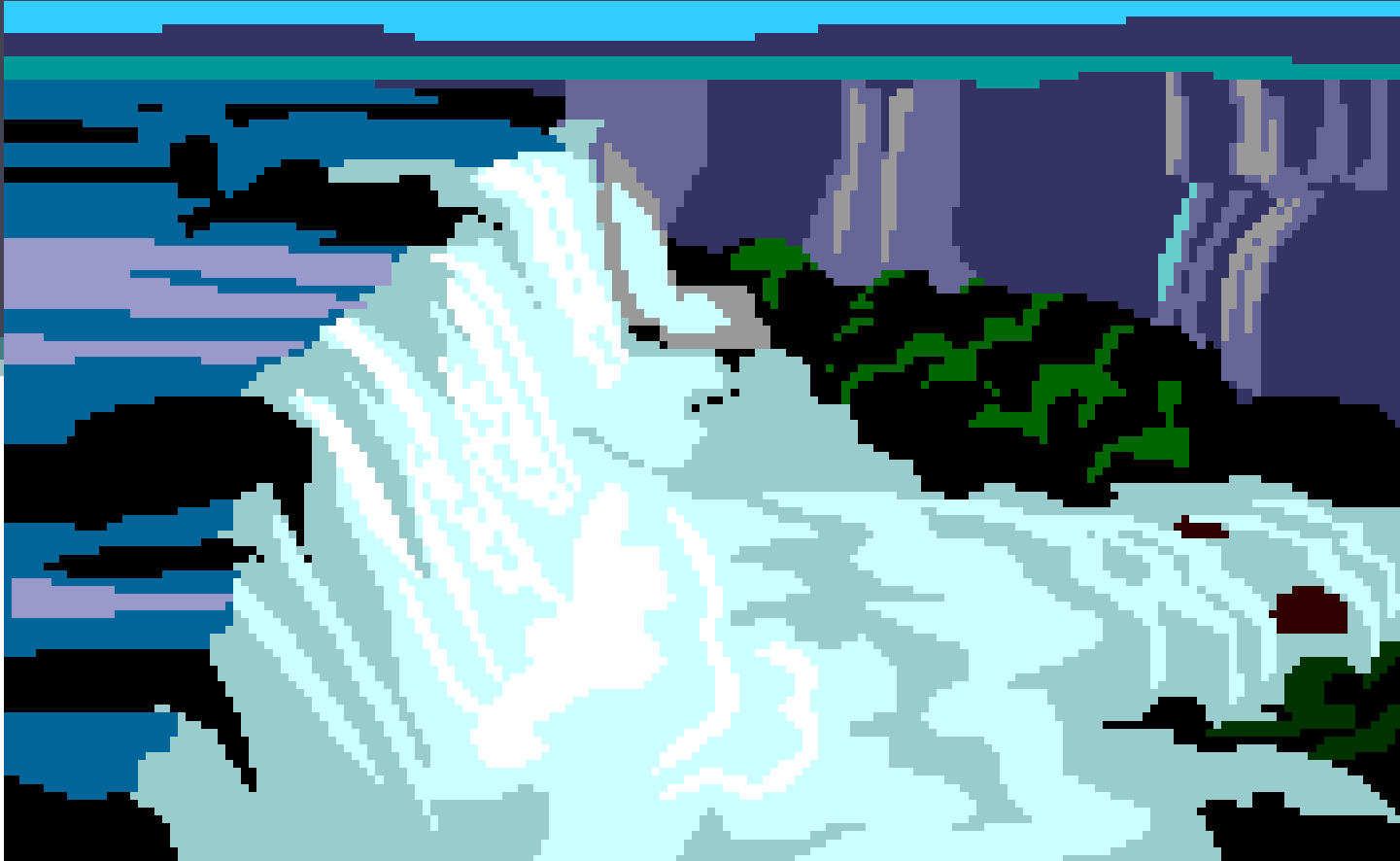


Water Treatment for Dialysis



Water Treatment for Dialysis

- Why Water Treatment?

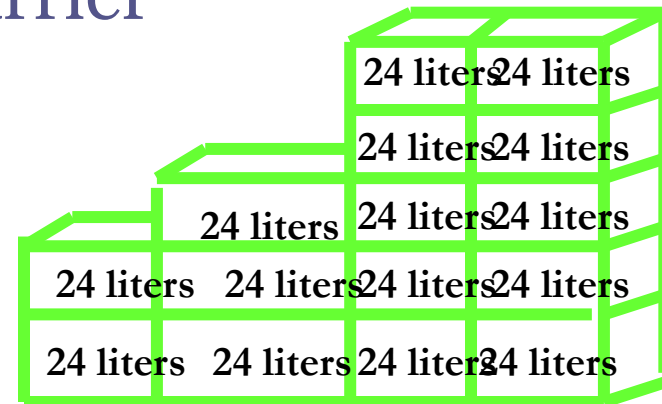
- Patient safety issues

- Very large exposure volume
 - Little or no renal excretion
 - Dialyzer membrane is sole barrier

- Prevention of equipment damage



★ Avg. person drinks 10-14 L/wk



★ Avg. dialysis pt. is exposed to about 360 L/wk

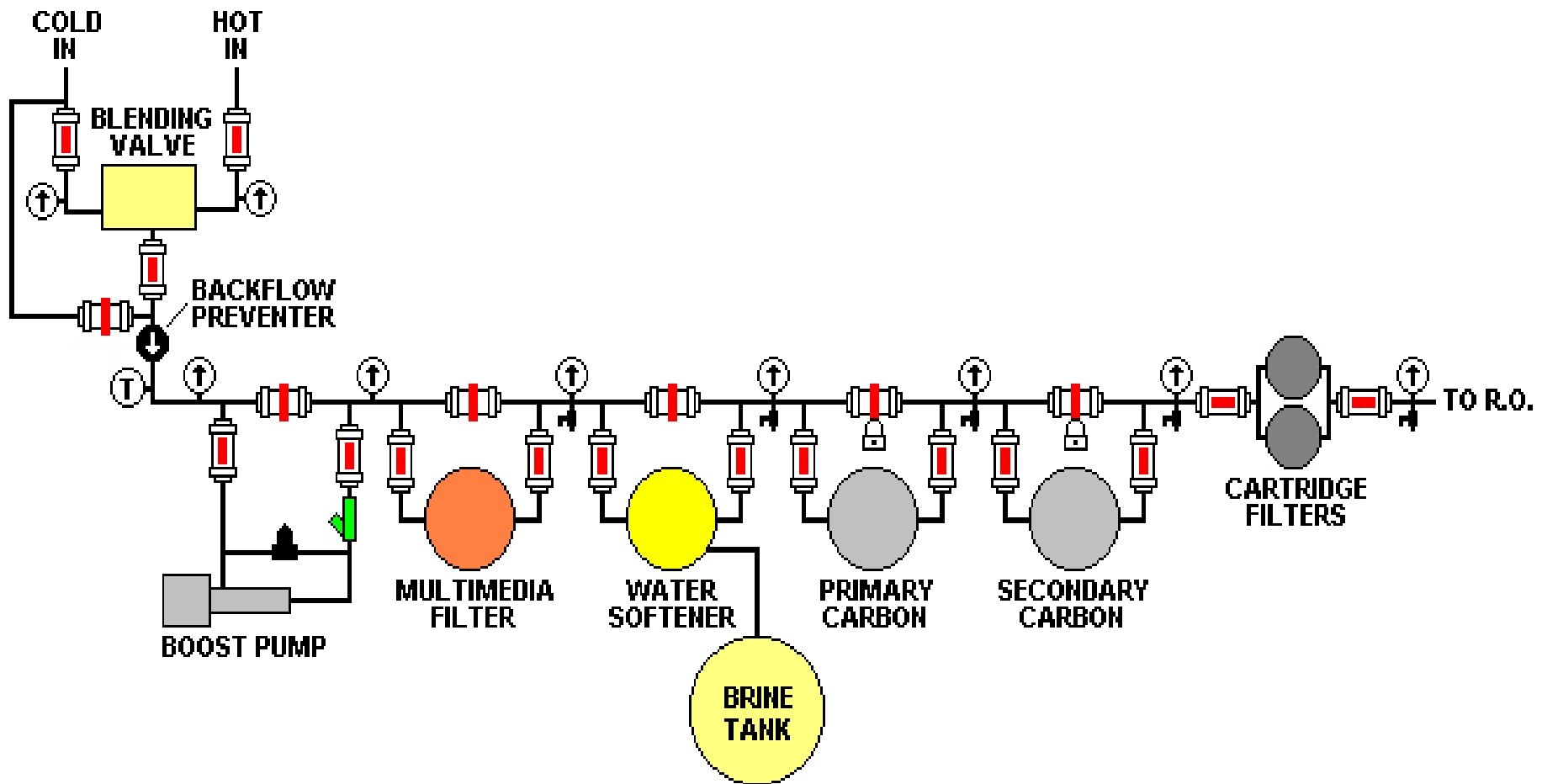
Water Treatment

- Regulatory Agencies
 - **AAMI** (Association for the Advancement of Medical Instrumentation)
 - KDOQI recommendations
 - Federal regulations
 - State regulations
 - Local regulations

Water Treatment Processes

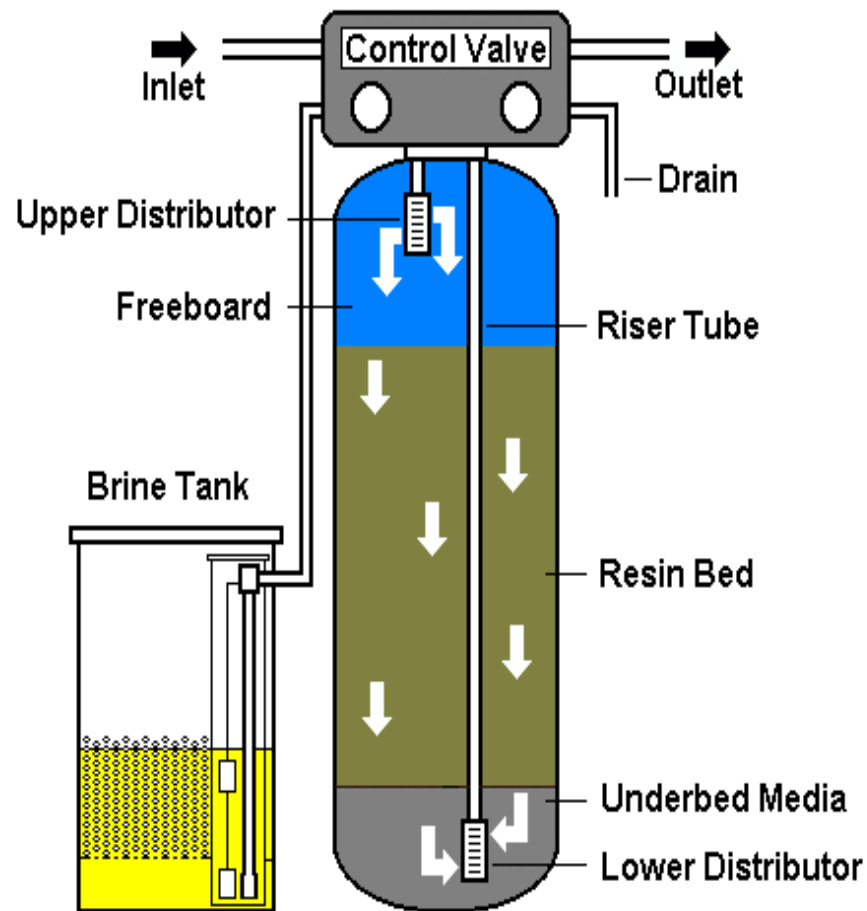
- Pre-treatment
 - Before the RO (Reverse Osmosis)
- Purification
 - Removes organic, inorganic and bacterial contaminants
- Distribution Loop

Typical Pre-Treatment System



Water Softener

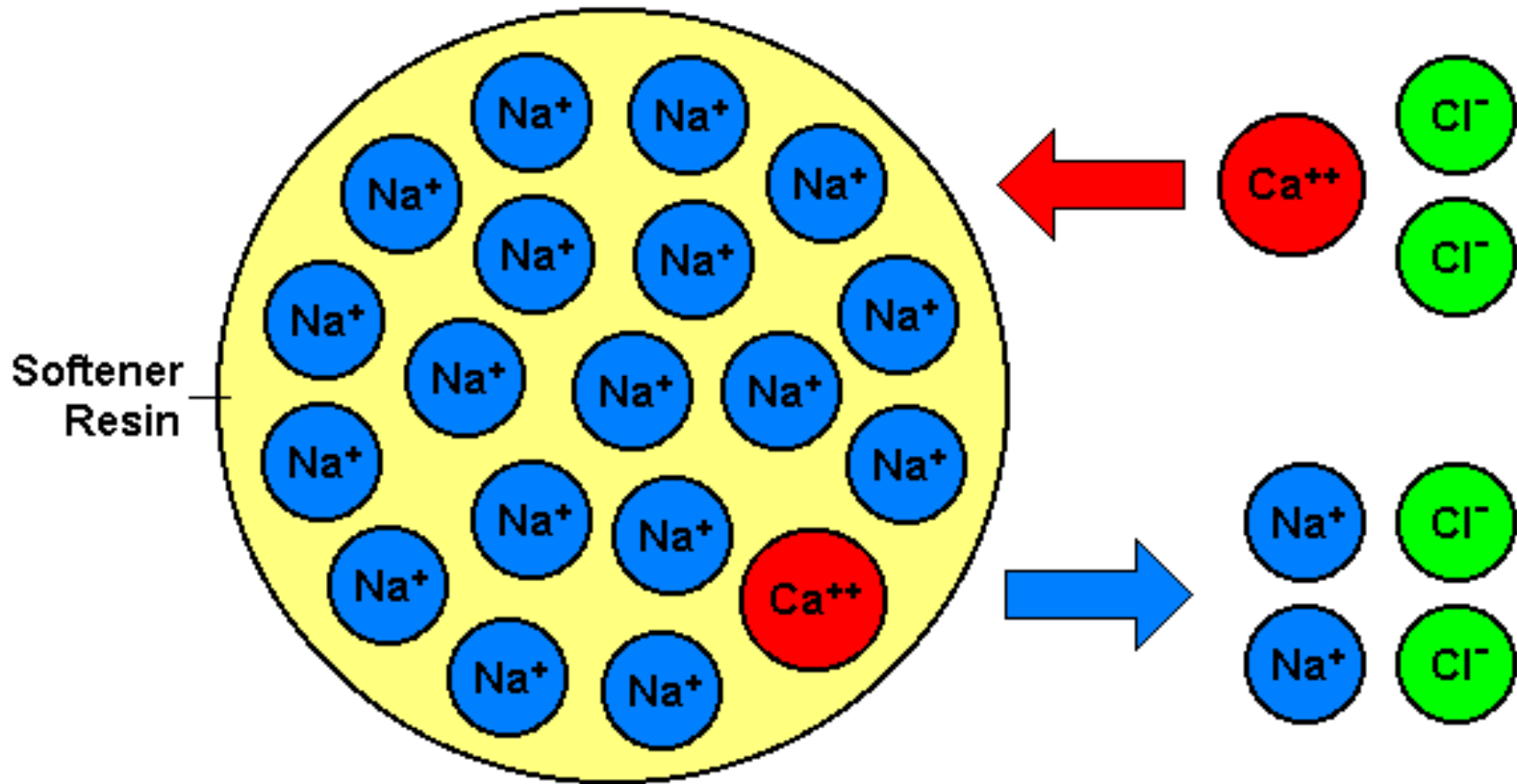
- Primarily for RO protection
- Removes “hardness” ions (calcium & magnesium)
- Sized for at least 1 day’s operation
- Regenerate with pellet salt



Water Softener Monitoring

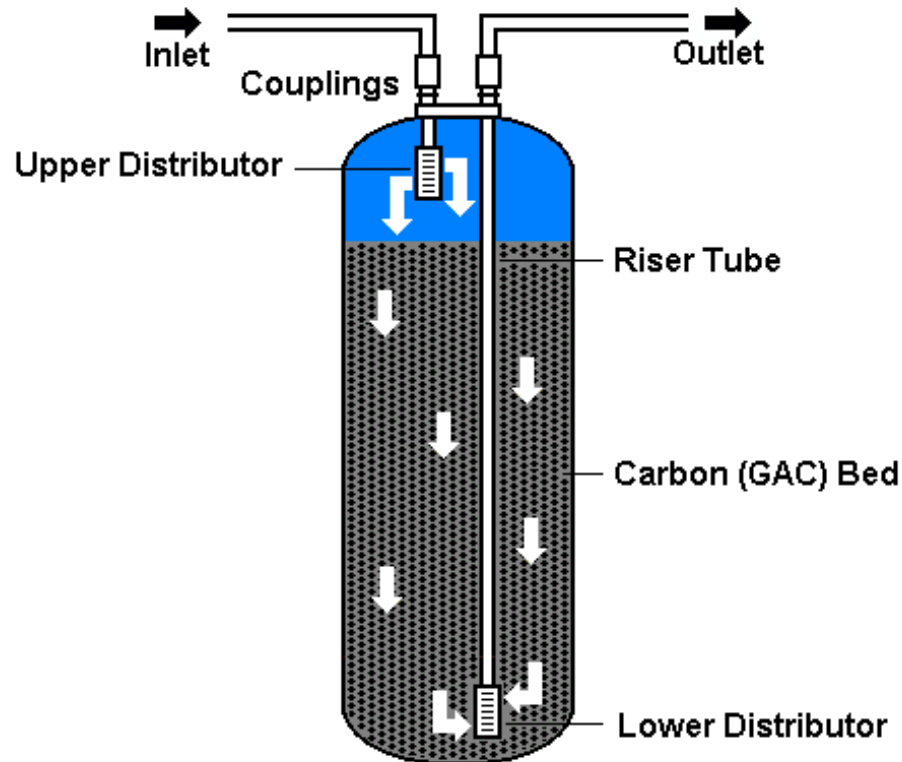
- Off-line hardness testing at the end of each operating day post Softener
- On-line monitoring of pressure drop with pressure gauges located pre and post Softener tank
- Daily verification of timer setting for the correct time of day

Ion Exchange Softening



Carbon Tanks/Filters

- Essential for the removal of total chlorine and chloramines

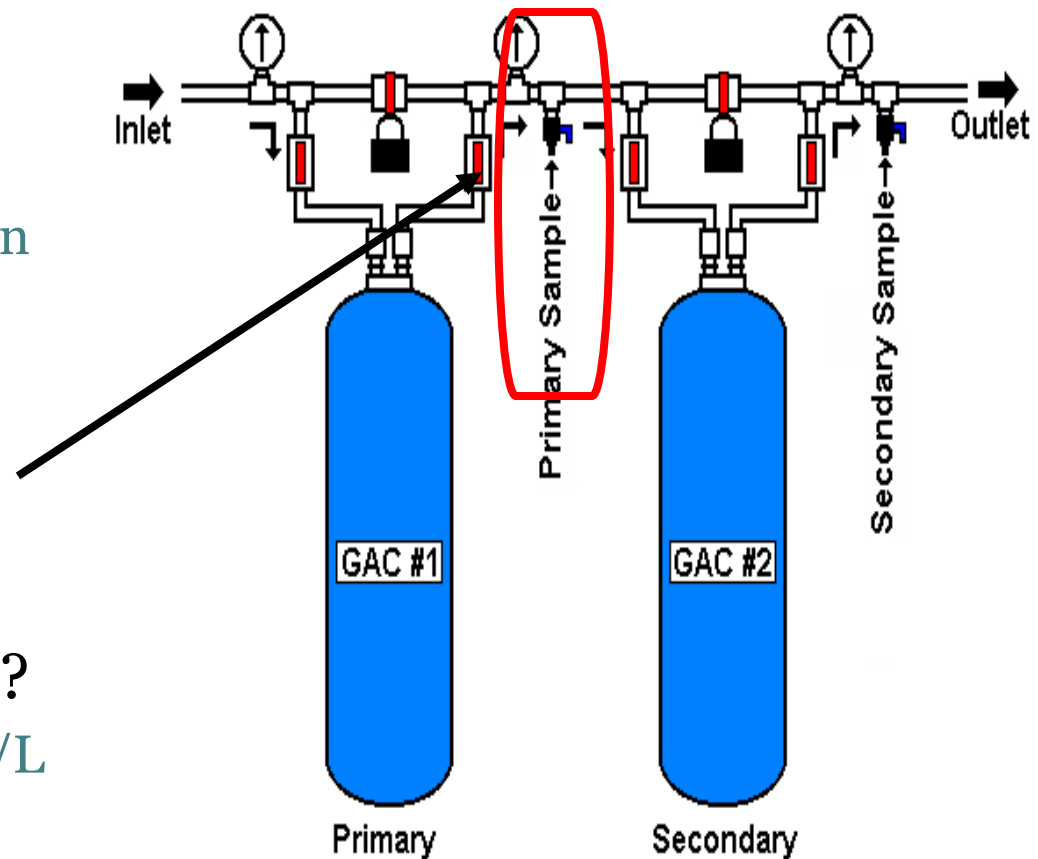


Paired Carbon Filters



Carbon Filter Monitoring

- When do we test?
 - Prior to first pt treatment then every 4 hours.
- Where do we get the sample?
 - Post Primary Carbon Tank, Pre Secondary Tank.
- What are acceptable limits?
 - Total chlorine limit is 0.1 mg/L or less



Carbon Filter Monitoring, cont.

- What do you do if the total chlorine levels are too high after the Primary Carbon tank?
 - Repeat, check after second tank
- If post-second tank levels are within limits, how often do we monitor?
 - Q 30 minutes and document
- If post-second tank levels become too high, what do we do?
 - Stop dialysis!

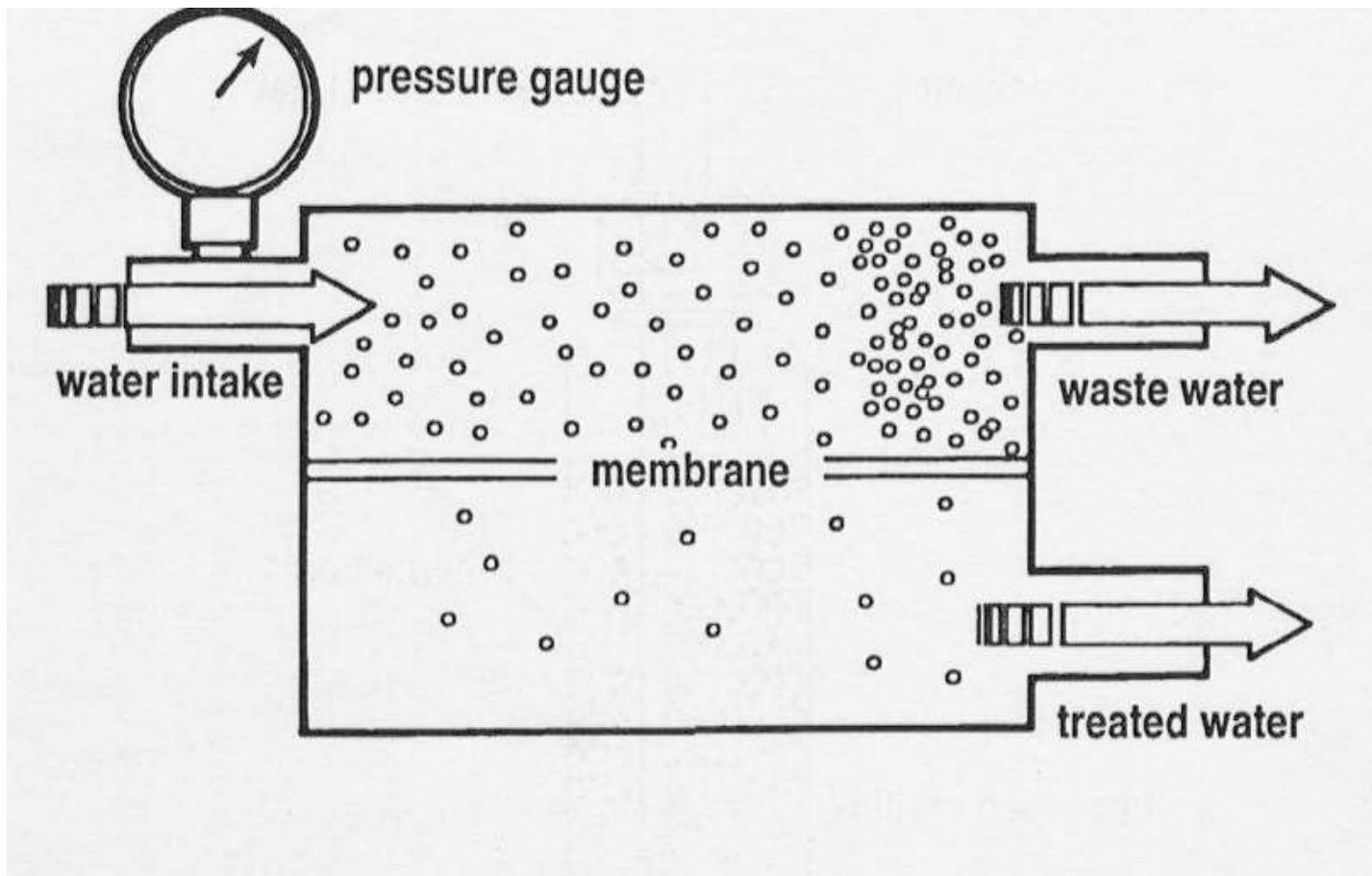
Purification Components

- Reverse Osmosis (RO) + Ultrafiltration (UF)
- Deionization (DI) + Ultrafiltration (UF)

Reverse Osmosis

- Semi-permeable membrane and pump to produce purified water
- What does the RO remove ?
 - Organic and inorganic contaminants
 - Bacteria and endotoxin
- Primary device for purification for water used in dialysis

Reverse Osmosis



RO Monitoring

- Continuous on-line Water Quality Monitoring
 - Percent rejection, >90%
 - TDS/Conductivity, facility specific limits
 - Audible and visual alarms on treatment floor
- Off-line monitoring
 - Product water analyses for AAMI inorganic contaminants
 - Product water bacterial & endotoxin levels

Deionization

- Ion exchange process forms water from cations (positive) and anions (negative)
- Produces water of highest ionic quality
- Highly dangerous when exhausted
- Typically increases bacterial & endotoxin levels
- May be used for RO “polish” or backup only when primary RO is non-operational

DI Tanks



DI Monitoring

- On-line resistivity monitoring
 - Final monitor must have audible/visual alarms located on the treatment floor
 - Divert to drain valve must be installed with DI tanks (water is diverted to drain if tank becomes exhausted, $<1\text{meg}/\text{ohm}$)
- Off-line monitoring
 - Analyses for AAMI inorganic chemical contaminants

Ultrafilter/Endotoxin Filter

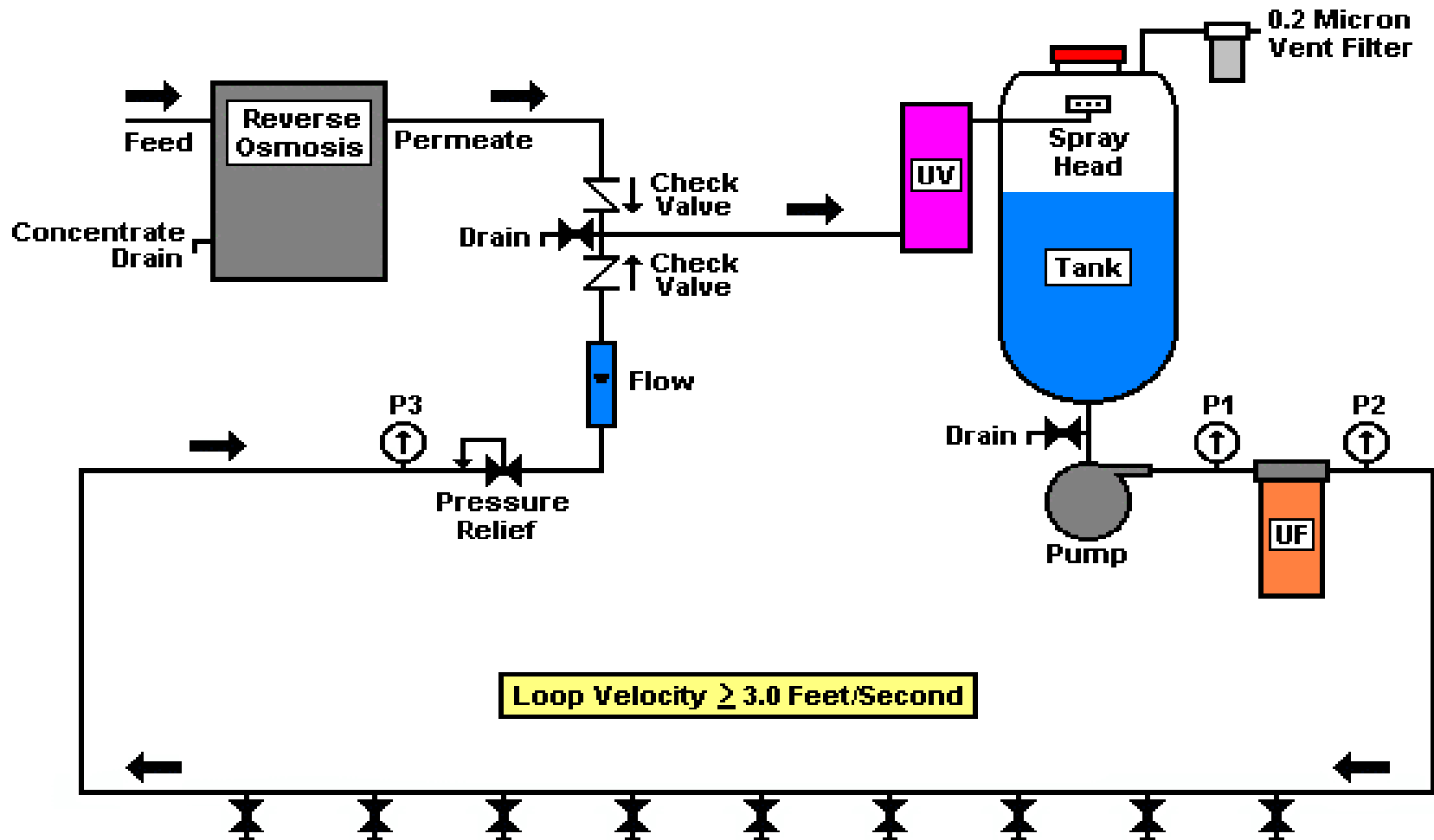
- Last component before water is distributed to patient stations (or first point of use such as bicarb mixer, reuse)
- Submicron filter for small particles
- Absorbs bacteria and endotoxin



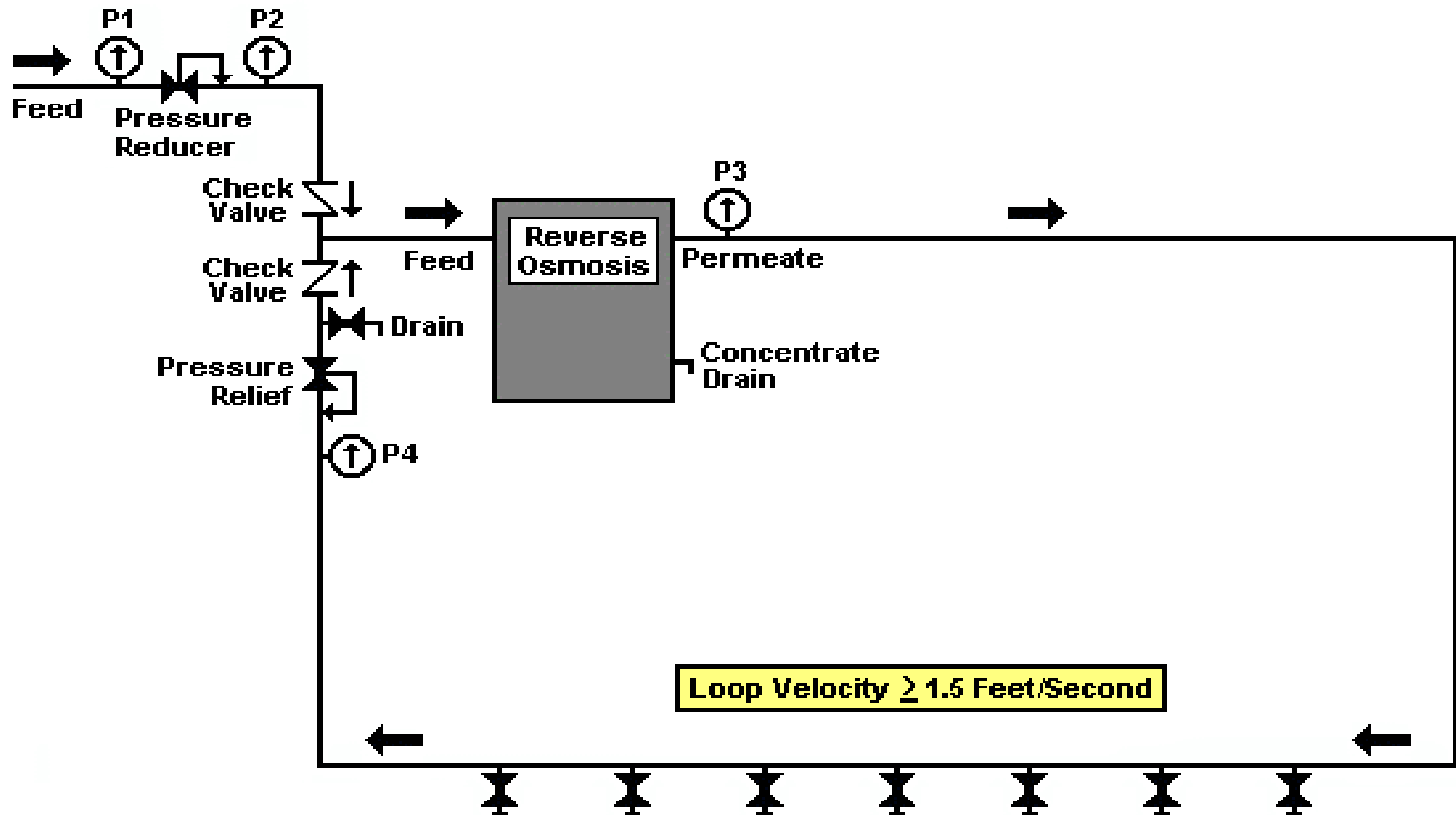
Distribution Systems

- Convey purified water to each point of use
- Must maintain purified water quality and water flow
- Components include pipes, valves, regulators & other piping fixtures
- May be indirect feed (holding tank) or direct feed design

Indirect Feed Design



Direct Feed Design



RO Disinfection Methods

- Disinfection schedule
 - Monthly for distribution system
 - Quarterly for RO (Typical)
- Why do you need to know when disinfection is done at your facility?
 - Microbial sampling must be complete prior to disinfection
 - Equipment availability
 - Verification of residual chemical.

Let's Review

- What does the water softener remove?
- When is hardness testing performed?
- What do the carbon tanks remove?
- How often are total chlorine checks done?
- What are acceptable results for total chlorine?
- What does the RO remove?

