INSTRUCTION MANUAL

eDNA SAMPLER

For eDNA Sampler videos and tutorials, visit: *www.smith-root.com/support/tutorials*

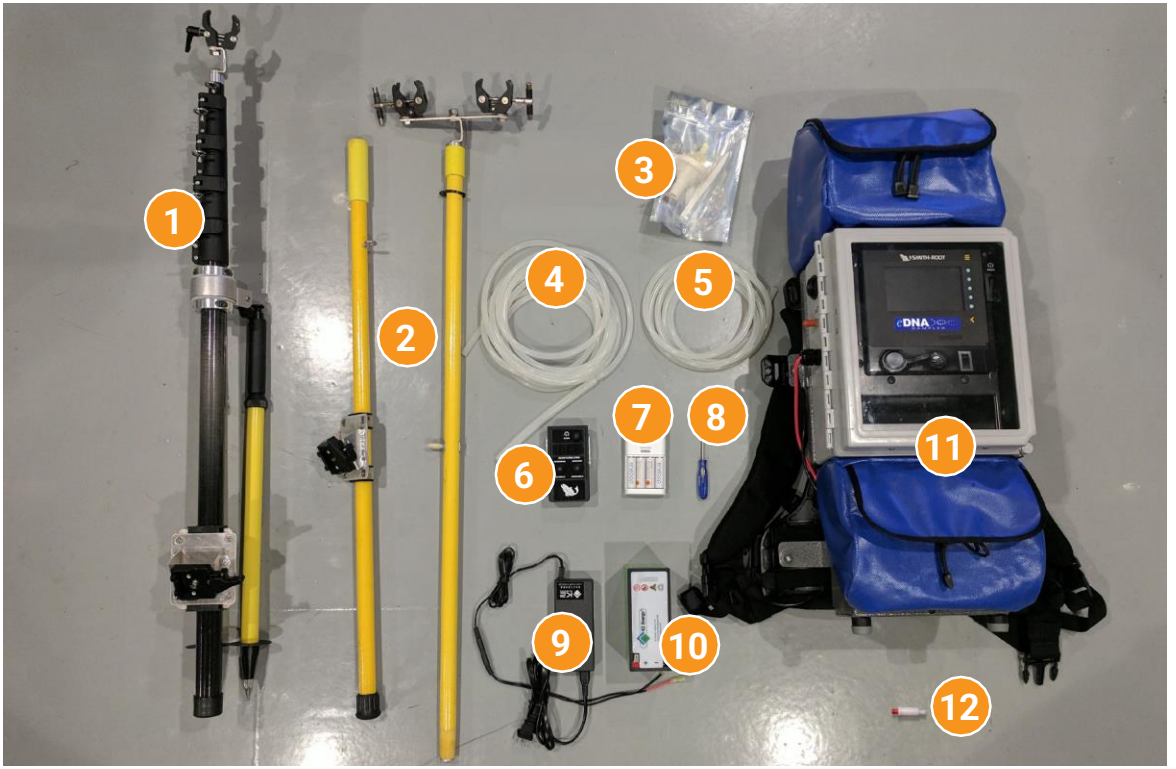
SMITH-ROOT

CONTENTS

Items manufactured by companies other than Smith-Root carry the original manufacturer's warranty. Please contact product manufacturer for return instructions.

All Smith-Root, Inc. manufactured products are covered by a one year warranty.

Credit & Refund Policy: Customers returning equipment, in new condition, will be given credit 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.



eDNA SAMPLER UNIT

1. Telescoping sampling pole with support bipod (sold separately)
2. Transect sampling pole for mobile sampling (sold separately)
3. Single-use filter packets for each sampling location (purchased separately)
4. Long tubing with inline strainer for eDNA Sampler “IN” port
5. Short tubing for eDNA Sampler “OUT” port
6. Remote control for eDNA Sampler pump
7. Rechargeable batteries and charger for remote control
8. Small Phillips head screwdriver for changing remote control batteries (not included)
9. AC charger for eDNA Sampler battery
10. Rechargeable 12v DC battery for eDNA Sampler unit
11. eDNA Backpack Sampler unit (shown)
12. Spare inlet inline strainer

Stand-alone sampler

A. Control/display panel
B. USB connector
C. Speaker/Volume
D. Power Switch
E. Water outlet
F. Water inlet
G. GPS antenna
H. Remote Control Unit

I. Input power cable
J. Battery (standalone sampler)
K. Harness*
L. Upper dry bag*
M. Lower dry bag*
N. Waterproof door

*Backpack unit only

Left and middle: stand-alone sampler; above: Backpack sampler

DEFINITIONS OF *CAUTION*, *WARNING*, AND *DANGER*:

⚠ ***CAUTION:*** is used in areas where potential injury or equipment damage is possible, or to caution against unsafe practices.

⚠ ***WARNING***: Indicates a hazardous situation that, if not avoided, could result in death or serious injury. ***DANGER***: Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

⚠: Read the manual for further information.

⚠ *CAUTIONS*

- Do not crimp or clamp tubing to the OUT port on the unit. This serves as a pressure blow-off if the tubing is accidentally blocked.
- Prolonged direct sunlight on display electronics may compromise product performance
- Do not Freeze. Storage or operation in freezing conditions can damage internal components.
- Ensure that the inline strainer is installed within the intake tubing to prevent damage to your eDNA water sampler pump . Do not allow sand or large particles to be sucked inside the unit. This will damage the pump.
- Wear proper PPE (Personal Protective Equipment).
- Do not apply suction hose to skin.
- Lead-acid batteries contain strong sulfuric acid that can cause severe chemical burns or damage equipment or clothing. Do not touch a lead-acid battery with a cracked case without proper protective equipment. Do not use a lead-acid battery if you suspect it has been damaged in any way

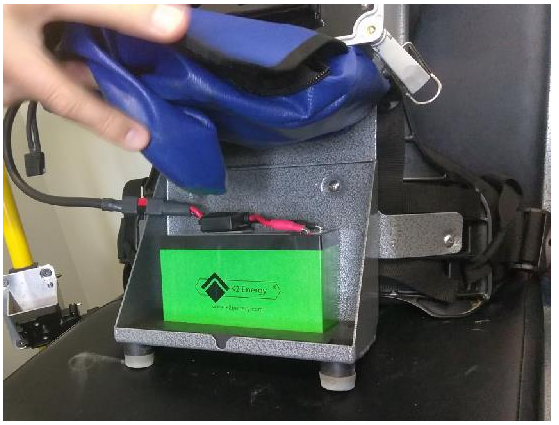
⚠**WARNING**: This product can expose you to chemicals including lead, which is known to the State of California to cause cancer, birth defects or other reproductive harm.

⚠ **CAUTION:** ***Product may contain a Lithium Iron Phosphate battery. Failure to follow instructions may void warranty.***

- Do not short circuit battery leads
- Do not drop battery
- Do not heat above 60°C
- Only use approved charger
- Ensure correct polarity when charging and when connecting to the system
- Do not reuse battery if you suspect it has been damaged in any way

BATTERY INSTALLATION

1. Using a small screwdriver, remove the water tight cover from remote control battery compartment. Do not fully remove the screw from the cover.
2. Install 2 rechargeable AA batteries (provided with unit), noting correct +/- orientation. Push them firmly into place to ensure good contact.
3. Replace water tight cover and tighten the screw to prevent water intrusion.
4. Empty the lower storage dry bag and fold it up to reveal the battery tray (backpack unit)
5. Place the battery in the rubber footer and align dual lock to snap in place
6. Connect the battery to eDNA Sampler power cable
7. Fold down dry bag to cover the battery



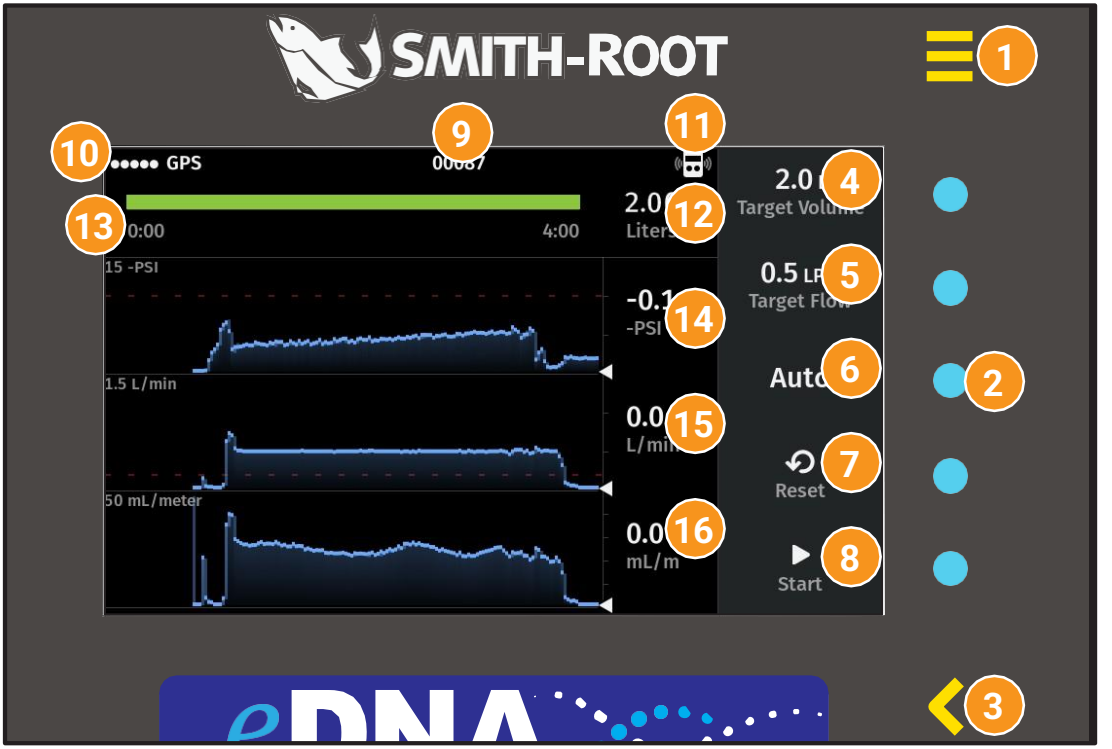
FUSE: Replace only with the same type and voltage of fuse (⊣▭⊢ 10A ATC or ATO).

⚠ **WARNING**: For continued protection against fire or explosion, use only batteries with the proper polarized connector and fuse, such as those supplied by Smith-Root.

INLINE STRAINER PUMP PROTECTION

The diaphragm pump inside your eDNA Sampler can be damaged if sand or other particles enter the unit. For this reason we have designed the unit to have two layers of protection to prevent such particles from entering the system, 1) the eDNA filter housing itself at the end of the intake tubing (replaced with each sample), and 2) the inline strainer positioned approximately 3 inches (~8cm) from the intake port of the pump (see picture).

Please do not operate the eDNA Sampler without the inline strainer in place. Occasionally the strainer may become clogged with particulate and prevent water flow, in which case the strainer will need to be replaced with a new one. Ensure that you re-install the strainer with the correct flow orientation as indicated by the flow arrow on the inline strainer housing.



eDNA SAMPLER INTERFACE

1. Menu button
2. Item select buttons
3. Back button
4. Target Volume – The target sample volume in liters (L)
5. Target Flow – The flow rate set point in liters per minute (L/min)
6. Mode – Mode selection between Auto/Manual (described below)
7. Reset – Creates a new sample data record
8. Start/Stop – Pump control. Initiate or end the water filtration cycle
9. Log ID – The event ID number in the .csv data record
10. GPS signal strength
11. Remote control connection indicator
12. Current sample volume
13. Sample collection time
14. Current pressure value
15. Current flow rate value (L/min)
16. Current transect rate: filtered volume per unit distance (ml/m)

AUTO MODE

When the system is in auto mode, the user will be alerted by 2 beeps indicating that the filter should be inverted to achieve the target sample volume. The system will continue to meter the water contained in hose and filter housing even after the nozzle is removed from water. Thus, the Volume Offset value accounts for the water in the filter and tubing when targeting specific sample volumes.

When the start button is pressed in Auto Mode a new sample ID and data record will be generated (equivalent to pressing the Reset button).

MANUAL MODE

In manual mode the system will not generate a new data record on Start, and it will not generate an alarm for Target Volume. This mode is useful when the user does not know what the Target Volume should be for a given environment/filter pore size, or when the pump is frequently started and stopped for a single filtration event (e.g., Transect sampling).

MENU SCREEN

1. Maximum Pressure – The maximum pressure in negative Pounds per Square Inch (PSI)
2. Minimum Flow – Flow rate at which the Low Flow Alarm will sound (5 rapid beeps)
3. Volume Offset – Value deducted from target volume to alarm user when to invert filter
4. Display Mode – Mode selection between dark and light display modes
5. Device Information – Additional device info (e.g., software and firmware version #)

VOLUME OFFSET

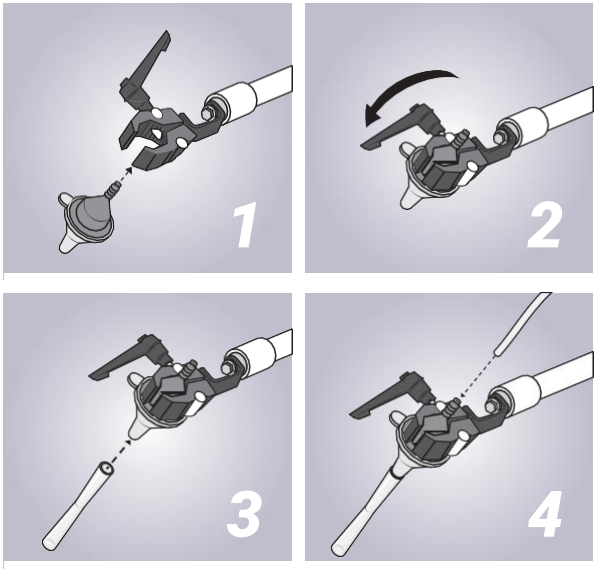
This value needs to be changed whenever the tubing length or filter arrangement is altered (for example, switching from 1 filter housing to 3 on the transect pole). To calculate the volume offset for the current setup, use the following procedure with an assistant:

1. Fill a bucket or reservoir with clean water.
2. In manual mode, start the pump and fill the tubing and system until a solid stream of water is visible emitting from the “out” tube, with no bubbles.
3. Stop the pump and press the reset button on the interface.
4. Invert the filter housings by rotating pole, while retaining as much water in the extension tubes as possible.
5. Press the start button on the interface and allow the pump to run until all water has been cleared from the tubing and pump. Then press the stop button.
6. The “Liters” value displayed (e.g., 300ml) can now be used for the “Volume Offset” for the new filter and tubing arrangement.
7. To confirm the setup, switch to auto mode and follow the sampling procedure (inverting filters at 2-beeps). The target volume should be achieved with the new Volume Offset value.

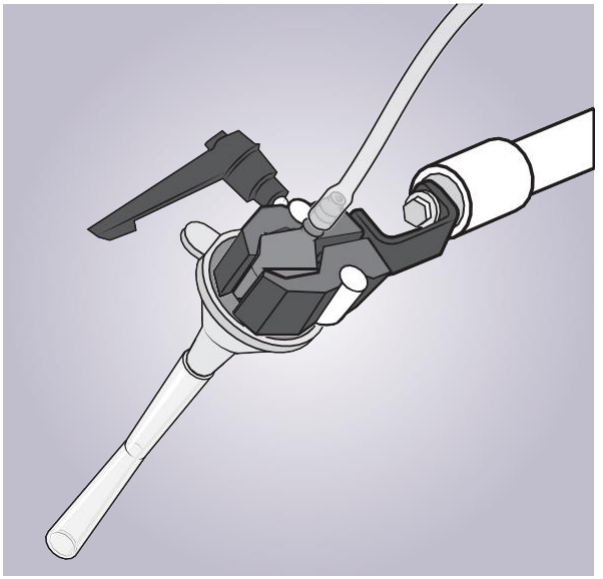
POINT SAMPLING PROCEDURE WITH TELESCOPING POLE

1. Program your eDNA Sampler for your desired Target Volume, Target Flow, and Maximum Pressure. We suggest 1.0 L/min and 10 -PSI as a starting point. For Target Volume, please see *"Determining a realistic sample volume"* section below.
2. Press the Reset button on the interface to start a new data record.
3. Fold out the bipod legs and extend them by pressing the black button on the top of each leg (they will drop down to full length). Place the pole on the ground in the manner of a tripod.
4. Extend the first telescoping pole section (section with clamp) and run the long piece of tubing (end with adapter) up through the guides to the end of extension near clamp.
5. Connect other long tubing end to the eDNA Sampler unit "IN" port on the right-hand side (if facing display).
6. Connect short length of tubing to the "OUT" port on the left-hand side of unit. Optional: Place other end in catch bucket to prevent discharge flow back into water body.
7. A fresh pair of rubber gloves is advisable at this stage.
8. Open a new Smith-Root filter packet, remove the filter housing (by grabbing the barbed nozzle) and attach the extension tube (in packet) to the white filter nozzle. **Note:** ***Avoid touching the extension tube which will be inserted into the water.***
9. Place the filter housing with attached tube into the clamp of the telescoping pole. Lightly tighten the clamp around the filter housing. ***Note****: Over-tightening will deform the filter housing can cause air leakage*.

10. Extend the telescoping pole to the needed length to reach your sampling location.
11. Power on the remote control using the ON/OFF button.
12. Select between Auto and Manual modes. Use Auto mode when targeting a specific sample volume.
13. Place nozzle in water and begin sampling by pressing the Start/Stop button. Note: the system may take several seconds to prime, and flow will only be registered after water reaches the pump.
14. Continue filtering until: 1) The system beeps 2 times indicating you need to remove nozzle to achieve target volume (Auto Mode), 2) The system beeps 5 times indicating that flow has dropped below a registrable level, 3) You have achieved your desired sampling volume (Manual Mode).
15. Once filtration is completed, quickly invert the filter housing by rotating the pole, then raise the nozzle end up (i.e. increase nozzle elevation). Allow the pump to run until the tubing and filter housing are cleared of water. Note: Under most circumstances you will hear a low flow alarm (5 rapid beeps) after 10 seconds when the tubing line is sufficiently cleared. Allow the pump to run until you hear a suction sound from the filter, indicating that all water has passed through the filter and it is pulling air.
16. Retract pole and turn the pump off using the remote control or interface Start/Stop button.



1): Insert filter housing into clamp as shown; 2): tighten clamp firmly; 3): Place collection tube on end of filter housing bottom; 4): Place tube over barbed fitting on top of filter housing, making sure it is secure and doesn't leak. Bottom: fully configured filter/tube assembly.



DETERMINING A REALISTIC SAMPLE VOLUME

If you are working in a new environment and the filterable water volume is not known, the low flow alarm can be used as an objective measure of filter clogging. When setting up a new project we recommend following this procedure in the worst-case scenario (highest likely level of suspended particulate) such as after a rain event. Then, a standardized sample volume (e.g. 1L) can be set for all samples, knowing that this volume is achievable under highly turbid conditions in your study system.

The following can be done with multiple filter pore sizes to determine which should be used:

1. Set the Minimum Flow value to 0.3 L/min flow rate in the interface menu.
2. Program the Target Flow to 1.0 L/min.
3. Set the pump to Manual Mode.

4. Press the Reset button on the interface to start a new data record.
5. Connect a filter of a given pore size (e.g. 1.2 um) to the pump tubing.
6. Start the pump and begin filtration such as the procedure described in the Point Sampling section. ***Note:*** *If the pump cannot prime (water cannot reach pump) and no flow is registered after ~1 minute, stop the filtration cycle and try a larger pore size filter.*
7. Allow the pump to run while monitoring the Flow Rate graph on the interface. Once the pressure limit is reached, the flow rate will begin to decrease gradually over time indicating filter loading.
8. When 5 rapid beeps are heard (the Minimum Flow value) invert and elevate the filter housing.
9. Allow the pump to run until all water is cleared from the line and metered.
10. Stop the pump and read the Liters value on the interface or remote control.
11. The displayed Liters value is a realistic sample volume for the current combination of filter pore size and environmental particulate load.
12. If the value is < 1L, we recommend testing a larger pore size filter.

SAMPLE PRESERVATION

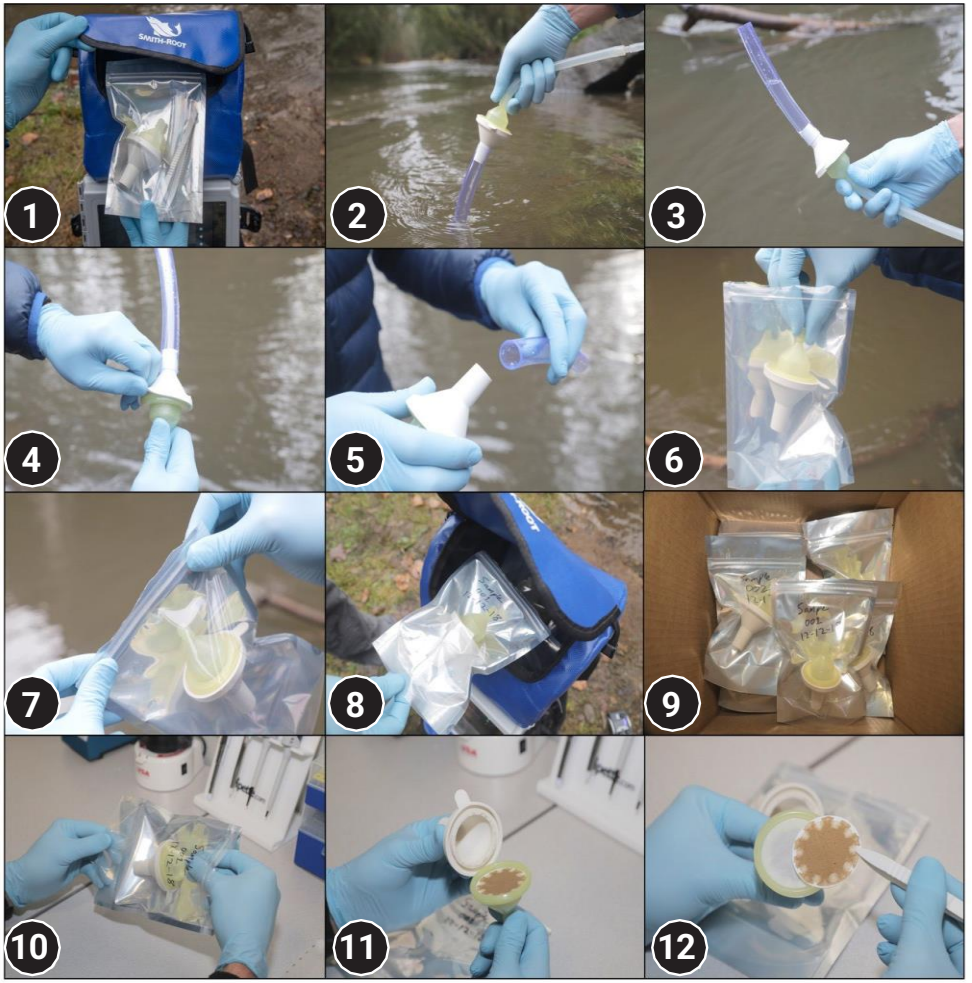



Steps for folding the filter and placing in vial.

1. Open filter housing
2. Extract filter using forceps included in kit.
3. Use nozzle extension end to aid folding filter.
4. Insert filter into vial.
5. Firmly close cap on vial.

1. For immediate sample preservation, open the filter housing by pulling on the nozzle tab which will expose the filter membrane.
2. Fold the filter using the forceps provided in filter packet and place into the vial containing user-provided preservative (e.g. ethanol). ***Note:*** *the nozzle extension tube can be used to help the filter folding process* (see above).
3. Label the sample with an ID and place the preserved sample in a storage box. Samples can then be stored in the dry bags of the eDNA Sampler unit.
4. Record the Log ID from the interface associated with the sample ID.
5. Record any other metadata associated with the sample (weather, water temp, etc.).
6. Move on to next sampling location.

INSTRUCTIONS FOR SELF-PRESERVING FILTERS



Note: *Self-preserving filter housings are currently rated to 10 PSI max pressure (20 in.-Hg; 508 mm-Hg). Please program your eDNA Sampler for a 10 PSI pressure threshold.*

1. Open a sample packet containing a 47mm self-preserving filter housing and attach the extension tube to the housing. Save the foil pouch for subsequent filter storage.
2. Attach suction tubing to the filter housing and activate pump to begin filtration.
3. When “low flow” alarm sounds or target volume is reached, quickly invert the filter housing and elevate it to filter all remaining water in housing and clear the suction line.

IMPORTANT: ***Crack the seal (do not open) and allow the pump to run for approximately 20 seconds to air dry the filter membrane. Excess moisture will prevent thorough desiccation and eDNA preservation.***

4. Remove the extension tube and discard in an appropriate field waste container.
5. Place the self-preserving filter housing back into the original packaging. Minimize excess moisture on the outside of the filter housing. A light shake can remove water droplets.
6. Reseal the foil pouch with the zip-type sealing strip. The filter housing material will immediately begin preserving the captured eDNA by desiccation.
7. Label the sample bag and place sample in a field storage container at ambient temperature.
8. Multiple samples can be aggregated and stored at room temperature (70°F, 21°C) until bulk laboratory processing. Current data support 6 months of preservation before DNA extraction.
9. Once in the laboratory for DNA extraction, remove the filter housing with the preserved 47mm eDNA membrane from the storage bag.
10. Open the filter housing using the pull-tab and reveal the eDNA filter membrane.
11. The eDNA filter membrane can then be removed from the housing using forceps for DNA extraction. The filter backer will remain stuck to the housing. All elements other than the eDNA filter membrane can then be discarded.

STATEMENT OF BIODEGRADATION

Smith-Root self-preserving filter housings contain a material that is recognized as one of very few synthetic polymers which are water soluble and “inherently” biodegradable in water.

The polymer manufacturer’s internal experimental results indicate it is “inherently” biodegradable in water when the degree of hydrolysis is higher than 70 mol%.

- Test method; ISO 14851
- Sludge concentration; 100 mg / L
- Sample concentration; 100 mg / L

In aqueous solution, adapted microorganisms are capable to mineralize the polymer into carbon dioxide and water.

For more information, visit:
https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.13212

TRANSECT SAMPLING PROCEDURE

The eDNA Sampler is optimized for mobile sampling, in which the user can filter water while wearing the backpack and walking along a transect. The system uses GPS to plot the eDNA filtration transect, while also giving the user a constant output of ml/meter – thus allowing for standardization of volume filtered per unit distance. For mobile sampling we suggest using the Smith-Root Transect pole (Part # 11203); this allows for up to 3 filter housing to be run simultaneously.

⚠ **CAUTION:** Self-preserving filters are not currently recommended for transect sampling, due to the likely need to work around obstructions in water. If prime is lost on a self-preserving filter, it may not be possible to re-prime the filter.

ESTIMATE YOUR TRANSECT DURATION

The transect duration is a function of: a) the programmed Target Flow; b) the number of filter housings; and c) the filterable water volume per filter (determined by environmental particulate load). Therefore, the total transect time can be calculated as:

$$\textit{Transect time (min)} = \frac{\textit{number of filters*volume per filter (L)}}{\textit{Target flow (L/min)}}$$

For example, if the local environment allows 2 Liters of water to be filtered on a single 1.2um filter membrane, 3 filters are used in the transect system, and the target flow is programmed to 0.5 L/min, then the total Transect time will be 12 minutes.

SAMPLING

1. Press the Reset button on the interface to start a new data record.
2. If the environment will require you stop and start the pump repeatedly to avoid obstructions or shallow areas, program the eDNA Sampler to Manual mode. In Auto mode the data record will be reset each time you press Start.
3. Set the Target flow to value in the lower range to extend transect duration. We recommend 0.5 L/min as a starting point.
4. Move to the beginning point of your transect. Remember to always start downstream and move upstream when transect sampling.
5. Place the extension tubes of the filter housings into the water.
6. Press the Start button on the remote control and begin walking forward. Do not wait until water reaches the pump before moving – you will begin filtration immediately on start.
7. Attempt to walk at a constant speed while transect sampling to maintain a consistent ml/meter value throughout the transect.

OBSTRUCTIONS

If you encounter an obstruction that requires you to break prime (remove the filter extension tubes from the water), it can be done several times within a transect if the appropriate technique is followed.

1. When an obstruction is encountered, press the Start/Stop button to stop the pump, but leave the extension tubes in the water.
2. Quickly rotate the pole and invert the filter housings, retaining as much water in the extension tubes as possible.
3. Move around the obstruction to the next point in your sampling transect.
4. Press the Start/Stop button while simultaneously flipping the pole back into the sampling position with the extension tubes in the water. ***Note:*** *when the pole is inverted, the remote control is upside down; it may require some practice to press the start button and flip simultaneously.*
5. If prime is not fully broken (i.e., water not fully drained from extension tubes), then the system will continue filtering without issue. If the filters run dry in this process you may have trouble re-priming the pump with wetted filter membranes.

COMPLETING THE TRANSECT

1. When you have reached your desired sample volume or the end of the transect distance, quickly rotate the pole to invert the filter housings.
2. Continue walking at the transect speed until all water is filtered and tubing line is cleared.
3. You may need to isolate suction to each filter housing to effectively dry them all. This can be done by pinching the suction tubing of the other two filters, thus directing all suction pressure to a single filter housing. Repeat this process for all three filters.
4. Preserve the filters according to the preservation procedure outlined above.
5. When recording the sample volume, divide the Liters value on the display by the number of filters used in the transect to determine sample volume per filter replicate.

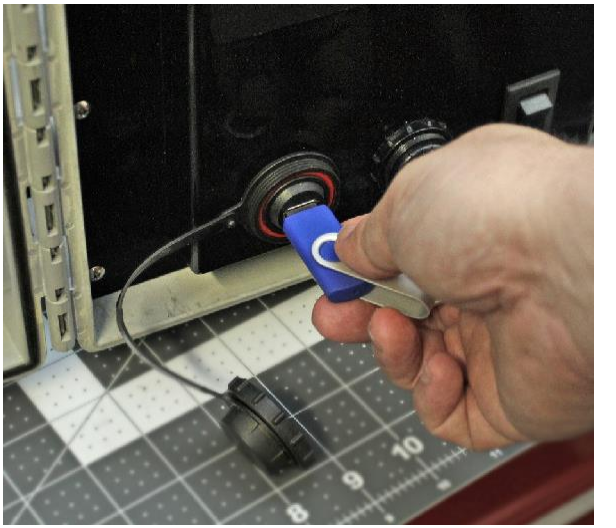
MARINE APPLICATIONS

The eDNA Sampler can be used in salt water, however, a fresh water rinse is required after each use. Please follow the storage procedure to flush the system.

DATA ACCESS AND MANAGEMENT

1. Plug an empty USB thumb drive formatted to FAT 32 into the eDNA Sampler USB port.
2. The unit will automatically transfer the data logs to the USB drive.
3. When prompted, remove the USB drive from unit.

A separate .csv file is created for each sampling event (Log ID). To locate the data associated with a particular sample, refer back to the Sample ID from your field records. Each .csv file contains summary information in the header followed by raw parameter data recorded every 2 seconds.



	A	B	C	D	E	F	G	H	I	J	K
1	Sample ID	106									
2	Start Time	2019-07-03 17:10:52 UTC									
3	Duration	2:42:35									
4	Total Volume (l)	9.97									
5	Distance (m)	197									
6	Peak Pressure (psi)	5.9									
7	Avg Flow (l/min)	1.1									
8	Avg Rate (mL/m)	175.7									
9	Avg Speed (m/s)	0.2									
10											
11											
12	Date (UTC)	Elapsed time (s)	Volume (l)	Pressure (psi)	Flow (l/min)	Rate (mL/m)	Speed (m/s)	Latitude	Longitude	Elevation (m)	Accuracy (+/- m)
480	7/3/19 19:51	9655	4.78	3.39	1.2	25.13	0.8	45.742476	-122.617496	69.7	5.5
481	7/3/19 19:51	9657	4.8	3.4	1.2	25.82	0.73	45.74249	-122.617511	71	5.5
482	7/3/19 19:51	9659	4.85	3.51	1.2	29.92	0.67	45.742493	-122.61753	71.8	5.5
483	7/3/19 19:51	9661	4.9	3.49	1.2	31.16	0.64	45.742461	-122.617516	72.6	5.5
484	7/3/19 19:51	9663	4.93	3.33	1.2	31.07	0.64	45.742431	-122.617526	73.6	5.5
485	7/3/19 19:51	9665	4.97	3.56	1.2	29.65	0.67	45.742415	-122.617536	74.8	5.5
486	7/3/19 19:51	9667	5	3.51	1.2	29.68	0.67	45.742418	-122.617549	76	5.5
487	7/3/19 19:52	9669	5.05	3.48	1.2	30.52	0.66	45.742401	-122.617552	77	5.5
488	7/3/19 19:52	9671	5.1	3.63	1.2	34.15	0.59	45.742403	-122.617558	78	5.5
489	7/3/19 19:52	9673	5.12	3.06	1.18	38.71	0.51	45.742389	-122.617556	78.3	5.5
490	7/3/19 19:52	9675	5.17	3.5	1.2	40.92	0.49	45.742362	-122.617572	79.1	5.5
491	7/3/19 19:52	9677	5.2	3.31	1.2	43.02	0.45	45.742366	-122.617568	80.1	5.5
492	7/3/19 19:52	9679	5.25	3.39	1.21	49.56	0.41	45.742364	-122.617576	81	5.5
493	7/3/19 19:52	9681	5.3	3.45	1.2	48.8	0.41	45.742473	-122.617631	85	5.5
494	7/3/19 19:52	9683	5.32	3.48	1.2	50.43	0.4	45.742591	-122.617707	89.6	3.7
495	7/3/19 19:52	9685	5.38	3.2	1.21	46.87	0.43	45.742678	-122.617754	93.7	3.7
496	7/3/19 19:52	9687	5.41	3.36	1.2	37.69	0.53	45.74272	-122.617781	98.3	3.7
497	7/3/19 19:52	9689	5.45	3.47	1.2	29.19	0.69	45.742714	-122.617801	101.3	3.7
498	7/3/19 19:52	9691	5.48	3.37	1.2	24.47	0.82	45.742672	-122.617812	102.6	3.7
499	7/3/19 19:52	9693	5.53	3.53	1.2	23.28	0.86	45.742637	-122.617807	103.3	3.2
500	7/3/19 19:52	9695	5.56	3.36	1.2	22.9	0.88	45.74268	-122.617823	107.5	3.2
501	7/3/19 19:52	9697	5.61	3.47	1.2	21.55	0.93	45.742676	-122.617828	108.6	3.2
502	7/3/19 19:52	9699	5.66	3.2	1.19	19.7	1.01	45.742678	-122.617823	109.6	3.2
503	7/3/19 19:52	9701	5.68	3.65	1.2	19.46	1.03	45.742675	-122.617825	111.2	3.2
504	7/3/19 19:52	9703	5.73	3.52	1.2	19.54	1.02	45.742672	-122.617819	112.7	8.1
505	7/3/19 19:52	9705	5.76	3.43	1.19	20.11	0.94	45.742655	-122.617819	112.9	8.1
506	7/3/19 19:52	9707	5.8	3.43	1.2	24.7	0.81	45.74265	-122.617823	114	8.1
507	7/3/19 19:52	9709	5.85	3.43	1.19	26.73	0.74	45.742646	-122.617821	114.5	8.1
508	7/3/19 19:52	9711	5.88	3.61	1.21	27.18	0.66	45.742614	-122.617787	96.4	8.1

MAINTENANCE

- Before each use inspect the equipment for wear or damage and replace worn or damaged parts as necessary.
- Inspect the batteries for damage. Do not use a damaged battery, replace it immediately.
- Follow the charging procedures to maintain the batteries.
- Follow the cleaning, sterilization, storage and marine flushing procedures to keep the eDNA Sampling Pump in good working order.
- Except when sterilizing or flushing the system do not run the pump without a filter in place.
- Do not expose the system to sub-freezing temperatures.

STERILIZATION

By design the eDNA Sampler system does not need to be sterilized between each sample. However, when moving between watersheds, it may be advisable to sterilize the system to avoid transferring bacteria or pathogens between sensitive systems. The eDNA sampler can be sterilized using the following procedure.

1. Fill a reservoir (e.g. 1L bottle) with a 2% bleach water solution. This can be achieved by adding 20ml of household bleach to a 1L bottle and filling it the rest of the way up with tap water. ***Note:*** *Higher concentrations of bleach may damage internal components.*
2. Place both the IN and OUT tubes (without filter) into the bleach water and start the pump.
3. Allow the pump run and circulate the bleach water for 10 minutes, then stop the pump.
4. Rinse the system with clean tap water by repeating the process using only tap water.

CLEANING

The sampling pump can be cleaned with a soft cloth and a mild soap and water solution. Do not use chlorinated cleaners on the window as these will damage the window. Do not use solvent based cleaners as these may damage the integrity of the enclosure.

STORAGE PROCEDURE

1. Always replace the orange “IN” and “OUT” port caps when the system is not in use.
2. When you return from sampling, or if the EDNA Sampler unit will not be in use for > 24 hours, please use the following procedure:
   a. Attach tubing to the unit. Place the “IN” tube into a clean container with > 3L fresh tap water, and the “OUT” tube in the sink. If a bleach solution is used for decontamination, be sure to fully flush the system with fresh water prior to storage. ***Note: Do not use bleach concentrations > 2%, as this will damage the pump.***
   b. Run the pump in manual mode at 1L/min, for 2 minutes, but do not run the pump dry.
   c. Stop the cycle with the stop button after 2 Liters have been flushed through. Disconnect the tubing (with water still in system), and replace the orange caps; this will ensure that the diaphragms are stored moist and will continue to function.

TROUBLESHOOTING

1) System cannot achieve prime (water does not reach pump)

The particulate load in the water may be too high for the given filter pore size, the max pressure is set too low, or the head pressure is too great. First, try lowering the elevation of the pump. Next, try increasing the pump pressure. If you still cannot achieve prime, try a larger pore size filter.

2) The remote control display light is flickering or remote not communicating with pump.

Change the remote control batteries. It’s advised to carry spare AA batteries and a #1 Phillips screwdriver when sampling.

OBTAINING SERVICE

For additional assistance with your eDNA Sampler system, or for repairs, please contact Smith-Root at 360-573-0202 or visit www.smith-root.com.

TIPS AND TRICKS FOR LONG TERM OPERATION

- Follow the pump storage procedure guidelines (do not store dry for prolonged periods).
- Use the caps provided for “IN” and “OUT” ports when system is not in use.
- Avoid getting water inside the remote control battery compartment.
- Do not twist the bipod legs (use the button on top to extend or retract).

For video tutorials and updates, please visit:
www.smith-root.com/support/tutorials

BATTERY MAINTENANCE

LiFePO4 Battery Storage Recommendations:

- Disconnect from unit.
- Fully charge before storage.
- Store indoors in a climate controlled environment (room temperature 21C or 70F) with low humidity (under 50% RH). As a general rule of thumb, if a human is comfortable in the environment, the battery will be as well.
- If stored for long term (six months or more), it should be recharged every three to six months. A 2% per month self-discharge rate is expected.
- Fully charge before first use after removing from storage.

Sealed Lead Acid Battery Storage Recommendations.

- Disconnect from unit.
- Fully charge before storage.
- Store indoors at room temperature (21C or 70F) or lower. Ideal storage temperature is (10C or 50F). Ideal storage humidity is 50% RH.
- If stored at room temperature, it should be recharged every six months. If stored at 10C (50F), it should be recharged every twelve months. Self-discharge rate is near 4% per month at room temperature and gets significantly worse as temperature increases.

SPECIFICATIONS*

BATTERIES

Main battery:	9.6 Ahr 12.8V LiFePO4, Model K2B12V19EB
Remote battery:	AA 1900 mAHr 1.2V NiMH x 2, Model BK-3MC-CA
Runtime Main Battery:	6-8 Hrs
Runtime Remote Battery:	~ 4 Hrs
Main Battery Terminals	Polarized latching slide type.
Main Battery Maximum Charge Current	4ADC, 14.6V max., Model K2C12V4A
Remote Battery Maximum Charge Current	300mADC, 1.5V max., Model BQ-CC17

DIMENSIONS AND WEIGHTS

Dimensions w/backpack:	30.5 (775mm) H X 16.4 (416.5mm)W X 15 (381mm)D
Handheld unit dimension:	16 (406.4mm) H X 15 (381.0mm) W X 9.25 (235mm) D
Weight w/o battery:	24.0 lbs. 10.89kg
Handheld unit weight w/o battery and remote:	16.2 lbs. 7.35kg
Main battery weight:	3.0 lbs. 1.36kg
Main battery dimensions	2.53 (64.3mm) W X 5.94 (151mm) L X 3.83 (97.3mm) H with (6mm) terminals
Remote battery weight:	0.1 lbs 45.4g
Telescoping pole dimensions inc. bipod:	41.5 (1054.1mm) to 144 (3657.6mm) L X 5.25 (133.4mm) D
Telescoping pole weight with bipod:	7 lbs. 3.18kg

REMOTE

Wireless communication:	2.4GHz DigiMesh w/ unique channel for each eDNA unit.
Remote control dimensions:	4.7 (119.4mm)L X 2.5 (63.5mm)W X 0.94 (23.9mm)H
Remote weight:	0.4 lbs. 181.5g
IP Rating:	IP54 with rear battery cover installed
Display type:	4 character 7 segment blue LED

SENSOR SPECS

Minimum flow rate:	0.1 l/min
Maximum flow rate:	1.4 l/min
Maximum measurable volume:	999.9 l
Volume accuracy:	> 90% at 0.1 l/min or higher flow
GPS system compatibility:	GNSS (GPS, Galileo, GLONASS, BeiDou)
Number of channels:	72
GPS, GLONASS sensitivity:	-167dBm
GPS position accuracy:	2.5 meter

COMMUNICATIONS

USB:	2
Log File Format:	.csv and .sqLite3

PUMP SPECS

Ports:	1/4 inch ID tubing
Priming vacuum:	~ 5 psi
Maximum wetted vacuum:	14 psi (96.5 kilo-pascals)

ENVIRONMENTAL

This equipment is designed for outdoor use in wet locations

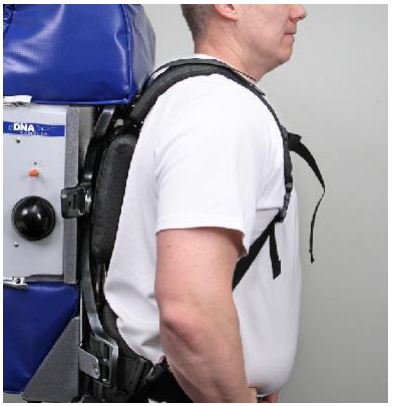
Ambient operating temperature:	0 - 40 C
Relative humidity:	10 - 95% non-condensing
Ingress protection:	IP65
Operating altitude:	0 - 3000m

PACKFRAME ADJUSTMENT

For maximum stability and comfort, adjustment points should be tightened enough that the backpack doesn't move independently of your body while walking. When worn correctly, the pack frame should be upright when you are standing; neither leaning in towards your shoulders nor leaning out away from your shoulders. To adjust the pack frame for proper weight distribution and comfort, follow these procedures:

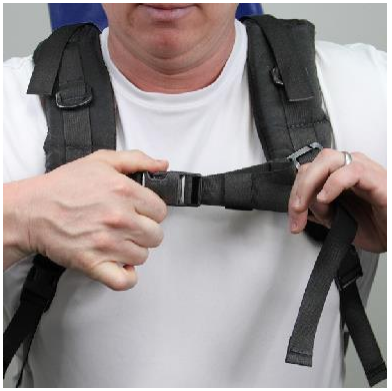
1. Adjust the shoulder strap tension straps tight enough that the area of webbing will remain behind the padded portion of back.

2. Loosen all straps to allow for ease of entry into the suspension
3. Place backpack on person
4. Secure Hip Belt and tighten to point where most of the weight of the backpack is carried on the hips. When properly worn, these help in reducing shoulder fatigue by transferring the burden of carrying the load to your legs.
5. Adjust the Shoulder Strap Adjuster. These keep the shoulder straps in place. Too loose, the backpack slides towards your bottom. Too tight and the shoulder straps bite through your shoulders.

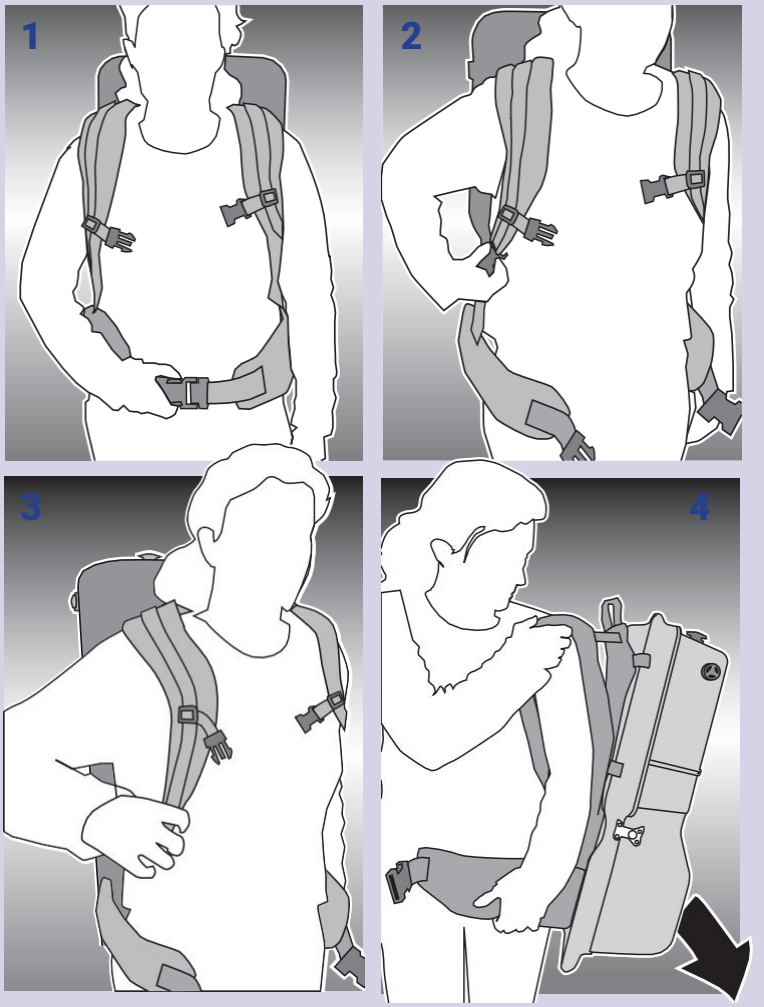


6. Adjust the Load Adjuster Straps. These straps are often ignored at their peril. These, help shift the load of the backpack to the right parts of your body. Tighten or loosen them to make the backpack sit snugly on your body.

7. Secure and adjust the Sternum Strap. Sternum straps ease the pressure on your shoulders.



⚠ CAUTION: Always unlatch the sternum strap of the pack before entering or crossing water. If left latched, this strap may prevent the user from quickly removing the Sampler unit in the event of an emergency, such as falling into deep water.



It may be necessary in some circumstances to remove the eDNA Sampler backpack quickly. The unit includes an integral quick release pack frame. By pressing the latch tabs on the waist belt and shoulder straps, the entire unit falls away. **This should only be done in an emergency situation!**

STEPS:
1: unlatch waist-belt; 2: unlatch shoulder strap; 3: carefully shrug unit off shoulder; 4 let it drop free.

BATTERIES

⚠ CAUTION: Failure to use this equipment in a manner consistent with the guidance provided in this manual may reduce the protection provided by this equipment.

The eDNA Sampler uses a 12 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, then removed from charger.

BATTERY CHARGING: For the remote control, use only the charger provided with the remote batteries for recharging.

For sealed lead-acid batteries, use only chargers designed for charging sealed 12V lead-acid batteries with a maximum charging rate of 4 amps or less.

For Lithium Iron Phosphate batteries, use only chargers designed for Lithium Iron Phosphate batteries with a cutoff of 14.6V and a maximum charge rate of 4.8 amps.

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 unit. If the battery is not taking a charge, it will not operate the unit 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, and every three months if unused.

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 Smith-Root 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 times are appropriate.

BATTERY TIPS & PRECAUTIONS

- Keep the battery charged! The most frequent cause of battery failure is not recharging after each use.
- Extreme temperatures kill batteries. Avoid storage in exceedingly warm, or cold 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.
- Avoid heavy vibrations or shocks, which may cause internal damage. Foam packing is cheap insurance.
- Avoid contact with oils or solvents which may attack the battery case (ABS plastic resin). Clean with soap and water only.
- Do not crush, incinerate or dismantle the battery. The electrolyte contains sulfuric acid which can cause serious damage to eyes and skin. Dispose of old batteries at a battery recycler.
- Do not leave battery on charger for extended periods of time when battery reaches a full charge.

BATTERY STORAGE INSTRUCTIONS

Fully charge batteries before placing in storage. As these batteries will self discharge, we recommend that they be recharged after 3 months of storage.

Batteries removed from storage should be recharged prior to placing back in service.

When not in use, store the charger indoors in a cool dry place.

MAINTENANCE AND CLEANING OF CHARGER

1. Very little maintenance is required other than protecting the charger from damage and weather.
2. Coil cord when not in use.
3. Clean case and cords with a slightly damp cloth.
4. Examine cords for damage periodically and replace if necessary with manufacturer approved parts.

Shipping: Lead-Acid 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. Lithium batteries are only acceptable on ground transport.

Reference: I.A.T.A. Dangerous Goods Regulations, 35th Edition, Jan 1, 1994 Section 4.4, Special Provisions.

BATTERY RATING

(The following deals with lead acid batteries) Batteries are rated at the current which will reduce the voltage per cell to 1.67 volts in 20 hours. The heavyweight battery has a 12 amp hour rating. However its life at 100 watt continuous discharge would be only 120 minutes. As the discharge current is increased, the efficiency and relative capacity decreases (Fig. Bat.1).

Life	Load	Capacity
20 hr	0.60A	12.0Ah
10 hr	1.05A	10.5Ah
5 hr	1.95A	9.7Ah
1 hr	7.20A	7.2Ah
30 min	12.00A	6.0Ah
15 min	20.00A	5.0Ah

Fig. Bat.1 Relative capacity of 12Ah deep cycle battery.

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 extreme temperatures.

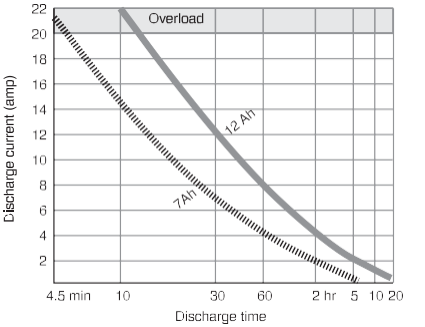


Fig. Bat.2 Discharge curves for 12Ah and 7Ah batteries.

BATTERY STORAGE

Batteries stored at room temperature will self-discharge at 3% to 6% per month. Storage temperature above 20°C (68°F) should be avoided. Shelf life can be increased by storing in a climate-controlled environment. Batteries should be fully charged before storing and should be recharged every three months.

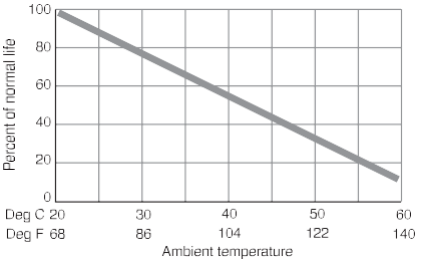


Fig. Bat.3 Effect of temperature on battery life.

EFFECTS OF TEMPERATURE

The temperature at which a battery is used also affects the relative capacity of the battery. In cold weather the run time will be less and the battery will have less capacity (Figs. Bat.3 & Bat.4).

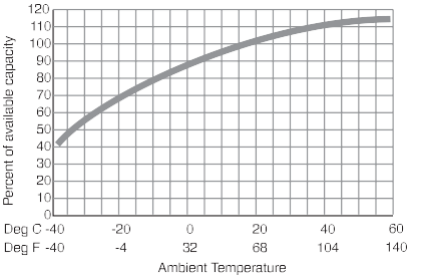


Fig. Bat.4 Effect of temperature on capacity.

LITHIUM IRON PHOSPHATE BATTERIES

ADVANTAGES:

- Much lighter than lead-acid batteries.
- Longer service life, i.e. more charge/discharge cycles.
- Much lower self-discharge rate than lead-acid batteries.
- More environmentally friendly; no lead, no acid, and no explosive gasses during charging.

Each of our lithium batteries contain a battery management circuit that monitors the condition of each individual cell. During charging, the management circuit works to distribute an even charge in each cell of the battery. During discharge, if the voltage of a single cell in the battery drops too low, the management circuit turns the battery off, helping to maximize the cycle life of the battery.

SERVICE LIFE:

Batteries that have been properly maintained should last several years depending on ambient temperature, depth of discharge (D.o.D) and number of cycles. The battery manufacturer rates these batteries for 600 cycles at 100% D.o.D. or 1000 cycles at 60% D.o.D., and 1500 cycles for 30% D.o.D. Battery temperatures above 40C, (104F) will reduce battery life slightly. Battery temperatures above 60C, (140F) will significantly reduce battery life. Batteries which have reached their end of life condition may still be useful where shorter operating time is acceptable.

SHIPPING:

When packaged for transport, the terminals must be protected from short circuit and movement that can cause a short circuit.

Shipping of these batteries requires special package labeling that may vary slightly from shipping company to shipping company. Check with your preferred shipper for their requirements.

Shipping of these batteries by air requires special training and certification as well as special packaging due to their IATA classification as “dangerous goods”. It is illegal to transport or attempt to transport these batteries on a passenger aircraft.

TIPS AND PRECAUTIONS:

Lithium Iron Phosphate batteries have a much lower self-discharge rate than lead-acid batteries. They do not require recharging during storage more than twice per year.

Remove them from the charger as soon as the charger indicates the battery is charged. Consistently overcharging these batteries may damage them and reduce their useful life. Recharge stored batteries before taking them into the field.

Heat kills batteries. Avoid storage in exceedingly warm areas and avoid leaving lithium batteries in a vehicle on hot days. 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 temperatures. Do not operate Lithium Batteries at a battery temperature above 60 degrees C.

Avoid heavy vibration or shock which may cause internal damage. Foam packaging is cheap insurance.

Avoid contact with oils and solvents which may attack the battery case (ABS plastic resin). Clean with soap and water only. These batteries are NOT GUARANTEED TO BE SEALED AGAINST LIQUID INCURSION. Avoid submerging these batteries. Do not crush, incinerate, or dismantle the battery. Dispose of old batteries at a battery recycler.

CAPACITY:
The 12V 9.6Ah lithium battery falls between the 12Ah heavy duty lead-acid battery and the 7Ah standard lead-acid battery Smith-Root offers.

RECHARGING:
Batteries should never be allowed to remain in a discharged state. Recharge as soon as possible after each use, even if the battery is only slightly discharged (these batteries do not have a memory). The total number of charge/discharge cycles varies inversely with the 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. Recharging with the Smith-Root supplied lithium battery charger is automatic and consists of two stages:

The recommended charge current is 4A and the cutoff is at 14.6V

STAGE 1- Constant Current Mode. The charger starts with maximum current until the battery reaches a preset voltage at about 80% of capacity.

STAGE 2- Timed Constant Voltage Mode. In this mode the charger maintains the same voltage on the battery while the charging current tapers down. Once the charger indicates the battery is fully charged remove the battery from the charger.

⚠ WARNING: DO NOT CHARGE LITHIUM BATTERIES WITH A LEAD-ACID BATTERY CHARGER. Doing so may result in over-charging and possible battery damage and reduced battery life.

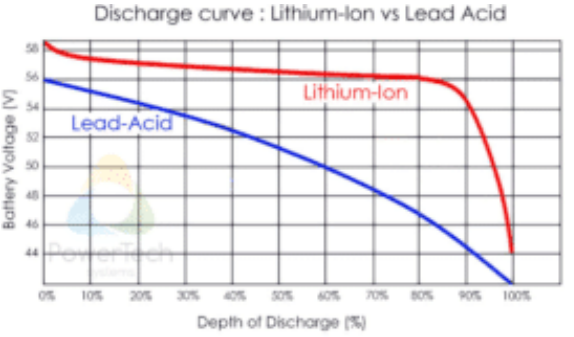
Smith-Root lithium battery chargers provide full electronic protection against short circuit and reverse battery connection.

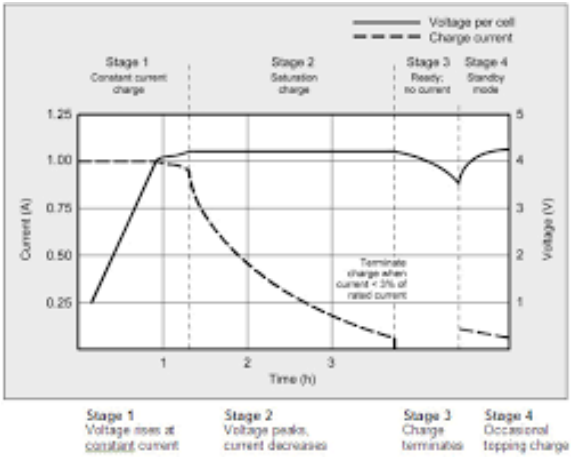
Time to recharge will vary depending on the state of charge and condition of the battery. It will typically take 6 or 7 hours to recharge a fully discharged 9.6Ahr battery. Do not leave the battery connected to the charger overnight or over a weekend. This may result in over-charging of the battery and possible damage to the battery and reduced battery life.

⚠ WARNING: Lithium batteries are not sealed. Do not submerge lithium batteries in liquids.

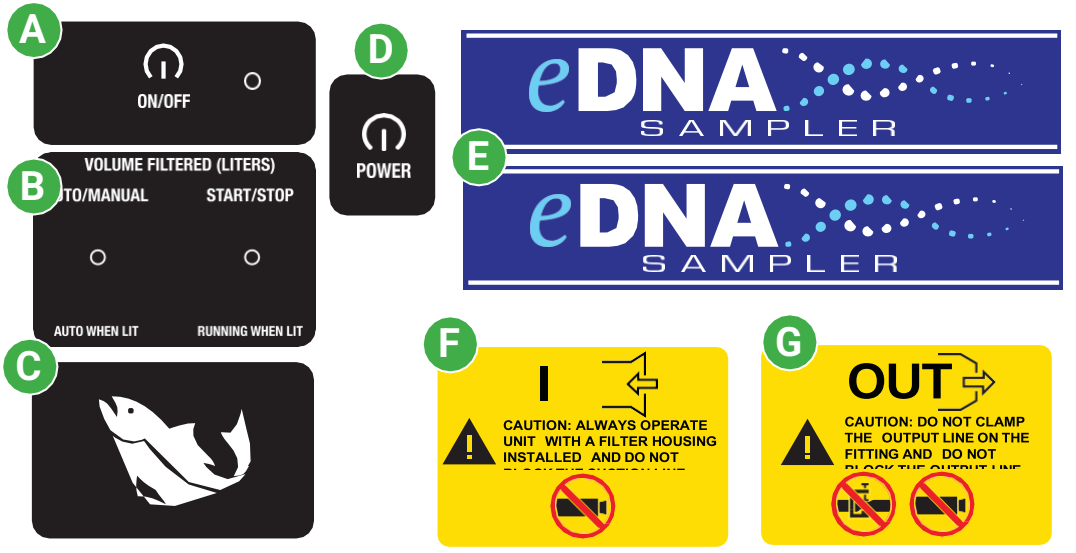
STORAGE:
All batteries self-discharge during storage. Lithium batteries have very low self-discharge rates. Fully charge the batteries before storing. We recommend they be recharged once every 6 months of storage at 20 degrees C. Storing batteries at temperatures above 40C can reduce their cycle life and increase their self-discharge rate. Batteries store better at low temperatures. Ideal storage temperatures are between 0 to 4 degrees C. Do not expose these batteries to temperatures below -20 degrees C. Batteries removed from storage should be recharged before being placed back into service.

DISPOSAL:
All batteries are subject to disposal and recycling regulations that very by country and region. Always check and follow your applicable regulations before disposing of any battery. Contact your local battery recycling organization or return to Smith-Root for recycling.





UNIT DECALS



A. ON/OFF, remote unit
B. Controls, remote unit
C. Logo, remote unit
D. Power switch, control box
E. Side markers, control box
F. Inlet, warnings - control box
G. Outlet, warnings - control box
H. Battery warning, tray
I. Battery terminal label
J. Power specs, control box
K. Power specs, remote unit
L. Cal. Prop 65

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