R-Tech Dental of Minnesota

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"The company that keeps your equipment smiling!"

CLEAN WATER SYSTEMS

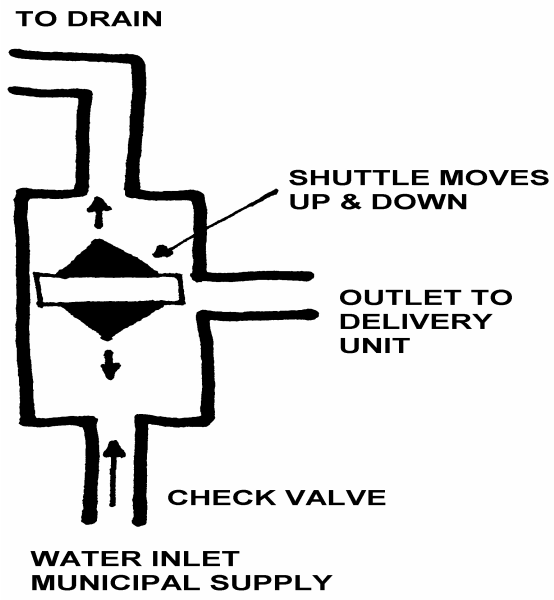
Origins

Mobile units & units designed for mission work where water quality was questionable.
Introduction of RPZ valve forced a choice of traditional or clean water systems.

RPZ Valve

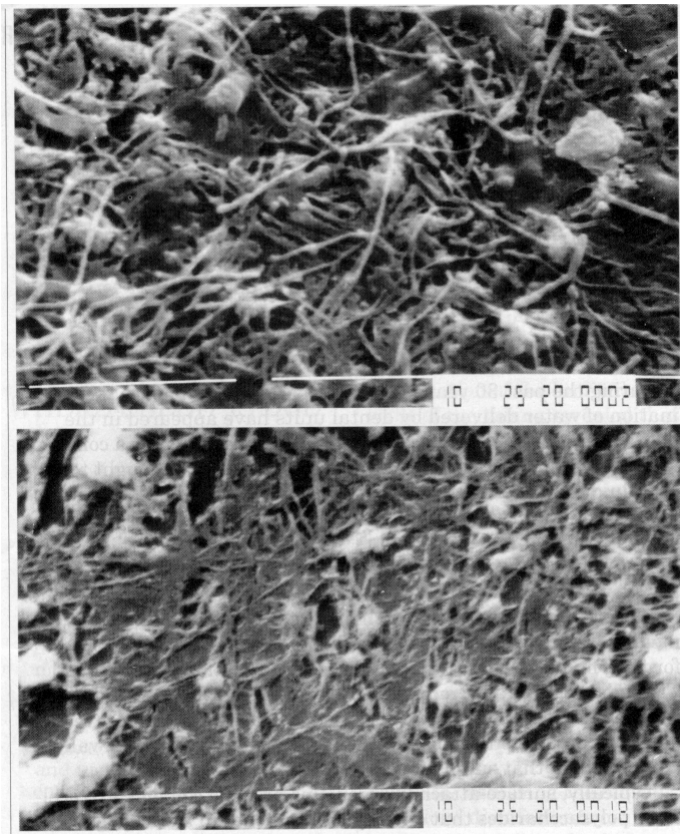
A few years back, plumbing codes changed for this region of the country. It was determined that bacteria that grew prevalently in dental delivery systems could make its way back into the city water lines.

The RPZ valves high cost (approx. $500) coupled with the need for the RPZ valve to have a drain line have made traditional dental setups more expensive and harder to maintain than the new clean water dental setup. Because of this, most new units now come pre-equipped with a clean water system instead of conventional hookups.



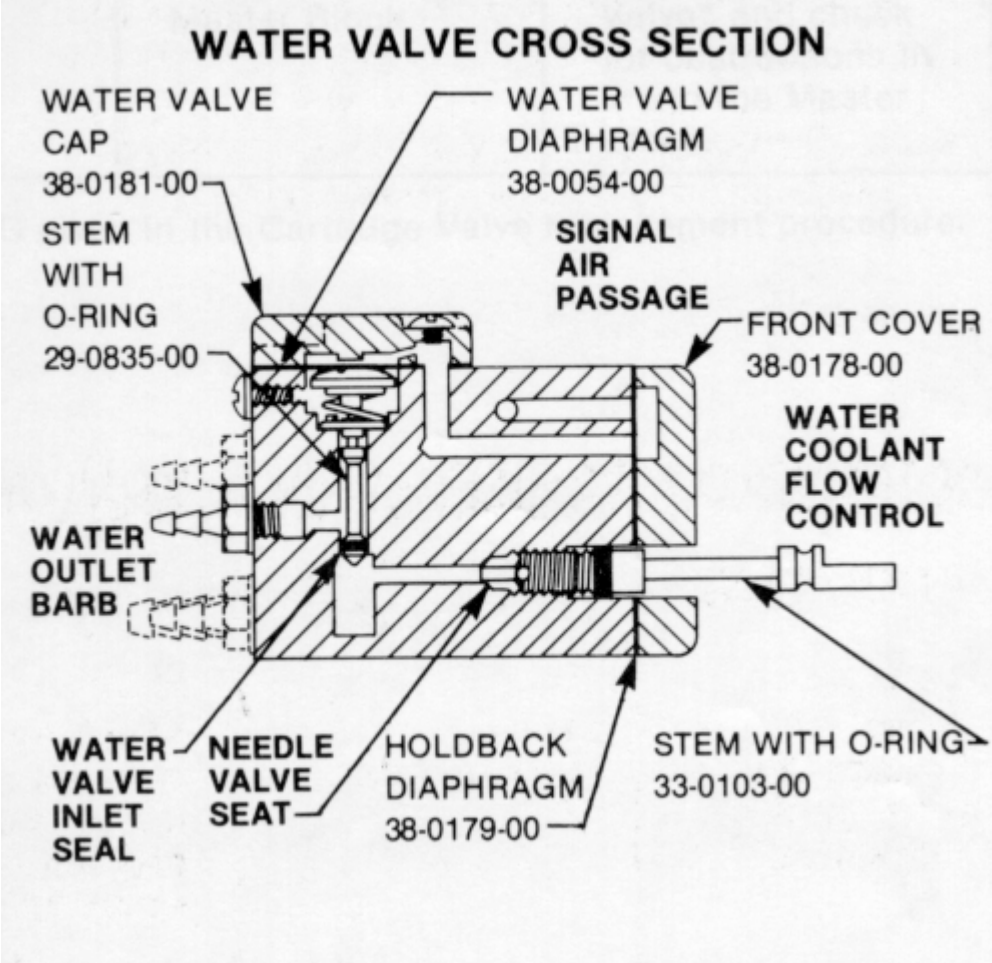
The RPZ valve consists of a water input that has some sort of mechanical check valve. Inside of the RPZ is a shuttle that moves up and down. In normal use the shuttle is pushed up sealing off the drain and allowing a flow of water to pass through to the unit. In the even of water supply interruption, the shuttle falls down and any back-flow from the unit is routed to the drain. This essentially protects the city water supply.

Biofilm



Due to the small sized tubing, light fluid flow, and usually warm water conditions inside of a dental delivery system, bacteria, grows wildly. It increases in concentration from 0-100 CFU/mL (Colony Forming Units per mL) at the municipal water source to over 1,000,000 CFU/mL at the handpiece of an untreated delivery system.

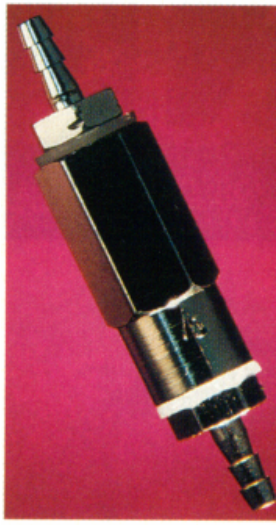
In addition to coming from the water source, bacteria gets retracted from the patient's mouth into the dental unit by the control blocks that control water flow inside of the unit. In fact it is believed that this retraction is the primary source for unit contamination.



In direct words from the "Adec SYSTEMS GUIDE":

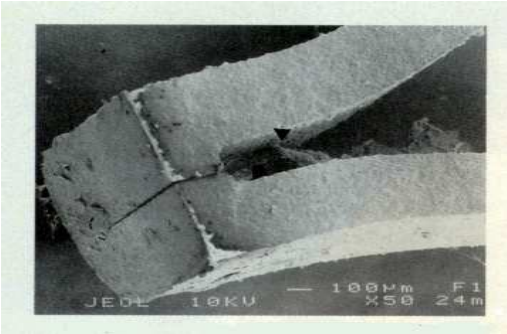
"Releasing the signal air pressure allows the spring to push the stem and diaphragm back up to close the valve. This movement of the stem and diaphragm creates a momentary low pressure at the outlet barb as the valve closes, so a small quantity of water is drawn back into the valve to prevent dripping from the handpiece."

The design of most control valves have some sort of inherent retraction problems. To combat the problem of "retraction" a little check valve was installed in the water line of each handpiece hose in many offices. (I believe it was an ADA recommendation.)



The cost of placing a check valve on each handpiece hose is about $8.50.

This valve does work to keep the retraction down to a minimum but it doesn't cure the ability of bacteria to spread. Bacteria still manages to get past this valve and spread into the system by growing to actually cover the lips of the duckbill inside the check valve. Due to the fact that this type of valve fails, it should be checked/replaced every 6 months or so.



The addition of an anti-retraction valve is beneficial when used in conjunction with a clean water system.

Bacteria that is suspended in the water lines becomes attached to the inner surfaces of the tubing. It produces a sticky gellike matrix that helps it adhere to the inner surfaces of the tubing. This bacteria then spreads by releasing itself into the system.

A clean water source that is attached to an infected unit becomes contaminated within 5 minutes of introduction to the unit. This contamination peaks at about 24 hours.

Unlike the city water supply that is chlorinated, a unit clean water bottle does not feed this type of water to the delivery unit unless it is installed in the bottle to begin with. In otherwords, a clean water bottle can actually make your delivery system a better breeding ground for bacteria if proper disinfection procedures are not followed.

Dis-infection procedure

Only works on clean water equipped delivery units because of the need to introduce different fluids.

Disinfectant solution preparation

Mix 1 part household bleach (5.25% sodium hypochlorite) with 9 parts distilled water. The one-in-ten mixture should be used as a disinfectant agent during flushing procedures.

Disinfection of the clean water bottles

It is important that the containers that hold the sterile water get cleaned. To do this pour 100mL of 1:10 disinfection solution into the bottle and shake for about 5 seconds. Then let the bottle stand with solution in it for about 10 minutes. Shake the bottle again. Empty the bottle and rinse the bottle well (at least twice).

Daily Procedures

1. **At the end of each day remove all handpieces and syringe tips.**
2. **Drape handpiece hoses and syringe into a nearby sink or facilitate the use of a bucket.**
3. **Remove the clean water bottle and drain it.**
4. **Re-install the clean water bottle, turn the unit on, and repressurize the bottle.**
5. **Operate the syringe and foot control until all water has been purged from the system.**
6. **Turn off the unit.**

Weekly Procedures

1. **Make certain that the unit has been purged free of water as described in the daily procedures.**

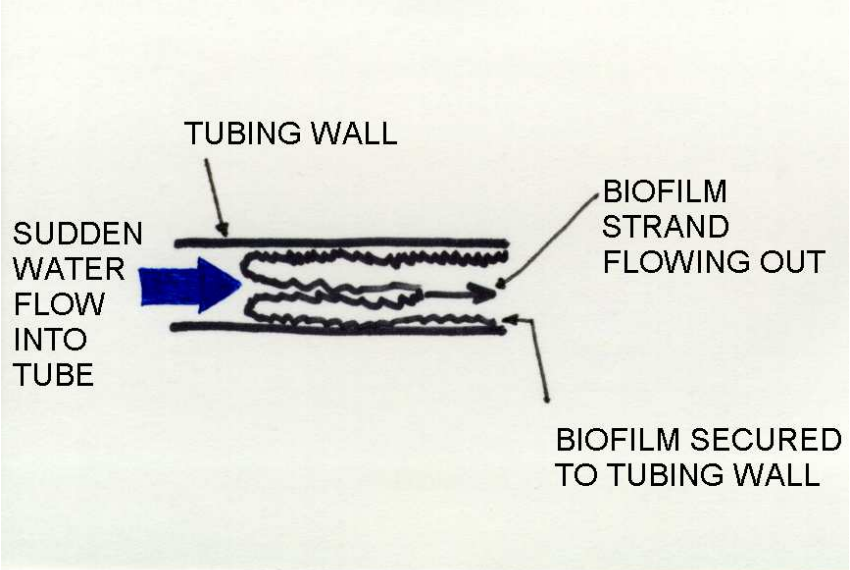
2. **Fill and flush with disinfectant**
3. **Perform disinfection of water bottles – no need to rinse.**
4. **Add about 750mL of the disinfectant solution to a disinfected bottle.**
5. **Operate the syringe and foot control until the disinfectant solution flows through the tubings. This generally takes about 20 seconds.**
6. **Let sit for 10 minutes (never more than 30)**
7. **Purge the unit clear with air**
8. **With the handpieces and syringe tips removed, drape hoses into a sink or bucket. Install an empty bottle onto the clean water system and flush the unit dry and free of the disinfectant solution.**
9. **Install normal treatment water**
10. **Re-install bottle filled with normal treatment water.**
11. **Again, with hoses draped into a sink or bucket thoroughly flush the unit until you can no longer smell the bleach. *This is important!* If a unit is not flushed out well, you will have patients complaining about a bad taste.**

This disinfection procedure does kill near surface & floating bacteria. It does not, however, kill bacteria lying protected under the sticky matrix. That is why the units must be flushed on a weekly basis to keep bacteria populations under control.

Bleaching solutions used in too high of a concentration will literally eat the block components away or have other adverse affects.

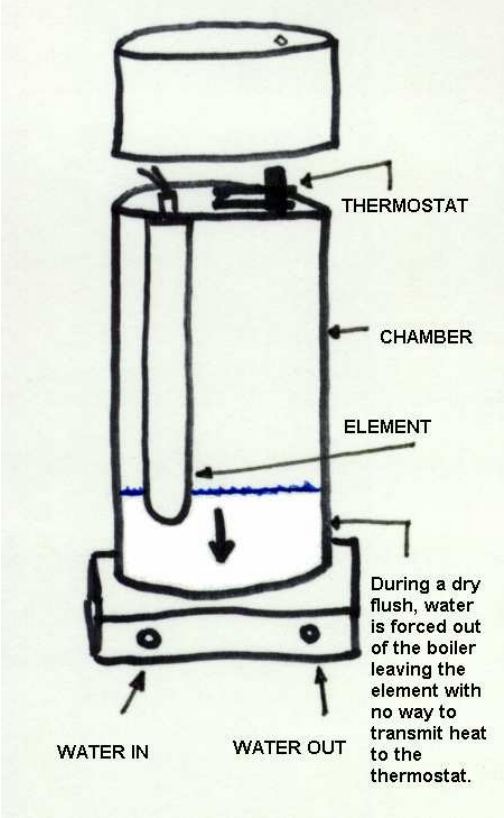
One recommended method for curbing bacteria growth is dry flushing the unit water lines. This procedure involves flushing the lines completely free of all water on a daily basis. The idea is that the bacteria suffers from greater difficulty growing with the lack of water.

At least initially when you start dry flushing you may have a problem of lines becoming plugged. The reason for this is sometimes when a line is allowed to dry out, the gel matrix looses its hold on the tubing and peels off when the sudden rush of water comes through it again. As this matrix is all inter-woven it can break loose in long strings that slide down and plug up unit control structures.



This means of flushing can also cause problems if there is a standard water heater in the system.

Air fills the boiler chamber and effectively insulates the thermostat from the actual element. As the thermostat can not determine the temperature of the element it continues to feed voltage to the element. The element, as it is no longer surrounded by water, has no means to dissipate the heat to the outer metal chamber, so it burns itself out.



Due to this problem we usually recommend the removal of any boiler when a clean water system is installed.

Under daily use, only distilled, mineral free, water should be used in clean water systems to eliminate hard water and other deposits from developing inside of your delivery unit.

Distillers

In-house production of distilled "safe" water is an attractive idea. It may not be cost-effective or practical for some small offices though.

We recommend a stainless steel reservoir unit with a site glass and spigot on the front of the unit. It is also preferred if the unit incorporates carbon filtration on the fill side where tap water is filled. It is a good idea to make sure that you purchase a good distiller, otherwise repair & maintenance costs can quickly exceed the cost of buying distilled water at a grocery store.

A unit is commercially available from Westbend that has an automatic water fill solenoid and two carbon activated filter cartridges to purify that water prior to completing the distilled cycle. It is made of stainless steel

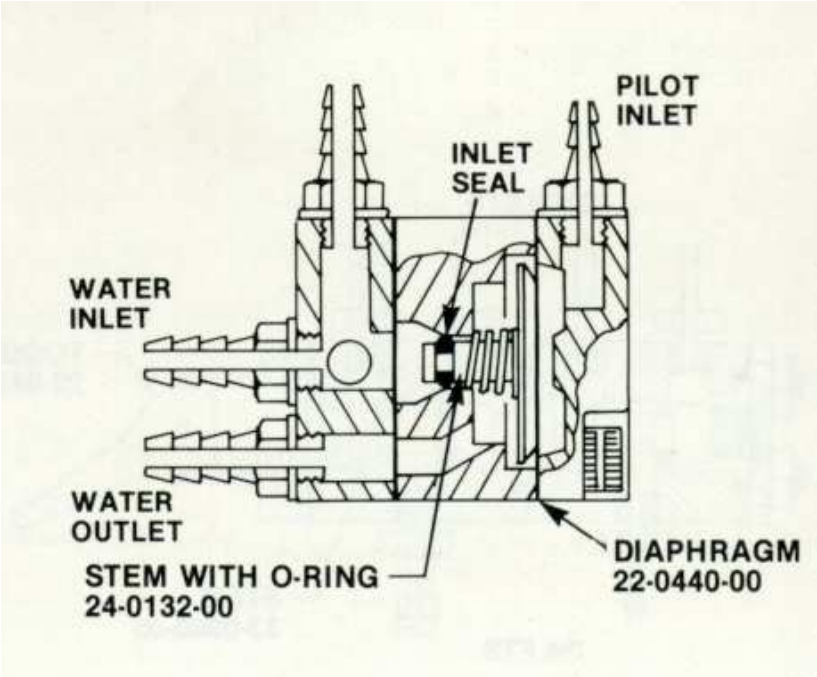
and has a site glass and spigot. Other models are available from other manufacturers.

Clean water systems do not have filters that normal shut-off block tend to have so it can be important to use water that is free of impurities.

Most "distilled" water can be very far from "sterile". Just because you get it in a bottle doesn't mean that it doesn't have a level of biological contamination. Military regulations for bottle water state that there should be no more that 500 CFU/mL. There are NO federal, state or dental regulations imposed on dental unit water line quality. If anyone tells you there is they are trying to either scare you or sell you something. The ADA has suggested that manufacturers begin to develop clean water systems that are capable of reducing unit water line contaminations to less than 200CFU/mL by the year 2000. There is no requirement placed on doctors at this time.

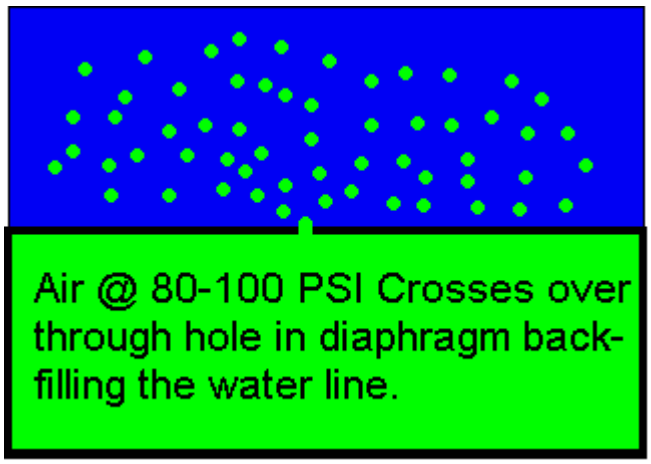
Some benefits of a clean water system

- **Eliminates Air/Water crossover that is seen quite commonly with traditional city water line shut-off blocks.**

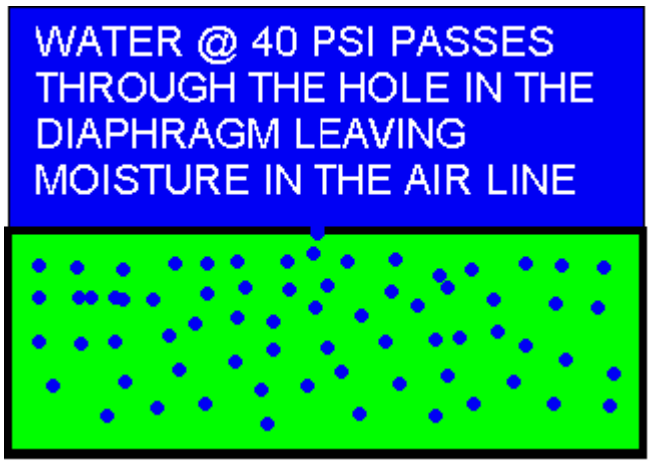


These blocks turn the water to the unit on and off. The air goes down and pushes on one side of a diaphragm that moves the water valve on the other. A problem occurs when the diaphragm rips or tears.

During the day when air pressure is high it passes through the damaged diaphragm and back fills the water line making sinks spurt and sputter, and also making water delivery intermittent.

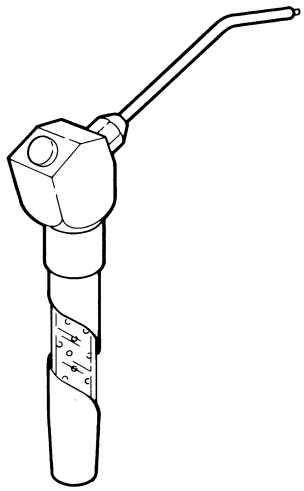


At night when air pressure goes down, water passes through the damaged diaphragm and begins to put moisture into the airline. With moisture in the air we begin to see restoration failures and handpiece turbine damage.



Restorative syringes are available for about $85 and they effectively work to eliminate moisture and oil in the airline.

RESTORATIVE ULTRA DRY AIR SYRINGE

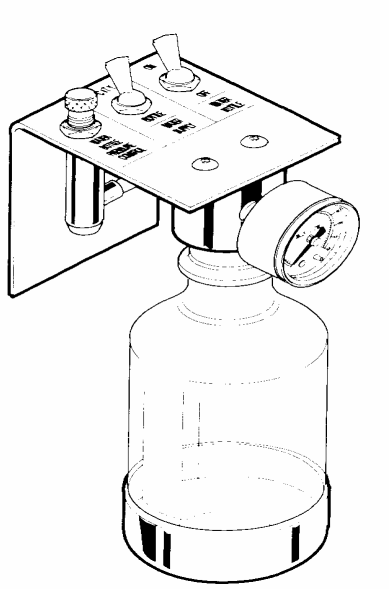


- **In high story buildings you have the power of setting your units water pressure (Up to 40 PSI) independent of the low water pressure that you may have on you floor.**

The recommended limits for water pressure in a clean water system is 40 PSI. Pressures that are higher run the risk of causing the 2 liter bottle to explode.

The majority of clean water bottle manufacturers have gone to a HDPE (High Density Poly-Ethylene) bottle that can withstand greater pressures.

We prefer DCI International's clean water system because it incorporates two HDPE bottles, a pressure gauge, regulator, and pressurize / depresssurize toggle right on the assembly. Some manufacturers do not have a gauge and that makes if fairly difficult to set pressure.



- **Eliminates the need for in-line water filters and softeners.**
- **Eliminates the possibility of a large weekend water leak.**

Without air pressure to the bottle there is no way for water to escape, so the largest amount of water that would ever leak would be 2 liters from a hole in the bottom of the supply bottle.

Some offices use water solenoids to supposedly eliminate the water leak tragedy, however from our experience, rarely do these valves ever "completely" shut the water off. They do obviously help to slow the leak but they would not eliminate a leak totally.

- **Allows introduction of sterile liquids for operative use.**
- **Allows simple means of flushing unit.**
- **Still operate under temporary contaminated or bottled water alerts.**

Some problems & hassles of clean water systems

- **2 liters of water should last you through a whole days worth of operation. The filling and changing of the clean water bottle is an additional hassle. Use of a funnel will make filling the bottle easier.**
- **Cost and additional handling/use of distilled water.**
- **Dis-infection procedures take some time and if they are not done fully or completely the water will either taste/smell bad or the unit may be damaged or have a high biofilm count.**
- **The possibility of an explosion -- This problem could be even worse if it was during a bleaching procedure.**

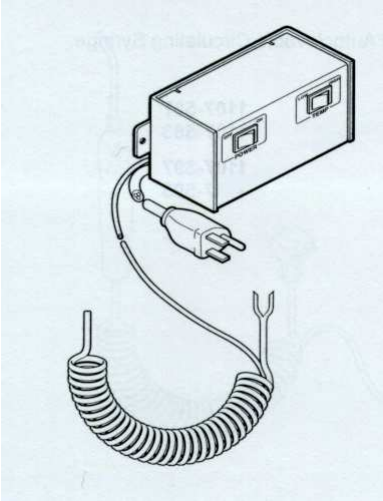
Syringe water heaters

Most delivery units are equipped with some sort of heater to make the water warmer for the patient.

Clean water systems tend to have warmer water than the city supply.

If the water from the clean water system is still too cold, conventional water heaters can still be used however you must make sure that the heater is never allowed to run dry. Water heaters require water to operate properly. A water heater without water will most likely burn itself out quickly.

For about $225, in place of a conventional water heater an electrically heated syringe cord warmer will not be damaged if the clean water system runs out of water.



Developments on the clean water front

- **Ultra-violet sterilization of water**
- **Fully autoclavable systems that remove the delivery system from the water circuit as much as possible. Leaving the water in a self contained circuit that can be sterilized as one piece between patients.**

System drawbacks

No power optic or fiber optic availability due to sterilization of hose
Bulky for sterilization
Awkward water flow controls

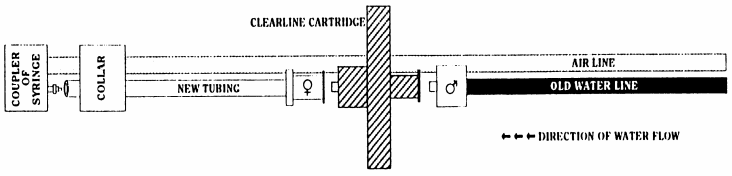
- **DentaPure – 800-972-3543 (MRLB International)**

Changed weekly inline in the tubing using luer locks. A cartridge will Filter water with .22 micron membrane and maintain purity even with suckback. Emits a 2-4 ppm iodine residual at the point of use reducing cross contamination.

System drawbacks

Can plug up.
Does nothing for the unit.
Possible pinching at connections or damage to the handpiece hose
Causes non-asepsis damage to end of hose
Iodine release. (Affects on patient & operator)
Expense ($12.95 each - $0.40 per patient)

- **Clearline Microfiltration -- 800-524-6984**



Changed between patients inline in the tubing using luer locks. Requires the use of an anti-retraction valve. One is required on each handpiece/syringe water line. Blocks flow of bacteria in each direction.

System drawbacks

Plugs up easily
Does nothing for the unit
Expense ($0.50 per patient)

- **SterilSOL – 800-489-8868 (Micrylium Laboratories) http://www.micrylium.com/**

System wide anti-microbial solution containing chlorhexidine gluconate.

System drawbacks

Some corrosion may result from the use of the chemical
Expense ($0.20 per patient)

Water line testing providers

- **"Waterline Monitoring Service" HCLS (Michigan) 800-829-4257 cost ($59 per sample)**
- **"AQUA DENT" MicroTest Laboratories (California) 800-713-3334 cost ($15-$26 per sample)**
- **Micrylium Laboratories (Arizona) 800-489-8868 cost ($25 per sample)**

Appears to be the best quality for the dollar.

- **PERIOgiene (aqualab, Inc.) (Arizona) 800-368-5776 cost ($10-$36 per sample)**

SOURCES

ADA Statement on Dental Unit Waterlines

Adec's Self-contained Water System Owner's Guide, Publication No. 85-0675-00

Adec's Systems Guide, Publication No. 85-0801-00

Clearline Microfiltration advertisement

Compendium, Vol. 17, No. 7, July 1996 Starting pg. 691

"Dental Unit Waterlines – Taking the High Road… Now" Dentistry Today August 1997 by Dr. Gary Kono, D.D.S.

JADA, Vol. 126, September 1995 starting pg.1255

JADA, Vol. 128, September 1997 starting pg.1235