance And Cleaning

Very little maintenance is required other than protecting the charger from damage and weather.

1. Coil cord when not in use.
2. Clean case and cords with a slightly damp cloth.
3. Examine cords for damage periodically and replace if necessary with manufacturer approved parts.

BATTERIES

The Model 12-B uses a 24 volt sealed deep cycle battery. Understanding the proper care of this battery will reduce problems in the field.

Batteries should never be allowed to remain in a discharged state and should be recharged as soon as possible after use.

Batteries should be charged until the green lamp on the charger comes on.

Charging Problems: Some older batteries may not charge within 24 hours. If a battery has been left in a discharged condition for a while, it may not take a charge. If you suspect that the battery has been left discharged, charge it for 48 hours and then discharge it with the electrofisher. If the battery is not taking a charge it will not operate the electrofisher for very long. Sometimes by cycling the battery a few times it will start taking a charge again.

Note that all batteries should be charged after each use even if the battery was only slightly discharged (these batteries do not have a memory). Total number of charge/discharge cycles possible varies inversely with depth of discharge on each cycle. Over-discharging or completely discharging the battery will greatly reduce the cycles possible and a battery left in a discharged condition may be ruined. For this reason, batteries should never be allowed to remain in a discharged state. Recharge as soon as possible after each use.

Service Life: Batteries which have been properly maintained should last 3 to 5 years depending on ambient temperature, depth of discharge (D.O.D.) and number of cycles (for batteries to maintain at least 80% of original capacity, they are rated 230 cycles for 100% D.O.D., 470 cycles for 50% D.O.D. or 1100 cycles for 30% D.O.D.). Batteries which have reached this end of life condition may still be useful where shorter operating time is acceptable.

Figure 4. The 24V sealed deep-cycle battery
Backpack Model 12-B

Shipping: These batteries conform to the UN2800 classification as "Batteries, wet, non-spillable, electric storage". They conform to the International Air Transport Association (I.A.T.A.) Special Provision A67, classifying them as non-dangerous goods and are therefore exempt from the subject regulations for dangerous goods and are acceptable for transport on both cargo and passenger aircraft.


Battery Tips & Precautions
1. Keep the battery charged! The most frequent cause of battery failure is not recharging after each use.
2. Heat kills batteries. Avoid storage in exceedingly warm areas. Recommended operating temperatures are between 5 and 35 degrees C (maximum - 15 to 50 degrees C). The energy available on a given discharge cycle decreases at low temperatures and increases at higher than normal temperatures. Increased temperatures increase the gradual processes of very slow corrosion which normally occur in all lead acid batteries.
3. Avoid heavy vibrations or shocks, which may cause internal damage. Foam packing is cheap insurance.
4. Avoid contact with oils or solvents which may attack the battery case (ABS plastic resin). Clean with soap and water only.
5. Do not crush, incinerate or dismantle the battery. The electrolyte contains sulfurous acid which can cause serious damage to eyes and skin. Dispose of old batteries at a battery recycler.

<table>
<thead>
<tr>
<th>Life</th>
<th>Load</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 hr</td>
<td>0.60 A</td>
<td>12.0 Ah</td>
</tr>
<tr>
<td>10 hr</td>
<td>1.05 A</td>
<td>10.5 Ah</td>
</tr>
<tr>
<td>5 hr</td>
<td>1.95 A</td>
<td>9.7 Ah</td>
</tr>
<tr>
<td>1 hr</td>
<td>7.20 A</td>
<td>7.2 Ah</td>
</tr>
<tr>
<td>30 min</td>
<td>12.00 A</td>
<td>6.0 Ah</td>
</tr>
<tr>
<td>15 min</td>
<td>20.00 A</td>
<td>5.0 Ah</td>
</tr>
</tbody>
</table>

Figure 5. Relative capacity of 12Ah deep cycle battery.

<table>
<thead>
<tr>
<th>Ambient temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deg C</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>60</td>
</tr>
</tbody>
</table>

Figure 7. Effect of temperature on battery life.

<table>
<thead>
<tr>
<th>Ambient Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deg F</td>
</tr>
<tr>
<td>68</td>
</tr>
<tr>
<td>86</td>
</tr>
<tr>
<td>104</td>
</tr>
<tr>
<td>122</td>
</tr>
<tr>
<td>140</td>
</tr>
</tbody>
</table>

Figure 8. Effect of temperature on capacity.

Figure 6. Discharge curves for 12Ah and 7Ah batteries.

BATTERY SPECIFICATIONS

Rating: Batteries are rated at the current which will reduce the voltage per cell to 1.67 volts in 20 hours. The Model 12-B standard battery has a 12 amp hour rating. However its life at 100 watt continuous would be only 120 minutes. As the discharge current is increased, the efficiency and relative capacity decrease.
Battery Life: Each time you cycle a battery it loses some of its ability to take a charge. Deep cycle batteries are capable of being charged and discharged from 100 up to 1,000 times, depending on the depth of the discharge and the type of charger used. Service life and shelf life are both adversely affected by warmer temperatures.

Battery Storage: Batteries stored at room temperature will self-discharge at 3% to 6% per month. Storage temperature above 20°C should be avoided. Shelf life can be increased by storing at lower temperatures, but store at above -30°C to prevent freezing. Batteries should be fully charged before storing, and should be recharged every four months.

Effects of Temperature: The temperature at which a battery is used also affects the relative capacity of the battery. Figures 7 and 8 show that in cold weather the shocking time will be less and the battery will have less capacity.

MODEL 12-B SPECIFICATIONS

Conductivity range .......................................... 10–1,600 microSiemens/cc
Output voltage .................................................. 100–1,100 VDC in 10 volt steps
Output current .................................................. 60 Amp peak
Output pulse .................................................. 256 stored waveforms: Pulse width and frequency modulation, Gated Bursts, Pulsed DC, Smooth DC.
Pulse duration .................................................. >100 microseconds
Pulse frequency .................................................. 1Hz to 120Hz, 1,000 pulses/sec.
Output protection ............................................. Output disabled by overload.

Automatic reset by releasing anode pole switch. Overload indication LED.

Output indicator ............................................. Audio tone indicates ≥30 VDC.
Electrode test ............................................. Continuity of anode and cathode wires and switches indicated by LED.
Safety devices ............................................. Tilt switch automatic shut off, Quick release backpack buckle.

Input current ............................................. Audio to increasing pulse rate at power above 100W. (tone indicates ≥4 Amps)
Low battery .................................................. Unit automatic output shut off. Indicated by LED.

Timer .................................................. Six digit LCD display, capacity 9,999,999 sec. Magnetic reset.

Construction ............................................. Sealed water-resistant case.
Weight .................................................. 30 pounds, incl. standard battery.

STANDARD EQUIPMENT

Anode pole .................................................. 6 foot, 1 piece 1" dia. fiberglass
Curl-cord .................................................. Extends from 12" to 72"
Anode .................................................. 11" diameter aluminum ring.
Cathode .................................................. 10 foot long rat-tail.
Battery .................................................. 24 volt 12Ah sealed deep-cycle.
Battery weight .................................................. 18.5 pounds.
Battery life .................................................. 120 minutes continuous at 100 watts.
Packs frame ............................................. Coleman® reinforced nylon with straps and battery-holder.

Battery charger ............................................. BC-24PS

Backpack Model 12-B

OPTIONAL EQUIPMENT

Metering package ........................................... Output current
Alternative anodes ...................................... 6" ring, 11" diamond, or cat's whisker
Anode poles ............................................. Two-piece poles, 6' or 9'
Lightweight battery ..................................... 12.5 pounds, 7Ah
Featherweight battery .................................. 3.8 pounds, 2Ah
Electrical gloves ....................................... 10kV rated. S, M, or L
Maintenance charger ................................... Charges up to 4 batteries at once.
Conductivity meter ...................................... Measures up to 1900 microSiemens/cc
Electric Field Probe ..................................... Measures up to 10 W/in. or 2.94V/cm
Carry-case ............................................... 39" x 18" x 15", aluminum
Extension cables ........................................ 25" up to 100', with or without floats
Extension cable ........................................... "Y" configuration for two anodes
Dip nets .................................................. 12" up to 31" wide
Dip net meshes ...................................... 1/8", 1/4", 1/2", 1 7/8" meshes

See "Parts Identification" section for full details and order numbers of optional equipment.

Specifications subject to change without notice
Programable Output Waveforms for Backpack Electrofisher

For over thirty years the leader in effective, safe, and reliable products for fisheries conservation. Knowledgeable field biologists depend upon Smith-Root equipment.

14014 NE Salmon Creek Avenue
Vancouver, WA 98686
Phone: (360)573-0202 Fax: (503)286-1931
Programable Output Waveforms

Contents: Programable Output Waveforms

Introduction ................................................................................................................. B-3
What is POW and why do I need it? ........................................................................ B-3
Programable Output Waveforms ............................................................................. B-3
Setting the mode switches ...................................................................................... B-5
Waveform tables ...................................................................................................... B-6

All Smith-Root, Inc. manufactured products are covered by a one year warranty. Items manufactured by companies other than Smith-Root carry the original manufacturer's warranty.

Due to increased handling costs a minimum order amount of $25.00 is required.

Smith-Root, Inc. Electrical Field Fish Barrier systems are protected by patent. Ideas, arrangements, drawings, and specifications are the sole property of Smith-Root, Inc. and are intended for this specific catalog and shall not be used for any other purpose, without written consent of Smith-Root, Inc.

U.S. - 4,750,451  Canada - 1,304,442

Credit & Refund Policy: Customers returning equipment, in new condition, will be given credit to the applicable Visa/Master Card account within five days from the date of the return. A return authorization must accompany returns. Valid equipment returns include, but are not limited to, ordering incorrect equipment, funding deficits, and defective equipment returned for reimbursement. All returns are subject to a restocking fee and applicable shipping charges. The restocking fee is figured at 10% of the purchase price but not less than $20.00. Customers receiving equipment in damaged condition will be referred to the shipping company for insurance reimbursement.
INTRODUCTION

Your P.O.W. electrofisher incorporates the latest microcontroller technology, to give you the widest range of output waveforms available on any electrofisher. It can not only produce smooth DC output, but a whole new series of very effective and efficient pulsed waveforms. Two hundred and fifty-six waveforms are available, and custom waveforms can be programmed for your own particular conditions.

WHAT IS P.O.W. AND WHY DO I NEED IT?

P.O.W. (Programmable Output Waveforms), prevents damaged fish, increases electrofishing time per battery, and extends the range of water conductivities for electrofishing.

P.O.W. gives you complete control over how the output pulses are produced. This lets you do things like using groups of narrow pulses to induce the same physiological responses as wider more powerful pulses. You can also vary the width of the pulses as they are applied, to reduce the initial impact on the fish. This method of synthesizing waveforms makes it possible to simulate virtually any low frequency waveforms with P.O.W. Some recent research has suggested that frequencies much higher than those traditionally used in electrofishing may be more effective and less damaging still. P.O.W. supports frequencies from smooth DC to 250 pulses per second (pps). However, with some slight additional modifications to your electrofisher it will support frequencies up to 1,500 pps. This is far more than is available with electrofishing equipment supplied by other manufacturers.

P.O.W. is safer for the fish because it allows you to use narrower less damaging pulses to achieve the same results as earlier electrofishing equipment. Narrower pulses mean that you put less electrical power into the water and into the fish. Less power means less damage to the fish. It also means your batteries will last longer on a single charge. Other benefits of P.O.W. include shocking in water that overloads other electrofishers, because of the narrower pulses that can be used. This makes it possible to electrofish in waters that were too conductive before. P.O.W. does not abandon the wider pulses, they are all still available, you simply have a greater array of waveforms to choose from (256 total).

The components that allow us to offer you P.O.W. have only very recently become available. High power transistors now being made can deliver the performance necessary for P.O.W.

PROGRAMMABLE OUTPUT WAVEFORMS

By varying the width and frequency of the output pulses over time, Smith-Root electrofishers are capable of generating a wide variety of pulse waveforms. Using this pulse modulation technique we simulate the effect of more complex waveforms while reducing the drain on the power supply. Smith-Root electrofishers are programmed with a sampling of these waveforms for your use and experimentation. You will find several that will be the most effective for your particular situation. What follows is a brief explanation of how P.O.W. works. We will start by describing a standard waveform, and work up to more complex ones.
Programable Output Waveforms

STANDARD PULSE
A standard pulse is a repeating cycle of the output voltage being turned on and off. The amount of time the current is turned on is called the pulse width. The time from the start of one pulse cycle to the start of the next one is called the cycle period. The number of pulses produced in a second is the pulse frequency, and is related to the cycle period as shown in the diagram on the left.

VARYING WIDTH PULSES
Often it is desirable to change the amount of power applied to the water while electrofishing. This can be done in a variety of ways. One way is to hold the cycle period constant but change the pulse-width over time. The time it takes to go from the starting pulse-width to the ending pulse-width is called the sweep time. The average power applied to the water varies linearly with the width of the pulse. This is shown in the graph on the left, and in the diagram on the next page.

VARYING FREQUENCY PULSES
Another way to vary the average power is to hold the pulse width constant, but change the cycle period. This produces an exponential change in the applied power as the cycle time or frequency is changed. This is shown in the graph on the left, and in the diagram on the next page.

GATED BURST
By modifying the pulse cycle, we can produce a group of fast pulses followed by a short off-time. This is just as effective as a pulse with a much longer on-time. However less power is applied to the water, and less is drawn from the power source. This grouping of pulses is known as a burst. It is a product of the width of the individual pulses, the time between pulses in the burst, and the period between the bursts. These bursts are produced by feeding the pulses through a switch or gate, hence this waveform is called a gated burst. This is illustrated on the right.
**CUSTOM WAVEFORMS**

This technique can be used to produce a wide variety of waveform types. The range is limited only by the maximum pulse rate the unit can produce, and the memory needed to describe it in the computer. Any mode switch position may be made into a custom setting. This setting will then always produce the special waveform. Please contact Smith-Root to have any special waveform that you would like us to implement.

**SETTING THE MODE SWITCHES**

The table on the next page shows how to set the mode switches to produce any of the 256 available waveforms. The entries shown in bold are the settings that have always been available on earlier Smith-Root electrofishers.

After using P.O.W. for a while you will find that you have a few favorite settings. For example many people like 60Hz at 6ms, which would be setting I5. The waveforms are selected via switch settings, so they can be easily repeated by other field personnel.
### Programable Output Waveforms

#### Standard Pulses

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1Hz</td>
<td>2ms</td>
<td>3ms</td>
<td>4ms</td>
<td>6ms</td>
<td>7ms</td>
</tr>
<tr>
<td>B</td>
<td>5Hz</td>
<td>1ms</td>
<td>2ms</td>
<td>3ms</td>
<td>4ms</td>
<td>6ms</td>
</tr>
<tr>
<td>C</td>
<td>10Hz</td>
<td>500μs</td>
<td>1ms</td>
<td>2ms</td>
<td>4ms</td>
<td>6ms</td>
</tr>
<tr>
<td>D</td>
<td>15Hz</td>
<td>500μs</td>
<td>1ms</td>
<td>2ms</td>
<td>4ms</td>
<td>6ms</td>
</tr>
<tr>
<td>E</td>
<td>20Hz</td>
<td>500μs</td>
<td>1ms</td>
<td>2ms</td>
<td>4ms</td>
<td>6ms</td>
</tr>
<tr>
<td>F</td>
<td>30Hz</td>
<td>500μs</td>
<td>1ms</td>
<td>2ms</td>
<td>4ms</td>
<td>6ms</td>
</tr>
<tr>
<td>G</td>
<td>40Hz</td>
<td>500μs</td>
<td>1ms</td>
<td>2ms</td>
<td>4ms</td>
<td>6ms</td>
</tr>
<tr>
<td>H</td>
<td>50Hz</td>
<td>500μs</td>
<td>1ms</td>
<td>2ms</td>
<td>4ms</td>
<td>6ms</td>
</tr>
<tr>
<td>I</td>
<td>60Hz</td>
<td>500μs</td>
<td>1ms</td>
<td>2ms</td>
<td>4ms</td>
<td>6ms</td>
</tr>
<tr>
<td>J</td>
<td>70Hz</td>
<td>500μs</td>
<td>1ms</td>
<td>2ms</td>
<td>4ms</td>
<td>6ms</td>
</tr>
<tr>
<td>K</td>
<td>80Hz</td>
<td>500μs</td>
<td>1ms</td>
<td>2ms</td>
<td>4ms</td>
<td>6ms</td>
</tr>
<tr>
<td>L</td>
<td>90Hz</td>
<td>500μs</td>
<td>1ms</td>
<td>2ms</td>
<td>4ms</td>
<td>6ms</td>
</tr>
<tr>
<td>M</td>
<td>100Hz</td>
<td>10μs</td>
<td>500μs</td>
<td>1ms</td>
<td>2ms</td>
<td>4ms</td>
</tr>
<tr>
<td>N</td>
<td>110Hz</td>
<td>10μs</td>
<td>500μs</td>
<td>1ms</td>
<td>2ms</td>
<td>4ms</td>
</tr>
<tr>
<td>O</td>
<td>120Hz</td>
<td>10μs</td>
<td>500μs</td>
<td>1ms</td>
<td>2ms</td>
<td>3ms</td>
</tr>
</tbody>
</table>

Settings available on previous electrofishers are in **bold**.

#### Wide to Narrow Varying Width

<table>
<thead>
<tr>
<th></th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>8-0.4ms</td>
<td>15Hz</td>
<td>15Hz</td>
<td>15Hz</td>
<td>15Hz</td>
</tr>
<tr>
<td>B</td>
<td>6-0.3ms</td>
<td>15Hz</td>
<td>15Hz</td>
<td>15Hz</td>
<td>15Hz</td>
</tr>
<tr>
<td>C</td>
<td>4-0.2ms</td>
<td>15Hz</td>
<td>15Hz</td>
<td>15Hz</td>
<td>15Hz</td>
</tr>
<tr>
<td>D</td>
<td>8-0.4ms</td>
<td>30Hz</td>
<td>30Hz</td>
<td>30Hz</td>
<td>30Hz</td>
</tr>
<tr>
<td>E</td>
<td>6-0.3ms</td>
<td>30Hz</td>
<td>30Hz</td>
<td>30Hz</td>
<td>30Hz</td>
</tr>
<tr>
<td>F</td>
<td>4-0.2ms</td>
<td>30Hz</td>
<td>30Hz</td>
<td>30Hz</td>
<td>30Hz</td>
</tr>
<tr>
<td>G</td>
<td>8-0.4ms</td>
<td>45Hz</td>
<td>45Hz</td>
<td>45Hz</td>
<td>45Hz</td>
</tr>
<tr>
<td>H</td>
<td>6-0.3ms</td>
<td>45Hz</td>
<td>45Hz</td>
<td>45Hz</td>
<td>45Hz</td>
</tr>
<tr>
<td>I</td>
<td>4-0.2ms</td>
<td>45Hz</td>
<td>45Hz</td>
<td>45Hz</td>
<td>45Hz</td>
</tr>
<tr>
<td>J</td>
<td>8-0.4ms</td>
<td>60Hz</td>
<td>60Hz</td>
<td>60Hz</td>
<td>60Hz</td>
</tr>
<tr>
<td>K</td>
<td>6-0.3ms</td>
<td>60Hz</td>
<td>60Hz</td>
<td>60Hz</td>
<td>60Hz</td>
</tr>
<tr>
<td>L</td>
<td>4-0.2ms</td>
<td>60Hz</td>
<td>60Hz</td>
<td>60Hz</td>
<td>60Hz</td>
</tr>
<tr>
<td>M</td>
<td>8-0.4ms</td>
<td>80Hz</td>
<td>80Hz</td>
<td>80Hz</td>
<td>80Hz</td>
</tr>
<tr>
<td>N</td>
<td>6-0.3ms</td>
<td>80Hz</td>
<td>80Hz</td>
<td>80Hz</td>
<td>80Hz</td>
</tr>
<tr>
<td>O</td>
<td>4-0.2ms</td>
<td>80Hz</td>
<td>80Hz</td>
<td>80Hz</td>
<td>80Hz</td>
</tr>
</tbody>
</table>

#### High to Low Varying Frequency

<table>
<thead>
<tr>
<th></th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>80-8 Hz</td>
<td>1ms</td>
<td>1ms</td>
<td>1ms</td>
<td>1ms</td>
</tr>
<tr>
<td>B</td>
<td>60-6 Hz</td>
<td>1ms</td>
<td>1ms</td>
<td>1ms</td>
<td>1ms</td>
</tr>
<tr>
<td>C</td>
<td>40-4 Hz</td>
<td>1ms</td>
<td>1ms</td>
<td>1ms</td>
<td>1ms</td>
</tr>
<tr>
<td>D</td>
<td>80-8 Hz</td>
<td>2ms</td>
<td>2ms</td>
<td>2ms</td>
<td>2ms</td>
</tr>
<tr>
<td>E</td>
<td>60-6 Hz</td>
<td>2ms</td>
<td>2ms</td>
<td>2ms</td>
<td>2ms</td>
</tr>
<tr>
<td>F</td>
<td>40-4 Hz</td>
<td>2ms</td>
<td>2ms</td>
<td>2ms</td>
<td>2ms</td>
</tr>
<tr>
<td>G</td>
<td>80-8 Hz</td>
<td>4ms</td>
<td>4ms</td>
<td>4ms</td>
<td>4ms</td>
</tr>
<tr>
<td>H</td>
<td>60-6 Hz</td>
<td>4ms</td>
<td>4ms</td>
<td>4ms</td>
<td>4ms</td>
</tr>
<tr>
<td>I</td>
<td>40-4 Hz</td>
<td>4ms</td>
<td>4ms</td>
<td>4ms</td>
<td>4ms</td>
</tr>
<tr>
<td>J</td>
<td>80-8 Hz</td>
<td>6ms</td>
<td>6ms</td>
<td>6ms</td>
<td>6ms</td>
</tr>
<tr>
<td>K</td>
<td>60-6 Hz</td>
<td>6ms</td>
<td>6ms</td>
<td>6ms</td>
<td>6ms</td>
</tr>
<tr>
<td>L</td>
<td>40-4 Hz</td>
<td>6ms</td>
<td>6ms</td>
<td>6ms</td>
<td>6ms</td>
</tr>
<tr>
<td>M</td>
<td>80-8 Hz</td>
<td>8ms</td>
<td>8ms</td>
<td>8ms</td>
<td>8ms</td>
</tr>
<tr>
<td>N</td>
<td>60-6 Hz</td>
<td>8ms</td>
<td>8ms</td>
<td>8ms</td>
<td>8ms</td>
</tr>
<tr>
<td>O</td>
<td>40-4 Hz</td>
<td>8ms</td>
<td>8ms</td>
<td>8ms</td>
<td>8ms</td>
</tr>
</tbody>
</table>

All varying waveforms start at their beginning values, sweep to their ending values in the set amount of time, and then remain at the final value until the output is switched off and then on again.

#### Gated Bursts 15Hz

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Gated Bursts 30Hz

<table>
<thead>
<tr>
<th></th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>DC</td>
</tr>
</tbody>
</table>

All Gated Bursts show the number of pulses, 900μs wide, 900μs between.
Electrofishing Safety & Principles

For over thirty years the leader in effective, safe, and reliable products for fisheries conservation. Knowledgeable field biologists depend upon Smith-Root equipment.

14014 NE Salmon Creek Avenue
Vancouver, WA 98686
Phone: (360)573-0202 Fax: (503)286-1931
Contents: Electrofishing Safety & Principles

Electrofishing Safety

Safe fishing ............................................................................................................................................. C-3
Preventing electrical shock .................................................................................................................... C-4
Planning for safety .................................................................................................................................. C-4
Backpack safety ...................................................................................................................................... C-5
Boat safety .............................................................................................................................................. C-5
Do's & Don'ts ......................................................................................................................................... C-5
Quick release system ............................................................................................................................ C-6

Electrofishing Principles

Introduction to electrofishing ............................................................................................................... C-7
Types of current ..................................................................................................................................... C-9
Electrode design .................................................................................................................................... C-10
Field techniques .................................................................................................................................... C-14
References ............................................................................................................................................... C-15

All Smith-Root, Inc. manufactured products are covered by a one year warranty. Items manufactured by companies other than Smith-Root carry the original manufacturer's warranty.

Due to increased handling costs a minimum order amount of $25.00 is required.

Smith-Root, Inc. Electrical Field Fish Barrier systems are protected by patent. Ideas, arrangements, drawings, and specifications are the sole property of Smith-Root, Inc. and are intended for this specific catalog and shall not be used for any other purpose, without written consent of Smith-Root, Inc.

U.S. - 4,750,451 Canada - 1,304,442

Credit & Refund Policy: Customers returning equipment, in new condition, will be given credit to the applicable VISA/Master Card account within five days from the date of the return. A return authorization must accompany returns. Valid equipment returns include, but are not limited to, ordering incorrect equipment, funding deficits, and defective equipment returned for reimbursement. All returns are subject to a restocking fee and applicable shipping charges. The restocking fee is figured at 10% of the purchase price but not less than $20.00. Customers receiving equipment in damaged condition will be referred to the shipping company for insurance reimbursement.
ELECTROFISHING SAFETY

SAFE FISHING

Electrofishing equipment uses voltages and currents that can be lethal to humans. The operators must always keep in mind that the chance of receiving an electrical shock is multiplied in or near water. Using an electrofisher is like using a firearm: if used properly and with good judgment it is perfectly safe; lose respect for it and you can lose your life!

Electrical equipment used in a moist field environment is always subject to deterioration that could lead to dangerous electrical shock. Field equipment is also subjected to vibration and impact during transporting and while in operation. Often equipment shared by different crews does not receive proper maintenance or a complete checkout.

Follow the safety guidelines, and use good common sense to handle unforeseen circumstances.

All personnel involved in electrofishing should be taught the fundamentals of electricity, and have an understanding of the safety requirements.

The most important factor in electrofishing efficiency and safety is the training and experience of the crew. At least two members of the crew should be qualified to administer cardiopulmonary resuscitation. As opportunities arise, all crew members should attend a course in basic life-support training.

ELECTRICAL SHOCK

It is the current that passes through the human body that does the damage. The voltage is relevant, because it is the force that "pushes" the current through the body. Experiments show that 20 to 500 Hz AC current is more dangerous than DC, or higher frequencies of AC.

The voltages used by electrofishing gear cause death by one of three means:

Ventricular Fibrillation
Ventricular fibrillation is uncoordinated contraction of the muscles of the heart. The heart quivers rather than beats. Electrical current through the chest can cause this condition. Once a person goes into ventricular fibrillation, the only way to stop the quivering is to use a defibrillator that applies a pulse shock to the chest to restore heart rhythm. Cardiopulmonary resuscitation may help to keep a victim alive until he can be defibrillated.

Respiratory Arrest
The respiratory center is at the base of the skull. Thus, shocks to the head can cause the breathing to stop. Artificial respiration by the mouth-to-mouth method should be used in this case.

Asphyxia
Asphyxia is caused by contraction of the chest muscles.
ELECTROFISHING SAFELY

When a current is above a certain level, a person cannot let go of an electrically hot wire. Currents above this level may not cause ventricular fibrillation, but may be enough to cause contraction of the chest muscles. If the current is not stopped, or the victim is not removed from the point of electrical contact, asphyxiation will result. Artificial respiration or cardiopulmonary resuscitation may be necessary.

PREVENTING ELECTRICAL SHOCK

Electricity needs to have a complete electrical circuit in order for current to flow. The only way you can get shocked is if you become the electrical conductor to complete the circuit. The current flows from the cathode to the anode through the water. The water is the electrical conductor. If you touched both the anode and the cathode you would become an electrical conductor and complete the circuit path and get a severe electrical shock.

WARNING: Touching any electrode is not recommended. Unless all conductive objects you come into contact with are connected to the same electrode, you will be shocked to find a current path that is not obvious, e.g., the water, or the boat.

Preventing electrical shock means preventing electrical current from entering and flowing through parts of the body. The skin is a partial but variable barrier, because it offers resistance to the passage of electrical current. Tough skin has more resistance than tender skin, and dry skin more than wet skin. But tough dry skin alone does not offer enough protection for electrofishing. Rubber lineman’s gloves, rated 5,000V minimum should always be worn.

Even while wearing rubber gloves and waders, never touch an electrode while the circuit is energized.

Do not work on the electrical system when the generator is running. Do not enter the water while the current is on during boom shocking operations.

A severe electrical shock from electrofishing gear may result in the need for artificial respiration; therefore it is imperative that no one ever works alone.

To prevent electrical shock all electrical equipment should be carefully inspected before each field operation. With all electrical equipment in good operating condition, and all insulation, junction boxes, bonding, and connections intact, there is much less danger of receiving an electrical shock.

PLANNING FOR SAFETY

1. Never electrofish alone! A minimum of two properly trained people are required for every electrofishing crew.
2. A crew leader shall be appointed for all electrofishing. The crew leader is responsible for the safety of the crew, and the enforcement of all safety regulations.
3. The crew leader, and at least one additional crew member, shall receive training in cardiopulmonary resuscitation (CPR), and First Aid.
4. All electrofishing personnel shall receive training in fundamentals of electricity and safety.
5. Check your electrofisher before each operation, to ensure that it is in good working order.
6. Turn off your electrofisher before making any connections or part replacements.
7. When not in use, and when transporting the unit, disconnect the power supply.
8. Check that the electrofisher gives an audible signal when there is voltage present at the anode.
9. Do not make any field modifications to your electrofisher without written approval from the manufacturer or a qualified electrical engineer.
10. Use only dip nets with insulated handles.
11. Wear personnel flotation devices.
12. Wear lineman’s gloves, rated 5,000V minimum.

13. Never reach into the water in vicinity of an electrode, even if rubber gloves are being worn.

14. Take frequent breaks. Stress and fatigue endanger the crew.

15. Practice the quick release system as shown on page C-6.

**BACKPACK SAFETY**

1. Before each operation, check that the frame emergency release is in working order and check that the tilt switch shuts off power if the unit is tipped more than 45°. Also, test the immersion shut-off switch with a damp towel or sponge.

2. Wear hip boots or chest-high waders, with non-skid soles.

3. Wear polarized sunglasses to help you detect sub-surface hazards and obstacles. Beware of turbid water that can hide unseen sub-surface obstacles and sudden drop-offs.

4. Shut off your electrofisher before entering or leaving a stream.

5. Do not operate an anode pole when carrying a backpack unit weighing more than 20 pounds when in hazardous conditions.

6. If you get water in boots, waders, or gloves, stop work immediately and get dry clothing.

7. Operate slowly and carefully. Footing in most streams is poor, and most falls often occur when operators are hurrying.

8. Use only a CSA/UL approved anode pole.

**BOAT SAFETY**

1. Ground the generator to the boat hull.

2. Be sure that all the metal parts on the boat are bonded to each other electrically.

3. Run all cables through electrical conduit, or use a heavy-duty rubber-covered cord recommended for wet locations.

4. Make all electrical connections in water-tight junction boxes.

5. Each dip netter should have his own foot switch to control the output. The switch should be wired in series with the emergency off switch of the boat operator.

6. When wading with a boat, even in shallow water, chest waders should be worn. An operator may trip and end up in a kneeling or sitting position in the water and receive a shock.

7. Any crew members who control the power switch must be constantly aware of the netters in the electrical field.

**DO’S AND DON’TS**

**Do’s:**

1. Always be sure that all personnel are clear of the electrodes before turning on the power.

2. Know how to administer first aid treatment for electrical shock.

3. Wear flotation devices.

4. Have electrical circuits checked only by qualified technicians.

5. Disconnect the power supply when the electrofisher is not in use.

**Don’ts:**

1. Don’t electrofish alone!

2. Don’t continue to electrofish if your boots or gloves get wet inside.

3. Don’t operate an electrofisher if you have had any prior heart ailments.

4. Don’t operate generators without covers or screens.

5. Don’t operate generators without a spark arrester.

6. Don’t use electrofisher if Voltage Range knob is loose or missing.

**GLOVE MAINTENANCE**

1. Gloves should be tested a minimum of every six months.

2. The tests shall consist of an air inflation to check for leaks, visual inspection while inflated, and then a routine dielectric test in accordance with the EN and ASTM standard for the class being tested.
QUICK RELEASE SYSTEM

It may be necessary in some circumstances to remove the electrofisher backpack quickly.

_This should only be done in an emergency situation! The backpack may be damaged from contact with the ground and/or water when using the quick release system._

The following procedure illustrates how the quick release system is designed to work.

1. Squeeze the release tabs on hip belt buckle to remove hip belt.

2. Grasp the Orange Safety Release Tab on either chest strap.

3. Pull tab up and away from your body. This will allow the pack to fall away from you very quickly!

4. Move away from pack as it falls.
ELECTROFISHING PRINCIPLES

INTRODUCTION TO ELECTROFISHING
For many years it has been known that fish react to electric current passed through water. Electricity was first used for fishing in 1863 when a British patent was granted. Major efforts to apply electricity as a tool in fisheries management did not occur until after 1950. Since then detailed studies have been made on the physiological effects of electricity on aquatic organisms.

RESPONSE OF FISH TO ELECTRICITY
To collect fish by electrical means we must create an electrified zone of sufficient amplitude to stun fish. In the basic electrofishing circuit, shown in Figure 1, a current is passed between submerged electrodes. A fish between these electrodes forms part of a closed circuit and some current flows through its body. The effectiveness of the electrofisher is affected by nine factors: voltage, electrode shape, water conductivity, water temperature, conductivity of the stream bed, fish's distance, size, species, and time in the field. If these environmental factors are too far out of line, poor electrofishing will result. To some extent, the effects of changes in water conductivity may be compensated for by changing the output voltage.

WATER CONDUCTIVITY
The conductivity of the water and that of the fish's flesh are the factors that affect electrofishing most. The conductivity of water depends on the quantity of dissolved salts and minerals in the water. The conductivity of potable waters in the United States ranges from 20 to 2,000 microSiemens/cc. Sufficient current at realistic power levels will flow through water in this range to electrofish successfully. Figure 2 illustrates the field patterns caused by the presence of a fish in water. In (a) no distortion is caused by the presence of the fish. In low conductivity water, (b), the distortion of the electric field is such that the voltage near the fish is less than it was before the fish was present. The reverse is true in (c) where the water conductivity is more than that of the fish. In this case the distortion is caused by the current concentrating in the water surrounding the fish. In both (b) and (c) not as much power is transferred into the fish's body as in (a).

Figure 1.
The basic electrofishing circuit.

Figure 2.
Electric field patterns caused by fish.
LOW CONDUCTIVITY WATER

Distilled water is a very good insulator. It has a conductivity range of 0.5 to 5.0 microSiemens/cc. If a normal voltage is applied in distilled water, very little current will flow. Power flow is too low to be effective for electrofishing.

The current passing through a fish decreases as the power flow decreases. To get the same response from fish, the current can be maintained by either increasing the voltage, or by keeping the resistance low.

If a higher voltage is used, up to 1,200 volts may be necessary. High voltages create three problems, special electrical equipment is required, safety is reduced for the operators, and conditions are lethal for fish close to electrodes.

The resistance can be kept low by increasing the size of the electrodes. The only limitations to this are the availability of larger electrodes, and the weight of electrode that can be handled by the operator.

HIGH CONDUCTIVITY WATER

High conductivity is over 2,000 microSiemens/cc. If a high voltage is applied, most current will flow easily through the water and the fish will hardly be affected. The electric current follows the path of least resistance and bypasses the fish completely. Therefore use low voltages and high currents. Currents as high as 60 amps are common, the limiting factor being the rating of the power-supply.

Some brackish water and industrial waste water have conductivities over 10,000 microSiemens/cc. Here smaller power-supplies are unable to deliver enough power to stun fish. Waters in this range can only be electrofished effectively with the larger model GPPs.

The Smith-Root 7.5 GPP outputs 62 amps through 8 gauge stranded cables. This unit can stun large fish in the interface between fresh and salt water. For example, Striped Bass can be stunned for taking brood stock.

Theoretically high conductivity could be dealt with by using smaller electrodes, but this would reduce the range and also create damaging current densities near the anode.

FISH CONDUCTIVITY

A fish will receive the maximum shock through its body when the conductivity of the water is the same as the conductivity of the fish's flesh. Unfortunately, this is rarely the case.

Fish flesh conductivity ranges from 500 to 1,500 microSiemens/cc. Each species has a different conductivity.

This affects their susceptibility to electric current.

Conductivities for some fish species are:

- Trout 1,220 microSiemens/cc
- Perch 1,089 microSiemens/cc
- Carp 870 microSiemens/cc
- Grudgeon 814 microSiemens/cc

E. Halsband - Vilbert 1967

FISH SIZE

Among fish of the same species, the larger fish are more sensitive to electrical currents. Fish absorb power as a function of body surface area. This is important to remember if you are shocking for small fish and large fish are also present. The large fish are going to receive a much greater shock than the small fish.

TEMPERATURE

Water conductivity and effective fish conductivity increase with higher temperature.

Conductivities reported for Carp:

- 5° 372 microSiemens/cc
- 10° 543 microSiemens/cc
- 15° 714 microSiemens/cc
- 20° 1,026 microSiemens/cc
- 25° 1,969 microSiemens/cc

Whitney and Pierce 1957

SUBSTRATE

Certain bottom substrates will conduct electrical current. These weaken the electric field in the water, making fish capture less effective.

ADJUSTING THE VOLTAGE

By adjusting the output voltage, the effects of the water's conductivity on electrofishing can be reduced.

The current flowing through the water is directly related to the voltage applied. The higher the voltage, the greater the current will be.
ELECTROFISHING PRINCIPLES

When adjusting the output voltage the major consideration is the power being used. This is especially true for battery powered electrofishers. Power is equal to the voltage multiplied by the current. When figuring the power for an electrofisher, the fact that it is usually putting out pulsed DC must be taken into consideration. The instantaneous power during a pulse may be quite high, but if the electrofisher is only producing pulses at a 25% duty cycle, the average power would be approximately 25% of the instantaneous power.

TYPES OF CURRENT

ALTERNATING CURRENT

Alternating Current (AC) is an electrical current in which the direction of current flow reverses a number of times per second. In an AC field, the fish takes a position transverse to the electrical field lines and attempts to face the anode and cathode successively, in rhythm with the AC cycle. When the field strength increases, tetany occurs, and the fish is stunned. Strong contractions of the body muscles make the fish feel rigid. At high voltages, the larger fish may be killed, the muscular contractions being so severe that vertebrae are fractured and the brain damaged. Hence AC electrofishing is only successful with small fish in low conductivity water.

DIRECT CURRENT

Direct Current (DC) is the term given to electrical current that flows only in one direction. The current flows from the negative electrode (cathode) to the positive electrode (anode). The reaction of fish to direct current is quite different from their reaction to alternating current. The first reaction of the fish is to turn toward the anode and start to swim toward it until it reaches an electrical field strong enough to stun it. Being stunned is called galvanonarcosis. The severe muscle contractions caused by AC do not occur, and the fish recover much faster. Mortality rate is much lower with direct current.

PULSED DIRECT CURRENT

Even greater anode attraction is possible with pulsed direct current. Pulsed direct current is made by interrupting steady DC with an electronically controlled switch. The switch gives several on-off pulses per second. The number of pulses per second (pulse frequency) and the on time (pulse width) have different effects on different species of fish. In a pulsed DC field a fish's body flexes with each pulse, and returns to normal between pulses. This flexing and straightening accentuates the involuntary swimming towards the anode, called galvanotaxis.

Smith-Root Programmable Output Waveforms give you complete control over your electrofisher output. This patented method of synthesizing waveforms makes it possible to produce virtually any waveform, so you can select the one that is safest for the fish. POW allows you to create narrow pulses to achieve the same results as wide pulses. Narrower pulses put less power into the water. This has three benefits: you have less chance of damage to the fish, your battery or fuel lasts longer, and you can work in very conductive water that overloads conventional electrofishers.

RESPONSE OF FISH TO DC FIELDS

An electric field in water can be considered to have three separate areas. The outer peripheral area is a weak field that the fish is indifferent to. The next area, closer to the electrodes, has a stronger electrical field, but not enough to stun the fish. In this area, the involuntary swimming action will occur and the fish will swim towards the anode. The innermost area has the strongest electrical field, and the fish within it are immobilized.

Zone of Indifference

When electrofishing first starts fish are usually hiding up to three meters away, so high power is required to attract them out of hiding. But as the fish nears the anode, high power can injure it.
Zone of Potential Fish Injury

Fish close to the anode receive a very high head-to-tail voltage. Most fish injuries occur within half a meter from the anode. This is called the Zone of potential fish injury. We can minimize the injury by reducing the time the electricity is turned on.

Duty-Cycle

Duty-cycle is the percent of on-time. It is a product of the pulse width and the pulse frequency. The duty-cycle can be lowered in three ways: by reducing the pulse width, by reducing the pulse frequency, or by using gated bursts, where the power is off for a period between each burst of pulses. Fish close to an anode with a low duty-cycle are far less likely to be injured than with a high duty-cycle.

ELECTRODE DESIGN

The way in which voltage and current distribute around electrofisher electrodes is complex. Figure 4 shows the field pattern created by a pair of closely spaced ring electrodes, and the voltage gradient between them. Note that the current density and voltage gradient are highest near the electrodes.

The dimensions of the electrodes are very important in determining the voltage distribution around electrofisher electrodes. Figure 5 compares a 10cm and a 20cm ring anode carrying 200 volts in open water. The cathode dimension is considered to be infinite. Note that the 20cm anode reaches out much...
ELECTROFISHING PRINCIPLES

Further, producing a 33 volt potential at 1.2 meter. But the 10cm anode produces the same potential at only 0.6 meter from the electrode. Figure 6 further illustrates the effect of electrode diameter. The voltage is applied head-to-tail to a 20cm long fish. The applied voltage is 200 volts with 10cm and 20cm diameter ring-electrodes. Note that the 20cm electrode reaches out farther, producing 7 volts head-to-tail between 1.0 and 1.2 meter from the electrode; as opposed to only 4 volts for the smaller electrode at the same distance. Note also that the voltage the fish receives closer to the electrode is less for the larger electrode (100 volts instead of 144 volts). Larger electrode thus offers two advantages: greater range, and lower maximum gradient. One drawback is that a larger electrode also has greater circuit loading, and thus draws more current for the same voltage (twice as much for the double size electrode). Thus, a larger electrode requires a larger generator. This dictates a practical upper limit on electrode size for a given generator and water conductivity. Except for this limitation, the larger the electrode, the better the fishing effectiveness and the easier it is on the fish.

Figure 7 shows that larger electrodes increase the fish collection area. The shaded areas have a voltage gradient between 0.12 and 1.2 volts per cm, and are suitable for electrofishing. The applied voltage is 300 volts.

ELECTRODE BEHAVIOR

1. Larger electrodes have lower resistance, need more current at given voltage, reach out farther, and have lower maximum voltage gradient.
ELECTROFISHING PRINCIPLES

The required voltage is reduced by diminishing the resistance of the cathode field. This compensates for the reduced resistance so that the current does not vary. The power consumption is directly proportional to the voltage used.

One advantage of a large cathode is that the risk of accidental electrocution is much reduced. A large cathode has very low potential with respect to the soil and the water around it. The resistance between the cathode and the water is halved each time the surface of the cathode is doubled. For example, a 100 square foot cathode would need another 100 square foot added to pass from 9 to 4.5 ohm. However a cathode larger than 100 square feet would be inconvenient to handle for shore-side electrofishing.

Figure 9 compares small and a large cathodes. With a standard grid cathode, the anode voltage falls distinctly from 324 to 265 volts when using two anodes. However with a very large wire netting cathode efficiency falls only slightly from 324 to 302 volts when using two anodes.

For shore-side operations, the cathode surface presents the least resistance when it is divided into several parts placed several meters apart. An electrode is more effective when its form is least concentrated. For example, a 3 inch strip is more effective than a square of 6 inch.

CATHODES

In electrofishing it is desirable to have a high voltage gradient around the anode, and a low voltage gradient around the cathode. Figure 8 shows variation of voltage, as a function of the distance from the fishing anode, for three types of cathode. It shows that it is advantageous to have the potential of the water as near as possible to that of the cathode.
ELECTROFISHING PRINCIPLES

Figure 10 illustrates the variation in both voltage and gradient between the electrodes. Whenever possible, the cathode should be placed in parts of the stream that you do not wish to fish, or even in parts completely separated from the stream itself. The anode should never be allowed to come close to where the cathode is located.

Boat Cathodes

Many aluminum electrofishing boats use the boat hull as the cathode and the boom electrodes as the anode. This is perfectly safe as long as you never come in contact with the anode and complete the electrical circuit. The National Safety Council in their data sheet #1-696-85 does not recommend using the boat hull as the cathode, but we have yet to hear of any accidents occurring because of it.

Figure 11 shows a Smith-Root tote barge designed for stream wading operations. Note the large cathode plate attached to the bottom of the fiberglass hull. The anode is a pair of ring electrodes about 28cm (11") in diameter mounted on fiberglass poles. With this arrangement, the resistance of the anode pair is four times the cathode resistance. Thus, four times as much voltage appears in the anode field as in the cathode field, and consequently 80% of the applied voltage appears at each electrode.

The situation could be further improved by enlarging the cathode, but a point of diminishing returns is reached. Doubling the cathode size would halve the cathode resistance and give an 8 to 1 ratio between anode and cathode resistance. Now 88% of the voltage would appear at the anode. This is only an 8% improvement, and is not worth the additional physical problems associated with the larger cathode.

The SR-6 field tested with two 28cm anodes and a voltage of 240 volts, showed good fishing effectiveness in 400 microSiemens/cc conductivity with a current of 3 to 4 amperes. In lower conductivities of 40 microSiemens/cc, a current of 1 to 1.5 amp is effective. This data may serve as a useful benchmark to judge whether a unit is operating under conditions such that fish should be caught. If the electrical performance is close to this reference point, and fish are not being caught, it is safe to conclude there are few fish in the area.

<table>
<thead>
<tr>
<th>Standard 0.5m² grid cathode</th>
<th>Large wire-netting cathode</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. one anode</td>
<td>b. two anodes</td>
</tr>
<tr>
<td>Resistance ohms</td>
<td></td>
</tr>
<tr>
<td>of cathode</td>
<td></td>
</tr>
<tr>
<td>of anode field</td>
<td></td>
</tr>
<tr>
<td>between anode and cathode</td>
<td></td>
</tr>
<tr>
<td>Potential difference volts</td>
<td></td>
</tr>
<tr>
<td>between cathode and water</td>
<td></td>
</tr>
<tr>
<td>between anode and water</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td></td>
</tr>
<tr>
<td>Current amps</td>
<td>3.6</td>
</tr>
<tr>
<td>Power kilowatts</td>
<td>1.62</td>
</tr>
</tbody>
</table>

Resistivity of the water in all cases is 143 ohm/cm

Figure 9. Comparison of two sizes of cathode.

Figure 11. Bottom mounted cathode plate on SR-6.
FIELD TECHNIQUES
An operator engaged in electrofishing must wade or float, depending upon the depth and swiftness of the water.

WADING
In shallow slow-moving waters the operators can wade and probe the anode into likely fish habitat. Wading upstream eliminates the effects of turbidity caused by bottom sediment. Furthermore, if collections are for food habitat study, stunned prey are not swept downstream and consumed by predators. Fish that manage to escape are often captured a short distance downstream. Closing a stream with seine nets at each end of the study area helps prevent the loss of stunned and frightened fish.

BOATS
Boat electrofishers are used in lakes and in streams that are too deep or swift to wade. Boats have the advantage of being able to carry large generators and holding tanks for the stunned fish. Electrofishing boats typically have two insulated booms extending from the bow. From the end of the booms electrodes hang into the water. Usually one boom is used as the anode and the other as the cathode. The boat operator guides the boat while the electrofishing crew activates the electrofisher when approaching likely habitat.

NIGHT FISHING
Electrofishing at night with lights is five to ten times more effective than daytime fishing, especially in lakes. In streams the reflection of the spotlight on the ruffled surface makes the fish difficult to see. Boats have flood lights on the bow to attract the fish and to help locate stunned fish.

SURPRISE
Collecting can be enhanced by introducing the element of surprise through intermittent fishing. The intensity of the anode’s peripheral field often frightens fish, causing them to bolt and hide. Do not work with the power on continuously, but turn it on only in likely habitats. Fish can be enticed from under areas of heavy cover or ice by inserting a portable anode, turning the power on, and withdrawing the anode slowly and smoothly. Fish will follow the anode, under the influence of galvanotaxis, into the open where they can be netted.

CLARITY AND DEPTH
Clarity of the water limits the ease of capturing fish. The length of the dip net handles and the visibility of the fish limit the depth of effective electrofishing. In general, waters over ten feet deep cannot be sampled effectively. For daytime fishing polarized sunglasses help in locating stunned fish.

VEGETATION
Aquatic vegetation grows better from certain substrates and can hinder electrofishing by fouling electrodes and entangling stunned fish.

WATER VELOCITY
Electrofishing in flowing water is not as effective as in still water, since fish are swept away from the electric field and netting is more difficult. Also, it is more difficult to see a fish in fast flowing water, and operators can lose their footing. Flows greater than 5 feet per second usually produce poor electrofishing efficiencies.
REFERENCES

The following are books, research papers, and other references on various aspects of electrofishing. The ideas and findings presented in them form the basis for much of the current practice in electrofishing.


Parts Identification for Backpack Electrofisher

For over thirty years the leader in effective, safe, and reliable products for fisheries conservation. Knowledgeable field biologists depend upon Smith-Root equipment.
Parts Identification

Contents

PARTS IDENTIFICATION

Back ........................................................................................................ D-3
Right ...................................................................................................... D-4
Left ....................................................................................................... D-5
Anode poles ....................................................................................... D-6
Handles ............................................................................................... D-7
Extention cords .................................................................................. D-8
Battery chargers ............................................................................... D-9
Carry case .......................................................................................... D-10
Dip net & poles .................................................................................. D-11
Dip net mesh ....................................................................................... D-12

All Smith-Root, Inc. manufactured products are covered by a one year warranty. Items manufactured by companies other than Smith-Root carry the original manufactures warranty.

Due to increased handling costs a minimum order amount of $25.00 is required.

Smith-Root, Inc. Electrical Field Fish Barrier systems are protected by patent. Ideas, arrangements, drawings, and specifications are the sole property of Smith-Root, Inc. and are intended for this specific catalog and shall not be used for any other purpose, without written consent of Smith-Root, Inc.

U.S. - 4,750,451  Canada - 1,304,442

Credit & Refund Policy: Customers returning equipment, in new condition, will be given credit to the applicable VISA/Master Card account within five days from the date of the return. A return authorization must accompany returns. Valid equipment returns include, but are not limited to, ordering incorrect equipment, funding deficits, and defective equipment returned for reimbursement. All returns are subject to a restocking fee and applicable shipping charges. The restocking fee is figured at 10% of the purchase price but not less than $20.00. Customers receiving equipment in damaged condition will be referred to the shipping company for insurance reimbursement.
<table>
<thead>
<tr>
<th>Item</th>
<th>Line#</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1542</td>
<td>Packframe</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3445</td>
<td>Packboard for Model 12-B</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2583</td>
<td>Model 12-B box</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3458</td>
<td>Model 12-B front label</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>0004</td>
<td>Four-pin environmental circular receptacle</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>4986</td>
<td>Anode/Cathode label</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>2113</td>
<td>Mesh back-band</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>3601</td>
<td>Battery connector assembly w/plug &amp; liquid-tight connector</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>1522</td>
<td>Liquid-tight connector</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>5107</td>
<td>Optional digital output current meter</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>5051</td>
<td>Optional flashing strobe light</td>
<td>1</td>
</tr>
</tbody>
</table>
### Parts Identification

<table>
<thead>
<tr>
<th>Item</th>
<th>Line#</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3497</td>
<td>Electrofisher box assembly</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1144</td>
<td>Piezo buzzer</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3462</td>
<td>Model 12 ON/OFF label</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1157</td>
<td>25 amp circuit breaker</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>4726</td>
<td>Battery box</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>3935</td>
<td>Battery strap</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>2595</td>
<td>12 amp-hour 24V battery pack</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>3298</td>
<td>7 amp-hour 24V battery pack</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>4380</td>
<td>2 amp-hour 24V battery pack</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>4988</td>
<td>Battery Pads</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>2112</td>
<td>Padded waist belt</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>2111</td>
<td>Shoulder straps (pair)</td>
<td>1</td>
</tr>
<tr>
<td>Item</td>
<td>Line#</td>
<td>Description</td>
<td>Qty</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>------------------------------------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>1</td>
<td>4987</td>
<td>Status LED table label</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1078</td>
<td>Elapsed shocking time seconds counter</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3947</td>
<td>Pointer knob 1/8&quot; shaft</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1141</td>
<td>Pointer knob, shockers</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>4038</td>
<td>Model 12 POW control label</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>3497</td>
<td>Electrofisher box assembly</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>2418</td>
<td>Reset magnet for elapsed shocking time seconds counter</td>
<td>1</td>
</tr>
</tbody>
</table>
### Parts Identification

<table>
<thead>
<tr>
<th>Item</th>
<th>Line#</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1046</td>
<td>Two-piece 6’ pole, cord, 11” ring</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1045</td>
<td>Two-piece 9’ pole, cord, 11” ring</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1047</td>
<td>One-piece 6’ pole, cord, 11” ring</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3284</td>
<td>Six-inch anode ring</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>3297</td>
<td>Eleven-inch ring (standard)</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>3980</td>
<td>Eleven-inch diamond anode</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>3939</td>
<td>Cat’s whisker anode</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>2885</td>
<td>Rat tail pull-behind cathode</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>2960</td>
<td>Trigger snap for strain relief of cathode</td>
<td>1</td>
</tr>
<tr>
<td>Item</td>
<td>Line#</td>
<td>Description</td>
<td>Qty</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>-------------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>1</td>
<td>3981</td>
<td>Molded handle for reed switch</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1703</td>
<td>Reed switch</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3065</td>
<td>Round rod magnet</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3982</td>
<td>Molded handle for magnet</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1523</td>
<td>Liquid-tight connector</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>1663</td>
<td>Coil cord, 14&quot;</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>1019</td>
<td>4-pin plug</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>3295</td>
<td>Complete replacement coil-cord assembly</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>3412</td>
<td>&quot;O&quot; ring seal for two-piece pole (min. of 2*)</td>
<td>2</td>
</tr>
</tbody>
</table>

*WARNING there is a safety hazard if the "O" rings are missing or broken in a two-piece pole, so keep two extra "O" rings on hand.
Parts Identification

<table>
<thead>
<tr>
<th>Line#</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>3296</td>
<td>ACE-25 Anode/cathode extension cable, 25' with belt</td>
<td>1</td>
</tr>
<tr>
<td>4071</td>
<td>ACE-25F Anode/cathode extension cable, 25' with belt and floats</td>
<td>1</td>
</tr>
<tr>
<td>4444</td>
<td>ACE-25-2 Anode/cathode extension cable, “Y” configuration for two anodes, 25' with belt</td>
<td>1</td>
</tr>
<tr>
<td>4566</td>
<td>Additional cable, 100' max</td>
<td>1</td>
</tr>
</tbody>
</table>
**Parts Identification**

**BC-24PS Battery charger**

Supplied with every Model 12-B

<table>
<thead>
<tr>
<th>Line#</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>4954 BC-24PS</td>
<td>Battery charger for 24 volt batteries</td>
<td>1</td>
</tr>
</tbody>
</table>

**MC-24 Maintenance charger and condition tester**

Optional Extra

<table>
<thead>
<tr>
<th>Line#</th>
<th>Description</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>3879 MC-24</td>
<td>Maintenance charger and condition tester for 24 volt batteries</td>
<td>1</td>
</tr>
</tbody>
</table>
Parts Identification

FRONT VIEW

TOP VIEW
with lid removed

Line# Description Qty
2999 ACC-87 Aluminum carry-case. 3'-3"L x 1'-6"W x 1'-3"H, plus handles. Carries any Smith-Root backpack electrofishe and a #1046 two-piece 6 foot anode pole. (Optional Extra) ................................. 1
All the dip nets feature chaff-protection over the bag-to-hoop lacing.

Tank Dip Net TDN-SC has square corners for easy removal of fish from square-shaped tanks.

MDD Tear Drop and Trapezoid Dip Nets fit your choice of fiberglass poles DNII which must be purchased separately.

Heavy Duty HDD and Super Duty Dip Nets SDD are ideal for larger fish. Quick-release couplings attach a 1.5" diameter fiberglass pole that is rated for 80 lbs.

<table>
<thead>
<tr>
<th>Order Number</th>
<th>Description</th>
<th>Order Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016 TDN-SC</td>
<td>Tank Dip Net, Square Corner 12&quot;W x 8&quot;L x 4&quot;D, 1/8&quot; mesh, with 18&quot;x 1&quot; dia handle</td>
<td>2074 DNH-6-1</td>
<td>Dip Net Handle 6' long, one 72&quot; section, fiberglass, 1&quot; dia.</td>
</tr>
<tr>
<td>4510 MDD-TD1/8&quot;</td>
<td>Tear-Drop Dip net 12&quot;W x 18&quot;L x 8&quot;D, 1/8&quot; mesh, no handle</td>
<td>2015 DNH-6-2</td>
<td>Dip Net Handle 6' long, two 36&quot; sections, fiberglass, 1&quot; dia.</td>
</tr>
<tr>
<td>2026 MDD-TD1/4&quot;</td>
<td>Tear-Drop Dip net 12&quot;W x 18&quot;L x 8&quot;D, 1/4&quot; mesh, no handle</td>
<td>3294 DNH-9-2</td>
<td>Dip Net Handle 9' long, two 54&quot; sections, fiberglass, 1&quot; dia.</td>
</tr>
<tr>
<td>4424 MDD-TZ 1/8&quot;</td>
<td>Trapezoid Dip net, 13&quot;W x 15&quot;L x 8&quot;D, 1/8&quot; mesh, no handle</td>
<td>1378 HDD-10</td>
<td>Heavy Duty Dip net, 17&quot;L x 17&quot;W x 12&quot;D, 1/2&quot; mesh, with 8&quot; x 1.25&quot; dia fiberglass handle</td>
</tr>
<tr>
<td>5094 MDD-TZ 1/4&quot;</td>
<td>Trapezoid Dip net, 13&quot;W x 15&quot;L x 8&quot;D, 1/4&quot; mesh, no handle</td>
<td>3091 SDD-11</td>
<td>Super Duty Dip net, 29&quot;L x 31&quot;W x 36&quot;D, 1-7/8&quot; mesh, with 8&quot; x 1.25&quot; dia fiberglass handle</td>
</tr>
</tbody>
</table>
**Dip Net Sizes**

**DIP NET MESH SIZES** Shown actual size

1 7/8" mesh on Super Duty Dip Net SDD-11

1/2" mesh on heavy duty dip net HDD-10.

1/4" mesh available as an option only on teardrop net MDD-TD, and trapezoid net MDD-TZ.

1/8" mesh is standard on tank dip net TDN-SC, medium duty teardrop net MDD-TD and medium duty trapezoid net MDD-TZ.

---

**DIP NET FRAME SIZES** scale 1" = 1'-0"

---

**Archive Manual - Specifications May Have Changed**