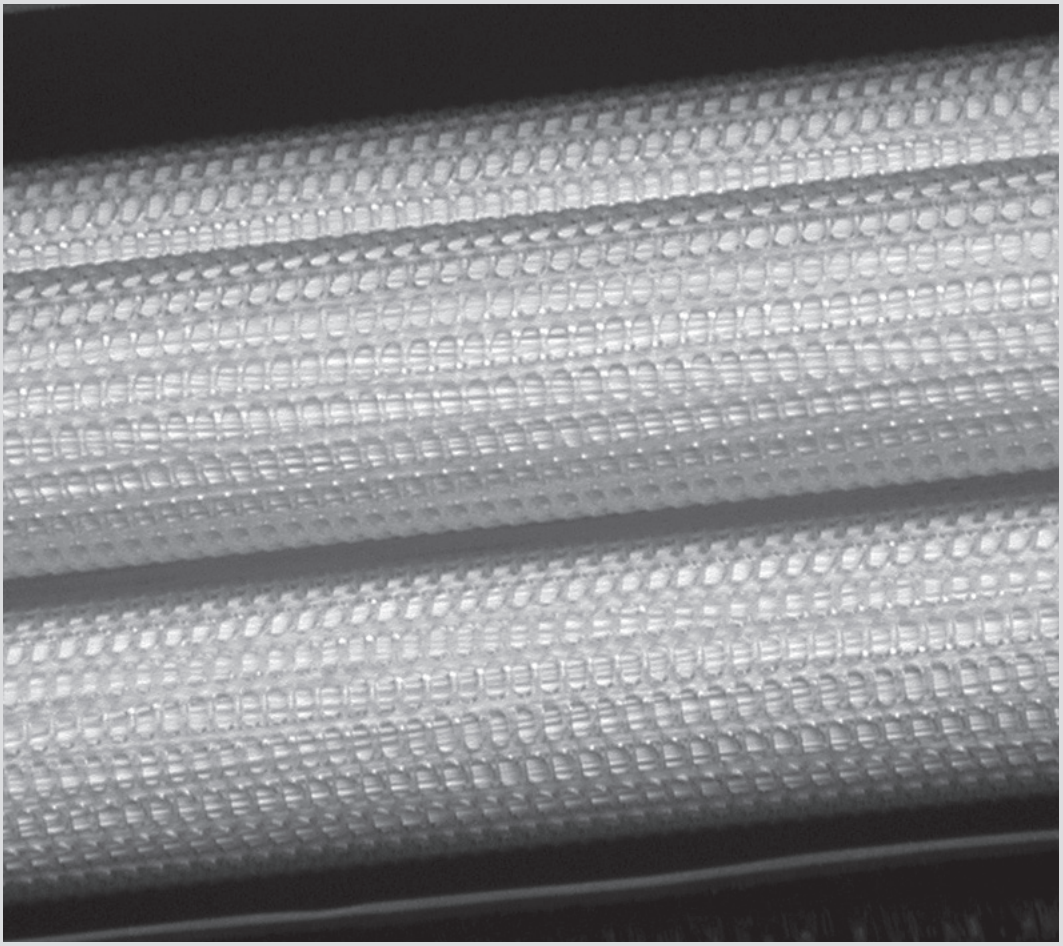
SAFE WATER TECHNOLOGIES, INC.

DEALER OPERATION & INSTRUCTION MANUAL

BRANEWAVE™ UF SYSTEMS

0.02 MICRON ULTRAFILTRATION



BraneWave UF System with Automatic Backflush Valve Model: UFA12C

BraneWave UF System with Manual Backflush Valve Model: UFM12F

JUNE 2019

Table of Contents

Manufacturing Specification

BraneWave UF

1. Application of hollow fiber technology.
2. Hollow fibers configured and potted in multiple bundles within module.
3. Hollow fiber module installed within 8 x 42 inch top and bottom open, extended base, polypropylene-lined container.
4. Filtration level is 0.02 micron.
5. Capable of 4.4 log reduction of bacteria and 2.4 log of virus at 10 gpm, 58 psi, and 15ºC as certified by BioVir Laboratories.
6. Fiber bundle is capable of sustaining a temperature of 150ºF.
7. Fiber bundle provides a permeate flow of up to 12 GPM at 25ºC and 60 psi.

Application Specification

BraneWave UF

1. The SWT BraneWave UF System consists of a hollow fiber ultrafilter installed within an 8 x 42 inch top and bottom open, extended base, polypropylene-lined container.
2. The system is designed for an operating valve (2.5"-8 thread) with a 1.05 inch riser opening.
3. The system has a 3/4 inch ball valve drain at the bottom of the tank.
4. The filtration level is 0.02 micron.
5. The system is capable of 4.4 log reduction of bacteria and 2.4 log of virus.
6. The operating temperature is 35 to 100ºF.
7. The operating pressure (inlet) is 10 to 100 psi.
8. The continuous flow rate is 10 gpm.
9. The system provides a treated flow of up to 12 gpm at 25ºC and 60 psi.
10. The raw water for treatment must meet the following specifications:
    a. Pre-filtration . . . . . 5 microns or less
    b. Chlorine . . . . . 1.0 ppm maximum for continuous flow (up to 500 ppm for cleaning only)
    c. Iron . . . . . Less than 0.30 ppm
    d. Manganese . . . . . Less than 0.05 ppm
    e. pH . . . . . 3 to 11
    f. Silt Density Index. . . . . Less than 6.0
    g. Clay, Tannin, Colloids . . . . . Subject to particle analaysis
11. A Pressure Decay Test (PDT) is required upon installation.
12. The routine membrane cleaning must include, as a minimum:
    a. Backflush (reverse flow to drain): Once per day (2 minutes at 2 gpm)
    b. Drain Flush (bottom drain flush to drain): Once per week (1 minute at 5 gpm)

Handling Procedures for the BraneWave UF

1. **Purpose.**
   The purpose of this protocol is to specify the procedures to be used in the handling, storage, manufacturing, and installation processes involved with the ultrafilter membrane model BraneWave UF.

2. **Background.**
   The BraneWave UF is a hollow fiber ultrafilter module. As such, it is susceptible to damage from shock and from bacteria when stored for long periods of time.

   a. The first enclosure provides the ultrafilter specification; the second enclosure specifies the ultrafilter module configuration.
   b. The ultrafilter module consists of four bundles of individual polysulfone fibers, or “lumens.” The loose lumens are suspended between two potting discs made from plastic. The junction of the lumen to the potting disc is the most likely place for damage to the lumens. Each bundle of lumens is encased in a plastic mesh both for rigidity and as a protective measure from damage to the lumens. The bottom potting disc provides a closure for each of the potted lumens. The top potting disc holds lumens that are open. The top potting disc is enclosed in a PVC capsule with a single 3/4 inch opening.
   c. If the module is idled for an extended period—normally over five months—it may be attacked by bacterial growth. If such growth is left unattended, it may cause permanent damage to the filtering specification of the lumens.
   d. This ultrafilter is designed for water flow from outside the lumens to the inside of the lumens. The lumen fiber provides the (ultra) filter as water passes through. Periodically the water flow may be reversed to inside-out for the purpose of cleaning the outside of the lumens.

3. **Storage Conditions.**
   The BraneWave UF has two acceptable storage conditions:

   a. *Semi-Dry State (Normal state from manufacturing until installation)* — This state is referred to as the “dry” state. In this condition, the smaller pores in the lumens are filled with glycerin, and are protected from freezing. This condition provides adequate protection for extended periods of time, provided that the membrane is not exposed to air flow. This is the condition for membranes from the time of shipment by the manufacturer through storage and installation by the Dealers.
   b. *Wetted State* — In this condition, the lumens have been treated with the wetting solution, then drained and enclosed in a plastic bag. This condition provides protection from freezing, dryness, and bacteriological damage for shorter periods of time. This is the condition for all uninstalled membranes after the wetting and immersed state.

4. **Shipping Procedures.**
   Precautions should be followed for shipping the encapsulated modules to prevent damage to the membrane from physical shocks (such as dropping) or from freezing.

   a. Modules should be shipped in a semi-dry state.
   b. Modules should have a cap plug on both the top and the bottom openings of the tank.
   c. Modules should be secured inside a rigid cardboard box with bubble wrap to minimize the impact of dropping the carton.

5. **Pressure Decay Test (PDT).**
   A certified PDT is conducted to ensure that no physical damage has occurred to the lumens. The PDT is also referred to as the Membrane Integrity Test. The principle behind this test is the ability of a semi-dry or wetted membrane to prevent air flow through its pores except if the membrane is damaged. During a PDT the membrane is pressurized to a preset value and held at that pressure. The decay of this pressure, if any, is then used as an indicator of a possible rupture of the membrane lumens.

   a. A PDT will be conducted and recorded by each Dealer upon receipt of a membrane assembly.
   b. A PDT will also be conducted at installation, and any time thereafter, when the integrity of the membrane lumens is in question.
   c. Dealers must have compliance of integrity testing.
   d. The results of integrity testing will be recorded by tank number, and the records maintained for one year from date of manufacture.

6. **Application Recording.**
   It is essential that a single source application specification be maintained for the manufactured module. This will enhance the marketing of the system, and will allow future module product improvement modifications. Accordingly, records must be developed for each shipped module by the manufacturer and the individual OEMs and Dealers.

   a. Before a manufactured module is released to a Dealer, the feed/raw water of the application and the intended purpose/outcome of the application must be specified and recorded.
   b. Within one month of shipping, the receiving Dealer will report the general results achieved and any issues or recommendations for improvement based upon the application.

Agreement Components for BraneWave UF Dealers

1. Authorized Dealers will be certified in the use of the Pressure Decay Test (PDT) equipment and procedures.
2. Upon receipt of the encapsulated ultrafilter, the Dealer must immediately pressure test the ultrafilter using the PDT protocol. (See page 6)

   a. Ultrafilters that pass the PDT may be sold.
   b. Ultrafilters that fail the PDT will be returned to the manufacturer.

3. All membranes returned must be preserved with a wetting solution. (See page 11)
4. Untreated water must meet the following specifications:

   a. Chlorine level less than 1 ppm
   b. Iron less than 0.3 ppm
   c. Manganese less than 0.05 ppm
   d. pH between 3 and 11
   e. Silt Density Index less than 6.0
   f. Tannin level (See 7 below)

5. All ultrafilter installations must include a 10 micron, or finer, pre-filter.
6. BraneWave UF warranty covers the integrity of the membrane only, and not membrane fouling.
7. All ultrafilter applications should be thoroughly investigated prior to prescription. Application testing should include procedures to determine the filtration level versus customer expectations, cleaning frequency, and the projected longevity of the membrane system. For tannin, since the molecular weights vary widely, it is important that the filtration level be demonstrated prior to installation.
8. Dealers agree to supply the results of field performance. Such data will be used to further refine the specification and application envelope for the ultrafilter.

Pressure Decay Test (PDT)

1. **General.**
   The purpose of the PDT is to ensure that the membrane fibers are intact and free from tears or ruptures that would allow particles to pass through the membrane. The PDT is conducted by the Dealer upon receipt of a manufactured ultrafilter, upon installation, and at any time that the integrity of the membrane is in question.

2. **Description.**
   The PDT is conducted on the membrane within the encapsulating tank. During the test, the membrane is maintained in the semi-dry state. The test consists in the application of air pressure to the inside of the membrane lumens (i.e. reverse flow). On intact membrane lumens, the surface tension of the glycerin at the membrane pores inhibits the flow of air through the membrane. This restriction should remain valid to a set air pressure. The integrity test device applies air pressure to that pressure set point and holds the pressure for about 3 minutes. If the pressure decay (loss) is less than the set point, then the membrane passes the test. If the membrane is broken or ruptured, the air will freely pass out of the lumens and the membrane will fail the test.

3. **Testing Equipment.**
   The integrity test requires the following items:

   a. Integrity Test Pump/Monitor (IntegriTest Assembly)
   b. PDT Assembly with pressure gauge
   c. 1/4 inch plastic tubing (approximately two feet)
   d. Small pail and 1 cup of bleach (5.25%) for disinfection

4. **IntegriTest Assembly Preparation.**
   The IntegriTest Assembly must be preset for testing of either: 1) semi-dry membrane as received from manufacturer or; 2) wet membrane after installation and wetting. The two settings are as follows:

SETTING	SEMI-DRY	WET
Test Pressure	14 psi	14 psi
PDT Limit	2.1 psi	3.5 psi
Stabilization	10 min	10 min
Test Duration	3 min	3 min

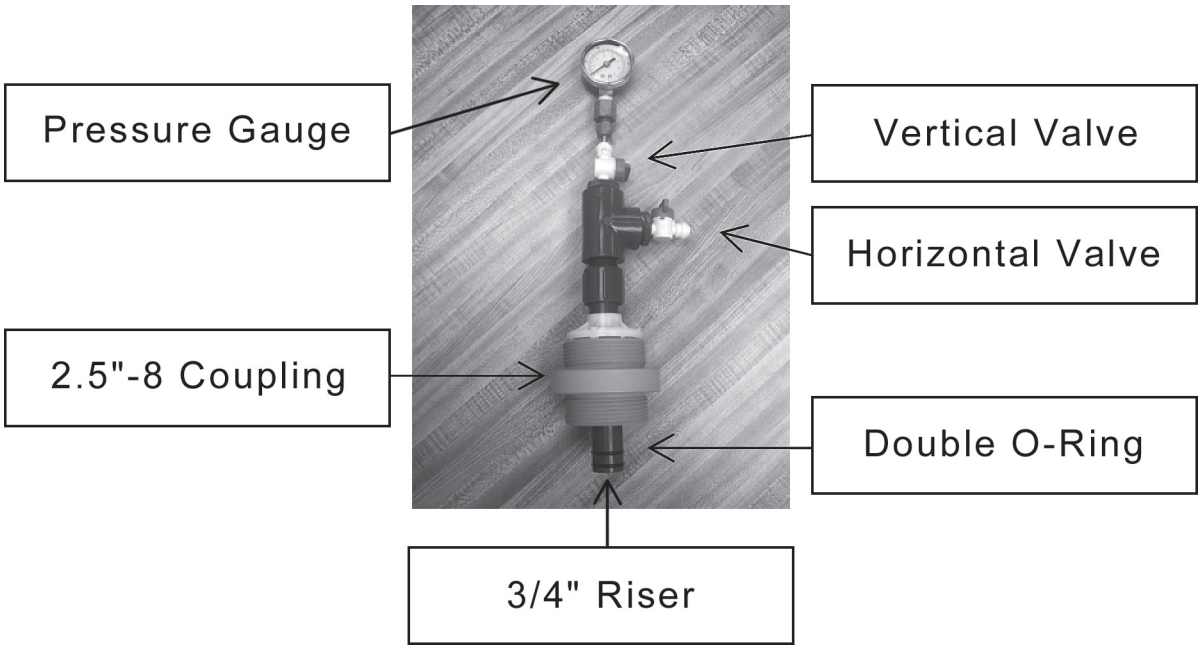
5. **Test Equipment Preparation.**
   Disinfection of the test equipment prevents the unnecessary introduction of bacteria to the lumen internals:

   a. With pressure gauge removed, close both valves on the PDT Assembly, turn the PDT Assembly upside-down over the small pail, pour a small quantity of bleach into the 3/4 inch riser opening, and let the assembly stand for 5 minutes.
   b. After 5 minutes, open both valves on the PDT Assembly, and allow the bleach to drain into the pail.
   c. Dip the pressure gauge into the bleach, and then place the pressure gauge onto the PDT Assembly.

6. **Membrane Preparation.**
   The ultrafilter assembly should be in the SEMI-DRY state as received from manufacturer.

   a. Place the PDT Assembly's 3/4 inch riser into the 3/4 inch female opening on the membrane, seat the o-rings in the female opening, and screw the 2.5"-8 coupling onto the top opening of the ultrafilter tank.
   b. Close the horizontal valve of the PDT Assembly (the vertical valve should still be open).
   c. Attach the 1/4 inch tubing to the horizontal valve and then to the IntegriTest Assembly.

PDT ASSEMBLY



7. **Testing Procedure.**
   The following procedure will be used for Pressure Decay Testing:

   a. Plug in the IntegriTest Assembly to the power source.
   b. Open the horizontal and vertical valves of the PDT Assembly.
   c. Press the INPUT key on the IntegriTest Assembly to activate the test.
   d. Press INPUT, and the IntegriTest will automatically conduct the PDT (13 minutes approx.).
      — *Step 1: Pressurizing.* The pump will activate and the pressure will be increased to 14 psi.
      — *Step 2: Stabilization.* The IntegriTest will periodically pump air into the membrane to maintain the test pressure of 14 psi. The timer will countdown the 10 minute Stabilization Phase.
      — *Step 3: Final Pressure and Measurement.* At the end of the countdown, the IntegriTest display will indicate the Final Pressure for testing, and will automatically initiate the Measurement (Test) Phase of 3 minutes.
      — *Step 4: Depressurize.* After the Measurement Phase, the system will depressurize.
   e. At the end of depressurizing, the screen will indicate whether the membrane has passed the test. If the membrane “PASSED,” close the horizontal valve, remove the 1/4 inch tubing from the valve, and then open the horizontal valve to release pressure. Then remove the PDT Assembly.

8. **Handling Failure and Retesting.**
   If the membrane does not pass the test, the following procedures should be used:

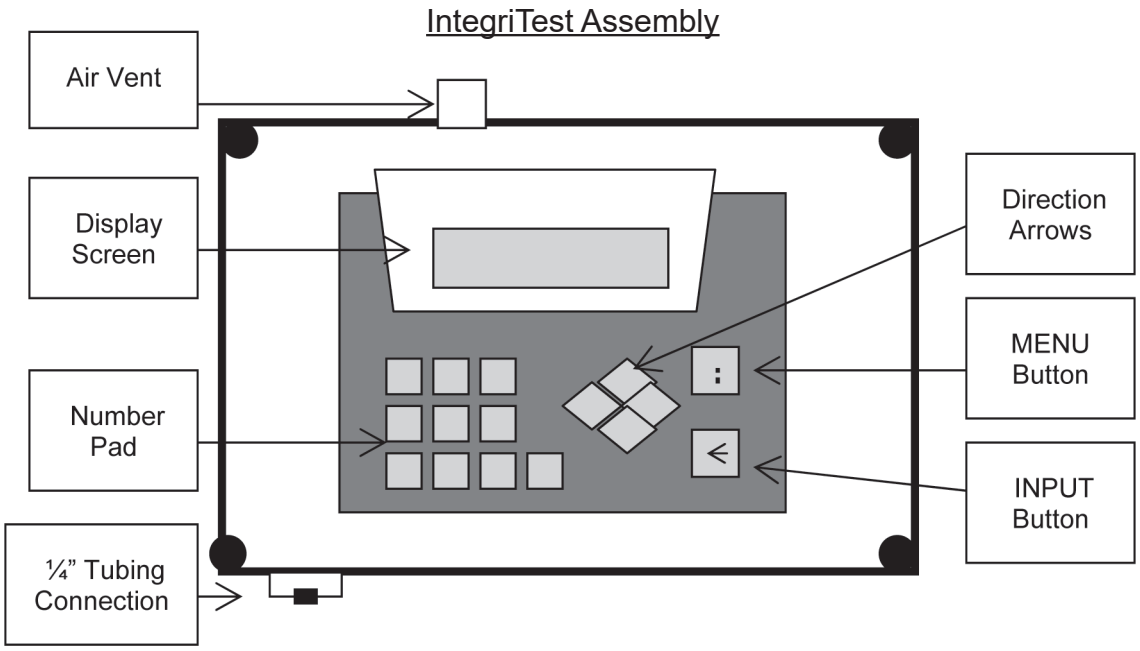
   a. If “FAILURE” occurs, note the pressure drop by pressing the INPUT button. The display will indicate the pressure decay.
   b. If “FAILURE” occurs, check the following possible causes:
      i. Clear the vent hole in the PDT Assembly.
      ii. Check the PDT Assembly for possible leaks, and reseat the 3/4 inch riser in the membrane.
   c. Retest the ultrafilter at least three times.
   d. If “FAILURE” continues to occur, do not install the ultrafilter.

9. **Disposition of Failed Membranes.**
   Membranes which have failed the Pressure Decay Test should be returned for autopsy. An RMA will be issued for the return and evaluation.

IntegriTest Assembly

1. **IntegriTest Assembly.**
   The IntegriTest Assembly consists of a pump and monitor plus a power cord with a European/US plug converter. The IntegriTest operates with 120VAC/60Hz power.

2. **IntegriTest Controls.**
   The IntegriTest Assembly has a display screen, ten (10) digit keypad, four (4) direction arrows, a MENU button, and an INPUT button.



3. **IntegriTest Screens.**
   The IntegriTest will display different screens during set-up and operation.

   a. Normal Screen: AUTO-INTEGRITEST

   b. Setting Menu:

1. Test Pressure	Used to set the test pressure
2. PDT Value	Used to set the limit for pressure decay
3. Stabilization	Used to set the duration of stabilization
4. Test Duration	Used to set the duration of test
5. Factory Settings	Not used
6. Factory Settings	Not used
7. Factory Settings	Not used
8. Language	1 is English

   c. Operation:

PRESSURIZATION	Initial membrane pressurization
STABILIZATION	Indicates time and pressure during the stabilization period
FINAL	Indicates the final pressure for testing
MEASUREMENT	Indicates the time of the testing period
DEPRESSURIZATION	Depressuring the membrane
TEST RESULT OK	Membrane has passed the test

4. **Pre-Installation Test Setup.**
   The following procedure is used to prepare the IntegriTest for testing a semi-dry membrane:

   a. Plug in the IntegriTest. Screen will show the Normal Screen.
   b. Press the MENU button. Screen will indicate SETTING MENU and will scroll between the menu options.
   c. Press the NUMERAL 1. Screen will show the TEST PRESSURE.
   d. Using the NUMERAL buttons and the DOWN arrow (decimal set), set the test pressure to 14.00 psi.
   e. Press the INPUT button twice. Setting Menu screen will appear.
   f. Press the NUMERAL 2. Screen will show PDT LIMIT VALUE.
   g. Using the NUMERAL buttons and the DOWN arrow (decimal set), set the PDT decay limit to 2.1 psi.
   h. Press the INPUT button twice. Setting Menu screen will appear.
   i. Press the NUMERAL 4. Screen will show TEST DURATION.
   j. Using the NUMERAL buttons and the DOWN arrow (decimal set), set the Test Duration to 3.0 minutes.
   k. Press the INPUT button twice. Setting Menu screen will appear.
   l. Press the MENU Button to return to the Normal Screen.
   m. Settings have now been made for Manufacturing Testing.

5. **Post-Installation Test Setup.**
   The following procedure is used to prepare the IntegriTest for testing a wetted membrane:

   a. Plug in the IntegriTest. Screen will show the Normal Screen.
   b. Press the MENU button. Screen will indicate SETTING MENU and will scroll between the menu options.
   c. Press the NUMERAL 1. Screen will show the TEST PRESSURE.
   d. Using the NUMERAL buttons and the DOWN arrow (decimal set), set the test pressure to 14.00 psi.
   e. Press the INPUT button twice. Setting Menu screen will appear.
   f. Press the NUMERAL 2. Screen will show PDT LIMIT VALUE.
   g. Using the NUMERAL buttons and the DOWN arrow (decimal set), set the PDT decay limit to 3.5 psi.
   h. Press the INPUT button twice. Setting Menu screen will appear.
   i. Press the NUMERAL 4. Screen will show TEST DURATION.
   j. Using the NUMERAL buttons and the DOWN arrow (decimal set), set the Test Duration to 3.0 minutes.
   k. Press the INPUT button twice. Setting Menu screen will appear.
   l. Press the MENU Button to return to the Normal Screen.
   m. Settings have now been made for Manufacturing Testing.

Cleaning Cycles

1. **Installation Intent.**
   The prescribed membrane cleaning cycle is a function of the quality of the feed water and the intended purpose of the BraneWave UF. In most cases, the feed water will have some pretreatment stage, including at least a 10 micron cartridge filter. The intended purpose of the ultrafiltration will be one of the following:

   a. Microbiological barrier
   b. Sediment/turbidity/tannin filter
   c. Combination

2. **Cleaning Routines.**
   The cleaning routine for membranes may be any or a combination of the following stages:

   a. *Raw backwash* — Reverse flow of feed water to drain
   b. *Treated backwash* — Reverse flow of a separate treated source to drain
   c. *Disinfection backwash* — Reverse flow with a disinfectant to drain (Disinfectant may be introduced through an injector using an upflow brine water softening valve.)
   d. *Raw flush* — Service flow of feed water (with exit at the bottom drain)

3. **Cycle Selection.**
   The following are examples of cleaning cycles:

   a. Standard cycle:
      Raw backwash (2 gpm for 2 minutes each day)
      Raw flush (5 gpm for 1 minute each week)

   b. Microbiology:
      Raw backwash (2 gpm for 2 minutes each day)
      Disinfection backwash (2 gpm for 2 minutes each week)
      Delay of 2 minutes
      Treated backwash (2 gpm for 2 minutes each day)
      Raw flush (5 gpm for 1 minute each week)

   c. Sediment:
      Treated backwash (2 gpm for 2 minutes each day*)
      Raw flush (5 gpm for 2 minutes every 3 days*)
      * May be decreased based upon clarity of effluents.

4. **Disinfectant Use.**

   Chlorine at 500 mg/l
   Solution Makeup: 1 ounce of 5.25% bleach in 5 gallons water

Membrane Wetting Process for Storage and Winterization of BraneWave UF

1. **General.**
   The wetting solution is intended for bubble testing of the membrane, for long-range storage (more than five months), and for treating the membrane for shipment during freezing conditions.

2. **Solution Components.**
   The wetting solution is an aqueous (water) solution of 50% (by weight) of glycerin and 1% (by weight) of sodium metabisulfite. The glycerin is heavier than water and provides pore protection from freezing and from drying out. The sodium metabisulfite provides protection from bacteriological damage to the membrane.

3. **Solution Makeup.**
   The wetting solution is made up as follows:

   a. *Water and glycerin:* Mix 5 gallons (volume) of glycerin with 6 gallons of cold water.
   b. *Water/glycerin and sodium metabisulfite:* Mix 1 ounce (by weight) of sodium metabisulfite with each gallon of water/glycerin solution. Mix the solid metabisulfite in warm water; then add to the glycerin/water solution.
   c. *Example:* Add 5 gallons of glycerin to the makeup tank. Add 6 gallons of cold water. Then dissolve 11 ounces (weight) of sodium metabisulfite in one quart of warm water. Add the metabisulfite solution to the water/glycerin solution and mix thoroughly.

4. **Wetting Treatment Process.**
   Ultrafiltration membranes should be wetted as follows:

   a. Attach closure fitting to the bottom tank opening.
   b. Add wetting solution until the level is above the lumens of the membrane.
   c. Top off the wetting solution after 10 minutes to allow for the absorption of the wetting solution in the lumen fibers.
   d. Afterwards, the membrane may be bubble tested or stored for later use.

5. **Removal of Wetting Solution.**
   To remove the wetting solution, use a gravity drain. There will be a residual in the membranes which will continue to drain afterwards.

6. **Wetting Solution Reuse.**
   The wetting solution may be reused provided that it is filtered at 130 microns.

Tech-EE Series Control Valve Setup Sheet

Model	
Unit No.	
Job	
Software Revision	

Configuration Settings

Enter Settings		Press **NEXT** & ▼ for 5 seconds and release, then Press **NEXT** & ▼ again for 5 seconds and release
Set Valve Type		1.0, 1.0T, 1.25, 1.5, 2.0
Set Meter Size		1.5, 2.0, 3.0, 1.0r, PUL *(For 1.5 and 2.0 only)*
Set Variable Meter Pulses		0.1 – 150.0 Pulses Per Gallon *(For PUL only)*
Set dP		oFF, on 0, dEL, HoLd
Set Control Valve Operation		nHbP, SEPS, SYS, ALT A, ALT b, oFF
Set Delayed Rinse and Fill		oFF, on *(For 1.0 – 1.5 with ALT A or ALT b only)*
Set Special Rinse Duration		oFF, 1 – 95 Minutes *(For 2.0 with ALT A or ALT b only)*

Filter System Setup Settings

Enter Settings		Press **NEXT** & ▼ for 5 seconds and release
Set Filtering Operation		FILTERING BACKWASH, FILTERING REGEN
Set Backwash		1 – 120 Minutes
Set Draw		1 – 180 Minutes *(For FILTERING REGEN only)*
Set 2nd Backwash		1 – 120 Minutes *(For FILTERING REGEN only)*
Set Rinse		1 – 120 Minutes
Set Fill		1 – 99 Gallons *(For FILTERING REGEN only)*
Set Volume Capacity		oFF, 20 – 1,500,000 Gallons
Set Regeneration Trigger		28 Day, 7 Day *(For oFF only)*
Set Regeneration Time		NORMAL, on 0, NORMAL + on 0
Set Relay Operation		Time, Gallons, Gallons Regen, Error, oFF
Set Relay Actuation		1 Second – 200 Minutes, 1 – 200 Gallons
Set Relay Deactivation		1 Second – 200 Minutes, 1 Second – 20 Minutes

Installer Display Settings

Enter Settings		Press **NEXT** & ▲ for 5 seconds and release
Set Day Override		1 – 28, oFF
Set Regeneration Time		Hour & Minutes

BraneWave UF — Dealer Prep Integrity Test Record Sheet

Model	Serial Number	Date	PDT Result	End State	Initials