Clinical Practice Standards and Procedures for Dialysis Water Quality: 6: Dialysis Water Equipment Monitoring

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1.0 PRACTICE STANDARD

1.1. Purpose

The Biomedical Technologist, Renal Dialysis Technician, or Renal Nurse who is trained and has demonstrated competency in dialysis water practices will use the procedure outlined in this document to conduct performance checks on the dialysis water equipment and treatment system. It is important to note that not all equipment mentioned in this standard may be applicable to or present at the respective Renal Unit.

1.2. Standards

The manufacturer recommendations and instructions should always be followed first.

The following parameters must be monitored continuously with audible and/or visible alarms:

Parameter	Alarm Limit
DI tanks	> 1 MΩ·cm
RO incoming water pressure	Manufacturr specific
RO incoming water temperature	25 °C ± 2°C
RO conductivity	< 15 mS/cm
RO percent rejection	> 90 %

There are certain important parameters that must be checked daily. If any problems are detected, Biomedical Engineering must be contacted. The Renal Dialysis Tech or Renal Nurse must check **daily**:

- Incoming water temperature (approx. 25°C ± 2°C).
- Water leaks as indicated by drips from fittings or water on the floor.
- Pressure drop across multi-media sediment filter, water softener, carbon tanks, DI tanks (if applicable), and endotoxin ultra-filter by measuring the inlet and outlet pressure gauges on the water lines (pressure drop changes should remain less than 10 PSI from baseline).

Biomedical Engineering will check all water treatment operating parameters, which may vary at sites with Renal Dialysis Technicians. In addition to the daily checks, Biomedical Engineering must check **monthly**:

- RO operational parameters, including pressures, temperatures, and water quality.
- DI operational parameters.
- Sediment filter backwash cycle timer setting.
- Carbon regeneration timer setting.
- Water softener effluent water hardness (less than 1 GPG, or 17.2 PPM).

- Brine tank salt level (at least half the tank and no salt bridge).
- Softener regeneration timer setting.
- For portable ROs, carbon filters should be changed.

2.0 DEFINITIONS AND ABBREVIATIONS

DI	Deionization.
Dialysis water	Water that has been treated to meet the requirements of the CSA-ISO standards and which is suitable for use in hemodialysis applications, including the preparation of dialysis fluid, reprocessing of dialysate, preparation of concentrates and preparation of substitution fluid for online convective therapies.
EDTA	Ethylenediaminetetraacetic acid.
GPG	Water hardness unit; grains per gallon.
Hemodialysis	Form of renal replacement therapy in which waste solutes are removed primarily by diffusion from blood flowing on one side of a membrane into dialysis fluid flowing on the other side.
Percent rejection	Measurement of rejection of solutes by RO membrane and, thus, measurement of equipment performance.
Product water	Water produced by a water treatment system or individual component thereof.
PSI	Pressure unit; pounds per square inch.
RO	Reverse osmosis.
Salt Bridge	Where salt at the top of the tank solidifies, making it appear as though the tank is full when it is actually empty underneath.
TDS	Total dissolved solids.
Water treatment system	Collection of water treatment devices and associated piping, pumps, valves, gauges, etc., that together produce treated water for hemodialysis applications and deliver it to the point of use.

Disclaimer: The procedure steps may not depict actual sequence of events. Site-specific considerations may be made when applying the following procedures and protocols.

3.0 EQUIPMENT

- EDTA titration test kit *(optional)*
- Dip-and-read test strips *(optional)*
- Daily Dialysis Water Equipment Monitoring Log Sheet
- Monthly Dialysis Water Equipment Monitoring Log Sheet

4.0 DAILY MONITORING PROCEDURE

4.1	Check the incoming water temperature.	
	4.1.1	If the temperature is not 25°C ± 2°C, contact Biomed to adjust the blending valve.
4.2	Look around the RO system for any visible fluid leaks.	
	4.2.1	If any leaks are observed, contact Biomedical Engineering.
4.3	Check and record the pressure gauge prior to the multi-media sediment filter.	

4.4	Check and record the pressure gauge prior to each of the carbon tanks.		
	4.4.1	Record the pressure before the primary carbon tank.	
	4.4.2	Record the pressure before the polisher carbon tank.	
4.5	Check and record the pressure gauge prior to the water softener.		
4.6	Check and record the pressure gauge prior to the RO.		
4.7	Check and record the pressure gauge prior to each of the DI tanks, if pressure gauges are present.		
4.8	Look over all recorded pressures. If any of the pressure changes are greater than 10 PSI from baseline, contact Biomed immediately.		
4.9	Check the pressure across the endotoxin ultra-filter.		
	4.9.1	Measure and record the pressures before and after the endotoxin filter.	
		4.9.1.1	Calculate and record the pressure change across the filter.
		4.9.1.2	If the change in pressure is greater than 10 PSI from baseline, contact Biomed to replace the filter cartridges.
4.10	Record all checks, including time and initials, on the Daily Dialysis Water Equipment Monitoring Log Sheet.		

5.0 MONTHLY MONITORING PROCEDURE

5.1	Check the incoming water temperature.		
	5.1.1	If the temperature is not 25°C ± 2°C, adjust the blending valve accordingly.	
5.2	Look around the RO system for any visible fluid leaks.		
5.3	Check the RO. *Note:* The microbiological, chemical, and chlorine testing of feed water to or dialysis water from the RO are covered in the *Microbial Testing of Dialysis Water, Endotoxin Testing of Dialysis Water, Chemical Analyses of Dialysis Water,* and *Daily Chlorine Testing of Dialysis Water* clinical standards.		
	5.3.1	Measure and record the pressures before and after the pre-filter.	
		5.3.1.1	Calculate and record the pressure change across the pre-filter.
		5.3.1.2	If the change in pressure is greater than 10 PSI from baseline, replace the filter cartridge.
	5.3.2	Measure and record the pressures before and after the RO membrane.	
		5.3.2.1	Calculate and record the pressure change across the pre-filter.
		5.3.2.2	If the change in pressure is greater than 10 PSI from baseline, the RO membranes should be cleaned. If cleaning fails to restore performance, the membrane modules might need to be replaced.
	5.3.3	Check and record the pump, reject, and product pressures.	
	5.3.4	Check and record the recycle, waste, and permeate flowrates.	
	5.3.5	Check and record the inlet and permeate conductivities. Read the RO monitor and record the conductivity and percent rejection.	
		5.3.5.1	If the conductivity is less than 15 mS/cm, perform chemical analyses for contaminants in the water. (Refer to the *Chemical Analyses of Dialysis Water* clinical standard.)
	5.3.6	Check and record the percent rejection.	
		5.3.6.1	If the percent rejection is less than 90%, perform chemical analyses for contaminants in the water. (Refer to the *Chemical Analyses of Dialysis Water* clinical standard.)

	5.3.7	Check and record the pump run hours.	
5.4	Check the multi-media sediment filter.		
	5.4.1	Measure and record the pressures before and after the multi-media filter.	
		5.4.1.1	Calculate and record the pressure change across the multi-media filter.
		5.4.1.2	If the change in pressure is greater than 10 PSI from baseline, troubleshoot and replace the cartridge, or, if necessary, perform disinfection. (Refer to the *Cleaning and Disinfection of Dialysis Water Equipment* clinical standard).
	5.4.2	Check and record the setting for the backwash cycle timer.	
5.5	Check the primary and polisher carbon tanks.		
	5.5.1	Measure and record the pressures before and after each carbon tank.	
		5.5.1.1	Calculate and record the pressure change across each of the carbon tanks.
		5.5.1.2	If the change in pressure is greater than 10 PSI from baseline for either of the carbon tanks, troubleshoot and replace the tank(s), or, if necessary, perform disinfection. (Refer to the *Cleaning and Disinfection of Dialysis Water Equipment* clinical standard).
	5.5.2	Check and record the settings for the carbon regeneration timers on the primary carbon tank and on the polisher carbon tank. The timers should be set to activate when the facility is not operating.	
5.6	Check the water softener.		
	5.6.1	Measure and record the pressures before and after the water softener.	
		5.6.1.1	Calculate and record the pressure change across the water softener.
		5.6.1.2	If the change in pressure is greater than 10 PSI from baseline, check that the regeneration timer is at the proper setting.
	5.6.2	Check and record the setting for the regeneration timer. The timer should be set to activate when the facility, especially the RO, is not operating.	
	5.6.3	Check the brine tank.	
		5.6.3.1	Look for the presence of a salt bridge, where salt at the top of the tank solidifies, making it appear as though the tank is full when it is actually empty underneath.
		5.6.3.2	Check and record whether the salt pellets fill at least half the tank (or as recommended by the manufacturer). Rock salt should not be used for water regeneration since it is not refined and typically contains sediments and other impurities that may damage other components of the water softener.
	5.6.4	Test for total hardness.	
		5.6.4.1	Collect a sample of water at the water softener output.
		5.6.4.2	Use an EDTA test or dip-and-read test strips to test for total hardness by measuring the calcium carbonate concentration.
		5.6.4.3	Record the total hardness measured.
		5.6.4.4	If the total hardness is greater than 1 GPG of calcium carbonate (or the limit established by the manufacturer), troubleshoot the water softener for proper operation.
5.7	Check the DI tanks.		
	5.7.1	If available, measure the pressures before and after each DI tank.	
		5.7.1.1	Calculate the pressure changes across each DI tank.
		5.7.1.2	If the change in pressure is greater than 10 PSI from baseline for either of the DI tanks, this could indicate that the tanks are becoming plugged with particulate matter, or that resin is potentially breaking down and restricting the flow of water. Troubleshoot and, if necessary, replace the tanks.

	5.7.2	Check and record whether the resistivity of each of the DI tanks is greater than 1 MΩ·cm.	
5.8	Check the endotoxin ultra-filter.		
	5.8.1	Measure and record the pressures before and after the endotoxin filter.	
		5.8.1.1	Calculate and record the pressure change across the endotoxin filter.
		5.8.1.2	If the change in pressure is greater than 10 PSI from baseline, troubleshoot and replace cartridge, or, if necessary, perform disinfection. (Refer to the *Cleaning and Disinfection of Dialysis Water Equipment* clinical standard).
5.9	For portable ROs, change the carbon filters.		
5.10	Record all checks, including date, time, and initials, on the Monthly Dialysis Water Equipment Monitoring Log Sheet.		

6.0 DOCUMENTATION CONSIDERATIONS

All daily and monthly monitored parameters must be recorded on the Daily Dialysis Water Equipment Monitoring Log Sheet and Monthly Dialysis Water Equipment Monitoring Log Sheet, respectively. The log sheets must be reviewed by the Area Renal Manager **semi-annually**.

7.0 SPECIAL CONSIDERATIONS

- Newer RO systems may have a direct reading for percent rejection.
- Baseline pressure readings should be noted on the filter at the time of installation.
- Deionizers must be monitored continuously using resistivity monitors that compensate for temperature and are equipped with audible and visual alarms.
- When choosing a test method for testing for water hardness, the user should ensure that the test accuracy and sensitivity are sufficient to satisfy the total hardness monitoring requirements of the RO machine manufacturer.

8.0 REFERENCES

- CAN/CSA-ISO 26722-11 – Water treatment equipment for hemodialysis applications and related therapies (Adopted ISO 26722:2009, First edition, 2009-04-15), *Canadian Standards Association,* 2011.
- Dialysate for hemodialysis (ANSI/AAMI RD52:2004/(R)2010), *Association for the Advancement for Medical Instrumentation,* Arlington (VA), 2009.
- Monitoring Your Dialysis Water Treatment System, *Northwest Renal Network*, June 2005.
- Richard A. Ward, Maintaining water quality for hemodialysis, *UpToDate*, Jan. 2011.

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FHA Renal Biomedical Technologists and Renal Managers
VIHA Renal Biomedical Technologists and Renal Managers
PHC Renal Biomedical Technologists and Renal Managers

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