AQUA RESEARCH

STREAM™

Disinfectant Generator Operation and Maintenance Manual

Revision K, July 2025

STREAM™ Disinfectant Generator

Operation and Maintenance Manual

Aqua Research, Inc. maintains a constant product improvement program that may affect design and/or specifications. The company reserves the right to make these changes without prior notice or liability. It is the responsibility of the operator to ensure that the STREAM™ disinfection unit is properly operated in accordance with the instructions in this manual. Aqua Research certifies this product was tested thoroughly, inspected, and found to meet specifications when it was shipped from the factory.

STREAM™ SYSTEM SPECIFICATIONS

FAC Capacity, lbs/day (kg/day) *[1]	1.25 (.55 kg)
Water treated at 2.5 ppm[2] (gal/day)	60,000 gallons (230,000 liters)
Power at Cell	0.12 kW
Power to Unit, DCV	12 V DC @ 1 7A [4]
Power to Unit, ACV	110/220, 2A
Hertz to System[3]	50 or 60
Phase[4]	Single
Approx. Salt Used per Hour, lbs (kg)[5]	0.16 (.07)
Flow Rate, Gallons/hr (Liters/hr)	1.25 (4.8)
Air Temperature Requirements (°F)	35°F (2°C) to 110°F (43°C)
Water Temp. Requirements (°F)	50°F (10°C) to 100°F (38°C)
Shipping Weight, lbs (kg)	18 (8.2)
Shipping Size (W x D x H) (inches)	16.5" x 13" x 7" (419mm x 330mm x 178 mm)

[1] Free Available Chlorine (FAC) is the sum of hypochlorous acid (HOCl) and hypochlorite ions (OCl-) in solution, measured by standard FAC analysis. Systems are tested using softened Albuquerque city water, which is considered to be very high quality.
[2] The nominal chlorine concentration is 5,000 mg/l.
[3] The operating frequency range is 47 to 63 Hertz.
[4] The power supply is IP65, essentially dust proof and splash resistant.
[5] The STREAM™ System needs a separate reservoir of salt water (brine) that is prepared manually and also needs a separate container to hold the chlorine-based mixed oxidant produced by the system.

WARNINGS AND PRECAUTIONS

The following WARNINGS and PRECAUTIONS must be heeded:

- The chlorine-based mixed oxidant solution is a disinfectant – NOT DRINKING WATER – and therefore should NOT be consumed without diluting it with water. Aqua Research, Inc. equipment is also not a desalinization device for making fresh water from salt water, but instead uses salt water in making the oxidant solution (a disinfecting solution).
- It is critical to use the correct amount of oxidant in the raw water in order to adequately remove any water-borne microorganisms that may cause illness or death. Before installing or operating the STREAM™ system, the factors described in *Section 2.3. Generation and Use of Oxidants* must be measured so that the correct Concentration x Time (CT) values can be calculated. Water systems that have seasonal variations in the water quality should obtain a series of measurements and use those measurements taken while water quality is the worst in calculating the proper mixture of oxidants. Measurements can usually be obtained from governmental health authorities, a licensed professional engineer, or water analysis laboratories. Calculating CT values should be done by a competent health professional, professional engineer with water systems expertise, or other such competent professional. It is the operator's responsibility to ensure adequate dosing and maintenance of a chlorine residual in the water distribution system.
- If the disinfection site is not adequately secured from tampering, dangerous substances not associated with the STREAM™. System can be introduced into the system, which could cause illness or death.

- The oxidants collected should be used as quickly as possible in treating raw water to gain the maximum benefit of their disinfectant power. If chlorine-based mixed oxidant is stored for more than 30 minutes before use, it should be stored in a dark, covered container. Containers for storage should be plastic and well-sealed. Chlorine-based mixed oxidant that has been properly stored for up to 21 days can be used for disinfection.
- Remember to always add acids/bases into water–NEVER ADD WATER INTO ACIDS/BASES.
- Use rubber gloves and safety goggles when working with acids.
- Flushing the cell with fresh water and draining it after use will prolong its productive life.

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury

WARNING! **Indicates a potentially hazardous situation that could result in death or serious injury**

CAUTION! **Indicates a potentially hazardous situation that may result in minor or moderate injury**

NOTE

Information that requires special emphasis

TABLE OF CONTENTS

ACRONYM LIST

AC	Alternating Current
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
CT	Concentration x Time
DC	Direct Current
FAC	Free Available Chlorine
ID	Inside Diameter
MCL	Maximum Contaminant Level
NC	Normally Closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NPT	National Pipe Thread
NSF	National Sanitary Foundation
OD	Outside Diameter
ORP	Oxidant Reduction Potential
RCRA	Resource Conservation and Recovery Act
RMA	Return Materials Authorization
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
UL	Underwriters Laboratory
US EPA	U.S. Environmental Protection Agency
VAC	Volts Alternating Current
VDC	Volts Direct Current

STREAM™ Disinfectant Generator Version K Operation and Maintenance Manual

1 Regulatory Compliance

EPA Registration – Aqua Research, Inc. is registered with the US EPA Office of Pesticide Programs. The US EPA company number is 90215, establishment number 90215-NM-1.

U.S. Environmental Protection Agency (US EPA) – Chlorine-based mixed oxidants (referred to herein as oxidant) are listed as a compliance technology for water disinfection. To be listed as a compliance technology, the system must be affordable and achieve compliance with the maximum contaminant levels (MCLs), and the operator must be capable of installing and reliably operating the technology. The oxidant category was added to this list in the Federal Register in 1997.

NSF International – Aqua Research, Inc. maintains a policy of verification and compliance of disinfection technology for water applications. The certification process is ongoing for the complete line of Aqua Research, Inc. products. For details of

specific NSF standards for specific Aqua Research, Inc. equipment, please consult Aqua Research, Inc. NSF listings can also be obtained through NSF International at (800) NSF-MARK, or their web site at www.nsf.org.

State Approvals – Aqua Research, Inc. maintains a policy of obtaining state regulatory approval in all states where all disinfection equipment is installed and operating.

USAID Environmental Assessment Study – Available upon request.

2 Introduction/Background

2.1 The Electrolysis Process

STREAM™ is a system that produces a chlorine-based mixed oxidant disinfecting solution (referred to herein as oxidant) by electrolyzing salt water (brine). A solution of brine is mixed by combining salt and water *(see Sections 2.2, 5.2)*, which is then pumped through the electrolytic cell. An electric current is passed through the brine inside the cell, producing strong oxidants which are discharged at the top of the cell and collected into a holding tank until they are mixed with untreated water. More energy is added to the process in order to produce not only chlorine but other oxygen species. Studies have shown that the other oxidant in the solution is a small amount of peroxide. The combined oxidants in the solution are more effective than chlorine alone. Studies conducted by the US Environmental Protection Agency (EPA) show that neither chlorine dioxide nor ozone are produced.

2.2 Water Quality Parameters for the Brine

The water used to make the brine solution should be tested prior to use to determine the

Total Hardness of the water in mg/l. A Total Water Hardness test strip is included in the STREAM™ System black mesh bag. To increase the life of the system and minimize maintenance of the electrolytic cell and plumbing fittings, a Total Water Hardness of less than 1gr (17.1 mg/l) hardness is recommended. Reverse Osmosis (R/O) water or ion exchange softened water has a Total Water Hardness of less than 1gr (17.1 mg/L) and is highly recommended for use when making the brine solution. Rainwater or surface water sources are highly recommended in lieu of bore hole water. If R/O water or softened water are unavailable to make the brine solution, it will be necessary to clean the system every 40 hours of operation, following section *7.1.6 - Acid Washing the Cell.*

2.3 Generation and Use of Oxidants

The oxidants produced by the STREAM™ system can be added to untreated water in proper amounts to disinfect the water by killing or inactivating water-borne microbes.

CAUTION!

The oxidant solution is a disinfectant –NOT DRINKING WATER–and therefore should not be consumed without diluting it with water. Aqua Research, Inc.'s equipment is also not a desalinization device for making fresh water from salt water, but instead uses brine in making the oxidant solution (a disinfecting solution).

Determining the correct amount of oxidant necessary to disinfect the untreated or "raw" water is dependent upon several measurable factors including:

1. Types and amounts of microorganisms in the water

2. Water quality and chemistry – measures the turbidity and color, total organic carbon (TOC), pH, total dissolved solids (TDS), hardness, and biological or chemical oxygen demand (BOD or COD)
3. Oxidizable materials such as iron and manganese in the raw water
4. Physical characteristics such as temperature
5. Residence time in the line – that is, the time between when raw water is treated and when it is ready for use

WARNING!

It is critical to use the correct amount of oxidant in the raw water in order to adequately remove any water-borne microorganisms that may cause illness or death. Before installing or operating the STREAM™ System, the factors described in the preceding four points must be measured so that the correct Concentration x Time (CT) values can be calculated. Water systems that have seasonal variations in the water quality should obtain a series of measurements and use those measurements taken while water quality is the worst in calculating the proper mixture of oxidants. Measurements can usually be obtained from governmental health authorities, a licensed professional engineer, or water analysis laboratories. Calculating CT values should be done by a competent health professional, professional engineer with water systems expertise, or other such qualified professional. It is the operator's responsibility to ensure adequate dosing and maintenance of a chlorine residual in the water distribution system.

3 STREAM™ System

The STREAM™ System (*See Figure: 1. STREAM™ System*) produces a strong disinfectant

solution by pumping brine into the electrolytic cell with a small pump. The brine solution is drawn from the brine tank through the brine filter. The oxidant solution flows from the cell into a holding tank or into the raw water. Electrical power can be obtained from a commercial source (110/220 VAC, 50/60 Hz), from a generator, or 12 VDC from a solar panel or a car battery.

Figure 1. STREAM™ System

3.1 Applications

The STREAM™ System is generally adaptable to water that requires disinfection or surfaces requiring sanitation. When properly installed and operated, the STREAM™ can be used for:

1. Point-of-use disinfectant generation for surface sanitization
2. Disinfection of drinking water up to 230,000L per day at 2.5 mg/L dose

3.2 General STREAM™ System Components

The STREAM™ System is to be operated by individuals familiar with its operation. The following basic components are included in the STREAM™ System:

- **STREAM™ Electrolytic Cell**

Electrolyzes brine into oxidants. Manufactured by Aqua Research, Inc., the oxidant cell operates on 12 VDC potential. The positive lead (red) is connected to the anode side (top connection) and the negative lead (black) is connected to the cathode side (bottom connection). *See Figure 2.*

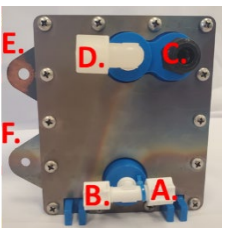


Figure 2. STREAM™ Electrolytic Cell

A. Brine Inlet – brine enters the cell.
B. Rupture disc outlet – tubing leads to the rupture disc union designed to protect the cell from over pressure or overheating.
C. Temperature sensor housing – houses the temperature sensor and monitors oxidant temperature protecting the cell.
D. Oxidant outlet port – oxidant exits the outlet port and is stored in the oxidant storage container.
E. Anode – electrolytic cell electrode, orientation and coated surface is very important. Do not scrape off the black coated surface.
F. Cathode – electrolytic cell electrode, orientation is important to ensure the cell functions properly.

- **Brine Circulating Pump**

Peristaltic pump that rotates in a clockwise direction to pump brine into the cell. *See Figure 3.*

G. Brine inlet tubing into the pump.
H. Brine outlet tubing going to the electrolytic cell.

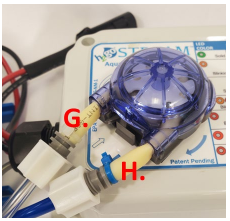


Figure 3. Brine Circulating Pump

- **Power Supply**

110 or 220 VAC auto-ranging, 50 or 60 Hz, 12 VDC output. *See Figure 4.*

I. Electrical plug connect to 110 or 220 VAC.
J. Surge protector – protect from electrical power fluctuations.
K. Power supply delivers 12 volts power to the control box.
L. Power connector from the power supply to the control box.

Figure 4. STREAM™ Power Supply

- **Control Box**

Houses the control board and electronics. *See Figure 5.*

Figure 5. STREAM™ Control Box

M. On/Off Button – turns the system on/off. Ring around the button gives status information.
N. Control box connector. The connector connects the control box to the power supply or to the optional battery power supply.
O. Wire harness connecting the power supply to the control box and control box to the electrolytic cell.

- **Pelican Case and Accessories**

Other STREAM™ components. *See Figure 6.*

Figure 6. STREAM™ Case and Accessories

P. Pelican STREAM™ case.
Q. Black mesh bag – houses accessories.
R. Brine mixing chart, and oxidant dosing chart
S. Jumper cables – supply power to the STREAM™ system from 12DC power supply, car battery.
T. Brine suction strainer – attach to the brine inlet tubing. Place in the brine tank. NOTE: Make sure not to lose the small ferrule fittings that seal the tubing.
U. Syringe – used to treat water with the appropriate volume of oxidant.
V. Power adapter – power adapter used to connect STREAM™ to alternative AC power sources.

W. Chlorine test strips – used to monitor the chlorine level in treated water used for drinking water.
X. Salt storage container – used to store salt.
Y. Measuring cup – used to measure salt.
Z. Total water hardness test strip – used to measure the total water hardness in source water used to generate brine .
AA. Manual – read before use.
AB. Replacement peristaltic tube – back up replacement.

- **Rupture Disc Union**

Houses the rupture disc. *See Figure 7.*

AC. Rupture disc union – attached to the ¼" OD tubing coming off the bottom side of the electrolytic cell.
AD. Rupture disc - .002" Teflon disc used to protect the cell from overpressure and overheating.

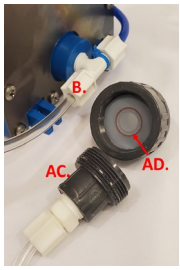


Figure 7. STREAM™ Rupture Disc Union

The following components are <u>not included</u> as part of the STREAM™ System but can be purchased separately or found locally:

AE. **Brine Tank** - sized to meet site requirements. Typically, a 5-gallon bucket, or a purchased brine tank from Aqua Research, Inc. *See Figure 8.* See *Appendix A Spare Parts and Optional Components*.

Figure 8. Brine and Oxidant Tank

AF. **Oxidant Day Tank -** The oxidant day tank collects disinfectant and is sized appropriately to meet the system configuration, demand, or availability. Typically, a 5-gallon bucket. This container should be the same size or larger

than the brine tank and should be dark to protect from UV rays. The STREAM™ System will operate automatically until the brine tank is empty, so the oxidant tank needs to be sized to hold the full capacity of the brine tank. An oxidant tank can be purchased from Aqua Research, Inc. See *Appendix A Spare Parts and Optional Components*.

Solar Option

Goal Zero Yeti 1400 Solar Power Unit and 2 – Boulder 200 brief case solar panels or equivalent. The power unit and solar panels will operate the STREAM™ System in remote locations or during natural disasters by using only solar power. See *Appendix A Spare Parts and Optional Components*.

4 Installation Guidelines

The STREAM™ System has been factory tested and must be operated by individuals familiar with the system.

4.1 Required Equipment

The tools and equipment needed to operate the STREAM™ System may vary from site to site depending on plumbing and electrical conditions.

- Brine tank – 20 liter (5 gal.) bucket
- Oxidant tank – 20 liter (5 gal.) bucket
- Salt
- Water – preferably softened or R/O water
- Electricity
- Mixing utensils

4.2 Site Selection

4.2.1 General

The STREAM™ System is portable and the site location will be based on the primary use of the

system. Primary uses include disaster response, healthcare facility sanitation, small community water treatment, and any application where a chlorine-based disinfectant is used. The ideal location will be close to the primary water source used to make the brine solution. For treating drinking water for small community systems, the point of injection is commonly after the system's filter and before the system's water storage tank. For systems that are to be used as a facility's disinfection system in locations such as homes, offices, or factories, the point of use should be between the incoming waterline and the water storage tank. ***It is important that the location of the STREAM™ System be at a point that will give the oxidant the correct contact time with the water before the water is consumed***, as described in *Section 2.3 - Generation and Use of Oxidants*. In addition, the storage tank must be large enough, given the amount of water usage, to provide for adequate contact time.

CAUTION!

The location of the STREAM™ System must be at a point that will give the oxidant the correct contact time with the water before the water is consumed.

4.2.2 Enclosure and Security

The STREAM™ System should be operated in a building that provides shelter from the weather and security from theft or tampering with produced disinfectant. The power supply, controls enclosure box, and electrolytic cell are designed to be resistant to water.

WARNING!

If the disinfection site is not adequately secured from tampering, dangerous substances not associated with the STREAM™ System can be introduced into the system or oxidant tank, which could cause illness or death.

4.2.3 Water Quality, Chemistry, and Hardness

As stated in *Section 2.3 - Generation and Use of Oxidants*, the quality and chemistry of the raw water source must be analyzed to determine the oxidant's ability to provide the desired disinfection. Factors such as pH, hardness, temperature, microbial types, turbidity, and oxidizable materials in the water (like iron and manganese) vary greatly, affecting the oxidant demand of each individual water disinfection site. These factors should be analyzed to calculate the appropriate injection rate. Oxidant demand can only be accurately determined through an oxidant demand test. The treated water can also be checked with a chlorine test kit, test strips, or even small test kits used for swimming pools. The residual chlorine value in the treated water should be at least 0.2 mg/l but may be as high as 4 mg/l. Water quality can vary from season to season, so it is important that the "worst case" measures are used in calculating the injection rate when the STREAM™ System is intended for disinfection at a fixed location for long periods of time. For emergency applications or disaster relief, these parameters may not be important. A constant water source like well water will probably have the same water quality year around, and the injection rate will probably be the same year-round.

If the water that is used to make the brine solution has a total hardness greater than 1 grain (17.1 mg/l), then it will be necessary to clean the unit every 40 hours of operation by using a mild

acid such as 5% vinegar, 30% cleaning vinegar, or a stronger acid such as muriatic acid (diluted hydrochloric acid). The system can be cleaned by following *Section 7.1.6 - Acid Washing the Cell*.

Refer to *Table 1. Water Quality Parameters* for other parameters that affect system performance. Most of these parameters will be below the limits at any given water system, but should be checked nonetheless. If a value is exceeded, it is possible the substance can be removed. Otherwise, system performance or lifetime may be adversely affected, or injection rate of the oxidant may need to be adjusted. Each parameter is marked according to whether it affects oxidant demand, FAC production, or cell life.

Table 1. Water Quality Parameters

	MEASURE	LIMIT	WHAT IS IMPACTED		
			Oxidant Demand	Chlorine Production	Cell Life
TDS	mg/l	*		√	
Alkalinity	mg$CaCO_3$/l	*		√	
Total Hardness**	grains/gal (or mg/l)	< 1 grain (17.1 mg/l)		√	√
Iron (Fe)**	mg/l	< 1 mg/l	√		√
Manganese (Mn)**	µg/l	< 50 µg/l	√		√
Fluoride (Fl)	mg/l	< 1 mg/l			√
Silica (SiO_2)	mg/l	< 1 mg/l		√	√
Bromide	mg/l	< 50 mg/l			√
Cyanide	mg/l	< 1 mg/l			√
Lead (Pb)	mg/l	< 2 mg/l			√
Tin	mg/l	< 20 mg/l			√
Hydrogen Sulfide (H_2S)	mg/l	****	√		
Total Organic Carbon (TOC)	mg/l	****	√		
Ph	-	5 - 9	√	√	√
Water Temperature Max.	°C or °F	< 38°C (100°F)	√	√	
Water Temperature Min.	°C or °F	> 10°C (50°F)	√	√	√

* If the TDS > 200 or Alkalinity > 400, then chlorine production could be impacted. Use of a de-alkalizer (anion resin) may be needed.

** Cation water softeners will remove these components up to a limit.

*** Total hardness affects cell life only in that higher hardness requires acid washing to remove carbonate deposits from the cell. Use of water softened to < 1 grain hardness will significantly reduce acid washing of the cell.

**** Oxidant demand is affected by any level of H_2S or TOC.

4.2.4 Electrical Power

All of the components of the STREAM™ System operate on 12-volt DC power. The system includes an auto-ranging power supply that can accommodate 100 to 240 VAC, 50 or 60 Hertz, single-phase power. When the unit is plugged into a power source, the power supply automatically adjusts to the power source and provides 12 volts DC to the components. International adapter plugs can be used with the power outlet plug that comes standard with the unit.

To connect to a 12-volt power supply, such as a car battery, disconnect the electrical connector between the power supply and the control box and reconnect to the jumper cables. *See Figure 9*. Do not exceed 16 volts direct current (VDC) on the system. If this voltage is exceeded, the system will shut down in order to protect the internal circuitry. Normally, 16 VDC will not be exceeded when connected to a car battery with the car engine running.

Figure 9. Electrical Connectors

4.2.5 Optional Solar Panel Power

An optional solar panel package can be purchased to operate the STREAM™ System. The Goal Zero Yeti 1400 with 2 Boulder 200 briefcase solar panels can operate the STREAM™ System for 2 to 8 continuous hours, depending on the solar

insolation, generating a minimum of 20L of 5,000 ppm oxidant solution per day. See *Figure 10.*

Figure 10. Goal Zero Yeti 1400 with 2 Boulder 200 Briefcase Solar Panels

To operate the STREAM™ System with the Goal Zero Yeti 1400 and 2 Boulder 200 briefcase solar panels, plug the electrical plug into the 110 VAC outlet on the Goal Zero Yeti 1400. Position the 2 Boulder 200 solar panels for maximum solar insolation. Monitor the power in, battery percentage, and power out on the Goal Zero display screen.

5 Initial System Set Up and Operation

5.1 Unpacking the STREAM™ System

The STREAM™ System is self-contained with the inlet and outlet tubing connected to each other end to end, creating a closed circuit to eliminate leaking during storage.

Figure 11. STREAM™ System

1. Open the STREAM™ sytem case. *See Figure 11.*
2. Release the power cord and clear plastic tubing from the back of the case. *See Figure 12.*
3. Unwrap the clear plastic tubing.

Figure 12. Release Power and Tubing

4. Disconnect the small tube from the large tube at the connector (red oval in *Figure 13*) by unscrewing the plastic nut on the small tubing side.

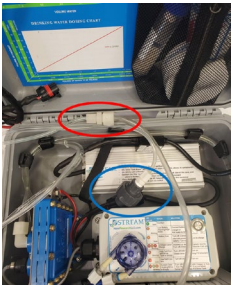


Figure 13. Release the Tubing, and Rupture Disc

CAUTION: Do not let the small plastic ferrules come off of the tubes. *See Figure 14.*

Figure 14. Unscrew ¼" fitting keeping threaded adapter with the hose

5. Attach the brine suction strainer (stored in the black mesh bag attached to the system case) to the small tube by screwing the plastic nut onto the brine strainer's fitting. *See Figure 15.*

Figure 15. Brine Suction Strainer Connected to ¼" Tubing

6. Place the small tube with the brine suction strainer and attached rupture disc assembly (blue oval in *Figure 13*) into the brine solution bucket. (Refer to section 5.2 for making the brine). *See Figure 16.*

Figure 16. Brine Suction Strainer with Rupture Disc.

7. Take the larger tube and place it in the oxidant tank. NOTE: Ensure that the oxidant bucket/tank is the same size or larger than the brine bucket.

Figure 17. Oxidant Outlet Tubing

5.2 Mixing the Brine Solution

A brine solution of 5.0% saturation (15 grams of salt per liter of water, 15 gr/l) should be used to operate the STREAM™ system.

Brine Water Quality –
Water that is low in calcium carbonate is strongly recommended for brine makeup. The best water to use is surface water such as:

- Rainwater (water from a rainwater collection system)
- Lake water
- River or stream water
- Distilled water
- Water from a water softener, reverse osmosis system, or nano-filter system. Small reverse osmosis or nano-filter systems such as those for household use are low cost and easy to set up with no electrical power required.

Verify the water is "soft" – low in calcium carbonate scale forming agents – by using the hardness test strip in the black mesh bag. Pass the test strip under a stream of sample water for 1 second, remove the test strip and shake off excess water, and wait 15 seconds. Compare the color on the test strip to the color chart on the test strip package.

Using hard water will damage the electrolytic coating on the cell electrodes. Regular cleaning

will be required if using hard water. *Refer to section 7.1.6 on Acid Washing the Cell.* Permanent damage to the cell due to scale formation is not covered under the warranty.

Salt Quality for Brine –
The salt quality should be the best quality available (99.7% or greater NaCl), with no more than 0.03% Ca, 0.02% Mg, and 0.005% Mn. Poor quality salt can work but may decrease free chlorine production and increase maintenance.

To mix a 20-liter brine solution follow the following steps:

1. Fill the bucket with 20L of water.
2. Add 300 grams of salt.
3. Stir until the salt is dissolved.

The following chart can be used to mix other brine volumes.

Table 2. Brine Solution Mixing Table

Water		Salt					
Liters Water	Gallons Water	Grams	Ounces Weight	Ounces Volume	Milliliters Volume	Lbs	Kg
1	0.3	15	0.5	0.4	12	0.03	0.02
2	0.5	30	1.1	0.8	23	0.07	0.03
3	0.8	45	1.6	1.2	35	0.10	0.05
4	1.1	60	2.1	1.6	47	0.13	0.06
5	1.3	75	2.6	2.0	58	0.17	0.08
6	1.6	90	3.2	2.4	70	0.20	0.09
7	1.9	105	3.7	2.8	82	0.23	0.11
8	2.1	120	4.2	3.2	93	0.26	0.12
9	2.4	135	4.8	3.6	105	0.30	0.14
10	2.6	150	5.3	3.9	117	0.33	0.15
15	4.0	225	7.9	5.9	175	0.50	0.23
20	5.3	300	10.6	7.9	233	0.66	0.30
25	6.6	375	13.2	9.9	292	0.83	0.38
30	7.9	450	15.9	11.8	350	0.99	0.45
40	10.6	600	21.2	15.8	467	1.32	0.60
50	13.2	750	26.5	19.7	584	1.65	0.75
60	15.9	900	31.7	23.7	700	1.98	0.90
70	18.5	1050	37.0	27.6	817	2.31	1.05
80	21.2	1200	42.3	31.6	934	2.64	1.20
90	23.8	1350	47.6	35.5	1051	2.97	1.35
100	26.5	1500	52.9	39.5	1167	3.30	1.50

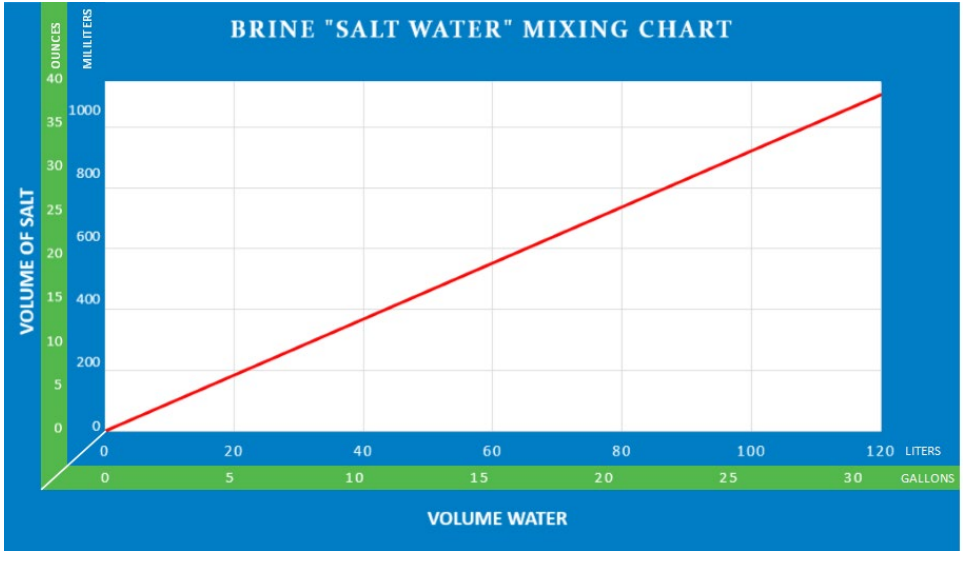


Figure 18. Brine Solution Mixing Chart

5.3 Checks Prior to Start-Up

Prior to turning on the STREAM™ System, the following items should be checked:

1. The power cord should be connected to the appropriate power source.
2. The brine tank should be full of brine, mixed with the correct ratio of salt and water. See *Table 2. Brine Solution Mixing Table* to determine mixing ratios. (Note that the mixing table is also on the inside lid of the system case.)
3. To begin operation, ensure that the brine strainer is submerged in the prepared brine solution and turn on the STREAM™ System. The strainer is weighted to hold it down in the brine solution. The pump is self-priming. Completely submerge the filter in the brine solution to charge the system and begin production of oxidants. A typical installation is shown below in *Figure 19*.

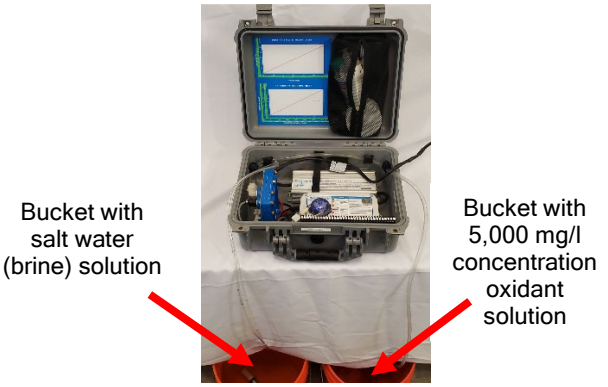


Figure 19. STREAM™ System Installation

5.4 System Start-Up

The system is plugged in to the appropriate power supply. The brine solution is made and the

brine suction strainer is in the brine tank. The oxidant tubing is placed in the oxidant tank.

Figure 20. ON/OFF Button

1. Push the ON/OFF button. A green LED will light up around the ON/OFF button.
2. The pump will begin to turn clockwise and pull brine into the cell. If the system has been emptied since last use, it will take up to 45 seconds for the cell and tubing to fill with brine.
3. Watch the tubing into and out of the cell to ensure that the pump is functioning properly and that brine is being pumped through the cell. If the pump squeals upon start up, the peristaltic pump tubing needs to be stretched. Remove the blue pump cap and remove the pump tubing. Holding firm on each end of the pump tubing stretch the tubing. Replace the tubing back in the pump (make sure to orient the tubing correctly so that the blue tube goes to the cell), and replace the blue cap.
4. After 45 seconds, the system applies power to the cell. The speed of the pump will vary, and bubbles should be visible in the liquid exiting the cell.
5. Oxidant will be produced out of the large tube at the top of the cell and should

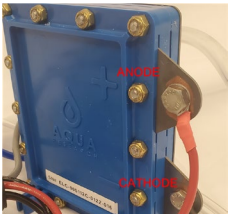


Figure 21. STREAM Electrolytic Cell

be collected in the oxidant tank. The oxidant solution will feel soapy and have a strong "bleach" smell. The electrolytic cell operates on 12 VDC potential. The positive lead (red) is connected to the anode side (top connection) and the negative lead (black) is connected to the cathode side (bottom connection). *See Figure 21.* The resulting amperage achieved by the cell is a function of the brine salinity and should range between 14 and 20 amps.

If a fault condition is indicated, push the on/off button to turn the system off. Resolve the issue by referring to the LED indicator and fault conditions listed below, and turn back on.

5.4.1 LED Indicator and Fault Conditions

The LED indicator light functions are shown below and are also displayed on the top of the control box in the STREAM™ system. The operation chart shows the various fault conditions that can occur and the recommended action to resolve the problem.

LED COLOR	CAUSE	SOLUTION
Solid	On/Run	
Blinking	Low Battery Warning/High Brine	Connect battery charger or Add water to brine
Solid	Battery Low	Turn off–Connect to alternate power source, or re-charge battery–Turn on
Blinking	Voltage Out of Range	Incorrect or discharged power source. Turn off–Check power source–Turn on
Blinking	High Salt Content/Brine Tank is Empty	Turn off-Add Water-Turn on Check brine filter for clog-Fill brine tank
Solid	Low Salt Content	Turn off–Add Salt–Turn on
Blinking	System Over Heating/Brine is Empty	Turn off-Clean Cell with Vinegar or Acid -See Manual. "Ok" if occurs when brine tank empties–Fill Brine Tank

Figure 22. Operational Chart

Aqua Research, Inc. has also prepared video tutorials that are available on Aqua Research - YouTube, as well as on our website at www.AquaResearch.com/video/, or by scanning the following QR Codes:

General Videos:

Figure 23. General Videos

Troubleshooting Videos:

Figure 24. Troubleshooting Videos

Solid GREEN LED light indicates that the brine conductivity is in the correct range and the appropriate amount of amperage is being drawn by the cell.

Blinking AMBER LED light indicates that the power supply connected to the system is running low.

1. Turn off the system.
2. Check the power supply. If using a car battery or solar panel, recharge the battery and reconnect.

Note: In rare cases the blinking AMBER LED can be generated when the brine concentration is too high. Turn off the system, add water to

the brine, and turn it back on. Allow the system to run for 1 to 2 minutes to stabilize.

3. Connect to a different power source, different outlet, car battery or solar panel. Refer to *section 4.2.4.*
4. Turn the system back on.

If the alarm continues – consult with a technician or contact Aqua Research Technical Support.

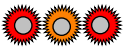
 Solid AMBER LED light indicates that the power supply is too low to operate the system.

1. Turn off the system.
2. Recharge the batteries or connect to a different power supply.

Note: In rare cases the solid AMBER LED can be generated when the brine concentration is too high. Turn off the system, add water to the brine, and turn it back on. Turn the system on until it faults out 2 - 3 times to purge the cell of the high brine solution.

3. Turn the system back on.
4. Allow to run for 1 to 2 minutes to stabilize.

If the alarm continues – consult with a technician or contact Aqua Research Technical Support.

 Blinking RED/AMBER/RED LED light indicates that the power supply connected to the system is out of the allowable voltage range.

1. Turn the system off.
2. Disconnect the power supply. The optimum voltage to operate the system is 12-15VDC.
3. Reconnect to a different power source.

Note: In rare cases the Red/Amber/Red light can indicate that the system has been supplied with overly salty brine or else that power has been applied to the cell with acid in the cell.

1. Flush the cell with clean water.
    a. Place the brine suction strainer in a container of clean soft water.
    b. Turn the system on for 30 seconds.
    c. Turn the system off.
    d. Repeat steps b - c 3 times to make sure the high concentration brine is flushed from the cell.
2. If the issue persists, the system power supply will need to be reset following the steps below.
    a. Remove power to system.
    b. Disconnect cell positive (red) power lead. *See Figure 25.*
    c. Make sure the red power lead stays away from the cell.
    d. Restore power to system.
    e. Turn on system and let it run until shutdown.
    f. Turn the system off.
    g. Repeat steps 2-3 times.
    h. Disconnect power to the system.
    i. Reconnect cell red positive power lead.
    j. Reconnect main power and restart system.

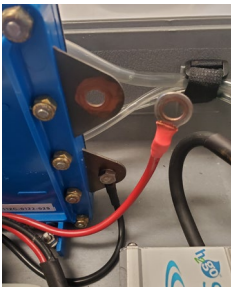


Figure 25. Removing the Red Power Lead

If the alarm continues – consult with a technician or contact Aqua Research Technical Support.

Blinking RED LED light indicates:

- **Brine tank is empty.**
  1. Verify the brine tank is not empty. If so, make new brine solution and restart the system.
- **Brine concentration in the brine tank is too high.**
  1. Add cool water to the brine solution, mix, and restart. Start by adding 10% water of the current volume in the brine tank. For example, if there are 4 liters of brine in the tank, add 400 ml of water to the tank, mix, and restart.
- **Brine temperature is too warm. (Brine solution temperature range is 50°F-100°F (10°C-38°C).)**
  1. Allow the brine solution to cool down, or remake the brine solution using cool water, mix and restart.
- **The rupture disc has popped.**
  1. Replace the rupture disc. *Refer to Section 7.2.1.*
  2. Acid washing the cell. *Refer to Section 7.1.6* for instructions.
  3. Restart the system.
- **Brine suction filter is clogged.**
  1. Clean the brine suction filter.
  2. Verify brine solution is being pulled up through the pump when the system is turned on.

3. Allow the system to run for 1 -2 minutes to stabilize.

If the alarm continues, consult with a technician or contact Aqua Research Technical Support.

 Solid RED LED light indicates:

- **Brine tank is empty.**
  1. Verify the brine tank is not empty. If so, make new brine solution and restart the system.
- **Not enough salt in the brine solution.**
  1. Add salt to the brine solution, mix, and restart. Start by adding 2 grams of salt for every liter of brine in the brine tank. For example, if there are 4 liters of brine in the tank, add 8 grams of salt to the tank, mix, and restart.
- **Low flow through the system.**
  1. Verify brine is flowing up through the pump, into and out of the cell.
  2. Check the plumbing fittings and tubing for clogs.
  3. Tighten all fittings. If tubing is clogged the system needs to be cleaned. Refer to *section 7.1.6 Acid Washing the Cell.*
  4. Verify the rupture disc is intact. If popped, replace the rupture disc *(refer to Section 7.2.1)* and clean the cell (refer to *Section 7.1.6 Acid Washing the Cell).*

  If the alarm continues – consult a technician or contact Aqua Research Technical Support.

 Blinking RED/GREEN/RED LED light indicates that the system is over-heating. High

temperatures are generated when flow out of the cell is obstructed. Obstructions could be due to a crimped outlet tube or scale build up in the tube.

1. Turn off the system.
2. Remove the tubing and check for clogs at the outlet of the cell.
3. Remove large scale from the tubing and flush the lines.
4. Reconnect the tubing and clean the cell. Refer to *section 7.1.6 Acid Washing the Cell.*

In some cases where the brine concentration is too low, and there is no flow obstruction, this alarm may be activated when the brine tank empties.

If the alarm continues, consult a technician or contact Aqua Research Technical Support.

NOTE: *The oxidants collected should be used as quickly as possible in treating raw water to gain the maximum benefit of their disinfectant power. If oxidant is stored for more than 30 minutes before use, it should be stored in a dark, covered container. Containers for storage should be plastic, dark, and well-sealed. Oxidant that has been properly stored for up to 21 days is more potent than chlorine alone.*

5.5 Oxidant Flow

When operating properly, the flow from the outlet tube should be warm with a mixture of disinfectant and gas bubbles. The flow rate may change due to temperature or brine concentration, but should flow in the range of 40 to 100 ml/min. The control system is designed to maintain a constant oxidant concentration of 5,000 mg/l. If the brine concentration is low, the brine pump will slow

down to allow more oxidant to be generated in the cell. If the brine concentration is high, the brine pump will speed up to decrease the residence time in the cell. This feature compensates for inaccurate brine makeup, maintaining the oxidant concentration at a constant level so that the dosing strategy is always consistent.

5.6 System Production

The STREAM™ System produces 5,000 mg/l (±1,000 mg/l) of free available chlorine (FAC) on a consistent basis, irrespective of the brine concentration–within limits. The flow of oxidant is nominally 1.25 gallons per hour (4.8 liters per hour). The amount of water that can be treated by the output from the STREAM™ System is a function of the oxidant concentration (5,000 mg/l) and the dose to the water. *Figure 26* shows the amount of oxidant needed to treat a set amount of water. Continuous operation of the STREAM™ system will result in enough oxidant to treat 60,000 gallons (230,000 liters) of water in 24 hours at a 2.5 PPM dose.

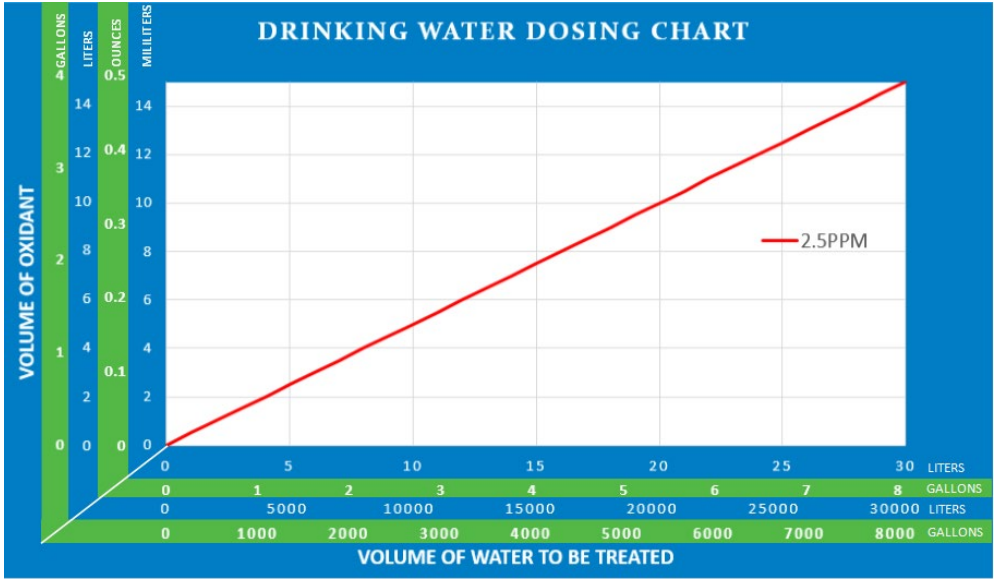


Figure 26. Oxidant Dosing Chart

5.7 Chlorine Residual, pH and Oxidant Readings

When tests for chlorine residual are performed on samples from the cell, the readings should be as shown in the following chart:

Table 3. Minimum FAC Concentration of Oxidant Solution

Free Available Chlorine (FAC)	5,000 ppm (±1,000 ppm)
pH	9-10
Flow	1.25 gph

The product will have a mild chlorine smell and should feel slightly soapy.

5.8 Communications and GPS

The STREAM™ System is equipped with WiFi communications and a global positioning system (GPS) capability. The system can be connected to a computer or cell phone via WiFi. To connect to the STREAM™ System with a WiFi-capable device:

1. Power on the STREAM™ System.
2. Using your WiFi capable device, find the system's unique WiFi network, named "STREAM WiFi-****-***", replacing the * symbols with the last 7 digits of the system's serial number (found inside the front-right corner of the STREAM™ System case). *See Figure 27.*

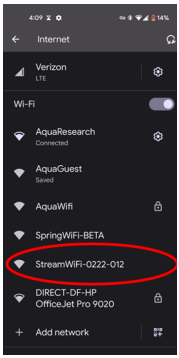


Figure 27. Connecting To STREAM™ WiFi

NOTE: If you are connecting with a device that has a mobile network connection (e.g. cell phone with cellular data connection), it may be

necessary to disable your cellular data connection for proper communication with the STREAM™.

3. After connecting your device to the STREAM™ System's WiFi network, open your web browser and enter "10.10.10.10" into the address bar. *See Figure 28.*
4. The following screen will display on your WiFi capable device. *See Figure 29.*
5. The follow page of commands can be used be typed the commands into the web browser to get the current status of the device.

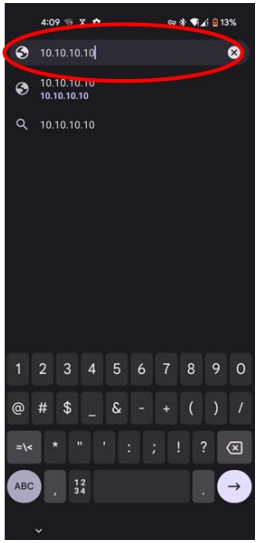


Figure 28. Entering 10.10.10.10 in Web Browser

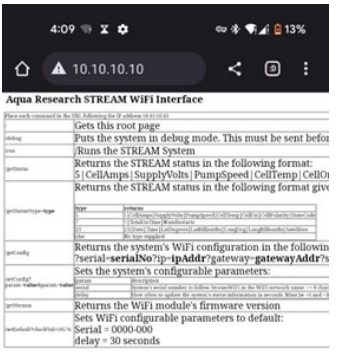


Figure 29. Display On WiFi Capable Device Once Connected to STREAM™ System

Table 4. WiFi Commands

<table>
<tr><td colspan="2">Place each command in the URL following the IP address 10.10.10.10</td></tr>
<tr><td>Command</td><td>Result</td></tr>
<tr><td>/</td><td>Gets this root page</td></tr>
<tr><td>/debug</td><td>Puts the system in debug mode. This must be sent before other commands</td></tr>
<tr><td>/run</td><td>/Runs the STREAM™ System</td></tr>
<tr><td>/getStatus</td><td>Returns the STREAM™ System status in the following format:
5|CellAmps|SupplyVolts|PumpSpeed|CellTemp|CellOn|CellPolarity|StateCode%7|TotalOnTime|NumRestarts%23|Date|Time|LatDegrees|LatBillionths|LongDeg|LongBillionths|Satellites</td></tr>
<tr><td>/getStatus?type=type</td><td>Returns the STREAM™ System status in the following format given the below parameters:
<table>
<tr><td>type</td><td>Returns</td></tr>
<tr><td>5</td><td>5|CellAmps|SupplyVolts|PumpSpeed|CellTemp|CellOn|CellPolarity|StateCode</td></tr>
<tr><td>7</td><td>7|TotalOnTime|NumRestarts</td></tr>
<tr><td>23</td><td>23|Date|Time|LatDegrees|LatBillionths|LongDeg|LongBillionths|Satellites</td></tr>
<tr><td>else</td><td>No type supplied</td></tr>
</table></td></tr>
<tr><td>/getConfig</td><td>Returns the system's WiFi configuration in the following format:
?serial=serialNo?ip=ipAddr?gateway=gatewayAddr?subnet=subnetMask?delay=updateDelay</td></tr>
<tr><td>/setConfig?param=value&param=value</td><td>Sets the system's configurable parameters:
<table>
<tr><td>param</td><td>Description</td></tr>
<tr><td>serial</td><td>System's serial number to follow STREAM™ WiFi in the WiFi network name. <= 8 characters.</td></tr>
<tr><td>delay</td><td>How often to update the system's status information in seconds. Must be >0 and <4294967295</td></tr>
</table></td></tr>
</table>

/getVersion	Returns the WiFi module's firmware version
/setDefault?checkVal=56576	Sets WiFi configurable parameters to default: Serial = 0000-000 delay = 30 seconds

6. By using the commands above, the system can be debugged and its operation monitored with any WiFi-capable device. For example, to see the system's current status;
   a. Connect to its WiFi network "STREAM WiFi-****_***"
   b. Enter "10.10.10.10/getStatus?type=5" in your web browser's address bar. If the system has not been running for at least 30 seconds the WiFi will be unable to communicate with the STREAM™ system.
   c. The following information will be displayed in very basic webpage with a string of information like:
      5|18.46|11.93|4524|97.26|1|0|3
      The given information is:
      - 18.46 Amps to the cell
      - 11.93 Volts from the power supply
      - 4524 pump speed (in steps/s)
      - 97.26° F temperature in the cell
      - The last three digits show the cell is ON ("1"), and polarity is normal ("0").

6 System Storage

6.1 General Storage

The STREAM™ System is designed to be stored in a closed case. The case is designed to be resistant to rain or a spray of water and is very robust. When the system is put in storage, or is not going to be used for a short period of time (up to a few days), residual brine and chlorine may be

present in the cell or tubing components. While the internal components of the cell, tubing, and pump should not be hurt by these fluids, it is highly recommended to seal the system so that the other components within the case are not exposed to these fluids. Seal the system by connecting the ends of the two clear plastic tubes at the mating connectors.

1. First, remove the brine suction strainer and place it in its container and close the lid. *See Figure 30.* Enclosing the filter will protect residual liquid in the filter from getting inside the case.

Figure 30. Brine Suction Strainer Storage

2. Connect the two ends of the clear tubes together at the connector. *See Figure 31.* The 1/4" tube on the inlet to the peristaltic pump has brine in it. The 3/8" tube on the discharge of the electrolytic cell has the oxidant solution. Both of these solutions are corrosive to most metals. Corrosion damage to hardware due to failure to seal the tubes is not covered under warranty. If water or brine gets inside the case, the liquid should be dried with a cloth or paper towel before the unit is stored. The tubing that comes from the pump and connects to the strainer will need to be removed from the union fitting when the system is operated again. *See section 5.1.* <u>Do not lose the ferrule fittings on the end of the tube.</u>

Figure 31. Connecting the Brine and Oxidant Tubing

6.2 Long Term Storage

If the system is going to be stored for a long period of time (more than a few days), all of the fluid in the system should be drained. The brine

solution and oxidant in the tubing should first be purged from the system.

1. Put clean water in a 0.5-1 liter container.
2. Drop the brine suction strainer in the water, the oxidant outlet tubing in a separate container, and turn on the unit.
3. After approximately two minutes the unit will shut down automatically and indicate a solid red light error indicating low salt.
4. If the system shuts down before the clean water purge is complete, turn off the power button and turn it back on. This will reset the timer and allow the unit to run for another short period of time.
5. After the water purge is complete, turn the system off and disconnect the power cord.
6. Disconnect the filter. *See Section 6.1*.
7. Pop the blue cap off of the peristaltic pump and lift the peristaltic tubing out of the pump head. Replace the cap on the pump, leaving the peristaltic tubing outside of the pump. *See Figure 32.*

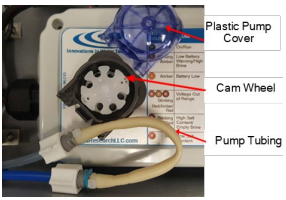


Figure 32. Release Removing the Peristaltic Pump Cap

8. Turn the unit on its side so that the tubing connections on the side of the electrolytic cell are pointing downward. Allow all fluid to drain from the cell and both clear tubes.
9. Connect the two tube ends together as in *Figure 31*.
10. Coil the clear tubes and power cord together and secure them with the Velcro strap at the back edge of the case. *See Figure 33*. Dry with a towel as needed. If necessary, leave the case open to dry.

Figure 33. Straps and Tubing Secure for Storage

7 Maintenance and General Repair

7.1 General Maintenance

7.1.1 Check for Leaks and Liquid in the Case

1. Check for liquid in the STREAM™ case, dry the case with a paper towel, and identify where the liquid is coming from.
2. Check for leaks at the cell and pump fittings. Tighten fittings.

7.1.2 Cleaning the Tubing

Blockage of the tubing will result in restricted or no flow through the cell or out the outlet port. The normal flow coming OUT OF THE CELL discharge tubing will have a chlorine smell, soapy feel, and air bubbles. If pressure has built up in the cell, the rupture disc may have failed.

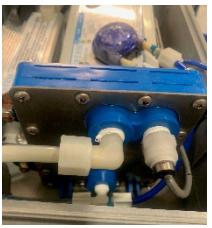


Figure 34. Disconnect the Tubing from the Elbow Fitting on the Cell

1. Remove the tubing connectors on the cell. *See Figure 34.* Look in the ends of the tubing and see if scale has blocked the openings. You can also try blowing air through the tubing, and if no air is coming out the other end, it is a strong indication that the tube is blocked.
2. Use a toothpick or pointed tool to remove the scale and restriction out of the tubing at the connectors. *See Figure 35.*

Figure 35. Checking the End of the Tubing for Scale Build-Up.

3. Verify all tubing is clear of restrictions and air is flowing through the system.
4. Acid wash the cell as in *Section 7.1.6.*

7.1.3 Check the Power Supply, Electrical Components

1. When the system is plugged in verify that the small green light on the surge protector turns on.
2. During operation the power supply will be very warm to the touch. Verify that the leads into and out of the power supply are secure and not damaged.
3. Verify the connector between the power supply and control box is secure, tight, and without corrosion.

7.1.4 Cell Electrical Connection Check

If the electrical connections at the cell are hot to the touch, the connections should be cleaned and tightened. The voltage at the cell is 12 VDC. This is similar to a car battery and is not lethal, but can cause significant sparks if the terminals are shorted with a metal object such as a wrench. Disconnect the STREAM™ System from any power source before working on the electrical components of the system.

WARNING!

Use safety goggles and rubber gloves when working on electrical components.

7.1.5 Verify the Rupture Disc is Intact

Open the rupture disc union and verify that the rupture disc is intact and secure. Replace if needed as described in *Section 7.2.1.*

7.1.6 Acid Washing the Cell

The cell will need to be cleaned of carbonate scale to prevent permanent damage and keep the system running. How often cell cleaning is required is a function of the hardness of the water and the quality of the salt used to make the brine solution.

If water with more than 1 grain total hardness is used, the cell will need to be cleaned every 40 hours of operation to prevent harmful amounts of scale formation. If reverse osmosis or a water softener is used to make the water for the brine, scale formation will be reduced, if not eliminated.

If the salt has high calcium content, scale will ultimately form. If food grade salt such as Morton's Cullinox 999 or Cargill CMF (Calcium and Manganese Free) is used, very little scale will form from the salt.

STREAM™ systems operated on hard water will need to be cleaned after every 40 hours of operation to minimize scale formation.

Cells with calcium carbonate buildup can be cleaned using any of the acids listed below:

- Household vinegar (5% acetic acid)
- Cleaning vinegar (30% acetic acid)
- Muriatic acid

Different acids will require variations in the cleaning procedure.

Verify the rupture disc has not been punctured prior to cleaning the cell. If the rupture disc has been popped, the system will not pull liquid into the cell. Replace the rupture disc prior to starting the cell cleaning cycle. Refer to *Section 7.2.1 Replacing the Rupture Disc*.

1. Clear all outlet tubes and fittings of scale and debris. Refer to cleaning the tubing in *Section 7.1.2*.
2. Verify the brine inlet fittings are free from scale and clogs.
3. Fill a small container with an acid solution, approximately 1L. Insert the brine suction strainer in the container. The rupture disc union fitting does not need to be added to the container with acid or vinegar. Make sure the brine suction strainer is completely submerged in the solution.
4. Place the oxidant outlet tube in a separate container.
5. **Elevate the outlet tube over the back of the case so that the acid sits in the cell to dissolve the calcium carbonate scale from the cell and tubing**. ***See Figure 36.***
6. **Turn the system on and allow the pump to run for 30 seconds, then turn the system off**. Do not leave the system on longer than 30 seconds because power will be applied to the cell at 45 seconds, and power should not be applied to the cell during acid cleaning.
7. **Repeat Step 6 a total of 3 times to make sure the system is full of the cleaning solution**.
8. Let the system sit for the appropriate Hold Time according to *Table 4* below, based on which acid is being used.

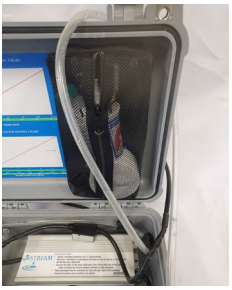


Figure 36: Elevate Oxidant Outlet Tubing Over Edge of Case.

Table 5. Acid Washing Hold Times and Required Cycles

	5% Household Vinegar	30% Cleaning Vinegar	Muriatic Acid
Hold Time	Overnight	60 Minutes	10 Minutes
# of Cycles	1	2	2

9. Repeat steps 6-8 to achieve the Number of Cycles required in the table above, according to the acid being used.
10. After completing the required number of flush/hold cycles, lower the outlet tubing so the acid can be flushed out easily.
11. Submerge the brine filter in a container with clean water.
12. Turn on the system and allow the pump to run for 30 seconds. Turn off the system.
13. Repeat step 12 a minimum of three times.

The system is now ready to operate normally. Place brine suction strainer in the brine tank and the oxidant discharge fitting in the oxidant container. Turn on the system and ensure it runs normally.

If using Muriatic acid (dilute hydrochloric acid) for cleaning, the following safety measures and cautions need to be followed.

CAUTION! **Muriatic acid is a strong acid and is hazardous to handle. Use protective gloves and a face shield. Make dilute muriatic acid by adding one part of acid to one part of water. Do not add water to acid. Add acid to water.**

CAUTION! Chlorine gas is given off in the reaction, so use in a well-ventilated area, and do not breath the vapors.

CAUTION! This gas is chlorine gas and is toxic to breathe. Do not breathe this gas.

NOTICE! Dispose of the muriatic acid solution according to the local and national environmental laws.

7.1.7 Check Chlorine Production

With the system in stable operation, take a 5ml sample from the oxidant line. Dilute this sample with the appropriate amount (5 L for 1000:1 dilution) of oxidant demand-free water. (*See Appendix C – Procedures, "Chlorine Testing."*) Test for chlorine content following standard procedures prescribed by the chlorine test kit.

7.2 Repair

The following repairs are in-field repairs that can be performed by the operators.

7.2.1 Replacing the Rupture Disc

If the system internal pressure exceeds 25 psi, the rupture disc will fail. High pressure is usually the result of scale forming in the cell or discharge tubing. Before the system can be cleaned, the rupture disc must be replaced and scale build up must be removed from the outlet tubing and fitting.

1. The rupture disc union is located off the left-hand side of the tee at the bottom of the cell. *See Figure 37.*

Figure 37. Rupture Disc Hose - Left of Tee at Bottom of Cell

2. Unscrew the rupture disc union fitting and replace the disc with a new rupture disc. *See Figure 38.* Spare rupture discs are located in the black mesh bag in the lid of the STREAM™ unit.

Figure 38. Rupture Disc Assembly

3. The rupture disc should fit fully over the O-ring in the union fitting. *See Figure 39.*

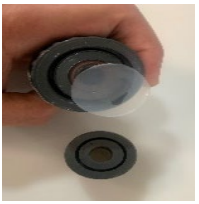


Figure 39. Teflon Disc in Rupture Disc

4. Clear the scale from the outlet tubing and fitting.

5. Acid wash the cell as described in *Section 7.1.6.*

7.2.2 Peristaltic Pump Tubing Replacement

Spare tubing is supplied with the STREAM™ System. This tubing is cream colored and is very rubbery and tough. It is 14 cm (5.5 inches) long.

1. Pop the blue plastic cover off of the top of the peristaltic pump. *See Figure 40.*

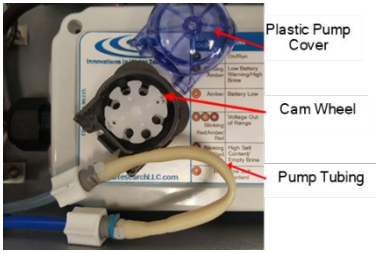


Figure 40. Peristaltic Pump Disassembled

2. Remove the pump tubing and cam wheel assembly.

3. Disconnect the pump tubing from the end fittings on the clear ¼" inlet tubing and blue ¼" outlet tubing.

4. Discard the old rubber pump tubing.

5. Reinstall the new rubber tubing on the fittings.

6. Use the small plastic tie-wraps (included) and tighten them firmly on the new hose ends as shown in *Figure 41.*

Figure 41. Peristaltic Pump Assembled

7. Fit the loop of tubing around the plastic "wheel" with the two rollers. Place this assembly back on top of the pump, making sure the clear tubing is coming in through the inlet and the blue tubing is coming out the outlet. Match the tubing with the arrows on the label.

8. Snap the blue plastic pump cover back in place. The system is ready to operate.

7.2.3 Electrolytic Cell Replacement

It is anticipated that the cell should have a production life of several thousand hours. An indicator that the cell is nearing its production life is a reduction in chlorine concentration (<4,000 mg/l) when the green LED light is operating normally. Test chlorine production in *Appendix C "Chlorine Testing" Procedure.*

NOTE: *Flushing the cell with fresh water and draining it after use will prolong its productive life.*

Removing old cell

1. Turn off power to the system.
2. Remove the nuts holding the cell to the case. This will make it easier to remove the tubes and wires.
3. Remove the inlet and outlet tubes from the cell. Note which tube goes to which cell port. The smaller tube from the pump discharge goes to the right port on the tee at the bottom of the cell. Unthread the connection to remove the tubing. Remove the left small tubing at the bottom of the cell that goes to the rupture disc union fitting.
4. Disconnect the cell leads. Positive (red) is at the top. Negative (black) lead is at the bottom. *Refer to Figure 21.*
5. Remove the titanium thermowell from the side of the cell. Push the collet up against the plastic fitting and then pull the thermowell out of the cell at the same time you are holding the collet against the fitting. *See Figure 42.* DO NOT PULL ON THE GRAY

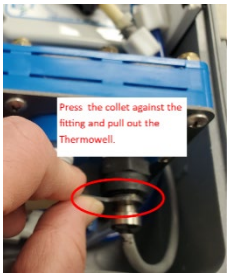


Figure 42. Pressing the Collet Against the Fitting.

THERMOWELL WIRE. Pull on the titanium housing only. *See Figure 43.*

Figure: 43 Pulling Out the Thermowell

Installing new cell

1. Inspect cell lead ends and lugs for corrosion:
   - Remove all corrosion with a wire brush or sandpaper.
   - Add copper conductive grease to the contact surfaces of the cell lugs and power lead lugs.
2. Connect cell electrical leads. The bolt sizes are different so that the connections cannot be made incorrectly. *Refer to Figure 21.*
   - Connect positive (red) lead to the upper electrode connection.
   - Connect the negative (black) lead to the lower electrode.
3. Check and tighten cell lead/lug flange nuts.
4. Attach tubing to cell ports:
   - The tube from the pump discharge goes to the right tee port at the bottom of the cell. The other tube at the bottom of the cell goes to the rupture disc union fitting. *Refer to Figure 2.*
   - The larger 3/8” tube going to the oxidant tank goes on the top of the cell. *Refer to Figure 2.*
5. Re-insert the thermowell in the fitting. Push it all the way in. You must push it past an o-ring in the housing. The collet has grippers that will hold the thermowell metal housing in the fitting. *Refer to Figure 42 and 43.*
6. Place the new cell in position and secure the mounting nuts.

Check Cell Operation

1. After the system is operating a while, check the temperature of cell connections:
   - Less than 100°F (38°C) (warm to touch) is normal.
   - Greater than 100°F (38°C) (hot to touch) indicates corrosion or loose connections.
2. If hot, shut down the system and repair.

8 Troubleshooting

The chart below can be used to help troubleshoot the STREAM™ System.

Table 6. STREAM™ Troubleshooting Table

Problem	Possible Cause	Remedial Action
1.) Loss of current indicated by the LED light	a.) Low salt concentration (solid red LED) b.) Low battery (solid yellow LED) c.) Poor electrical connection d.) Calcium carbonate fouling e.) Cell life depleted f.) Air trapped in brine feed line or pump head	a.) Check brine for proper salt concentration. *See Section 5.2.* b.) Recharge battery. c.) *See Section 7.1.4.* d.) *See Section 7.1.6.* e.) Replace cell. *See Section 7.2.3.* f.) Be sure brine strainer is fully submerged and no leaks in hoses.
2.) Low chlorine residual (indicated in periodic samples)	a.) Low salt concentration. b.) Loss of power. c.) Calcium carbonate fouling. d.) Cell life depleted.	a.) *See Section 5.2.* b.) Check power source. *See Section 7.1.3.* c.) *See Section 7.1.6.* d.) *See Section 7.2.3.*

3.) Blinking red-yellow-red light	a.) Low power to the cell b.) Salt brine concentration too high c.) Power supply has over-amped	a.) Recharge battery or check power supply. b.) Check brine concentration. Add water if necessary. c.) Power supply has internally shut down for self-protection. *See section 5.4.1 Red/Amber/Red Fault.*
4.) Loss of power to cell	a.) Power failure b.) Fluctuations in power supply c.) Loose or corroded wires d.) Faulty electronics	a.) Check ON/OFF button. b.) Plug the system into an alternative power source (different outlet) or into a car battery or solar power system. c.) Remove wires, clean, and reattach with conductive electrical paste. d.) Consult with the technician, or call Aqua Research Technical Support.
5.) Leaking tubes or fittings	a.) Short circuit of cell or electrical box, electrical connections, and components.	a.) Turn off power. Fix leak. Dry and clean connections. Start system. *See Section 7.1.1, 7.1.2, and 7.1.6.*
6.) No flow through cell	a.) Clog in strainer or hose line b.) Air in brine feed line c.) Calcium carbonate fouling d.) Rupture disc failed	a.) Clean strainer and hose fitting. *See Section 7.1.2.* b.) Check for leaks in strainer or hoses. *See Section 7.1.1.* c.) *See Section 7.1.6.* d.) *Repair blockage in system and replace Teflon disc. See Section 7.1.5.*

7.) Pump not pumping	a.) Clogged hose line b.) Debris in the pump head c.) Bad electrical connection d.) Pump turns on but the gears don't spin e.) Pump motor or gear head damaged	a.) Clean hose lines and restart system. *See Section 7.1.2.* b.) Remove hose from pump head. Force clean water through tubes. *See Section 7.2.2.* c.) Check wiring and power. *See Section 7.1.4.* d.) Remove peristaltic tubing and stretch the tubing several times. Reinstall tubing and turn power back on. e.) Consult with the technician, or call Aqua Research Technical Support.
8.) Low chlorine residual value in the treated water	a.) High flow through cell b.) Injection system malfunction c.) Cell life depleted d.) Break in water distribution lines e.) Water production exceeds maximum for system design f.) Oxidants stored too long before use	a.) Measure flow. Flow rate should be between 40-100 ml/min. b.) Check injection of oxidant into water system. c.) Check cell amperage, flow, and chlorine production. Replace cell if necessary. d.) Check for leaks and repair. e.) Call distributor or Aqua Research for options. f.) Drain the oxidant tank and start system again. Use fresh oxidants for injection.

9.) System overheating as indicated by the Red/Green/Red LED lights	a.) Calcium carbonate fouling b.) Brine concentration too low or when the brine tank empties.	a.) *See Section 7.1.6 Acid Washing the Cell* and *Section 7.1.2 Cleaning the Tubing*. b.) Check the brine tank to make sure it is not empty. Refill if empty. Verify the brine suction strainer is immersed in the brine solution.

Appendix A – Spare Parts and Optional Components

After two years of operation, the following spare parts are recommended for a STREAM™ System.

PARTS	AR Part Number
STREAM™ Parts:	
Peristaltic Pump Hose	FAB-3201
STREAM Peristaltic Brine Pump	FAB-3200
Brine Filter, 3/8” MPT	FAB-3209
Power Supply, 12V, 42Amp + Connectors	FAB-2111
Power Supply, 12V, 42Amp + Connector with surge protector	FAB-2122
Thermowell Assembly	FAB-3131
STREAM™ Cell – REPLACEMENT CELL NO RUPTURE DISC, NO TITANIUM	FAB-3214
STREAM™ Cell – REPLACEMENT CELL, RUPTURE DISC, EXTERNAL TITANIUM PLATE	FAB-3215
Rupture Disc, 0.002” Teflon x 1.25” qty 12	FAB-3218
Rupture Disc Assembly, 3/8” Union, Teflon Disc, Connector	FAB-3219
Misc. Parts (purchased locally):	
Clear Tubing, 1/4” OD, 10 feet	FAB-3204
Clear Tubing, 3/8” OD, 10 feet	FAB-3210
Blue Tubing, 1/4” OD, 1 foot	FAB-3211

Connect Fittings:	
• Connector, 3/8” MPT x ¼” Compression, Kynar	FAB-3202
• Elbow, 3/8” MPT x 3/8” Compression, Kynar	FAB-3217
• Tee, ¼” MPT X ¼” Compression, PP	FAB-3213
• Connector, 3/8” MPT x 3/8” PF, Kynar	FAB-3216
• Reducing Union, 3/8” HC x ¼” HC, Kynar	FAB-3207
• Coupler, 3/8” Stainless Steel	FAB-3208
• Nut, 1/4”HC with Ferril	FAB-3212
OPTIONAL COMPONENTS	
Oxidant Tank, STREAM™ 17” Black w/ cover	FAB-4110
Brine Tank, STREAM™ 15”, White w/ cover	FAB-4111
Solar System, STREAM™ Controller with 2 x Solar Panel Briefcases	FAB-2092

Appendix B - STREAM™ System Warranty Statement

Standard System Warranty:
WARRANTY – Aqua Research, Inc. warrants that the system components manufactured by Aqua Research, Inc. will be free from defects in material and workmanship for one year. (Limited life items such as brine suction strainer, tubing, tube fittings, test strips, misplaced items, or items damaged by the customer are not included.)

PERIOD – One-year warranty period begins at date of delivery to the customer.

Standard Cell Warranty:
WARRANTY– Aqua Research, Inc. warrants the electrolytic cell from defects in material and workmanship for one year. The warranty **does not** cover cells that have been operated on hard water (> 1 grain hard) and that have not been acid washed according to the procedures in the service manual every 40 hours of operation. *See Section 7.1.6 Acid Washing the Cell*. Cells that have been operated on soft water (< 1 grain hard) are covered under the warranty as long as the cell is returned to Aqua Research for evaluation and has not been opened by the user. Opening the cell voids the warranty. Damage due to abuse by the user is not covered under the warranty.

A Return Materials Authorization (RMA) must be obtained from Aqua Research prior to returning the cell. Return shipping will not be paid by Aqua Research if an RMA was not obtained prior to shipping. Returned cells that continue to perform above minimum specifications when tested will be returned to the customer with freight charges billed to the customer.

Power Supply Warranty

Damage to the power supply from electrical transients is not covered by this warranty.

Standard Parts Warranty.

WARRANTY- Any components on the STREAM™ system that are not manufactured by Aqua Research (for example power supply) are warranted to be free from defects in material and workmanship for 60 days from the date of receipt by the customer.

NOT INCLUDED – Peripheral equipment such as the injection system, solar power systems, and other components are not covered by Aqua Research, Inc.'s warranty. Peripheral equipment may be covered by the manufacturer's warranty.

VOIDING THE WARRANTY – The STREAM™ warranty does not apply to defects caused by customer abuse, misuse, improper operation or installation, neglect, accidents, acts of God, failing to connect the salt water (brine) and discharge tubes together during storage, or maintenance or modification performed by anyone other than Aqua Research, Inc. or its official representatives. The warranty is voided if the equipment is used in any manner other than described in Aqua Research, Inc.'s STREAM™ system documentation.

REPLACEMENT OR REPAIR – Aqua Research, Inc.'s responsibility under these warranties is to correct by repair, or replacement, at the option of Aqua Research, Inc. any such defect, disclosed on examination by Aqua Research, Inc. or its representative.

AGREEMENT AND TRANSACTIONS – Warranty service is provided by Aqua Research, Inc. or an authorized representative of Aqua Research, Inc. Aqua Research, Inc. offers this warranty to the owner of the Aqua Research, Inc. equipment. If

warranty service is required, service can be obtained by contacting your local Aqua Research, Inc. distributor or Aqua Research, Inc.'s customer service department and obtaining an RMA, after which service will be arranged.

If the equipment owner deals directly with Aqua Research, Inc. for warranty service and not with his or her local distributor, the equipment owner is responsible for paying all freight and handling charges for components returned to Aqua Research, Inc. under this warranty. Aqua Research, Inc. will pay for freight and handling charges for replacement components returned to the end user, except for expedited freight charges, which, if necessary, will be the responsibility of the end user. Aqua Research, Inc. will examine all returned components or systems for warranty service and determine if the warranty will be applied.

AQUA RESEARCH, INC. RESPONSIBILITY EXCLUSIVE TO CLAIMS IN THIS DOCUMENT – This warranty is in lieu of all other warranties covering the products, expressed or implied, including those of fitness and merchantability. No one is authorized to create for Aqua Research, Inc. any other warranty in connection with the sale of our products. Aqua Research, Inc. shall not be held liable for consequential or incidental damages.

DESIGN CHANGES – Aqua Research, Inc. reserves the right to make design changes, additions to, and improvements on any of our products, and has no obligation to make the same changes, additions, or improvements on any products previously manufactured.

PRODUCTS TO BE REPAIRED OR REPLACED –

- Must be accompanied by a Return Materials Authorization (RMA)

- Must be shipped/delivered to Aqua Research, Inc. Customer Service at the company offices in Albuquerque, New Mexico.
- Must have included in the package a statement covering the nature of the malfunction, the name and phone number of the person returning the unit, and the address to which the equipment should be returned.
- Should be shipped in the original packaging or its equivalent to provide adequate protection.
- Must be returned all transportation charges prepaid.

Appendix C – Procedures

CHLORINE TESTING PROCEDURE

Aqua Research, Inc.'s STREAM™ systems produce an oxidant disinfectant. Measuring free available chlorine (FAC) production is the easiest way to check the performance of the system. A cell producing below the specified parts per million (ppm) of FAC may be in need of cleaning, may be supplied with brine that is oversaturated or too hot, or may be at the end of its life. The following are the steps needed to correctly determine chlorine production.

Note: The instructions below are for use with a Hach Pocket Colorimeter II and 25ml DPD reagent packets. If using a different method to measure FAC, follow the instructions for that method.

Equipment Needed

- 1000 ml or larger container with lid
- 250 ml or similar size collection beaker
- 10 ml container with lid
- Pipette that can accurately measure 1 ml
- Chlorine Test Kit such as a Hach Pocket Colorimeter II
- Chlorine Demand-Free Water (or if not available, non-chloraminated potable water with a chlorine residual value)
- 1000 ml Graduated Cylinder
- Timer or a watch with seconds
- Calculator

Preparing Chlorine Demand-Free Water

1. Add 5 mL of 5.25% bleach into one gallon of distilled water in a clear container.
2. Shake to mix thoroughly.

3. Move the water outside where it will be exposed to direct sunlight since ultraviolet light reduces chlorine to chlorides.
4. Let it sit outside or in direct sunlight for a day.
5. Test a sample for chlorine and allow to sit longer in direct sunlight if chlorine is present.

Alternate Method

Use non-chloraminated tap water with a chlorine residual. Chloramines are used by many communities today to reduce disinfection by-products from surface water sources. Chloramines are made by mixing chlorine and ammonia at the water plant. To de-nitrify chloramines, however, requires 10 mg/l of chlorine per 1 mg/l of chloramines in the tap water. Using chloraminated tap water as the dilution water for chlorine measurements will throw off the calculation significantly. By using tap water with an FAC residual, these oxidant demand issues are avoided. In the chlorine calculations discussed below, the residual value of the chlorine will need to be subtracted from the calculation.

Measuring Chlorine Concentration of the Oxidant

Note: Use a 1:1000 ratio for the STREAM™ System. This system produces a nominal FAC concentration of 5,000 mg/l +/- 1,000 mg/l.

(1:1000 ratio would be 1 ml solution added to 1000 ml water.)

1. Ensure your colorimeter is in the correct range (0-8 ppm, High Range on the Hach Pocket Colorimeter II).
2. Zero the colorimeter by adding 10ml of oxidant demand-free water to the measuring cuvette, placing the cuvette into the colorimeter, placing the cover over the cuvette, and using the zero key. Discard this water once complete.

3. Fill the 250 ml beaker with approximately 200 ml of mixed oxidant solution.
4. Rinse the 1-liter container several times with chlorine demand-free water (or clean tap water) and then carefully measure 1000 ml into this container.
5. Rinse the pipette several times by drawing in several ml of the STREAM™ oxidant solution and discarding it.
6. With the pipette, accurately measure 1 ml of oxidant solution and add to the 1 liter of demand-free water (or tap water with a chlorine residual) to produce a 1:1000 diluted solution of oxidant.
7. Thoroughly mix the oxidant solution with the oxidant demand-free water (or tap water with chlorine residual) by covering and shaking.
8. Measure 10 ml of the diluted solution into the 10 ml container and add the contents of one 25ml DPD reagent packet. Shake gently to combine.
9. The solution should turn a shade of pink. Pour this solution into the colorimeter's measuring cuvette, place the cuvette in the colorimeter and add the cover over the cuvette. Use the measurement key to measure the amount of FAC in ppm.
10. Multiply this value by the dilution ratio used. In these instructions, a 1:1000 dilution ratio was used, so a reading of 5.1 on the colorimeter indicated a FAC concentration of (5.1 x 1000 = 5,100 ppm).
11. However, if tap water with a chlorine residual is used, or other water with a chlorine residual is used, then the chlorine residual in the dilution water will need to be subtracted from the measured number before multiplying by the dilution ratio. For instance, if the chlorine residual in the tap water is 0.2 mg/l, then subtract 0.2 from 5.1

mg/l = 4.9 mg/l. Then multiply by the dilution ratio to get the concentration of the chlorine based mixed oxidant (i.e. 4,900 mg/l).

12. Repeat this process three times and take the average of the three readings.
13. This value will be used for "X" in the production equation below.

Calculating Chlorine Production of the System

Chlorine production is a function of concentration of the oxidant (X) *and* flow (Y) from the system.

Measuring Flow

The STREAM™ system has a nominal output flow rate of 4.8 liters per hour of oxidant. However, several factors can affect this rate.

To determine exact flow, measure the volume out of the outlet tubing in exactly 30 seconds while the STREAM™ system is running normally. This volume will be F in the equation below to calculate daily output (Y) in gal/hour:

$$Y = F\frac{\text{ml}}{30\text{ seconds}} \times \frac{60\text{ seconds}}{1\text{ minute}} \times \frac{60\text{ minutes}}{1\text{ hour}} \times \frac{1\text{ liter}}{1000\text{ ml}} \times \frac{1\text{ gal}}{3.79\text{ liters}}$$

OR

$$Y=(F)0.0316622$$

To calculate daily chlorine production (Z) in lbs:

$$Z = X\frac{\text{mg}}{\text{liter}} \times \frac{3.79\text{ liters}}{1\text{ gal}} \times Y\frac{\text{gal}}{\text{hour}} \times \frac{24\text{ hr}}{1\text{ day}} \times \frac{1\text{ lb}}{454000\text{ mg}}$$

OR

$$Z=(X)(Y)0.0002$$

Where the sample solution variables are:

X = ppm (mg/l) chlorine concentration
Y = gph flow

USING ON-SITE GENERATED CHLORINE AS HAND SANITIZER

Liquid chlorine is made from the electrolysis of salt water – brine. Liquid chlorine is commonly referred to as bleach.

- Commercial bleach is typically 12 to 15% (120,000 to 150,000 mg/l) chlorine.
- Household bleach is typically 6% (60,000 mg/l) chlorine.
- On-site generated oxidant is 0.5% to 0.8% (5,000 to 8,000 mg/l) chlorine.

To generate a hand sanitizer solution using oxidant dilute one part of oxidant with nine parts of water (500ppm). A 500ppm oxidant solution can be used for hand washing and food preparation. (The oxidants generated directly from the STREAM™ system at 5,000ppm can be used for disinfection of highly contaminated surfaces and in healthcare settings.) Note that using a 500ppm oxidant solution as a hand sanitizer without a softening agent will dry out the skin when used over an extended period of time.

Appendix D – Material Safety Data Sheet (MSDS)

AQUA RESEARCH

MATERIAL SAFETY DATA SHEET

IDENTITY (As Used on Label and List)
Mixed Oxidant Solution

Note: Blank spaces are not permitted if any item is not applicable, or no information is available. The space must be marked to indicate that.

Section I

Manufacturer's Name **Aqua Research LLC**	Emergency Telephone Number **1-505-362-0575**
Address (Number, Street, City, State, and Zip Code) **5601 Midway Park Place NE** **Albuquerque, NM 87109**	Telephone Number for Information **1-505-362-0575**
	Date Prepared **April 17, 2019**
	Signature of Preparer (Optional)

Section II.a- Hazardous Ingredients/Identity Information (Mixed Oxidants)

Hazardous Components (Source Chemical Identity: Common Name(s))

Concentrations in mg/L						OSHA PEL	ACGIH	Other Names
Aqua Research Unit	Stream							
Aqua Research Cell Size (Kg/day as FAC)	0.7					mg/m^3	TLV	Recommended
Cl_2/HOCl/OCl$^-$ Chlorine gas/Hypochlorous acid/Hypochlorite Ion (as Cl_2 equivalent)	5000					0.5	N/A	N/A
H_2 Hydrogen Gas dissolved in solution	8					N/A	N/A	N/A
NaOH Sodium Hydroxide (pH < 10.0)	< 5					N/A	N/A	pH<12.5[†]
H_2 Hydrogen Gas Rate (mL/min) at STP §	285					N/A	N/A	N/A

*Gas phase limit for chlorine gas. Also see Section IV below. †RCRA characteristics of corrosivity in solution.

The Aqua Research mixed oxidant solution is generated electrolytically from a sodium chloride brine. The mixed-oxidant solution contains several chemical components which are either dissolved completely, or are in dynamic equilibrium with the overlying gas phase.
Hazards are associated largely with the gases that may evolve from the solution. At the operational pH of the solution, dissolved Cl_2 gas is completely hydrolyzed to the forms HOCl and OCl$^-$; thus Cl_2 gas evolution is minimal.
The pH of the mixed oxidant from all cells is pH < 10.0 (usually < 9.0). The NaOH concentration in these solutions is nominally < 4 mg/L. § STP is 0C and 1 atmosphere. Gas rate increases proportional to the absolute temperature and inverse to barometrici pressure. * Extrapolated from Fang, et.al., 2002, Wat. Res., 36(14):3533-3542.

Section III - Physical/Chemical Characteristics

Boiling Point	100° C	Specific Gravity (H_2O= 1)	1.03
Vapor Pressure (mm Hg)	N/A	Melting Point	0° C
Vapor Density (AIR = 1)	N/A	Evaporation Rate (Butyl Acetate =1)	N/A

Solubility in Water: **Completely Soluble.**
Appearance and Odor: **Clear Liquid. Mild Caustic Odor.**

Section IV - Fire and Explosive Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL*	UEL*
None	**None**	**4.1% (H_2)**	**74.2% (H_2)**
Extinguishing Media	**N/A**		
Special Fire Fighting Procedures	**No special procedures required.**		

*Lower and Upper Explosive Limits from N. Irving Sax, Dangerous Properties of Industrial Materials, 5th ed. Van Nostrand Reinhold Co., NY. 1979.

Unusual Fire and Explosion Hazards

Hydrogen buildup can occur in a tightly sealed, unventilated enclosure. Sparks, open flames, smoking, and other sources of ignition should be avoided when systems are in operation. Ensure compliance with local and national building, electrical, and safety codes.

Aqua Research H2gO STREAM

MATERIAL SAFETY DATA SHEET

Aqua Research Mixed Oxidant Solution and Hypochlorite solution continued...

Section V – Reactivity Data

Stability	Unstable		Conditions to Avoid
	Stable	X	

Incompatibility (Materials to Avoid)

No Vapor incompatibilities.

Hazardous Decomposition or By-products	May Occur		Conditions to Avoid
None	Will Not Occur	X	

Section VI – Health Hazard Data

Route(s) of Entry:	Inhalation?	Skin?	Ingestions?
	X	X	X

Health Hazards (Acute and Chronic)

Inhalation of hydrogen gas causes no symptoms (the primary hazard from hydrogen gas is explosions.) Exposure to combined solution causes minor skin or eye irritation. Ingestion causes vomiting and gastric distress.

Carcinogenicity	NTP?	IARC Monographs?	OSHA Regulated

None- No components are known carcinogens.

Signs and Symptoms of Exposure

Exposure to skin causes mild irritation. Ingestion causes vomiting.

Medical Conditions

Generally Aggravated by Exposure. **Dermatitis**

Emergency and First Aid Procedures

Wash immediately if skin, eyes, or mouth are exposed to solution.
Induce vomiting if solution is ingested.

Section VII – Precautions for Safe Handling and Use

Steps to be taken in case material is released or spilled: **Flush spill area with clean water.**

Waste Disposal Method: **Sanitary or storm sewer.**

Precautions to be taken for handling and storing: **No special precautions required.**

Other Precautions: **Oxidant production area must be well-ventilated to prevent hydrogen gas accumulation. Ensure compliance with local and national building, electrical, and safety codes.**

Section VIII – Control Measures

Respiratory Protection (Specify Type)

None required.

Ventilation	Local Exhaust	**Normal room ventil**	Special	**Not required**
	Mechanical (General)	**Normal room ventil**	Other	**N/A**

Protective Clothing/Gloves	Eye Protection
Rubber gloves advised	**Goggles Advised**

Other Protective Clothing or Equipment

None

Work/Hygienic Practices

Avoid open flames, sparks, smoking and other ignition sources in the vicinity of on-site generation systems and associated equipment.

NFPA Placard

Clockwise from Left:
Health = 1
Flammability = 0
Reactivity = 0
Other Specific Hazard = Null