

SELECTION GUIDE

Deionization



PORTABLE WATER SYSTEM WITH BUILT-IN RESERVOIR

| | Description | Applications | Flow Rate | Unique Features | Water Quality | Page |
|--|---|---|-----------|---|---|------|
| SUPERIOR ANALYTICAL WATER AND PORTABLE! | EASYPure® RF Reservoir Feed Ideal for areas where plumbing is not available Ideal for usages of < 15 /Day | High performance liquid chromatography (HPLC) Atomic absorption (AA) Total organic carbon (TOC) Gas chromatography/mass spectrometry (GC/MS) ICP and ICP/MS | 0.5 /min | Portable No plumbing required Built-in 6.5 liter feed reservoir | Type 1 reagent grade water Resistivity up to 18.3 megohm-cm TOC less than 5 ppb | 339 |

BASIC REAGENT GRADE WATER SYSTEMS

| | | | | | | |
|--|---|---|---|---|--|-----|
| OUR MOST POPULAR SYSTEM! | NANOpure Infinity® Base System Ideal for your analytical needs | Atomic absorption (AA) ICP and ICP/MS Ion Chromatography Gas Chromatography/mass spectrometry (GC/MS) High performance liquid chromatography (HPLC) | Pressurized feed (30 psig/min) up to 1.5 /min. Gravity feed up to 1.2 /min | Field upgradable with addition of modules. Complete with remote dispenser. Digital reading of resistivity, conductivity and total dissolved solid Optional N.I.S.T. calibration module Large capacity individual cartridges | Type 1 reagent grade water Resistivity up to 18.3 megohm-cm TOC less than 4 ppb Bacteria less than 1 CFU/ml | 332 |
| LOW ON COST... HIGH ON QUALITY! | E-pure Low cost reagent grade water | Atomic absorption (AA) ICP and ICP/MS Ion Chromatography | Pressurized feed (30 psig/min) 2.0 /min. Gravity feed 1.5 /min | Inexpensive design Recirculation pump Digital resistivity meter | Type 1 reagent grade water Resistivity up to 18.3 megohm-cm TOC less than 5 ppb | 345 |
| SMALL IN SIZE, HIGH QUALITY! | EASYPure® LF Line Feed Perfect for low volume requirements utilizing direct plumbing | Atomic absorption (AA) ICP and ICP/MS Ion Chromatography | Pressurized feed (30 psig/min) 1.3 /min. Gravity feed 0.5 m/min | 50% more ion exchange capacity than EASYPure RF unit Permanent water connection ideal for analytical procedures | Type 1 reagent water Resistivity up to 18.3 megohm-cm TOC less than 10 ppb | 340 |

ULTRAVIOLET OXIDATION (UV) WATER SYSTEMS

| | | | | | | |
|--|---|--|---|--|--|-----|
| ELIMINATES ORGANIC INTERFERENCES FROM YOUR WATER! | NANOpure Infinity® UV Ultraviolet Oxidation water with less than 1 ppb TOC ideal for your most stringent organic determinations | Gas chromatography (GC) Gas chromatography/mass spectrometry (GC/MS) High performance liquid chromatography (HPLC) Ion Chromatography Total organic carbon (TOC) | Pressurized feed (30 psig/min) up to 1.5 /min. Gravity feed up to 2 /min | The same unique features of the base unit plus: Dual wavelength (185 & 245 nm) ultraviolet lamp oxidizes organics and controls bacterial growth UV lamp change indicator Superior system design | Type 1 reagent grade water Resistivity up to 18.3 megohm-cm TOC less than 1 ppb Bacteria less than 1 CFU/ml | 333 |
| SMALLER AMOUNTS OF ULTRA PURE WATER! | EASYPure® UV Ultraviolet Oxidation Produces water meeting the stringent requirements of your most critical organic determinant analysis Ideal for usages of < 15 /Day | Gas chromatography (GC) Gas chromatography/mass spectrometry (GC/MS) High performance liquid chromatography (HPLC) ICP and ICP/MS Ion Chromatography Total organic carbon (TOC) | Pressurized feed (30 psig/min) 1.5 /min. Gravity feed 500 ml/min. | Dual wavelength (185 and 254 nm) ultraviolet light oxidizes organics and controls bacterial growth | Type 1 reagent grade water Resistivity up to 18.3 megohm-cm TOC less than 2 ppb Bacteria less than 1CFU/ml | 342 |

SELECTION GUIDE

Deionization



ULTRAFILTRATION (UF) WATER SYSTEMS

| | Description | Applications | Flow Rate | Unique Features | Water Quality | Page |
|--|--|--|--|--|--|------|
| IDEAL FOR YOUR LIFE SCIENCE APPLICATIONS! | NANOpure Infinity® UF Ultrafiltration produces water with < 0.001 EU/ml pyrogens Ideal for Life Science needs | Cell and tissue culture In Vitro fertilization DNA studies Monoclonal antibody production | Pressurized feed (30 psig min) up to 1.5 l/min Gravity feed up to 1.2 l/min | The same unique features as the base unit plus: Automatic intermittent flush Standard 10,000 mw ultrafilter Optional 5,000 mw ultrafilter | Type 1 reagent grade water Resistivity up to 18.3 megohm-cm TOC less than 10 ppb Pyrogen level less than 0.001 EU/ml Bacteria less than 1 CFU/ml | 334 |
| LOWER COST, PYROGEN FREE WATER! | EASypure® UF Ultrafiltration The ideal system for your low volume biological requirements including cell and tissue culture | Cell and tissue culture In Vitro fertilization DNA studies Monoclonal antibody production | Pressurized feed (30 psig min) up to 1.2 l/min Gravity feed 500 ml/min | 10,000 molecular weight ultrafilter | Type 1 reagent grade water Resistivity up to 18.3 megohm-cm TOC less than 10 ppb Pyrogen level less than 0.005 EU/ml Bacteria less than 1 CFU/ml | 341 |

ULTRAVIOLET OXIDATION/ULTRAFILTRATION (UV/UF) WATER SYSTEMS

| | | | | | | |
|-------------------------------------|--|--|--|---|--|-----|
| OUR BEST WATER SYSTEMS! | NANOpure Infinity® UV/UF Ultraviolet Oxidation and ultrafiltration in a single unit. The only validated RNase, DNase and DNA free water system | Ion free water - AA, ICP ICP/MS Pyrogen free water, tissue culture and cell culture Organic free water, HPLC and GC/MS DNA studies | Pressurized feed (30 psig min) up to 1.5 l/min Gravity feed up to 1.2 l/min | The same unique features of the base unit plus: Automatic intermittent flush 10,000 mw ultrafilter and dual wavelength UV lamp (185 and 254 nm) | Type 1 reagent grade water Resistivity up to 18.3 megohm-cm TOC less than 2 ppb Pyrogen level less than 0.001 EU/ml RNase, DNase & DNA free Bacteria less than 1 CFU/ml | 335 |
| OUR BEST SYSTEM AND SMALLER! | EASypure® UV/UF Ultraviolet Oxidation plus Ultrafiltration Perfect for virtually all pure water requirements along with the UV/UF Infinity, the only validated Nuclease free water system | Ion free water - AA, ICP, ICP/MS Pyrogen free water, tissue culture and cell culture Organic free water HPLC and GC/MS DNA studies | Pressurized feed (30 psig min) up to 1.3 l/min Gravity feed 500 ml/min | 10,000 molecular weight ultrafilter Dual wavelength (185 and 254 nm) ultraviolet lamp | Resistivity up to 18.3 megohm-cm TOC levels less than 3 ppb Pyrogen levels less than 0.005 EU/ml Bacteria less than 1 CFU/ml No detectable RNase A and RNase T1 | 343 |

SINGLE AND DOUBLE CARTRIDGE SYSTEMS AND HOLDERS

| | | | | | | |
|--|---|--------------------------------------|--|--|--|----------|
| DON'T NEED TYPE 1 WATER—B-PURE, BANTAM AND HOSE NIPPLE SYSTEMS ARE FOR YOU! | B-pure, Bantam, Hose Nipple When you need moderately pure water | Moderate quality for general lab use | Dependent on feed water pressure and quality between 0.5 and 2.0 l/min | Simple design, low cost source of purified water | 0.05 to 10 megohm-cm depending on cartridge type and configuration | 346, 350 |
|--|---|--------------------------------------|--|--|--|----------|

Deionization

WHAT IS DEIONIZATION?

Barnstead

WHAT ARE IONS?

Ions are divided into two-groups; cations and anions. Cations have a positive charge and include sodium (Na^+), calcium (Ca^{++}), and magnesium (Mg^{++}). Anions have a negative charge and include chloride (Cl^-), sulfates (SO_4^-), and bicarbonates (HCO_3^-).

HOW ARE IONS REMOVED FROM WATER?

Ions are removed from water through a series of chemical reactions. These reactions take place as the water passes through ion exchange resin beds. In the regenerated form, cation resin contains hydrogen (H^+) ions on its surface which are exchanged for positively charged ions. Anion resin contains hydroxide (OH^-) ions on its surface which are exchanged for negatively charged ions. The final product of these two exchanges, H^+ and OH^- , form water molecules.

SEPARATE BED REACTION

When cation and anion resins are separated, reactions take place independently. This does not allow the ion exchange reaction to reach its completion. For this reason maximum resistivities can not be achieved.

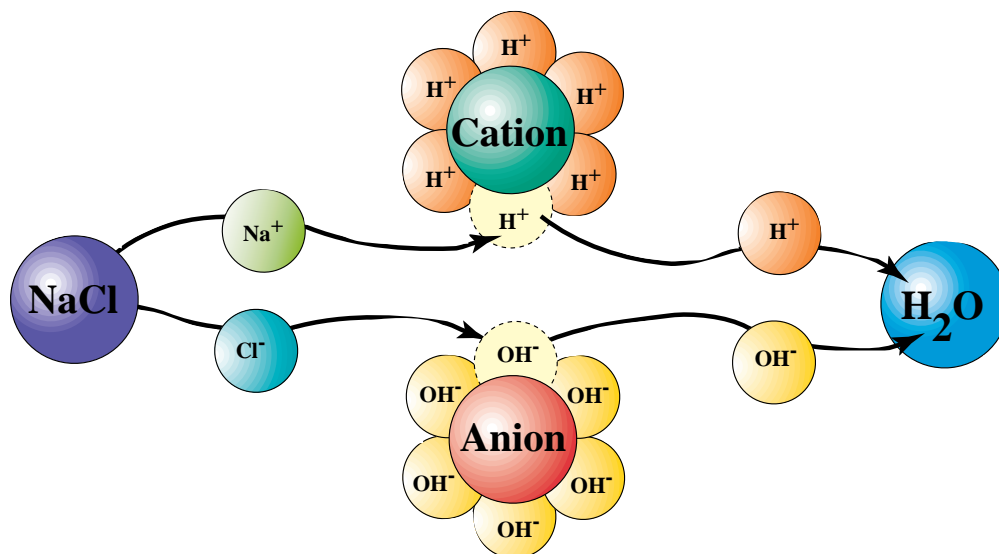
MIXED BED REACTION

When cation and anion resins are mixed, reactions take place to their completion simultaneously exchanging both cations and anions, providing water that is virtually ion free.

HOW ARE IONS MEASURED?

Electrical conductance or resistance is measured by two in-line electrodes. Electrical current moves through water using ionic molecules as stepping stones. The fewer stepping stones, the more difficult the passage of electricity. This causes less electrical conductance and more electrical resistance. The temperature of the water also affects its conductivity/resistivity. Barnstead electrodes and meters automatically compensate for water temperature difference to ensure accuracy and recognizable readings.

| | Deionization | Distillation | Reverse Osmosis | |
|----------------------------|-----------------|------------------|------------------|--|
| DISSOLVED INORGANIC SOLIDS | Large blue drop | Medium blue drop | Small blue drop | |
| DISSOLVED GASES | Large blue drop | Medium blue drop | Small blue drop | |
| DISSOLVED ORGANICS | Large blue drop | Medium blue drop | Small blue drop | |
| PARTICULATES | Small blue drop | Large blue drop | Medium blue drop | |
| BACTERIA | Small blue drop | Large blue drop | Medium blue drop | |
| PYROGENS | Small blue drop | Large blue drop | Medium blue drop | |



Deionization

DEIONIZATION TECHNOLOGIES

Barnstead

DO I NEED WATER PRETREATMENT BEFORE DEIONIZATION?

Pretreating feedwater by large scale deionization, distillation, or reverse osmosis will extend the life of deionization cartridges. Most feedwater contains non-ionized material that may foul deionization resin. These materials, including particles and organics, are removed using a Barnstead pretreatment cartridge in the first position of deionization systems. The Barnstead W.A.T.E.R. program determines if there is a need for pretreatment.

STEP-BY-STEP TECHNOLOGIES USED IN BARNSTEAD DEIONIZATION SYSTEMS

1. Adsorption

Barnstead pretreatment cartridges use activated carbons and a unique macroporous resin. Together they remove organics, chlorine, colloids, some bacteria, and endotoxins from feedwater. Carbon and macroporous resin extend the life of deionization resin and are only available in Barnstead pretreatment cartridges. The use of two different carbons promotes the removal of both large molecular weight and smaller volatile organics, providing for lower TOC values in the final product.

2. Two bed deionization

Some Barnstead systems use a cation resin and anion resin in separate halves of a cartridge which remove most but not all ionic impurities.

3. Mixed bed deionization

When feedwater is distilled or deionized and resistivity is greater than 50,000 ohms, and if feedwater alkalinity + CO₂ + silica is greater than 50% of total solids, a two bed cartridge is not useful. We use semi-conductor grade mixed bed deionization resin to achieve maximum resistivity and low TOC. Semi-conductor grade resins provide for quick rinse up and negligible organic carry over.

4. Ultraviolet oxidation (UV)

Barnstead NANOpure Infinity® UV and EASYpure UV and UV/UF include a dual wavelength ultraviolet lamp that oxidize organics and kills bacteria. Product water from these systems can have a total organic carbon (TOC) content of 1 ppb or less.

Dual wavelength UV light (185 and 254 nm) kills microbes by disrupting cell metabolism and reacts with dissolved oxygen to create ozone, promoting hydroxyl radical formation which oxidizes organics. By-products of this reaction (ionic species) are removed by the organic free cartridge that follows.

5. Combination mixed bed deionization and adsorption

We use a combination semiconductor grade mixed bed deionization and adsorption cartridge to achieve maximum resistivity and low total organic carbon (TOC). With the optional ultraviolet lamp we can achieve 1 ppb or less TOC. Without the optional ultraviolet lamp we can achieve less than 10 ppb.

6. Ultrafiltration (UF)

Ultrafiltration in Type 1 systems are used to remove pyrogens and is critical when product water is to be used for tissue culture, cell culture and media preparation. The Barnstead ultrafilter is capable of producing water with a pyrogen (endotoxin) level of less than 0.001 EU/ml and as a system a > 7 log reduction occurs.

7. Membrane filtration

Membrane filtration of 0.2 micron is used on the outlet of all systems to remove bacteria or particles that may have passed through the cartridges.

8. Combination Ultraviolet oxidation and Ultrafiltration (UV/UF)

The use of ultraviolet oxidation and ultrafiltration technologies in conjunction with adsorption and deionization in the same system produces water free of virtually all impurities. These technologies have demonstrated the ability to remove nucleases such as RNase, DNase as well as DNA when challenged with known concentration. The UV/UF units produce reagent grade water with resistivities up to 18.3 megohm-cm, organics < 2 ppb, pyrogens <0.001 EU/ml and no detectable RNase, DNase or DNA.

Deionization

TECHNICAL APPLICATION BULLETIN

Barnstead

HPLC INTERFERENCES: CAUSES AND CURES

Barnstead|Thermolyne has done extensive testing of its products, ensuring that they are capable of producing water suitable for the most demanding requirements of our customers. One criterion was to produce high purity water that can be used with confidence by researchers and analysts performing reverse phase HPLC. We paid close attention to mobile phase interferences and the elimination of ghost peaks that can plague chromatography procedures.

INTRODUCTION

In the development stage of our products, we have evaluated the components utilized in these systems ensuring each individual component is capable of producing water meeting our exacting standards. We have compared our results to competitive water systems and performed a direct HPLC comparison utilizing different sources of water, including bottled (HPLC) water.

It is the purpose of this bulletin to report these results, and provide you the techniques we have effectively used to eliminate potential background interferences.

Mobile phase baseline interferences have generally not been a problem at the higher wavelengths, such as 254 nm or above. Most of the interfering organic species are invisible to the detector at these settings. However, interferences or ghost peaks have presented problems at the lower wavelengths such as 210 nm. The following discussion will attempt to address the causes or sources of some of the interferences which may be encountered during reverse phase gradient HPLC procedures which utilize reagent grade water and acetonitrile mobile phase solvents. The following chromatographic method was utilized extensively in the evaluation of both the NANOpure UV® and EASYpure UV® water systems.

Chromatography Method

60 ml of test water is pumped through a 5 micron C18 ODS 4.6 x 250 mm column with C18 guard column at 2.0 ml/minute for 30 minutes. This is immediately followed by a reverse phase gradient from the 100% water enrichment to 100% acetonitrile at 2.0 ml/minute for 30 minutes. Dual wavelength detection at 254 nm and 210 nm are used during the procedure at 0.05 AUFS. In order for the sample to pass lab evaluation, there must be no peaks greater than 0.0005 AU at 254 nm and 0.001 AU at 210 nm. (The 0.001 AU maximum peak at 210 nm is often limited by the acetonitrile solvent itself). Typical chromatograms will be shown throughout this bulletin.

CHROMATOGRAPHIC COMPARISONS

Figure 1 shows a chromatographic comparison of NANOpure UV reverse phase gradients with bottled HPLC and conventional DI water. Note that both the NANOpure UV and EASYpure UV systems produce baselines that are free of ghost peaks that could potentially interfere with your chromatograms.

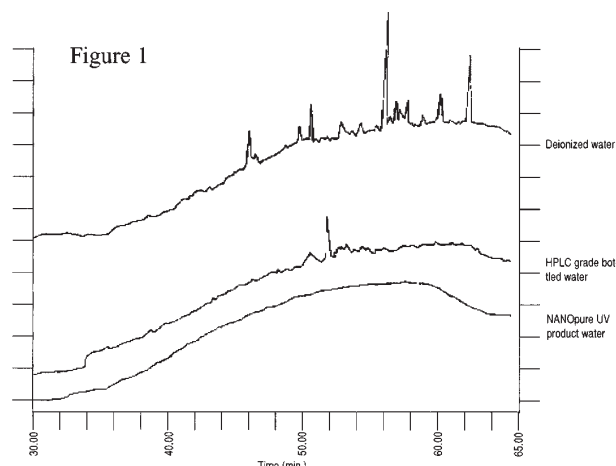


Figure 1
Determined with a Beckman HPLC system: 165 detector at 210 nm, 4.6 x 250 nm C-18 column; linear gradient mobile phase from 100% water to 100% acetonitrile at 2 ml/minute in 30 minutes, 60 ml

SOURCES OF CONTAMINATION

Elimination of organic contamination begins with the choice of equipment manufacturers. The water system should be constructed of a natural homopolymer (such as polypropylene) with no fillers, plasticizers or mold release agents. Purification media and resins should be semiconductor grade quality. Properly designed adsorption and ultraviolet oxidation techniques should be incorporated into the design of the unit. In addition to these prerequisites, the following potential sources of contamination are presented for consideration.

FINAL FILTER DESIGN

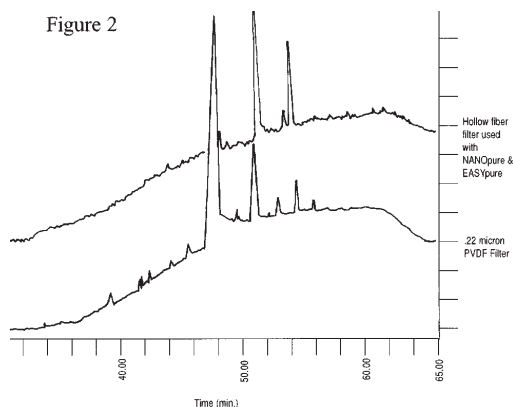
One of our main concerns was the performance of the 0.2 micron absolute filter, used as the final purification process in all reagent grade water systems. Our challenge was to provide absolute filtration without contamination caused by filtration particles, wetting agents, and bubble point chemicals. The amount of water required to rinse a filter, both new and before each use, was evaluated and compared to other filter material available. Figure 2 and Figure 3 show the baselines from a NANOpure UV reagent grade water system utilizing both the Barnstead hollow fiber filter and a "comparative" filter used on a different reagent grade water system. Figure 2 shows a comparison of the first samples drawn without any appreciable rinse up. Notice the presence of interfering peaks on both filters. Figure 3 shows the baselines after an approximately 8 liter initial rinse. The hollow fiber filter nicely rinsed to a flat baseline, while the other filter still showed substantial peaks. It was repeated after a 16 liter rinse on the other filter material; the peaks were still present.

Deionization

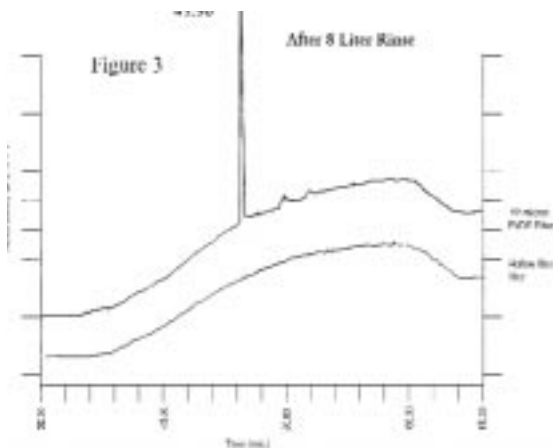
TECHNICAL APPLICATION BULLETIN

Barnstead

Figure 2

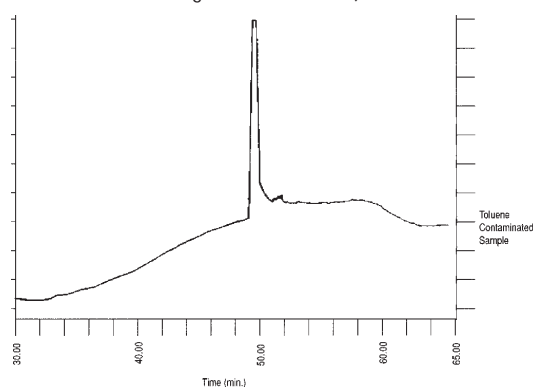


The conclusion of these assays showed us that the hollow fiber filtration material utilized on Barnstead NANOpure and EASypure water purification systems was superior in its ability to rinse out any interfering substances quickly. We attribute this to the naturally hydrophilic nature of the filtration material, as well as the material utilized for the filter housing. It is also evident that the competitor's filter material required extensive rinse-up to produce anything close to a flat baseline. Requiring such large quantities of water to rinse the 0.2 micron filter (to drain) wastes the capacity of the ion exchange cartridges unnecessarily. It may also take several runs or a column cleaning to remove filter contaminants. This can waste time and solvent.



LABORATORY ENVIRONMENT

Peaks in a chromatogram may not be due to contamination in the water system or other mobile phase solvents; organic solvents present in the laboratory environment can cause airborne contamination. If organic solvents are handled in the laboratory, the results can and most likely, will be affected. Figure 4 shows the effect of a partially opened container of toluene next to the chromatograph. The chances of environmental contamination affecting a point-of-use water purification system is less because the water is used as it is produced (not opened and closed like HPLC grade bottled water).



OTHER CONTAMINATION CONTROL CONSIDERATIONS

It is necessary to look at other factors when conducting HPLC. Those factors include the baking of glassware to remove any organic contaminants that may have adhered to the glass and, the proper purging of a system. At a minimum, the first chromatogram of the day should be thrown away. This will help flush any material out of the chromatograph that may be present from prior samples or that may leak out of the liquid handling hardware of the chromatograph during idle periods. The choice of solvents is extremely important because if the solvent is not pure enough, interferences will exist as a result of using this solvent. We also believe that prompt testing of the samples is necessary. This is required because water of this quality tends to pick up contaminants in a relatively short amount of time.

SUMMARY

The following criteria should be applied to your HPLC determinations to eliminate unwanted interferences.

1. Produce high purity water at the "point-of-use," with no storage.
2. Utilize a high purity water system which incorporates pure plastic components, semiconductor grade purification media for adsorption and ion exchange, ultraviolet oxidation and properly designed filters to ensure the lowest possible organic effluent.
3. Rinse system and sample prep filter prior to each use.
4. Use good laboratory practices.

Deionization

TECHNICAL APPLICATION BULLETIN

Barnstead

RNase FREE WATER... WHO SAID IT COULDN'T BE DONE?

RNase is an enzyme that causes the degradation of RNA molecules. It is a critical regulator of life processes in the cell. As critical as it is to this process, it is devastating to any RNA studies that rely on the presence of RNA.

Research involving RNA has become extremely important in the molecular biology field. RNA is an extremely unstable and difficult molecule to work with. The presence of RNase in nature and in the laboratory as well as RNA degrading on its own makes satisfactory yields difficult to obtain. With its increased importance in the research community, it has become necessary to ensure that a RNase-free environment exists and that all reagents utilized are prepared to ensure that RNase is not present. RNase, if present even in trace quantities, will severely limit the ability of researchers to conduct studies where RNA is essential to the results. Yields and product quality are drastically reduced in the presence of even a small amount of RNase. An example of this is in metabolism studies where they rely on the presence of mRNA whose levels are at or below detectable limits in cell extracts, any loss due to the presence of RNase will make achieving acceptable results impossible. RNA mapping, ribonuclease protection assays and northern blot hybridization are also affected by the presence of RNase.

Water is an essential reagent for most molecular biology applications. Ensuring that RNase is not present in the water has long plagued researchers. Up to this time, research has relied on DEPC to inactivate RNase. Using DEPC is expensive, time consuming and toxic. For these reasons, researchers would prefer not to depend on this chemical. DEPC also alters the chemistry of the water and could potentially affect results by the addition of both inorganic and organic impurities.

The Barnstead NANOpure Infinity and EASYpure UV/UF water purification system were designed to remove RNase from purified water without the use of DEPC. The technologies incorporated in the water purifier have demonstrated, through an independent detailed study, that RNase is completely removed by the system. Both systems incorporate adsorption, deionization, UV oxidation, and ultrafiltration within the same unit. We believe that ultrafiltration is the component that is primarily responsible for the majority of RNase removal. We also know that ultrafiltration is not absolute in its ability to remove impurities above the rated pore size of the filter. If no other technologies were present, a small amount of the challenged RNase would escape from the system and contaminate the product water. This was not the case as will be proven by the reported results. We believe that the carbon adsorption process, the strong base anion exchange and UV oxidation compliments the ultrafilter in the removal of RNase.

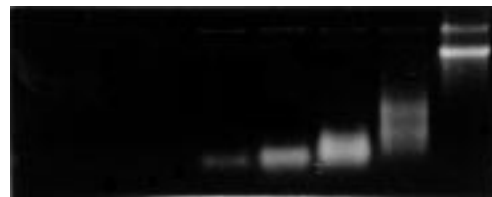
An independent two phase study was conducted at MO BIO Laboratories in Solana Beach, California. In the first phase, RNA spiked water was processed through the systems and the product water from

the system was tested for detectable RNase activity. The detection of RNase activity is based on electrophoresis of RNA standards which were incubated with test effluent water samples from the UV/UF system. The RNA standard was a 7 kb poly (A) tailed mRNA. If RNase was present during the incubation, the RNA standard would be degraded by enzymatic activity.

In phase two, the systems were repeatedly challenged with RNase spiked feed water over a four month period. The system was challenged, once a week, for three weeks followed by twice a month for 3 additional months.

Sensitivity of the test method was determined by making ten-fold serial dilutions of RNase cocktail stock solutions (10 mg/ml RNase A, 2.6 mg/ml RNase T1). Serial dilutions were incubated separately with a 7 kb RNA standard in 100 mM NaCl, 10 mM MgCl₂ at 37°C for 60 minutes. The reactions were then loaded in separate lanes from the highest to the lowest concentration of RNase added and run on a 1.2% Agarose gel in 0.5 x TAE containing 5 mg/ml of ethidium bromide. The gel banding of the RNA standard was dependent on the level of degradation caused by RNase. As the level of RNase decreased, the RNA banding was less smeared. The level of the sensitivity of the test method was represented by the lane where smearing still occurred. RNA incubated with DEPC treated water showed no smearing and was used for comparison. The sensitivity was confirmed to be 10-12 g (1 picogram) of RNase A/0.26 picograms RNase T1. The gel photograph shown below (Gel 1) shows the confirmation result of the reported sensitivity.

Gel 1 a b c d e f g h



Lane (a) 1 mg/ml RNase A, 0.27 mg/ml RNase T1
Lane (b) 1×10^{-1} mg/ml RNase A, 3×10^{-2} mg/ml RNase T1
Lane (c) 1×10^{-2} mg/ml RNase A, 3×10^{-3} mg/ml RNase T1
Lane (d) 1×10^{-3} mg/ml RNase A, 3×10^{-4} mg/ml RNase T1
Lane (e) 1×10^{-4} mg/ml RNase A, 3×10^{-5} mg/ml RNase T1
Lane (f) 1×10^{-5} mg/ml RNase A, 3×10^{-6} mg/ml RNase T1
Lane (g) 1×10^{-6} mg/ml RNase A, 3×10^{-7} mg/ml RNase T1
Lane (h) Negative control, or zero RNase

The photograph shows levels of detection as low as 10-6 mg (1 picogram)/ml RNase A and 3×10^{-7} mg (0.3 picogram)/ml RNase T1.

Deionization

TECHNICAL APPLICATION BULLETIN

Barnstead

The testing protocol utilized for the 10 assays completed during the four month study is listed below. All the assays were performed according to this schedule.

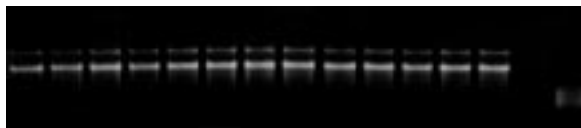
1. Switch the EASYpure UV/UF from STANDBY to ON.
2. Draw off 200 ml. of water from the EASYpure UV/UF.
3. Prepare RNase cocktail: 100ml RNase stock: 50 mg/ml Lot: A2214A39 100ml RNase T1 Stock: 1000u/ml Lot: AM112, 500 ml DI water. Save 50 ml for positive control.
4. Spike system with the 500 ml of RNase cocktail as feed water, followed by deionized water.
5. Zero point is just before adding the spike. Take 1 ml samples of water after drawing off 1000 ml, 1500 ml, 1600 ml, 1700 ml, 1800 ml, 1900 ml, 2000 ml, 2100 ml, 2200 ml, 3 L, 5 L, and 10 L.
6. Prepare RNA/Salt Pool: 16 ml RNA Lot: EM4702, 16 ml 1M NaCl Lot: MB1, 16ml 100 mM MgCl₂ Lot: MB1.
7. Into 0.5 ml tubes place 7 ml of each sample and add 3 ml of the RNA/Salt to each.
8. Negative control: 7 ml of DEPC treated water and 3 ml of RNA/Salt.
9. Positive Spike control: 7 ml of the RNase cocktail and 3 ml of the RNA/Salt.
10. Positive sensitivity control: 6 ml of DEPC treated water, 1 ml RNase A/T1 10⁻⁶ dilution and 3 ml of RNA/Salt. (Final RNase A/T1 conc. 1 picogram/ml/0.3 picogram/ml)
11. Incubate all tubes for 1 hr. at 37°C.
12. Prepare 1.2% agarose gel: 50 ml of _ X TAE Lot: MB1, 0.6 g agarose, 5 ml of ethidium bromide (5 mg/ml) Lot: MB1.
13. After 1 hour incubation, heat all tubes to 65°C for 5 minutes.
14. Spin all tubes to send condensation back into tube.
15. Add 2 ml of gel dye to each tube and load on gel in this order; Gel: Samples 1-12 in lanes 1-12 respectively, followed by, (-) control (lane 13), (+) Spike control (lane 14) and (+) sensitivity control (lane 15).
16. Run for 20 minutes at 80 volts.

RESULTS:

The three gels shown below represent testing assays completed initially (Gel 1), after 45 days, (Gel 2), and after 4 months, (Gel 3). Identical results were reported on the 10 assays completed during the 4 month evaluation.

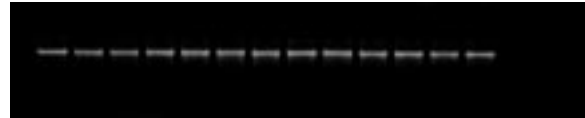
Gel 1

a b c d e f g h i j k l m n o



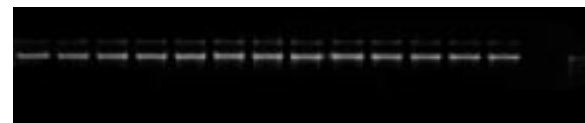
Gel 1

a b c d e f g h i j k l m n o



Gel 1

a b c d e f g h i j k l m n o



| | | |
|------|------------|--|
| Lane | a. 1000 ml | l. 2200 ml |
| | b. 1500 ml | j. 3 liters |
| | c. 1600 ml | k. 5 liters |
| | d. 1700 ml | l. 10 liters |
| | e. 1800 ml | m. Negative control |
| | f. 1900 ml | n. Positive control- Sample of RNase cocktail |
| | g. 2000 ml | o. Positive control- 1 picogram RNase A/0.3 picograms RNase T1 |
| | h. 2100 ml | |

CONCLUSION:

The NANO Infinity UV/UF and the EASYpure UV/UF both demonstrated through empirical independent lab evaluation that it consistently produces RNase free water, even when challenged over an extended period of time with large quantities of RNase. The sensitivity of the procedure proved that if as little as 1 picogram of RNase was present in a 10 microliter water sample it could be detected after only an hour of incubation. The water was also tested under more sensitive assay conditions by incubating at 37°C for 24 hours. This showed that RNase activity was less than 0.5 picograms/microliter. RNA incubated with water from the EASYpure UV/UF showed no visible degradation even after the 24 hour incubation. The positive control which contained 0.5 picograms of RNase A showed very measurable degradation.

"The EASYpure UV/UF is a reliable source of RNase free water."

—Dr. Mark Brolaski of MO BIO Laboratories

If you require a copy of the entire study for both the EASYpure UV/UF and NANOpure Infinity UV/UF it can be supplied to you by simply contacting Barnstead/Thermolyne at 1-800-446-6060, or by Fax at 319-556-0695.

Deionization

NANOPURE INFINITY® BASE SYSTEM

Barnstead

NANOpure Infinity
Base System



Includes
FREE
Wall Bracket

OUR MOST POPULAR SYSTEM!

- — Adaptable for your specialized needs
- — Standard remote dispenser delivers water up to 2.4 meters from the unit
- — Applications: AA, ICP, ICP/MS, IC and HPLC
- ★ — 24 Month Warranty

—30 DAY MONEY BACK GUARANTEE—

PRODUCT DESCRIPTION

- Produces up to 1.5 /min. of water with resistivities of up to 18.3 megohm-cm, and T.O.C. values of < 4 ppb. (See the independent test results following NANOpure Infinity pages.)
- This system provides you superior analytical quality water at a lower cost per liter than competitive models.
- Can be easily upgraded at your facility to incorporate the UV, UF or UV/UF modules needed for future pure water requirements.
- The NANOpure Infinity can be wall mounted or bench mounted without the addition of any special brackets.
- All models come complete with a remote dispenser allowing you to deliver up to 1.5 liters per minute of water up to 8 feet (2.4 meters) away from the unit.

OPERATION

- Microprocessor controlled purity monitor and controls for simple and accurate operation.
- An easy-to-read L.C.D. display provides you a digital indication of resistivity, conductivity, T.D.S. (total dissolved solids) or temperature.
- A user programmable setpoint will alert you when it is time for you to change cartridges at a purity level you choose.
- Start/Stop and Standby modes of operation. In standby the unit recirculates water within the system for 10 minutes every hour during periods of inactivity, assuring you water of the desired purity when you need it, without wasting valuable time or water waiting for the system to rinse up.
- Calibration verification of the electronics are accomplished automatically on start-up or can be verified as you require. An optional N.I.S.T. traceable module can be used to calibrate the electronics traceable to N.I.S.T. standards.
- An optional purity sensing electrode can be easily added to the unit providing you an indication of the resistivity, conductivity or T.D.S. (total dissolved solids) or temperature of the feed water entering the NANOpure Infinity.

48 Hour or Sooner
Express Shipping
Guaranteed!*

*see inside front cover for details

PRODUCT SPECIFICATIONS

| Overall Dimensions Inches (cm) | | | Maximum Inlet Pressure psig | Shipping Weight Lb. (kg) | Operating Temp Range °F (°C) |
|-----------------------------------|---------|---------|-----------------------------------|--------------------------------|------------------------------------|
| W | H | D | | | |
| 20 (51) | 24 (61) | 16 (41) | 100 psig | 80 (36.3) | 40-120°F (4-49°C) |

Product flow rates up to 1.5 /min dependent upon feed water pressure and installed modules.

ORDERING INFORMATION

| Model # | Description | Electrical | | US List Price |
|----------|-------------|------------|------|---------------|
| | | Volts | Amps | |
| D8961 | Base | 120 | 3 | \$4108.00 |
| D8962-33 | Base | 230 | 2 | \$4284.00 |

-33 Models CE Marked

ACCESSORIES

| Model # | Description | Capacity | US List Price |
|---------|--|------------------------|---------------|
| D50256 | Type 1 Cartridge Kit Tap/DI Feed 1 ea. D50251, 3 ea. D50253, 2 ea. FL703X2 | 2037 Grains as NaCl | \$453.00 |
| D50257 | Type 1 Cartridge Kit R/O or Dist. Feed 1 ea. D50250, 3 D50253, 2 ea. FL703X2 | 2037 Grains as NaCl | \$421.00 |
| D50254 | ORGANICfree Cartridge Kit Tap/DI Feed 1 ea. D50251, 2 ea. D50253, 1 ea. D50252, 2 ea. FL703X2 | 1686 Grains as NaCl | \$440.00 |
| D50255 | ORGANICfree Cartridge Kit R/O or Dist. Feed. 1 ea. D50250, 2 ea. D50253, 1 ea. D50252, 2 ea. FL703X2 | 1686 Grains as NaCl | \$432.00 |
| CMX25 | Sanitization Syringe | | \$17.00 |

U.S. Patent Issued: 5,397,468; 5,399,263

- Four individual easy to install purifying cartridges provide increased flexibility in choosing the proper purifying media for your specialized applications.
- Integral pressure regulating valve provides you the ability to utilize feed water with pressures up to 100 psig without additional equipment.
- All water pathways are virgin polypropylene. Fluoro polymers or equally inert material ensuring maintenance of pure water within the system.

Deionization

NANO PURE INFINITY® UV (ULTRAVIOLET)

Barnstead

NANOpure Infinity UV



Includes
FREE
Wall Bracket

ELIMINATES ORGANIC INTERFERENCES FROM YOUR WATER!

- — T.O.C. < 1 ppb, flat HPLC baselines...the Infinity UV sets a new standard
- ★ — 24 Month Warranty

—30 DAY MONEY BACK GUARANTEE—



PRODUCT DESCRIPTION

- Includes all of the benefits of a NANOpure Infinity base system plus the following added benefits.
- Produces up to 1.5 /min. of water with less than 1 ppb organics and resistivities up to 18.3 megohm-cm.
- Ideal for your most critical organic determinant analysis including low wavelength HPLC, gas chromatography, GC/MS, IC (Ion Chromatography) and TOC (Total Organic Carbon) analysis.
- The dual wavelength UV lamp maintains a bacterial free environment within the system while lowering the TOC.
- Infinity UV can be upgraded in your lab with a UF module to make a UV/UF Infinity for RNase DNase and DNA free applications.
- The unique design of the NANOpure Infinity UV assures that the system produces water with < 1 ppb TOC at a lower cost per liter than competitive models.
- Maximum contact time between the water and the UV lamp and cartridges ensures that low organic water is maintained as you are dispensing.
- The UV lamp is energized periodically in standby maintaining both the ionic and organic purity within the system during periods of inactivity.
- System automatically reminds you when it's time to change the UV lamp.

APPLICATIONS

- Gas chromatography (GC).
- Gas chromatography/mass spectrometry (GC/MS).
- High performance liquid chromatography (HPLC).
- Ion chromatography (IC).
- Total organic carbon (TOC).

**48 Hour or Sooner
Express Shipping
Guaranteed!***



*see inside front cover for details

PRODUCT SPECIFICATIONS

| Overall Dimensions Inches (cm) | | | Maximum Inlet Pressure psig | Shipping Weight Lb. (kg) | Operating Temp Range °F (°C) |
|-----------------------------------|---------|---------|-----------------------------------|--------------------------------|------------------------------------|
| W | H | D | | | |
| 20 (51) | 24 (61) | 16 (41) | 100 psig | 80 (36.3) | 40-120°F (4-49°C) |

Product flow rates up to 1.5 /min dependent upon feed water pressure and installed modules.

ORDERING INFORMATION

| Model # | Description | Electrical | | US List Price |
|----------|-------------|------------|------|------------------|
| | | Volts | Amps | |
| D8961 | UV | 120 | 3 | \$4108.00 |
| D8962-33 | UV | 230 | 2 | \$4284.00 |

-33 Models CE Marked

ACCESSORIES

| Model # | Description | Capacity | US List Price |
|---------|--|------------------------|------------------|
| D50256 | Type 1 Cartridge Kit Tap/DI Feed 1 ea. D50251, 3 ea. D50253, 2 ea. FL703X2 | 2037 Grains as NaCl | \$453.00 |
| D50257 | Type 1 Cartridge Kit R/O or Dist. Feed 1 ea. D50250, 3 D50253, 2 ea. FL703X2 | 2037 Grains as NaCl | \$421.00 |
| D50254 | ORGANICfree Cartridge Kit Tap/DI Feed 1 ea. D50251, 2 ea. D50253, 1 ea. D50252, 2 ea. FL703X2 | 1686 Grains as NaCl | \$440.00 |
| D50255 | ORGANICfree Cartridge Kit R/O or Dist. Feed. 1 ea. D50250, 2 ea. D50253, 1 ea. D50252, 2 ea. FL703X2 | 1686 Grains as NaCl | \$432.00 |
| CMX25 | Sanitization Syringe | | \$17.00 |
| LMX13 | UV Lamp Replacement | | \$84.00 |

U.S. Patent Issued: 5,397,468; 5,399,263

Deionization

NANO PURE INFINITY® UF (ULTRAFILTRATION)

Barnstead

NANOpure Infinity UF



IDEAL FOR YOUR LIFE SCIENCE APPLICATIONS!

- — Produces up to 1.5 LPM of pyrogen free water
- — Pyrogen levels below 0.001 EU/ML
- — > 7 log reduction in pyrogens
- ★ — 24 Month Warranty

—30 DAY MONEY BACK GUARANTEE—

Includes
FREE
Wall Bracket



PRODUCT DESCRIPTION

- Includes all of the benefits of a NANOpure Infinity base unit plus the following added benefits:
- Produces up to 1.5 /min. of pyrogen free water (<0.001 Eu/ml, >7 log reduction) with resistivities up to 18.3 megohm-cm and TOC values < 10 ppb.
- Automatic intermittent ultrafilter and manual flush ensures that impurities do not deposit on the surface of the ultrafilter.
- Automatic & manual flush modes provide consistent effective cleaning of the ultrafilter membrane.
- Extended (5 minute) fast flush quickly rinses up the NANOpure Infinity to maximum purity.
- Optional 5,000 mw ultrafilter can be used in place of the 10,000 mw cutoff weight ultrafilter included with the unit.
- Produces superior biologically pure water at a lower cost per liter than competitive models.

APPLICATIONS

- Cell and tissue culture.
- In Vitro fertilization.
- DNA studies.
- Monoclonal antibody production.

PRODUCT SPECIFICATIONS

| Overall Dimensions Inches (cm) | | | Maximum Inlet Pressure psig | Shipping Weight Lb. (kg) | Operating Temp Range °F (°C) |
|-----------------------------------|--------|--------|-----------------------------------|--------------------------------|------------------------------------|
| W | H | D | | | |
| 20(51) | 24(61) | 16(41) | 100 psig | 80 (36.3) | 40-120°F (4-49°C) |

Product flow rates up to 1.5 /min dependent upon feed water pressure and installed modules.

ORDERING INFORMATION

| Model # | Description | Electrical | | US List Price |
|----------|-------------|------------|------|---------------|
| | | Volts | Amps | |
| D8981 | UF | 120 | 3 | \$5128.00 |
| D8982-33 | UF | 230 | 2 | \$5302.00 |

-33 Models CE Marked

ACCESSORIES

| Model # | Description | Capacity | US List Price |
|---------|--|------------------------|---------------|
| D50256 | Type 1 Cartridge Kit Tap/DI Feed 1 ea. D50251, 3 ea. D50253, 2 ea. FL703X2 | 2037 Grains as NaCl | \$453.00 |
| D50257 | Type 1 Cartridge Kit R/O or Dist. Feed 1 ea. D50250, 3 D50253, 2 ea. FL703X2 | 2037 Grains as NaCl | \$421.00 |
| D50254 | ORGANICfree Cartridge Kit Tap/DI Feed 1 ea. D50251, 2 ea. D50253, 1 ea. D50252, 2 ea. FL703X2 | 1686 Grains as NaCl | \$440.00 |
| D50255 | ORGANICfree Cartridge Kit R/O or Dist. Feed. 1 ea. D50250, 2 ea. D50253, 1 ea. D50252, 2 ea. FL703X2 | 1686 Grains as NaCl | \$432.00 |
| D50258 | Sanitization Cartridge | | \$34.00 |
| FL898X1 | Ultrafilter 5000 mw | | \$662.00 |
| FL550X1 | Ultrafilter Replacement, 10,000 mw | | \$886.00 |

U.S. Patent Issued: 5,397,468; 5,399,263

48 Hour or Sooner
Express Shipping
Guaranteed!*



*see inside front cover for details

Deionization

NANOPURE INFINITY® UV/UF

Barnstead

NANOpure Infinity UV/UF



Includes
FREE
Wall Bracket

OUR BEST WATER SYSTEM!

- — RNase free water...with the UV/UF we have proven we can do it
- — Ideal for all pure water applications
- ★ — 24 Month Warranty

—30 DAY MONEY BACK GUARANTEE—



PRODUCT DESCRIPTION

- Includes all of the benefits of a NANOpure Infinity base unit plus the following added benefits.
- Produces up to 1.5 l/min. of pyrogen free water (< 0.001 Eu/ml, > 7 log reduction) with resistivities up to 18.3 megohm-cm and TOC values < 2 ppb.
- Automatic intermittent ultrafilter and manual flush ensures that impurities do not deposit on the surface of the ultrafilter.
- Automatic & manual flush modes provide consistent effective cleaning of the ultrafilter membrane.
- Extended (5 minute) fast flush quickly rinses up the NANOpure Infinity to maximum purity.
- Optional 5,000 mw ultrafilter can be used in place of the 10,000 mw cutoff weight ultrafilter included with the unit.
- Produces superior biologically pure water at a lower cost per liter than competitive models.
- RNase, DNase and DNA free water.

APPLICATIONS

- Cell and tissue culture.
- In Vitro fertilization.
- DNA studies.
- Monoclonal antibody production.
- All other water applications.

**48 Hour or Sooner
Express Shipping
Guaranteed!***



*see inside front cover for details

PRODUCT SPECIFICATIONS

| Overall Dimensions Inches (cm) | | | Maximum Inlet Pressure psig | Shipping Weight Lb. (kg) | Operating Temp Range °F (°C) |
|-----------------------------------|---------|---------|-----------------------------------|--------------------------------|------------------------------------|
| W | H | D | | | |
| 20 (51) | 24 (61) | 16 (41) | 100 psig | 80 (36.3) | 40-120°F (4-49°C) |

Product flow rates up to 1.5 l/min dependent upon feed water pressure and installed modules.

ORDERING INFORMATION

| Model # | Description | Electrical | | US List Price |
|----------|-------------|------------|------|------------------|
| | | Volts | Amps | |
| D8991 | UV/UF | 120 | 3 | \$5952.00 |
| D8992-33 | UV/UF | 230 | 2 | \$6138.00 |

-33 Models CE Marked

ACCESSORIES

| Model # | Description | Capacity | US List Price |
|---------|--|------------------------|------------------|
| D50256 | Type 1 Cartridge Kit Tap/DI Feed 1 ea. D50251, 3 ea. D50253, 2 ea. FL703X2 | 2037 Grains as NaCl | \$453.00 |
| D50257 | Type 1 Cartridge Kit R/O or Dist. Feed 1 ea. D50250, 3 D50253, 2 ea. FL703X2 | 2037 Grains as NaCl | \$421.00 |
| D50254 | ORGANICfree Cartridge Kit Tap/DI Feed 1 ea. D50251, 2 ea. D50253, 1 ea. D50252, 2 ea. FL703X2 | 1686 Grains as NaCl | \$440.00 |
| D50255 | ORGANICfree Cartridge Kit R/O or Dist. Feed. 1 ea. D50250, 2 ea. D50253, 1 ea. D50252, 2 ea. FL703X2 | 1686 Grains as NaCl | \$432.00 |
| CMX25 | Sanitization Syringe | | \$17.00 |
| FL898X1 | Ultrafilter 5000 mw | | \$662.00 |
| FL550X1 | Ultrafilter Replacement, 10,000 mw | | \$886.00 |
| LMX13 | UV Lamp Replacement | | \$84.00 |

U.S. Patent Issued: 5,397,468; 5,399,263

Deionization

NANOPURE INFINITY® UPGRADE MODULES

Barnstead

NANOpure Infinity Upgrade Modules



AS YOUR NEEDS CHANGE, UPGRADE YOUR NANOPURE!

- — Allows you to upgrade your water system to suit your needs
- — Easily accomplished in the field; no need to return your unit to the factory



NANOPURE INFINITY UPGRADE MODULES

- If you expand your laboratory the NANOpure Infinity can be expanded to provide water for any of your pure water needs. You can easily add these modules to your Infinity in your laboratory.
- If you need biological pure water for RNA or DNA studies, a UV/UF module can be added. If you need water guaranteed to be free of pyrogens for tissue culture, or monoclonal antibody production, you can add a UF module. If you need low TOC water for your critical HPLC, GC/MS or IC applications a UV module can be added.

N.I.S.T. CALIBRATION MODULE

- Allows you to calibrate your NANOpure Infinity in your laboratory traceable to N.I.S.T. standards.
- Comes complete with a certificate verifying N.I.S.T. traceability.
- Calibration Module can be returned for recertification.
- NANOpure Infinity is easily checked and recalibrated in the laboratory.

INLET CELL OPTION

- An inlet cell can be added to your NANOpure Infinity, allowing you to monitor the purity of your feedwater on a constant basis. No longer will you have to guess at the purity of your feedwater.
- The inlet cell provides a digital reading of the resistivity, conductivity or total dissolved solids and temperature of your incoming water.
- Easily added to an existing NANOpure Infinity in your laboratory.

ACCESSORIES

| Model # | Description | US List Price |
|---------|-----------------------------|---------------|
| D8974 | UV Module | \$1803.00 |
| D8984 | UF Module | \$1415.00 |
| D8994 | UV/UF Module | \$2021.00 |
| E896x5 | N.I.S.T. Calibration Module | \$82.00 |
| E896x3 | Inlet Cell | \$470.00 |
| D2706 | Pressure Switch | \$370.00 |
| D8964 | Low Water Pump Protector | \$324.00 |

48 Hour or Sooner
Express Shipping
Guaranteed!*



*see inside front cover for details

Deionization

NANOPURE INFINITY® TEST RESULTS

Barnstead

ORGANIC DETERMINANT ANALYSIS

The Total Organic Carbon (T.O.C.) content of a water indicates its general organic content. It does not specify which types of organic compounds are present in the water sample. It does indicate how well a particular ultrapure water system is able to remove organic molecules.

To determine specific organic compounds in a water sample, organic determinant analyses such as H.P.L.C. and/or GS/MS are necessary. These tests identify the presence and concentration of individual organic molecules that form the T.O.C. content of a water sample. This is important in environmental testing applications and all organic determinant analyses, where specific organic compounds are quantified.

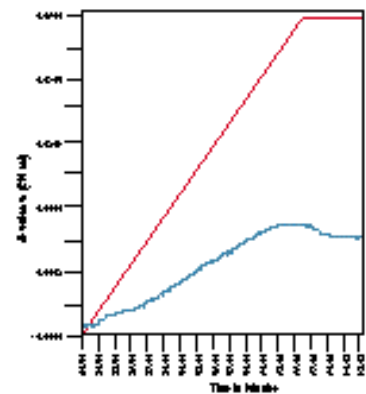
GC/MS - ALL UNITS^{1*}

| Volatile | Result | Units |
|-------------------------------|--------|-------|
| Acetone | < 10 | µg/L |
| Acrolem | < 10 | µg/L |
| Acrylein | < 10 | µg/L |
| Acrylonitrile | < 10 | µg/L |
| Benzene | < 0.5 | µg/L |
| Bromodichloromethane | < 0.5 | µg/L |
| Bromoform | < 0.5 | µg/L |
| Bromomethane | < 0.5 | µg/L |
| Carbon tetrachloride | < 0.5 | µg/L |
| Chlorobenzene | < 0.5 | µg/L |
| Chloroethane | < 0.5 | µg/L |
| Chloroform | < 0.5 | µg/L |
| Chloromethane | < 0.5 | µg/L |
| Dibromochloromethane | < 0.5 | µg/L |
| 1,1 - Dichloroethane | < 0.5 | µg/L |
| 1,2 - Dichloroethane | < 0.5 | µg/L |
| 1,1 - Dichloroethene | < 0.5 | µg/L |
| trans - 1,2 - Dichloroethene | < 0.5 | µg/L |
| cis - 1,2 - Dichloroethene | < 0.5 | µg/L |
| 1,2 - Dichloropropane | < 0.5 | µg/L |
| cis - 1,2 - Dichloropropene | < 0.5 | µg/L |
| trans - 1,3 - Dichloropropene | < 0.5 | µg/L |
| Ethylbenzene | < 0.5 | µg/L |
| 2 - Hexanone | < 0.5 | µg/L |
| Methyl ethyl ketone (MEK) | < 0.5 | µg/L |
| Methyl isobutyl ketone (MIBK) | < 0.5 | µg/L |
| Methylene chloride | < 0.5 | µg/L |
| 1,1,2,2 - Tetrachloroethane | < 0.5 | µg/L |
| Tetrachloroethene | < 0.5 | µg/L |
| Toluene | < 0.5 | µg/L |
| 1,1,1 - Trichloroethane | < 0.5 | µg/L |
| 1,1,2 - Trichloroethane | < 0.5 | µg/L |
| Trichlorofluoromethane | < 0.5 | µg/L |
| Vinyl chloride | < 0.5 | µg/L |
| Xylenes, Total | < 0.5 | µg/L |

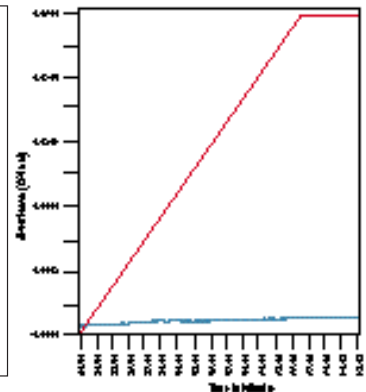
¹ Volatile organic compounds base/neutrals, acid extractable organic compounds and phthalate esters

* Hewlett Packard HP-5970A Mass. Spec.GC Keystone Laboratories.

HPLC 210 nm



HPLC 254 nm



T.O.C. Analysis^{1,2}
 Base System < 4 ppb
 UV System < 1 ppb
 UV/UF System < 2 ppb
 UF System < 10 ppb

¹ Feed water Tap, Distilled, Deionized or Reverse osmosis
² Seivers model 800 Total Organic Carbon Analyzer

NOTE: NANOpure UV distilled feed 0.2 micron filter determined with a Beckman® HPLC system; 168 detector at 210 nm and 254 nm, 4.6 x 250 nm C-18 column Direct-Connect™ Guard column .05 AUFS; linear gradient mobile phase from 100% water to 100% acetonitrile at 2 ml/minute in 30 minutes, 60 ml sample enrichment at 2 ml/minute.