OPERATION
&
MAINTENANCE MANUAL

FOR

UF PLANT

Client

H2O Innovation.

TABLE OF CONTENTS

1. GENERAL INFORMATION

The Manual

This manual has been prepared to provide the operator with information on the installation, operation, maintenance and troubleshooting of Q-SEP® modules.

The manual may be supplemented with drawings, schematics and technical notes for clarification.

Safety Labels

Words in **ENHANCED CAPITAL** letters are used to identify labels on the device and key safety or qualifying statements.

Following are the safety labels and their definitions. This does not contain all of the safety statements in the manual. Other safety statements are included within the manual text as well.

NOTE

NOTE indicates statements that provide further information and clarification.

CAUTION!

CAUTION indicates statements that are used to identify conditions or practices that could result in equipment or other property damage.

WARNING!!

WARNING indicates statements that are used to identify conditions or practices that could result in injury or loss of life.

2. INTRODUCTION

QUA is a manufacturer of advanced membrane products for water, wastewater and water reuse applications. Extensive R&D activities for over a decade have resulted in a range of cutting edge products such as hollow fiber ultra filtration modules (Q-SEP) The Q-SEP ultra filtration (UF) membrane fibers and modules are manufactured in a state-of-the-art environmentally controlled manufacturing facility with continuous online monitoring to maintain consistent quality.

About Ultra filtration

Ultrafiltration (UF) is a membrane filtration process used to remove suspended solids, colloidal matter, high molecular-weight substances, bacteria and viruses from various feed water sources. UF can achieve a low and consistent silt density index (SDI) and is often used as pretreatment for reverse osmosis using surface water, seawater and biologically treated wastewater as feed source. Q-SEP modules incorporate high strength hollow fibers that deliver superior performance without the risk of fiber breaks. Q-SEP UF fibers are made from a hydrophilic polyether sulfone (PES) material with excellent low fouling characteristics. These hollow fibers operate under a pressurized inside-out flow configuration for superior performance.

Q-SEP modules contain an advanced UF fiber prepared by an innovative cloud point precipitation method (patent pending). This method ensures a very uniform pore size distribution and high pore density in the fiber. As a result the product water quality from Q-SEP modules is significantly better than the quality compared to conventional UF Modules at a very low operating pressure. The fibers in the Q-SEP module are held firmly in place which reduces the stress on the fibers even at high flow velocities. Uniform fiber packing limits the pressure drop variation within the module and prevents localized high fouling conditions. Unique end cap sealing design allows for high pressure operation.

Q-SEP UF modules can be used as dead-end filtration or in cross flow mode. The fibers are available with 0.8 mm ID fibers suitable for feed water with low turbidity and 1.2 mm ID Fibers suitable to treat water with higher turbidity.

The Q-SEP UF fibers and modules are manufactured in a state-of-the-art environmentally controlled manufacturing facility with continuous online monitoring to maintain consistent quality.

3. Q-SEP UF FEATURES

- Superior module design
- Consistent pore sizes
- High porosity along the entire length of fiber
- Quality checks to ensure integrity of individual fibers prior to module assembly

Q-SEP Module

Module Cross Section

Fibers

Advantages of Q-SEP UF over Conventional Media Filtration

- Improved product quality
- Product SDI typically less than 1
- Removal of virus, bacteria and germs
- Removal of microbiological matter
- Removal of colloidal matter
- Improvement of downstream Reverse Osmosis (RO) performance
- Consistent treated water quality irrespective of changes in feed water quality

Applications of Q-SEP UF

- Pretreatment to RO system (brackish and seawater applications)
- Purification of surface and well water for potable applications
- Filtration of industrial water
- Wastewater recycle and reuse

4. Q-SEP MODULE DETAILS

Q-SEP UF modules are available with 0.8 mm ID and 1.2 mm ID (inner fiber diameter). The unit comes with molded end cap design with 2" Victaulic® connections in each cap. Multiple modules can be connected to a centralized header to achieve desired treatment capacity.

Figure-1: Q-SEP Module

5. Q-SEP MEMBRANES & MODULE SPECIFICATIONS

Technical Information

Operational Instructions	
Filtrate Flux Range	50 to 150 l/m^{2}h (30 to 90 gfd)
Maximum feed pressure	4.8 bar (70 psi)
Membrane Burst pressure	8.5 to 9.5 bar
Trans-membrane pressure	0.3 to 1.4 bar (5 to 20 psi)
pH range	2 to 12
Typical instantaneous chlorine tolerance	100 to 200 ppm
Maximum operating temperature	45°C (113°F)
Typical feed turbidity	0.8 mm ID: 25 NTU 1.2 mm ID: 50 NTU
Backwash flux range	150 to 300 l/m^{2}h (90 to 180 gfd)
Backwash feed pressure	0.7 to 2.1 bar (10 to 30 psi)
Backwash frequency & duration	Every 15 - 45 minutes for 30 - 60 seconds
Chemically Enhanced Backwash (CEB)	
Estimated Frequency	Every 1 to 10 days of operation (depending upon feed water conditions)
Duration	10 to 20 minutes
CEB chemicals	NaOCl (100-200 ppm), NaOH (pH:11- 12), Acid (pH : 2-3),H_2O_2, Citric acid.
Module Characteristics	
Membrane material	Hydrophilic PES
Housing material	UPVC
End cap material	GRP
Nozzles material	2” Victaulic

Module Specification

Parameter	Description / Information
Configuration	Self-encapsulated hollow fiber ultra filtration membrane module (inside-out)
Operating Mode	Dead-end or Cross flow, Backwash able
Module mounting	Vertical
Membrane pore size	0.02 micron

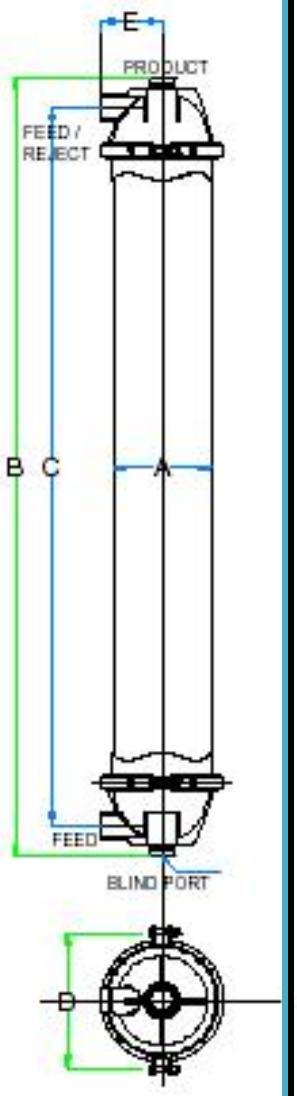
Module Specification

Q-SEP Modules 0.8 mm

Product Data		Q-SEP 4508	Q-SEP 6008
Membrane area	m^2 / ft^2	45 / 484	60 / 645
Filtrate flow rate minimum	m^3/hr / gpm	2.25 / 9.9	3.0 / 13.2
Filtrate flow rate maximum	m^3/hr / gpm	6.75 / 29.7	9.00 / 39.6
Inside diameter	mm / inch	0.8 / 0.03	0.8 / 0.03
Outside diameter	mm / inch	1.2 / 0.05	1.2 / 0.05
Module Dimensions			
Diameter (A)	mm / inch	225 / 8.85	225 / 8.85
Length – with end cap (B)	mm / inch	1809.4 / 71.23	2264.5/89.15
Length – feed connections (C)	mm / inch	1666 / 65.59	2116.2/83.31
Distance – width (D)	mm / inch	316 / 12.44	346/13.62
Distance – feed to center (E)	mm / inch	140 / 5.51	140/5.51
Module weight	kg / lbs.	47.2 / 103.5	53/116.2

Q-SEP Modules 1.2 mm

Product Data		Q-SEP 3412	Q-SEP 4512
Membrane area	m^2 / ft^2	34 / 365	45 / 484
Filtrate flow rate minimum	m^3/hr / gpm	1.7 / 7.48	2.25 / 9.9
Filtrate flow rate maximum	m^3/hr / gpm	5.1 / 22.45	6.75 / 29.7
Inside diameter	mm / inch	1.2 / 0.047	1.2 / 0.047
Outside diameter	mm / inch	1.9 / 0.08	1.9 / 0.08
Module Dimensions			
Diameter (A)	mm / inch	225 / 8.85	225 / 8.85
Length – with end cap (B)	mm / inch	1809.4 / 71.23	2264.5/89.15
Length – feed connections (C)	mm / inch	1666 / 65.59	2116.2/83.31
Distance – width (D)	mm / inch	316 / 12.44	346/13.62
Distance – feed to center (E)	mm / inch	140 / 5.51	140/5.51
Module weight	kg / lbs	52/ 114	58.4/128



6. Q-SEP DESIGN GUIDELINES

1. Q-SEP UF modules are designed for pressurized inside-out flow.

2. Q-SEP modules are currently available with fiber internal diameter (ID) of 0.8 mm and 1.2 mm.

   The 0.8 mm ID fiber is available in two models:
   - Q-SEP 4508
   - Q-SEP 6008

   The 1.2 mm fiber is available in two models:
   - Q-SEP 3412
   - Q-SEP 4512

3. Modules with 0.8 mm ID fibers are typically recommended to filter low turbidity (<30 NTU) feed water and modules with 1.2 mm ID fiber are recommended for higher turbidity (>30 NTU) feed water.

4. To determine the total flow capacity requirements of the UF system, the design should include using UF Product / Permeate water for back flushing of the modules. This additional back flush water should be added to the net capacity requirement. Refer to the Q-SEP Design software for details.

5. The back flush water would vary from 5-12% of the feed flow, depending on the feed water turbidity levels. Normally 8-10% back flush water usage would be considered for design conditions while treating water with 5-10 NTU turbidity loading.

6. Number of modules for the required design flow can be calculated as follows:

$$Modules = \frac{Flow(gpm)x1440}{0.9xArea\ (ft^2)flux(gfd)}$$

Or as follows for metric units

$$Modules = \frac{Flow\ (m^3/h)x1000}{0.9xArea\ (m^{2)}flux\ (lm^2h)}$$

In the above formula, 0.9 is the factor considered based on average 90% recovery. This means aprox 10% of the UF Product/Permeate water would be used for back flush, rinse, etc. and aprox 90% of the UF Product/Permeate water would be available for net usage. The recovery normally varies depending on the quality of feed water. In case of clean feed water the recovery can be as high as 95%.

7. Membrane areas of the various Q-SEP modules are as follows.
   i. Q -SEP 6008 - 60 m² (645 ft²)
   ii. Q -SEP 4508 - 45 m² (484 ft²)
   iii. Q-SEP 4512 45 m² (484 ft²)
   iv. Q-SEP 3412 - 34 m² (365 ft²)

8. Ensure that the Trans Membrane Pressure (TMP) (which is the difference between the average Feed / Inlet pressure and the Product pressure) does not exceed 1.4 bar (20 psi).

$$\mathbf{TMP = (P_F + P_R) / 2 - P_P}$$

P_F = Feed Pressure
P_P = Product Pressure
P_R = Reject Pressure

9. When selecting the feed water pump of the UF system, ensure that the shut off head is less than 70 psig (4.8bar), or other suitable provisions are to be made like installing a modulating control valve.

10. It is recommended to use a Variable Speed Frequency Drive (VFD) or a Soft-Start or a modulating flow control valve on the Feed and Back flush pumps to avoid water hammering.

11. It is strongly recommended to incorporate a 100 - 150-Micron self cleaning strainer at the feed side to screen larger particles that could damage the fibers.

12. A suitable coagulant dosage would be required in case of high turbid water. A coagulant such as Ferric Chloride can be dosed. Dosage rates can range from 1-5 ppm in low turbid water and 10-30 ppm in high turbid water, depending on type of coagulant and feed water character. The type of coagulant and dosages are normally established during start-up with jar testing.

CAUTION

Do Not Overdose Coagulant!

13. For chemically enhanced backwash, **Sodium Hypochlorite (NaOCl), Sodium Hydroxide (NaOH)** and **Sulfuric Acid (H_2SO_4) or Hydrochloric Acid (HCl)** would be required. Proprietary chemicals can also be used for specialized enhanced cleaning steps as approved by QUA. Contact QUA for further details on other chemical options.

NOTE

Refer to the Caution and Safety Considerations section 14 of this manual when working with any chemical.

14. The chemical metering pumps should be rated for approximately 200 ppm Sodium Hypochlorite, pH of 12 for caustic and pH of 2 for acid. In case of acid and caustic dosing, it is recommended to use low TDS water (preferably RO Permeate or similar if available) to avoid excessive consumption of caustic and acid due to buffering effect of alkalinity, etc. present in the backwash water.

15. For integrity testing of fibers, compressed air should be made available at 1 bar (14.5 psig).

16. Ensure the assembled system skid design has a suitable high-mounted vent and low mounted draining capability.

17. The system design should be such that there is no water hammer or air pockets. Provide a suitable anti-siphon arrangement (vacuum breaker) on the backwash drain line.

18. Refer to the following table that provides information on recommended flux rates for various water conditions and other cleaning details.

7. SUGGESTED PARAMETERS FOR DESIGN OF Q-SEP UF SYSTEM

Table-1: Suggested Parameters for Design of Q-SEP UF System

			City water / Well water				Surface water (coagulation may be required)					Tertiary water		Sea water		
	Case		1	2	3	4	1	2	3	4	5	1	2	1	2	3
	Turbidity	NTU	<1	1 to 3	<5	<10	<1	<5	<10	<20	<30	<2	<5	<1	<5	<10
	Filtration	Flux GFD	70.7	64.8	58.9	53	70.7	58.9	53	47.1	35.3	47.1	41.2	64.8	58.9	53
Service		Flux LM²H	120	110	100	90	120	100	90	80	60	80	70	110	100	90
	Time	Minutes	60	50	40	35	60	45	35	30	25	50	40	50	40	30
Back Flush	Pre Forward Rinse	Minimum Service flow or up to 60 GFD (101.9 Flux LM²H)														
	Time	Seconds				10			15	15	15	15	15		15	15
	Backflush	Flux GFD	120	120	120	120	120	120	120	120	120	120	120	120	120	120
		Flux LM²H	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8
	Time	Seconds	30	30	30	40	30	30	40	40	50	40	40	30	40	50
	Final Rinse	Minimum Service flow or up to 60 GFD (101.9 Flux LM²H)														
	Time	Seconds	10													
Insitu cleaning	NaOCl	Dosage	100 to 200 PPM													
	NaOH	Dosage	11 to 12 pH													
	HCL or H_2SO_4	Dosage	2 to 3 pH													
	CEB Flow (BW Pump)	Flux GFD	50	50	50	50	50	50	50	50	50	50	50	50	50	50
		Flux LM²H	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8	84.8
	CEB Duration	Seconds	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	CEB Soaking	Minutes min	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Backflush	Flux GFD	120	120	120	120	120	120	120	120	120	120	120	120	120	120
		Flux LM²H	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8	203.8
	Time	Seconds	30	30	30	40	30	30	40	40	50	40	40	30	40	50
	Final Rinse	Minimum Service flow or up to 60 GFD (101.9 Flux LM²H)														
	Time	Seconds	10													

NOTES ON SUGGESTED DESIGN PARAMETERS

Notes on Suggested Design Parameters	
1	All values are recommended. In certain cases detailed feed water Analysis and / or pilot study may be required to arrive at appropriate flux and cleaning frequency.
2	Pre forward rinse and final rinse after back flush are recommended but can be eliminated based on feed water condition.
3	For more turbid water, it is recommended to alternate service flow from bottom to top and top to bottom after every back flush for uniform solids loading.
4	For improved cleaning performance for more turbid water, the back flush outlet can also be alternated once from the top and the next from the bottom during every back flush. Alternatively during each back flush for 50 % of the duration the back flush waste can exit from the top and for the remaining time from the bottom.
5	Every CEB should follow with a back flush and final rinse.
6	Considering down time during back flush, CEB and soaking, it is recommended to provide a filtered water break tank of about 15 minutes storage. In case of multiple trains configuration about 10 minutes storage is recommended. The soaking can be minimum 5 minutes but in some cases enhanced soaking may be required.

8. Q-SEP ASSEMBLY INSTRUCTIONS

Q-SEP UF modules are suitable for **vertical** installation only. The unit is recommended to be operated in a Dead- End mode, however in special cases the unit can also be operated in Cross-Flow mode (consult Qua for recommended operating procedures). Each module is capable of withstanding a maximum operating pressure of 4.8 bar (70 psig) at 25ºC (77ºF). The modules should be installed with the Product connection at the top. The Inlet/Feed and Concentrate/Reject connections are from the sides. All connections are 50 mm (2 inch) Victaulic.

1. Inlet/Feed enters at the bottom of the module. Under certain conditions such as high solids loading, it is recommended to alternate the feed direction from Bottom-to-Top, followed during the next cycle in a Top-to-Bottom configuration.

2. The skid assembly must be capable of supporting the weight of the Q-SEP modules as follows:

Module	Shipping Weight	Operating Weight
Q-SEP 6008	53 kg (116.2 lb)	78 kg (172 lb)
Q-SEP 4508	47.2 kg (103.5 lb)	65 kg (144 lb)
Q-SEP 4512	58.4 kg (128 lb)	78 kg (172 lb)
Q-SEP 3412	52 kg (114 lb)	65 kg (144 lb)

3. A typical process diagram is show in figure 3. Use Victaulic flexible joints to connect all three (3) ports of each module to the system piping.

CAUTION

The modules should be supported at the center of the bottom end cap. At least two straps and two saddles should be utilized to hold the modules to the support structure.

4. A minimum section of 2” length of clear pipe with each module is required in the Product / Permeate exit line to identify modules in the event that one might have lost integrity. See “Q-SEP FIBER INTEGRITY TESTING” section for more details. Qua can provide this clear section of pipe (part no. 1301001021).

5. The Q-SEP modules are preserved in a solution of *glycerin/water/sodium bisulfite solution (20:79:1wt %)*. If the caps are removed from the modules, about 2.0L of this solution will drain. If the modules are to be subsequently shipped, they must be re-preserved with the above solution.

6. **THE MAXIMUM FEED PRESSURE ALLOWED FOR Q-SEP MODULES IS 4.8 bar (70 PSI) at 25°C (77º F).**

7. Do not remove the end caps from the Q_SEP modules during assembly **of the UF skid.** .

9. INSTALLATION PROCEDURE

Figure-2 Typical Assembly

The Q-SEP modules are shipped from the factory with a preservative solution as previously noted. It is imperative to drain all preservative from the modules before installation. All three blind caps removed from the ports should be kept in safe custody for any future use. After installation, if start-up and commissioning are going to be delayed for any extended period of time, refill approximately 2.0 liters (0.53 gallons) of the preservative solution through the top reject port until the unit can be commissioned.

The following are the recommended procedures for installation:

1. Clean the system top vent and all associated piping to prevent any foreign matter from entering and contaminating the modules.

2. Using clean gloves, remove the caps on the three connection ports. NOTE: Do not remove the module end caps by removing the stainless clamp.

3. Place the module on the support rack such that the bottom end cap is supported near its center. Then continue installing the modules using at least one strap that attaches to the support structure to hold the module in place.

4. Connect all ports starting with the bottom (Inlet/Feed) port and finishing with the Product/Permeate port. A spool piece with Victaulic connections (Type 75) is recommended for use with Victaulic connections. Tighten all Victaulic clamps. Slowly pressurize the system and check for connection leaks. Retighten and adjust if a persistent leak is discovered.

5. Flush thoroughly with clean city water, or if available, filtered water is preferred.

6. Prior to start-up - it is advisable to record the various module S/N's, their installation position within the skid assembly and the date of installation to assist in the recordkeeping process.

CAUTION

It is strongly advisable to recheck ALL clamp connections after a minimum of 15 hours of on-stream operations to avoid leaks.

10. Q-SEP STORAGE, HANDLING AND SHIPMENT

Storage

Q-SEP UF modules are typically shipped in special cartons or wooden crates, which provide protection during transport. The packing crates with the fiber modules should be stored in a dry, normally ventilated, secure place, away from sources of heat, ignition and direct sunlight.

- Store in a suitable area between 5°C - 30°C. (40°F - 85°F)
- Handle the modules with care and as per instructions
- Avoid freezing

The modules are integrity tested prior to shipment. To prevent dehydration and to control bacterial growth the fibers are saturated with a water/glycerin/sodium bisulfate solution (20:79:1 wt %) as previously noted.

Modules can be stored for 8 months at a temperature of 5°C - 30°C (32 °F - 85 °F) in their original packing. When exceeding 8 months of storage, the indicated preservative solution has to be refreshed. Preferably RO or demineralized water is used for the solution. If not available, city water can be applied. In this way the modules can be stored for one to two months after which the solution has to be refreshed once again.

NOTE

Modules that have been in use need to be cleaned thoroughly before storage. Cleaning is done as installed on-line using the CEB, backflush / wash steps with clean water or UF product water.

CAUTION

Remember that an additional backflush with clean water is needed when chemicals are used to thoroughly remove any residual chemicals.

Cleaned modules removed from the installation should be saturated with the already indicated preservative solution when destined to be used again. In this way the modules can be stored for one to two month after which the solution has to be refreshed.

Handling

Note that the modules can be heavy when in wet condition! To avoid any injuries in handling them, exercise caution when handling or lifting the modules.

Disposal of Used UF Elements

Users are responsible for ensuring that elements are disposed of in accordance with all local and federal regulations in the applicable jurisdiction. Used elements typically can be disposed of as municipal waste provided that they do not contain any free liquids or hazardous substances at levels that exceed regulatory thresholds.

11. START-UP & OPERATING PROCEDURE

1) The feed water has to be tested to check the required parameters are within limits as per the design feed water analysis.

2) Make sure the entire system has been thoroughly checked for any leaks and all the pipes have been flushed with clean water to remove any contamination during the assembly and installation process.

3) Check that the sequence of all valves is properly programmed and functioning in the required sequence via the PLC program (in case the system is automated).

4) Make sure that all required chemicals tanks are filled with required chemicals.

5) Ensure that the minimum water level in the feed tank or required flooded suction head is available for the feed pump and that the suction valve is open. The feed pump must be started, keeping the by-pass open so that the initial water hammer is sent back into the tank, if by-pass line is available. If by-pass line is not available then precaution should be taken by gradually opening the feed pump discharge valve to avoid initial water hammer. Alternatively the feed pump can be VFD driven or a modulating control valve can be provided at pump discharge.

6) First step is rinsing of the Q-SEP modules. In this case essentially the UF is operated in forward flush mode (refer Figure 4 below) for a period of one (1) minute. This ensures that all the preservative solution within the module is completely flushed out of the system.

7) Second step is disinfection of the Q-SEP modules. In this case the soaking step of Chemical Enhanced Backwashing (CEB) is followed with NaOCl (Figure 6 below). The duration of soaking for this step is five (5) minutes.

8) After disinfection repeat the rinsing step in item 6 above for one (1) minute.

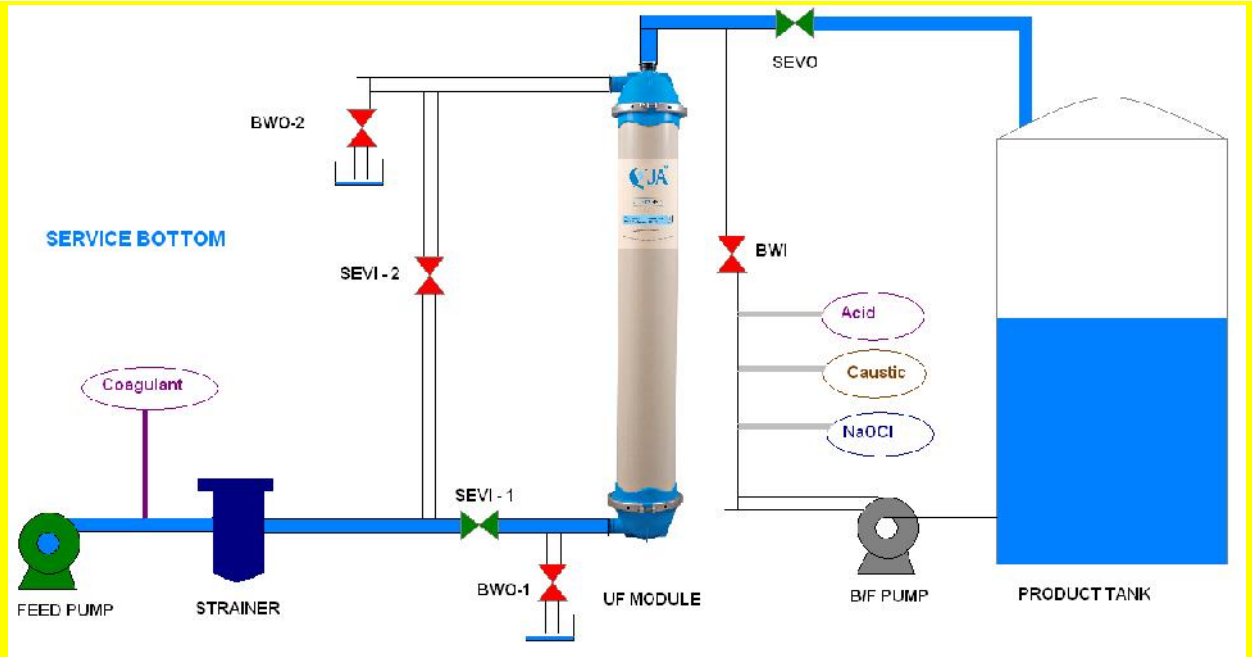
9) Now the system is ready for start-up. The mode of operation will be as illustrated in Figure 3 below.

10) Refer to Typical P&ID (Figure 7 below) and suggested Sequence of Operation chart (Table 2 below) for satisfactory operation of the UF system.

11) Ensure all operating parameter in Section-2 and Table-1 of this manual are followed and not exceeded.

Figure-3: Typical Process Flow Diagram

Option-1 Service from Bottom



Option-2 Service from Top

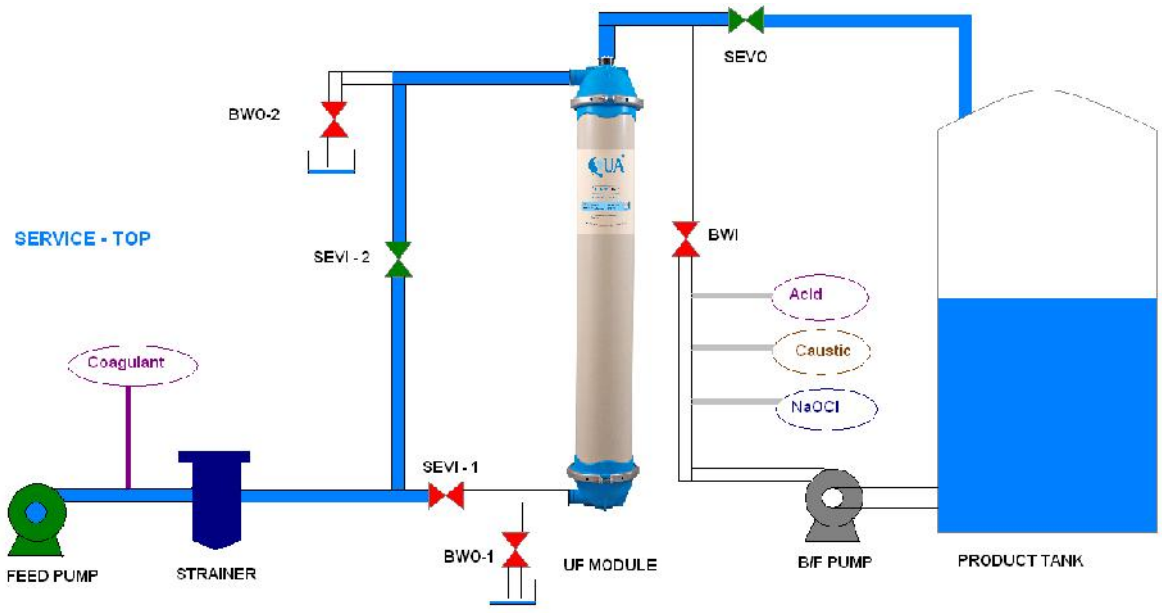
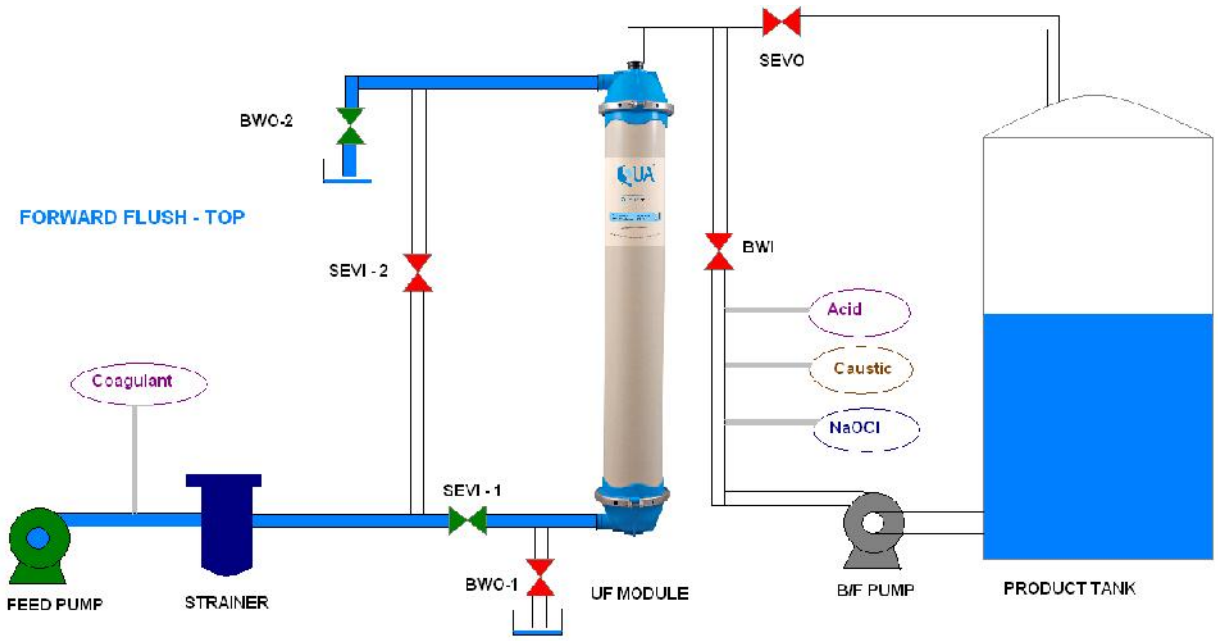


Figure-4: Forward Flush Mode

Option-1 From Top



Option-2 From Bottom

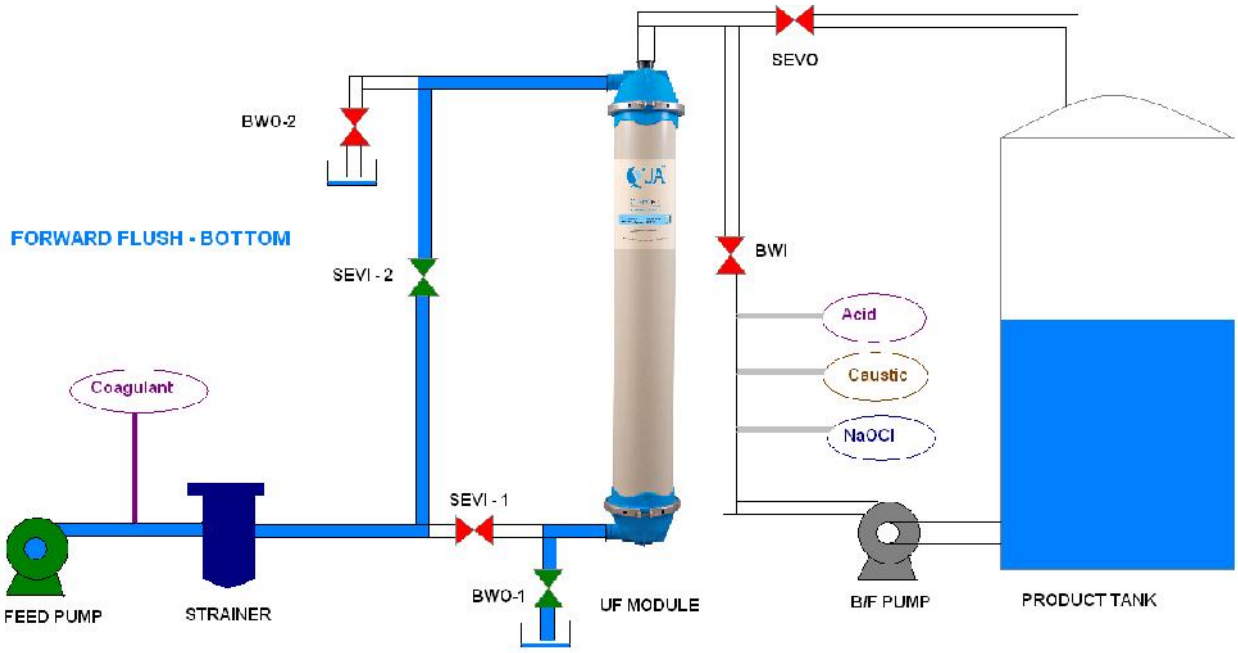
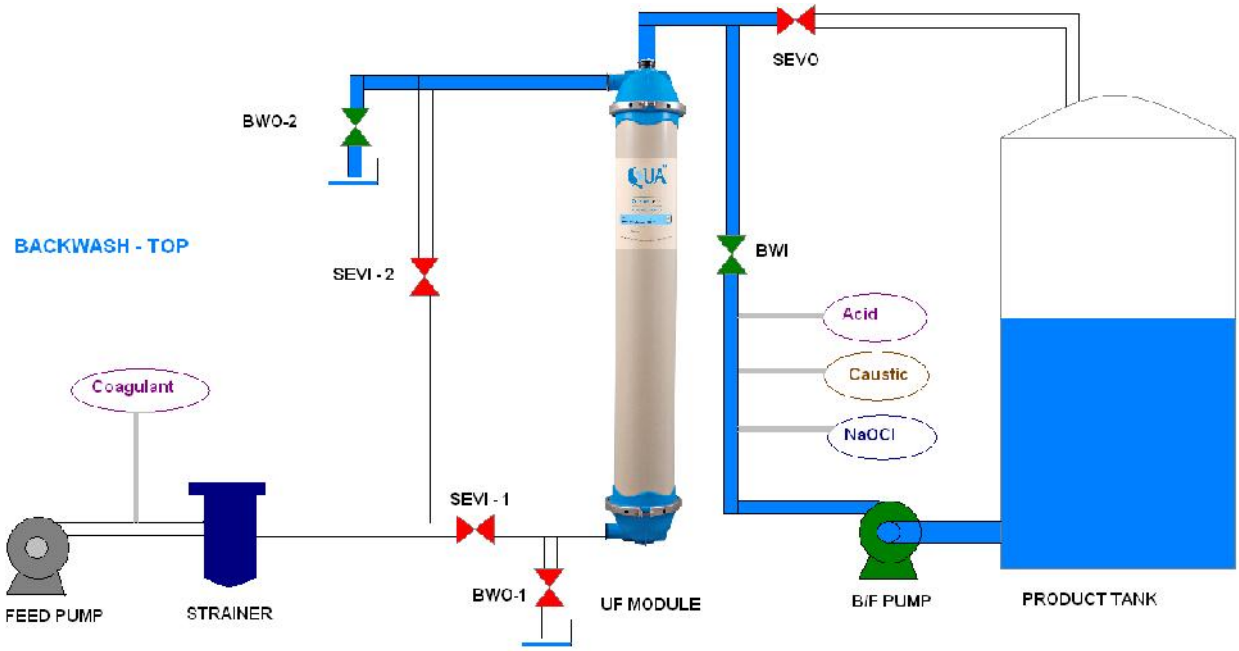


Figure-5: Backwash Mode

Option-1 Top



Option-2 Bottom

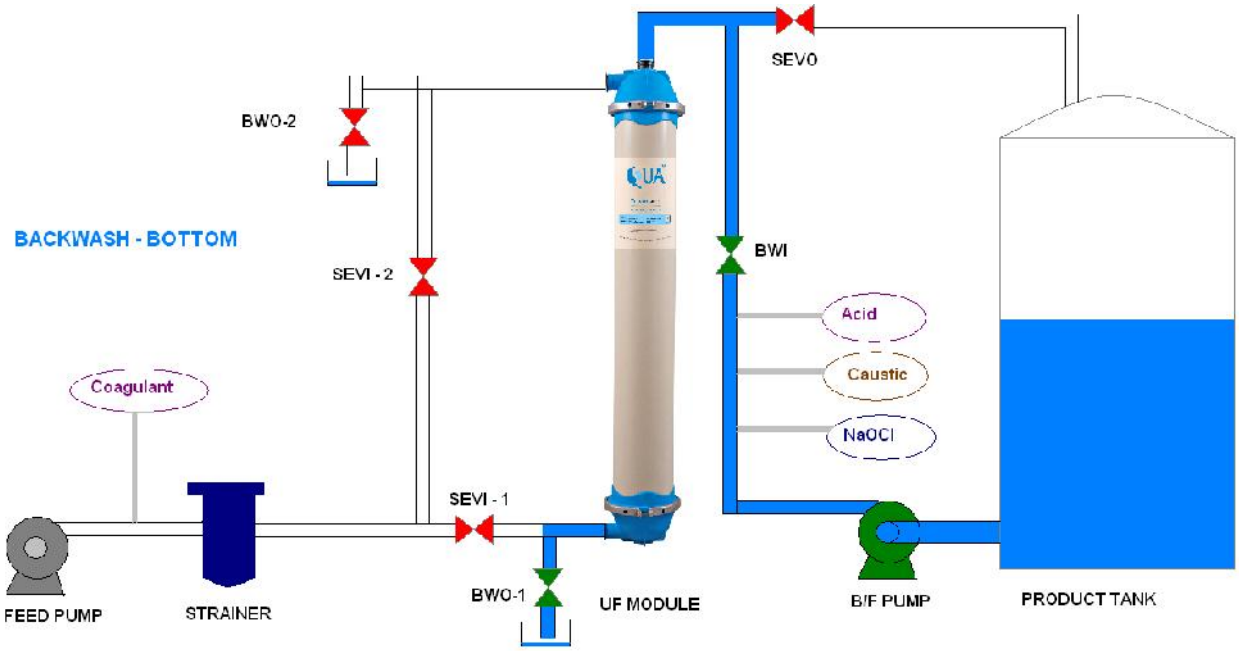
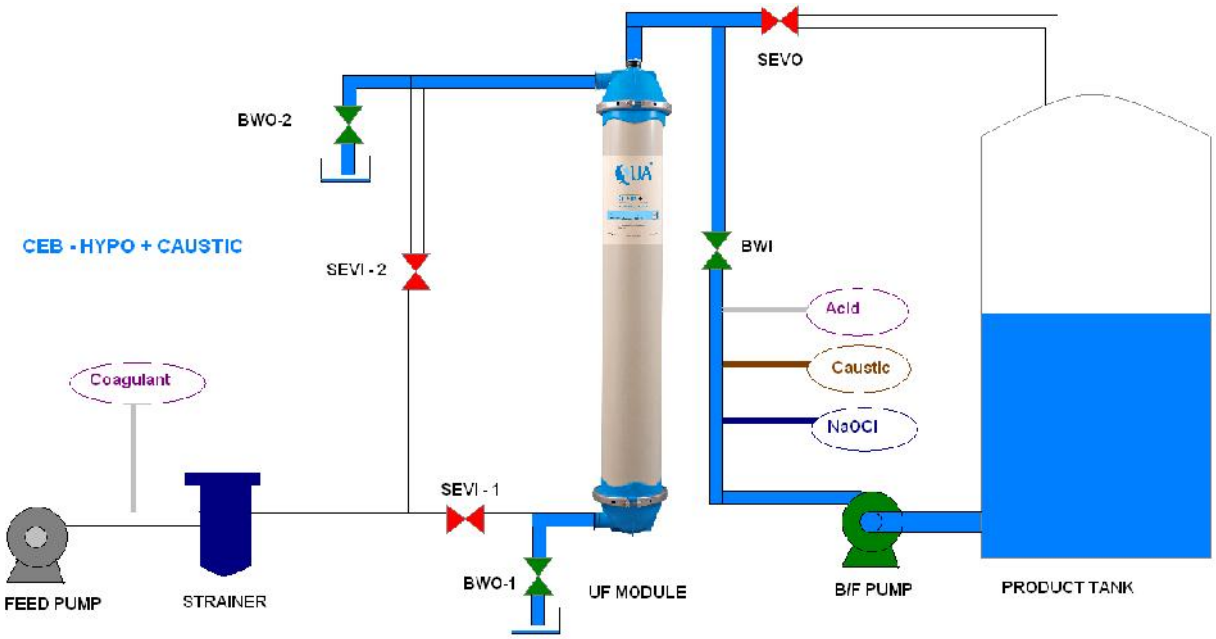
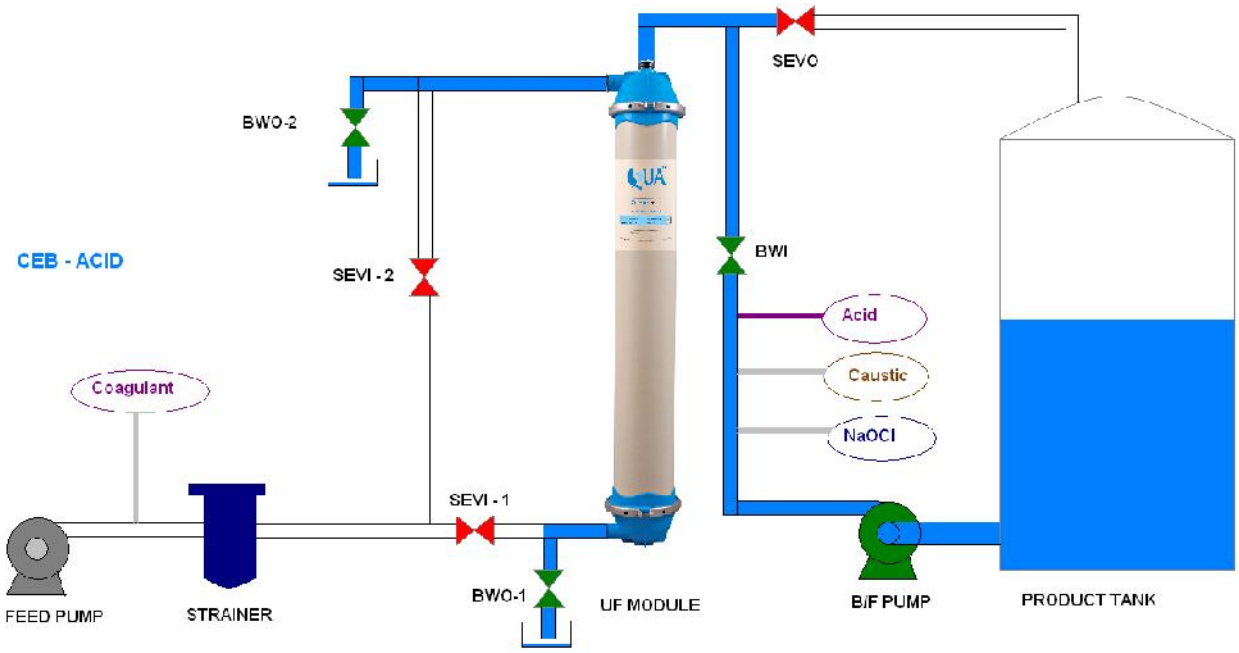


Figure-6: Chemical Enhanced Backwash (CEB)

Step-1 With Hypochlorite & Caustic



Step-2 With Acid



12. SUGGESTED SEQUENCE OF OPERATION CHART (TABLE-2)

QUA UF MEMBRANE OPERATIONAL LOGIC												
	OUTPUT	TIME (SEC)	1	2	3	4	5	6	7	8	9	10
			VA1	VA2	VA3	VA4	VA5	VA6	HYPO+NAOH	HCl	FEED PUMP	BACKWASH PUMP
			Service Inlet Bottom	Service Inlet Top	Backwash Outlet Top	Bakwash Outlet Bottom	Backwash Inlet	Service Outlet	Dosing Pump	Dosing Pump		
Def step	Service Top	1800		ON				ON	OFF	OFF	ON	OFF
1	Forward Flush Top	10	ON		ON				OFF	OFF	ON	OFF
2	Backwash Top	30			ON		ON		OFF	OFF	OFF	ON
3	Forward Flush Bottom	10		ON		ON			OFF	OFF	ON	OFF
4	Service Bottom	1800	ON					ON	OFF	OFF	ON	OFF
5	Forward Flush Bottom	10		ON		ON			OFF	OFF	ON	OFF
6	Backwash Bottom	30				ON	ON		OFF	OFF	OFF	ON
7	Forward Flush Top	10	ON		ON				OFF	OFF	ON	OFF
COUNTER 1												
8	Backwash Top	30			ON	ON	ON		ON	OFF	OFF	ON
9	Soak	300							OFF	OFF	OFF	OFF
10	Forward Flush Bottom	10		ON		ON			OFF	OFF	ON	OFF
11	Service Bottom	1800	ON					ON	OFF	OFF	ON	OFF
12	Forward Flush Bottom	10		ON		ON			OFF	OFF	ON	OFF
13	Backwash Bottom	30			ON	ON	ON		ON	OFF	OFF	ON
14	Soak	300							OFF	OFF	OFF	OFF
15	Forward Flush Top	10	ON		ON				OFF	OFF	ON	OFF
COUNTER 2												
16	Backwash Top	30			ON	ON	ON		OFF	ON	OFF	ON
17	Soak	300							OFF	OFF	OFF	OFF
18	Forward Flush Bottom	10		ON		ON			OFF	OFF	ON	OFF
19	Service Bottom	1800	ON					ON	OFF	OFF	ON	OFF
20	Forward Flush Bottom	10		ON		ON			OFF	OFF	ON	OFF
21	Backwash	30			ON	ON	ON		OFF	ON	OFF	ON

	Bottom											
22	Soak	300							OFF	OFF	OFF	OFF
23	Forward Flush Top	10	ON		ON				OFF	OFF	ON	OFF
Note	**NaOCL+NaOH CEB will be done after 5 service cycles (step 1 to 7 x 5 times)**											
	HCL CEB will be done after 5 CEB of NaOCL+NaOH cycles (step 8 to 15 x 5 times)											
	2 pumps will run parallel during normal backwash & 1 pump will run during CEB.											

NOTES ON SEQUENCE OF OPERATION CHART

1) All times and flow rates are estimated and adjustable during start-up depending on required flux.
2) O = Valve Open; ON = Pump Running.
3) Backwash sequence will begin every 15 to 60 minutes of service time. Backwash frequency is adjustable depending on feed condition.
4) ** Back wash outlet would be alternated one time from the top and the other time from the bottom.
5) *** Soaking is done when CEB is carried out. This is done when the TMP does not return to the original TMP value even after back wash. It is assumed Caustic (Δ) is injected once a day or as required. Acid (†) is added only when the operator initiates low pH backwash. During low/high pH backwash, Sodium Hypochlorite. (◊) injections are disabled. During soaking the outlet valve V5 or V2 is opened for 30 seconds and then closed. Soaking is for five (5) minutes. The outlet valves are again open for 30 seconds. As the pH is 10-11 during caustic backwash ensure good water quality is used to avoid scaling. Soaking of 5 minutes minimum recommended. However in certain feed water condition a longer soaking may be needed.
6) Sodium Hypochlorite injection should be typically after every six (6) back wash cycles in case there is no presence of free chlorine in feed water.
7) The solenoid valves (or in some cases manual valves) are to be opened only to vent and drain whenever required.
8) Forward flush is optional and may not be required for very clean water.

13. OPERATIONAL PARAMETERS LOG SHEETS

Recommended Log Interval: Once every 4 hours (twice per shift)

Date	Time	Hrs	Pressure				Flow		Turbidity (NTU)		pH		Backwash Data				
			Feed	Reject	Product	TMP	Feed	Product	Feed	Product	Feed	Product	Pressure	Flow	Gap (min)	Duration (Sec)	Mode
	1																
	4																
	8																
	12																
	16																
	20																
	24																
		Measure SDI every 8 hour shift. Log backwash & CEB event.															

14. Q-SEP CAUTION AND SAFETY CONSIDERATIONS

This manual provides general information about biocides/preservatives/cleaning chemicals that may be used with Q-SEP UF fiber elements. The Q-SEP UF modules, as delivered, contain a preservative chemical (water/glycerol/sodium bisulfite) solution. The UF modules need to be drained of this preservative before start-up of the system, and sufficiently rinsed before the product water can be used.

Before storage or disinfection of Q-SEP elements, the user should become familiar with the general storage and flushing procedures for the PES fiber elements.

WARNING

- ★ **Some of the biocides listed in this procedure are toxic in some degree to humans.**
- ★ **As with any chemical, proper handling must be observed at all times.**

→ **QUA assumes no liability for the misuse of any chemicals listed herein, and all safety issues are the responsibility of the end user.**

→ **Consult your chemical supplier and the specific chemical manufacturers Material Safety Data Sheets (MSDS) for proper handling and disposal of any of the listed chemicals**.

Sodium Hypochlorite (NaOCl), Sodium Hydroxide (NaOH), Hydrogen Peroxide (H_2O_2) and/or Hydrochloric Acid (HCl), Sulfuric Acid (H_2SO_4) and **Citric Acid** are some of the chemicals that are used for module cleaning. Use of any other chemicals for cleaning or for chemically enhanced backwashing procedures should be approved s by QUA.

We would recommend that the plant owner/operator maintain adequate records including the specific MSDS sheets for **ALL** chemicals on hand. These sheets should be reviewed prior to any chemical cleaning step.

15. Q-SEP MODULE INTEGRITY TESTING

Each Q-SEP module is subject to strict quality testing protocol during the manufacturing process. Integrity of each module is confirmed prior to shipment.

Integrity testing on site is to identify whether any fiber is broken and to isolate the leaking module from the UF system/skid.

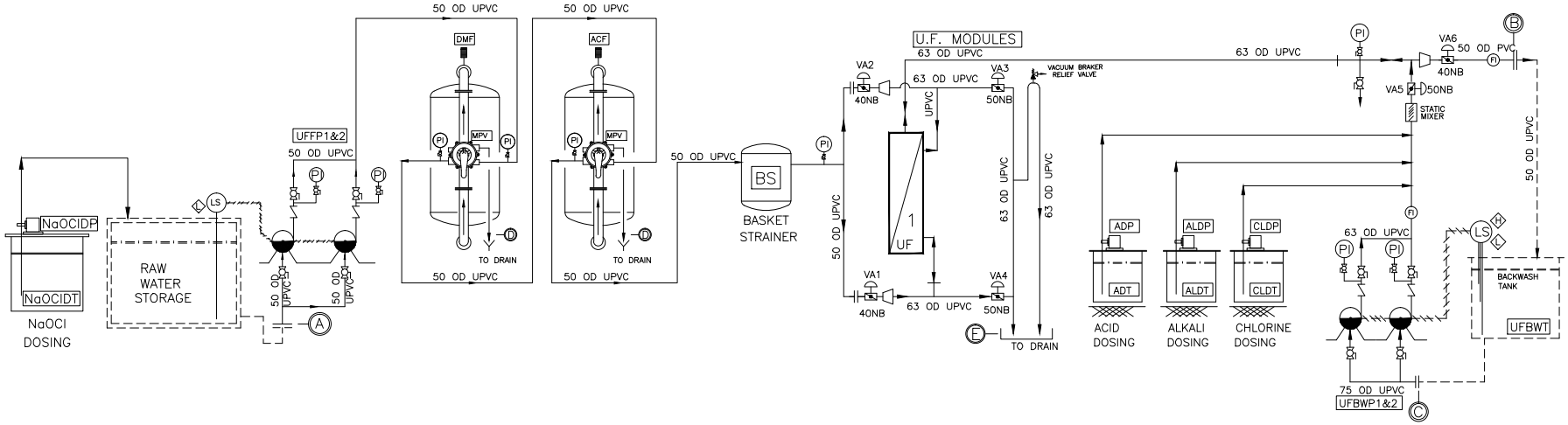
As a first step of testing, the integrity of a module can be verified online using turbidity meter or particle counters or physically measuring SDI.

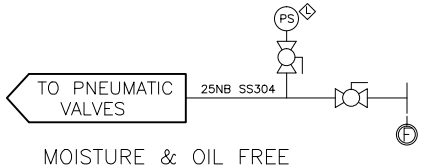
If the turbidity or SDI readings are not within the required limits, then air integrity testing should be carried out.

The steps involved in air integrity testing are as follows:

- Isolate the UF module/skid to be tested and shut the unit.
- Open the filtrate/product valve of the UF module / skid.
- Relieve pressure in the Inlet/Feed port and the Concentrate/Reject port within the module/skid by opening the drain valves on the Inlet and Reject (feed top) manifold for approximately 10 to 20 seconds. These are the two solenoid valves shown in the typical P&ID in this manual. These can also be manual valves instead of the solenoid type shown. After 10 to 20 seconds, close the drain valve on the top/concentrate header and keep the bottom drain valve open.
- Slowly pressurize the system by feeding oil free instrument quality air at 1.0 bar (14.5 psi) to the concentrate/reject manifold (feed top).
- The water inside the module would start draining through the bottom drain valve. After approximately 5 to 10 minutes the draining should stop, after which the bottom drain valve should be shut off.
- Allow the system to pressurize until it reaches 1.0 kg/cm² (14.7 psi). If the system does not pressurize, check for air leaks. Once the system has pressurized to 1.0 kg/cm² (14.7 psi) wait for 2 minutes and shut the air supply. The filtrate/product valve should always remain open.
- Record the pressure drop for the next 3 minutes. Due to natural air diffusion through the pores of the membrane a small pressure drop would be noticed. This is normally about 20 to 50 mbar (0.03 to 0.05 psi). If the pressure drop is larger than this, it indicates that there are damaged fiber / fibers in the module.

- To identify the module which has lost integrity, repeat the above test without draining of the water (keep all the drain valves on the feed and concentrate side closed) and keep the product valve fully open. Apply air from the concentrate side or feed side and maintain at 1.0 bar (14.5 psi). Visually inspect each of the transparent tube provided on the filtrate/product port. Large and regular stream of air bubbles would be seen and is an indicator for the affected module. Small air stream would be noticed in all other modules due to air diffusion but the one with broken fiber would show a significantly higher flow. Isolate this module from the skid/system and contact QUA representative for further repair instructions.





MOISTURE & OIL FREE
INSTRUMENT AIR
@ 5–7KG/CM2
(BY CLIENT)

UNIT DETAILS:

SR.NO.	DESCRIPTION	MARK	SIZE/CAP	NO.OFF	REMARK
1	NaOCl DOSING PUMP	NaOCIDP	CAP–5 LPH @ 3.5 BAR MODEL F–0505	1	PENTAIR
2	NaOCl DOSING TANK	NaOCIDT	CAP–30 LIT	1	LDPE
3	UF FEED PUMP(1W+1S)	UFFP1&2	CAP–3.4M3/HR @ 3.5 BAR MODEL–CHL 4–40	2	NANFANG SS316
4	DUAL MEDIA FILTER	DMF	SIZE–21"DIA X 62" HEIGHT	1	PENTAIR
5	ACTIVATED CARBON FILTER	ACF	SIZE–21"DIA X 62" HEIGHT	1	PENTAIR
6	BASKET STRAINER	BS	CAP–3.4M3/HR,100 MICRON	1	AZUD
7	UF BACKWASH PUMP(1W+1S)	UFBWP1&2	CAP–6M3/HR @ 2 BAR MODEL–CHL 8–30	2	NANFANG SS316
8	UF MODULE	UF	MODEL–QSEP 6008	1	QUA
9	CHLORINE DOSING PUMP	CLDP	CAP–20 LPH @ 3.5 BAR MODEL–TCO–0420	1	PENTAIR
10	CHLORINE DOSING TANK	CLDT	CAP–30 LIT	1	LDPE
11	ACID DOSING PUMP	ADP	CAP–20 LPH @ 3.5 BAR MODEL–TCO–0420	1	PENTAIR
12	ACID DOSING TANK	ADT	CAP–30 LIT	1	LDPE
13	ALKALI DOSING PUMP	ALDP	CAP–10 LPH @ 3.5 BAR MODEL–F–0510	1	PENTAIR
14	ALKALI DOSING TANK	ALDT	CAP–30 LTR	1	LDPE

INSTRUMENT LIST

MK.NO.	DESCRIPTION	QTY	MAKE
PI	PRESSURE INDICATOR	7	MICRO/WAREE
FI	FLOW INDICATOR	2	ASTER
LS	LEVEL SWITCH	2	BLUE
LC	LOGIC CONTROLLER	1	DELTA

OUT TERMINATION POINT:

MK.NO.	DESCRIPTION	END CONNC.
A	UFFP INLET	40 NB ANSI
B	UF OUTLET	40 NB ANSI
C	BWP INLET	65 NB ANSI
D	FILTER DRAIN	40 NB ANSI
E	UF DRAIN	50 NB ANSI

VALVE LEGEND
- DIAPHRAGM VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- NEEDLE VALVE
- GATE VALVE
- BUTTERFLY VALVE(PNEUMATICALLY OPERATED)
- BALL VALVE
- GLOBE VALVE
- SOLENOID VALVE (SV)

NOTE:
NECESSARY AIR PRESSURE @ 4.5KG/CM2 – 7KG/CM2
– – – – – – – – SCOPE OF CLIENT

REV. NO.	DATE	DESCRIPTION	DRAWN BY	CHKD. BY	APPD. BY

CLIENT:–H2O INOVATION

APPD. BY	MMB		
CHKD. BY	SDD		
DRAWN BY	SDD		
DATE	05.12.2012	SCALE	NTS

MARCURAS WATER TREATMENT (I) PVT.LTD
W–194 (B)
S–BLOCK,BHOSARI
MIDC,PUNE–411026

PROJECT:–UF PLANT

TITLE:– P & I FOR UF PLANT

O.C.NO.MWT221	DRG.NO. M221P01–12–13	SHEET NO. 1 OF 2	REV.NO. 00