

TYPE XV ELECTROFISHER

INSTRUCTION MANUAL

SMITH-ROOT INCORPORATED

14014 N.E. Salmon Creek Avenue
Vancouver, Washington 98665

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1.0 INTRODUCTION TO ELECTROFISHING

For many years it has been known that fish react to electric currents passed through water. These currents either frighten, lead, stun, or kill fish and it is these aspects that have interested fisheries biologists.

Smith-Root has produced the Type V* Through Type XV electrofishers. Our electrofishers represent the state of the art in design and electronic components. Smith-Root electrofishers are manufactured with the highest quality electronic components and materials available insuring maximum reliability and performance. The following discussion should help you to get the most from your electrofisher.

1.1 OUTPUT PARAMETERS

ALTERNATING CURRENT is a flow of electricity in which the direction of current flow reverses a specified number of times per second.

When a fish enters an A.C. field of sufficient strength, it is stunned and can be easily picked up with a net for examination. There is usually a very strong contraction of the body muscles, which accounts for the rigid condition of the fish when they are picked up. When using alternating current, care must be taken not to use too high a voltage or the larger fish may be killed. The muscular contractions are sometimes so severe that vertebrae are fractured and/or brain damage may occur.

DIRECT CURRENT is a flow of current in one direction only. This flow is from the negative cathode to the positive anode. (electron flow)

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 positive anode and start to swim toward it. This reaction, known as galvanotaxis, will continue until the fish either reaches the anode or encounters a current sufficiently strong to cause it to turn on its side and become incapable of any further forward movement. This reaction is known as galvanonarcosis. The severe and often harmful muscle contractions encountered with alternating current do not occur and the fish recover much more quickly from a direct current shock.

*Smith-Root Inc. no longer manufactures the Type V Electrofisher.

Thus the mortality rate is much less with direct current than with alternating current. Also, galvanotaxis does not occur with alternating current.

Even greater anode attraction is possible by the use of pulsed direct current. Pulsed direct current is obtained by interrupting a direct current flow with an electronically controlled switch which will give a number of on and off pulses of direct current. Different species of fish differ in the number of pulses per second which will best attract them. Pulse frequency can be important to produce the desired galvanotaxis reaction. Research has also shown that a pulse shape with a fast rise slow decay enhances the galvanotaxis reaction.

2.0 CONSIDERATIONS FOR ELECTROFISHING

The effectiveness of the shocker's output is sometimes effected drastically by environmental and/or biological factors. The power that reaches the fish is greatly effected by the waters parameters and the animals physiological make-up. If these environmental and biological parameters are too far out of line, poor electrofishing will result. Adjustments in the electrofishers output can help to reduce erratic actions and the escape of fish. The following discussion should help to clarify the wide variation of reactions among fish.

2.1 INFLUENCE OF CONDUCTIVITY

The conductivity of the water and of the fish flesh are the main factors that effect electrofishing.

The conductivity of natural water depends on the quantity of dissolved salts and minerals in the water available to carry electric current.

Distilled water is a very good insulator of electric current. If a voltage is applied between two electrodes in distilled water, little or no current would flow through the water and the water would be considered to have extremely low conductivity.

In the past it was customary to talk in terms of volts per inch required to evoke a given response in a fish. From a theoretical standpoint, it is possible to have many volts per inch and not shock the fish at all.

For example, if a fish were placed in distilled water with high voltage applied, no current would flow through the water and hence, no

current would pass through the fish's body even though many volts per inch may be present. What a fish reacts to is the current flowing through its body.

On the other side of the coin if we were able to put a fish in water that had very high conductivity and applied a voltage, a corresponding large current would flow through the water, but negligible current would flow through the fish's body because the electric current would find it much easier to pass through the highly conductive water than through the fish's flesh of medium to low conductivity.

It can be seen from the afore mentioned considerations that a fish will receive the maximum shock (current flow) when a voltage is impressed across water having a conductance per cube equal to the conductance per cube of fish flesh.

Generally in lower conductivity, higher voltage is needed in order to get a response from the fish. It also helps to maintain a large cathode while keeping the anode medium size (not over 100 sq. in.). For a given current the smaller anode has a more intense current field near the anode while a large anode distributes the current over a larger area. The Type VIII-A, Type XI, Type XV and Type VI-A have the high voltage necessary for low conductivity use down to about 10 microsiemens/cm³.

In waters of very high conductivity the only solution is to run very heavy current through the water. However, a limit is soon reached where the electrofisher cannot deliver sufficient current to electrofish successfully. The Type IX and the 7.5 GPP have the high current capability necessary for high conductivity use up to about 10,000 microsiemens/cm³.

2.2 EFFECTS OF FISH SIZE

Individual variation is notable among fish even though they are of the same species and have similar lengths. However, the longer the individual of a species, generally, the more sensitive it is to electrical shock. Fish absorb power as a function of body surface area.

2.3 EFFECTS OF TEMPERATURE

Fish flesh has a certain conductivity that increases with increasing temperature. The success of electrofishing may be enhanced or hindered by this effect depending upon whether the water's conductivity is higher or lower than the fish's flesh. If it is in a direction to

cause a closer conductivity match, the fish will receive a greater shock.

Output energies commonly used in electrofishing are capable of killing fish. Mortalities caused by A.C. electrofishing are usually higher than those caused by D.C. or pulsed D.C.. Harmful effects from pulsed D.C. are usually a result of excessive exposure or very intense electrical fields.

** To convert ohms to microsiemens - $\text{microsiemen} = 1(10^6)/(\text{ohm}/\text{cm}^3)$
*** siemen is the internationally used value of conductance - mho=siemen

3.0 ELECTROFISHING TECHNIQUES

One engaged in electrofishing must wade or float, depending upon the depth or swiftness of the water. In suitable waters, the operators wade and can 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. If turbidity and predation are unimportant, collections can be made more efficiently and less strenuously when moving downstream. The fish are normally oriented upstream, or toward the descending electrical field, and the shocked fish initially bolt upstream into higher voltage densities, where they are held. Fish that manage to escape are often captured a short distance downstream.

The floating method of electrofishing is used when the stream is too deep or swift to wade. The anode is clamped rigidly ahead of the boat, extending into the water. The cathode is typically clamped to each side of the boat. One man guides the boat with the oars while one or two operators dip fish as the boat drifts with the river.

Collecting can be improved further by introducing the element of surprise through intermittent fishing. The intensity of the anode's peripheral electric energies only frightens fish, causing them to bolt or penetrate deeper into cover. In either situation, chances of capture are reduced. It is better not to move through a body of water with the power continuously on, but rather to fish only in likely habitat. Fish can be extracted from areas of heavy cover or from under shore ice by inserting the anode, turning the power on, and withdrawing the anode slowly and smoothly. Fish follow the anode under the influence of galvanotaxis into the open, where they can be netted. If the stream velocity is appreciable, the electrical power can be left on during floating without loss of efficiency.

Night fishing with lights has proven to be exceedingly productive in lakes but it is not so in streams. The reflection and refraction of the spotlight beam caused by the ruffled stream surface greatly impairs sighting of the fish. Headlamps are useful for electrofishing when wading at night. For daytime fishing the use of polaroid sunglasses greatly improves locating stunned fish.

4.0 SAFETY PRECAUTIONS FOR ELECTROFISHING

The operator of an Electrofisher must always keep in mind that his chance of receiving an electrical shock is multiplied when dealing with electric currents in or near water more than any other place. Using an electrofisher is like using a firearm, if used properly and with good judgement it is perfectly safe. Have respect for electricity and it is easily controlled, lose respect and you could lose your life.

SMITH-ROOT ELECTROFISHERS HAVE A HIGH VOLTAGE OUTPUT AND CERTAIN SAFETY PRECAUTIONS MUST BE OBSERVED TO PROVIDE SAFE OPERATION AND PREVENT POSSIBLE DANGEROUS ELECTRIC SHOCK.

When operating the Electrofisher NEVER let yourself come in contact with the anode. If it were to happen your body could complete a path for the electric current and a possible lethal shock would result.

All of the Electrofishers currently being made by Smith-Root have an isolated output so that the case is not common with the cathode. Minor capacitive charges caused by the proximity of the internal wiring to the case may be present, but are of no real danger to the user.

The following articles must be worn when using the backpack Electrofisher. They are not just to keep you dry, they are to keep you insulated from the electric currents that may be present.

1. Nonleaking wading boots chest high. If they become wet inside, STOP electrofishing and let them dry out thoroughly. Wet boots can conduct electricity as well as water around them.
2. Nonleaking rubber electricians gloves that reach the elbow or higher. If they become wet inside, STOP electrofishing and let them dry out. Wet gloves conduct electricity.

When boat shocking the following items should be worn to keep you insulated from electric currents that may be present.

1. Nonleaking rubber boots knee high. If they become wet inside dry them out.
2. Rubber gloves for crew members that are operating dipnets or anode assemblies. If they become wet inside dry them out.

4.1 DO'S AND DON'TS FOR ELECTROFISHING

DO - Always make sure that all personnel are clear of the area surrounding the anode before turning on the power. DOUBLE CHECK.

DON'T - Continue to electrofish if your boots or gloves become damp or wet.

DO - Make sure that the anode and cathode electrodes make good connection to the output cable and that both electrodes are in contact with the water.

DON'T - Operate an electrofisher if you have any prior heart ailment history or if you have been under abnormal strain, which may weaken your heart.

DO - Study and know how to administer first aid treatment for electrical shock.

DON'T - Operate an electrofisher without a second person to back you up in case of an emergency.

DO - Wear a floatation device when electrofishing. More than one fisherman has been sucked under by his hip waders.

DO - Remove wristwatch, rings and any other jewelry when handling batteries. A battery is capable of producing very high currents that can severely burn.

DON'T - Smoke or permit flame or spark to occur near a battery at any time, particularly when it is charging.

DO - Take precautions to prevent unqualified personnel from tampering with or attempting to operate the electrofisher.

DO - Have electrical circuits serviced only by qualified technicians.

DO - Disconnect the battery when the electrofisher is not in use.

DON'T - Operate generator without covers or screens. Keep hands, hair, necktie and test leads well away from the flywheel and moving engine parts.

DO - Keep hands and face away from the carburetor when the air cleaner is removed. A sudden backfire can cause serious burns.

DO - !BE CAREFUL!

5.0 TYPE XV ELECTROFISHER

5.1 DESCRIPTION

The TYPE XV Electrofisher is a generator powered, backpack mounted, high energy electrofisher. It is designed for use in low to medium conductivity waters. The generator is the recently developed TAS model QEG-300. This generator is capable of delivering 250 watts continuous and 300 watts intermittently. The generator output is 115 volts AC at 300 hertz and 12 volts DC rated at 10 amps. The 12 volts DC can be used to charge 12v batteries. The 115 volts AC has been modified for electrofisher operation. The 115 volts can still be used to power lights and hand tools provided they are a two-wire, ungrounded type with a plastic case.

The Type XV Electrofisher uses the 115 volts AC to deliver 0 to 1200 volts of pulsed DC for best fish attraction over a wide range of water conductivities. The electrofisher is mounted in a gasket-sealed, weather proof case located below the generator for best weight distribution. The generator is mounted so that the exhaust is directed away from the operator.

The generator and electrofisher are removable as a single unit from the packframe. A hole is provided in the mounting plate near the generators petrol fill cap for refueling. The recommended fuel mixture is 25 parts petrol to 1 part two-stroke oil. A full tank provides about 1.5 hours of continuous operation.

The backpack is a reinforced nylon plastic frame manufactured by Coleman, which not only provides excellent electrical insulation, but also has proven to be much more durable than its aluminum counterpart. The frame features over 2000 possible adjustment points providing a comfortable fit for almost any size person. For added safety, an "instant pack release" is provided for an emergency situation, should it ever arise. Just pull on two rings and the whole pack frame drops instantly.

A newly designed fiberglass anode pole and floating cathode, along with two anode arrays, are supplied with each new Type XV Electrofisher. The anode arrays consist of a diamond shaped ring for general purpose use and the new "cat whisker" array for probing in vegetation and under overhangs. The electric field pattern generated with the diamond shaped anode covers an arc of about 270 degrees around the anode and in a forward direction. The electric field generated with the cat whisker anode is mostly forward, covering an arc of about 45 degrees and extending 3 to 4 feet ahead of the anode array. An optional second anode pole can be plugged into the cathode receptical.

5.2 CONTROLS AND FEATURES

The voltage controls for the Type XV are located so that they can be adjusted by the operator without removing the backpack. As a safety feature, an audio tone is provided giving the operator and crew positive indication that an output voltage is present. An optional timer is available which indicates true shocking time in seconds.

VOLTAGE RANGE SWITCH - This switch is located on the left side near the bottom corner. It is placed in this position so that the operator can reach the switch without removing the packframe. The switch has 3 voltage ranges with an off position between each range. The 300 volt range is designed for high conductivity waters (300 to 600 micromhos). The 600 volt range for medium conductivities (100 to 300 micromhos). The 900 volt range for low conductivities (10 to 100 micromhos).

VOLTAGE ADJUST AND POWER (ON/OFF) CONTROLS - The voltage adjust control is located at the bottom left side of the instrument cover. This control also has been located so that the operator can adjust the percent on output voltage of the range selected by the range switch. The power (on/off) switch is ganged with the percent of voltage control. When the control is fully counter-clockwise the shocker power is turned off.

OUTPUT TONE-ALARM - The output tone circuit detects actual output voltage between anode and cathode. It is provided as an added safety feature to let the operator and crew know if a voltage is present. If another shocker is also being used nearby and the probes are in the water, the alarm will sound.

TIMER - The optional 4 digit timer totalizes seconds of shocking time while the anode pole switch is closed. It accumulates time in fractional seconds to give a more accurate indication of true shocking time. A view window is located on the left side top of the instrument case to read the accumulated time. The timer is not resettable so the last reading should be logged before using the electrofisher each field trip.

FUELING - Remove the generator and electrofisher from the packframe. Lay the unit on it's back so that the fuel cap is facing upward. Fill the tank with 25:1 fuel mixture. Allow enough time for any spilled petrol to evaporate before mounting the unit back on the packframe.

ANODE AND CATHODE - The anode pole is supplied with two electrodes. You can use the diamond shape ring for general purpose shocking and the "cat whisker" probe for waters difficult to shock in. (CAUTION: The cat whisker probe provides a much "hotter" field and may cause fish injury in some waters.) Plug the anode pole and cathode into their connectors on the bottom of the instrument case. Located inside the pole is a

sealed magnet-operated reed switch to control the shocker output. A magnet must be placed directly over a flat spot located on the pole. A magnet embedded into flexible plastic is mounted on the anode pole. This magnet must be adjusted so that when pressed it is located directly over the switch inside. If an optional second anode pole (cathode use) is used the magnet switch is not required.

5.3 OPERATING PROCEDURE

STARTING THE GENERATOR - With the fuel tank filled and the shocker mounted on the backpack, locate the choke lever on the top left side of the generator near the gas fill. Lower the lever to choke. Align the red mark on the throttle knob to the arrow, pull the starter rope and slowly lift the choke lever as the engine warms up. To kill the engine, press on the red button located near the sparkplug.

CAUTION: Do not run generator throttle knob red mark past the arrow while electrofishing or possible damage may occur to the Type XV Electrofisher.

USING THE ELECTROFISHER - With the generator running and the anode and cathode electrodes in the water, turn the range switch to the 300 volt position. Turn the percent voltage knob clockwise until a snap is felt. Increase the voltage setting while at the same time pressing the magnet on the anode pole. As the voltage output increases above about 30 volts, the audio tone will be heard. Keep turning the voltage knob clockwise while watching for fish reaction. It is recommended that the voltage setting not be increased beyond the point where good fish reaction is obscured. A high voltage setting may cause damage to fish especially if using the cat whisker anode. circuit which causes the output to pulse on and off, automatically keeping the output power limited. The best setting for the water being shocked is when the output voltage is just below the point where the output pulses on and off.

CAUTION: Be careful not to short the electrodes together as this may cause damage to the shocker, especially on the 900 volt range.

6.0 TYPE XV SPECIFICATIONS:

Conductivity Range 5-600 micromhos/cm
Output Voltage 0-300, 0-600 and 0-900 VDC
Output Current 48 amps peak max.
Output Protection Power adjusted automatically
Output Pulse Shape Rectangular pulsed DC
Output Indicator Audio tone for 30 VDC and greater
Construction Sealed weatherproof case
Weight 32 lb. wet
Size 9" W x 7" H x 5" D
Anode Pole 6 ft. long, 1" diameter, fiber-
glass with 72" curl cord
Arrays supplied Diamond shape & 4 probe "cat
whisker", stainless steel
Cathode Floating aluminum, 84 sq. in.,
approx.
Pack Frame Coleman, reinforced nylon with
padded shoulder straps, hip belt
and emergency quick release. 1.5 lb

STANDARD EQUIPMENT SUPPLIED: Type XV Electrofisher & TAS Generator mounted on a Coleman pack frame, 6 foot Anode Pole with two electrodes, and a floating cathode.

OPTIONAL EQUIPMENT:

Timer 4 digit display - shocking time
in seconds (+)5%

Anode or Cathode Pole (1 piece) 6 ft., 1" diameter

Anode or Cathode Pole (2 piece) 3 ft. per section, 1" diameter

Anode Arrays Diamond ,cat whisker or ring

Electrical gloves 10,000 volt rated

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