

WATERGROUP INC.

WGR Series

Reverse Osmosis System

Installation, Operation, and Service Manual

WGR-600

WGR-1200

WGR-1800

WARNING

This Reverse Osmosis System contains a preservative solution to prevent microbiological growth and freezing which if ingested, may cause irritation of the gastrointestinal tract, colic, diarrhea or other similar symptoms. Therefore the unit should be flushed for 2 hours prior to use. The water should be disposed of immediately.

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Introduction To Reverse Osmosis (RO)

Common Terms & Definitions

Feed Water - The water that is introduced to the RO membrane for purification.

Product Water - The purified water produced by the RO unit.

Waste Water - The water that does not pass through the RO membrane. This water is to be directed to a drain.

Membrane - The fabric that the feed water passes through to become product water. It is usually a large surface area sheet that is spiral wound into a tube shape. It has channels for product flow and removal once the feed water has passed through the membrane.

Module - This is the completed package with the RO membrane installed inside the pressure vessel.

Gallons per Day (GPD) - RO systems are normally sized with this rating. An 1800 GPD rating means this unit could produce 1800 gallons per day of purified water at a given temperature.

TDS - Total Dissolved Solids. This is a measure of product water purity, measured in parts per million.

Parts per Million (ppm) - The measure of TDS. The parts of Total Dissolved Solids per one million parts of water (i.e. one pound of mineral salts dissolved in one million pounds of water will give one part per million of TDS).

Percent Recovery - The amount of feed water that passes through the membrane to become product water (i.e. If 1000 gallons of feed water are introduced to the RO system and 500 gallons of product water are produced then the percent recovery would be 50%).

Percent Rejection - The amount of silt or chemicals rejected by the RO membrane.

Turbidity - Suspended biological, inorganic and organic particles in water which may be in sufficient amount to make the water seem cloudy.

How Reverse Osmosis Works

Osmosis is the process by which water moves across a semi-permeable membrane from a low concentration of solute to a high concentration of solute. Reverse osmosis depends on the presence of a barrier or membrane that is selective so that solvent of a solution can pass through the membrane while other components of the solution cannot. The osmotic pressure is the pressure required to stop the flow of solvent through a semi-permeable membrane separating two solutions of different concentrations. To separate water from dissolved solids by reverse osmosis, the applied pressure must be greater than the osmotic pressure.

Reverse osmosis is the finest level of filtration available. The RO membrane acts as a barrier to all dissolved salts and inorganic molecules, as well as organic molecules with molecular weight greater than approximately 100. Water molecules on the other hand pass freely through the membrane creating a purified product stream. Rejection of dissolved salts is typically 95% to greater than 99%.

Factors Affecting Performance

Permeate flux and salt rejection are the key performance parameters of the reverse osmosis process. They are mainly influenced by variable parameters such as; pressure, temperature, recovery, and feed water salt concentration.

Pressure

Increased feed water pressure will increase permeate flux and decrease the permeate TDS. With excessive pressure the membrane may become deformed or compacted and a decrease in product flow will result.

Temperature

Increased temperature will increase permeate flux, which increases salt passage. It is also important to note that every unit is rated for a product flow temperature of 77°F (25°C). With a temperature decrease, the product flow will decrease. On average the membranes lose about 2% production for every degree below 77°F.

Recovery

The recovery is the ratio of the permeate flow to the feed flow. When recovery is increased, the permeate flux will decrease and the salt passage will increase.

Feedwater Concentration

Increased TDS or salt concentrations will decrease permeate flux and increase salt passage. This can also lead to surface coating or fouling by the salt.

Bacteria

If bacteria is allowed to grow on the membrane it will digest the top layer of the membrane and reduce the ability of the membrane to reject salt.

Hydrolysis

This is the effect of chemicals in the feed water on the membrane. This happens when the water temperature is high and the pH of the water is above 7 and below 2.5. To achieve optimum membrane life, a pH between 5 and 6 should be maintained.

WaterGroup Inc. WGR Series Specifications

<i>Model</i>	<i>Membrane Element</i>	<i>Number of Elements</i>	<i>Motor HP*</i>
WGR-1800	FILMTEC - TW30-2540	3	3/4
WGR-1200	FILMTEC - TW30-2540	2	3/4
WGR-600	FILMTEC - TW30-2540	1	1/2

*(115 V,60 HZ, 1 pH)

<i>Filters</i>	<i>Size</i>	<i>Type</i>
Sediment Filter	20"	5 µm
Carbon Filter	20"	GAC

Operating Limits

<i>Membrane Type</i>	<i>Thin Film Composite</i>
Maximum Operating Pressure	200 psi
Feed Line Pressure Min./Max.	30-85 psi
pH Range, Continuous	2 - 11
Feed Water Hardness	<10 gpg
Feed Water Iron	<0.1 ppm
Feed Water Manganese	<.05 ppm
Feed Water Hydrogen Sulfide	must be removed
Chlorine Tolerance	0 ppm
Organics Tolerance	0 ppm
Oil Tolerance	0 ppm
Maximum Allowable Back Pressure	40 psi
Operating Temperature	40-110 °F
Maximum Feed Turbidity	1 NTU
Maximum Feed Silt Density Index	SDI 5
Maximum TDS	2000 ppm

Note: Operating in excess of these conditions may result in more frequent cleaning or premature failure of the membrane. The limited warranty will become void if failure or reduced performance is due to improperly treated feed water

System Components

1. On/Off Control

This switch turns the R.O. system on or off. Switching the switch to on will start the system and activate the green light. The system will not start if the storage tank is full or there is insufficient feed water pressure. Once the system is running, it will continue to run until the storage tank is full or a low pressure feedwater situation occurs.

2. Feed Water Pressure Gauges

The inlet pressure gauge reads the feed water pressure. The second pressure gauge, after the sediment filter and carbon filter, reads the water pressure entering the process pump. As the filters become clogged, a pressure drop will develop across the filters. A pressure drop of 7 psi or more will indicate the need to check or replace filters.

3. System Pressure Gauge

This gauge indicates the water pressure that is being discharged by the pump and applied to the first R.O. membrane. The recommended system operating pressure is 200 psi. This should not be exceeded.

4. Process Pump

The R.O. unit uses a rotary vane positive displacement pump. It has a brass external housing with stainless steel internal components. Maximum discharge pressure for the pump is 200 psi.

5. Operating Pressure Control

The maximum system operating pressure is controlled by a built in by-pass in the positive displacement pump. The pump is factory pre-set for 200 psi. In the event an adjustment is required, turn the slot blade screw to the right for higher pressure and to the left to decrease the pressure.

6. Pump Motor

The electrical service required for the motors is 120 V, 60 HZ, single phase. Verify that available power exactly matches the voltage, hertz, and phase on the motor name plate before connecting any power to the unit. Connecting the unit to a power source which does not match the unit power rating exactly may cause damage and void the warranty.

7. Low Pressure Switch

The low pressure switch will automatically shut down the system should the feedwater pressure drop below 15 psi. The system will re-start when the pressure rises to 25 psi. Operating the system below feed water pressure of 25 psi will cause pump damage.

8. Tank Full Switch

The system is designed for pressurized storage tank system. The system will shut down when the storage tank pressure reaches 50 psi. It will re-start when the storage tank pressure drops below 30 psi.

8. Tank Full Switch (optional)

The system can be used in conjunction with an atmospheric tank as well. A float switch installed in the tank will measure tank level and turn the RO system on when levels are low and off when levels are high.

9. Waste Flow Meter

This meter is calibrated in gallons per hour (gph). It measures the waste or concentrate volume going to drain. For 50% recovery, the waste water flow meter reading should equal the product water flow meter reading.

10. Product Water Flow Meter

This meter is calibrated in gallons per hour (gph). It measures the product water or permeate volume going to storage tank. For 50% recovery, the product water flow meter reading should equal the waste water flow meter reading.

11. Recycle Flow Meter

This meter is calibrated in gallons per hour (gph). It measures the concentrate being recycled through the R.O. membrane. In order to achieve 50% recovery, part of the waste stream is recycled back into the feedwater of the R.O. system. In order to ensure that membranes do not burn out prematurely, the following recycle flow rates should be used as base values. Minimum rates are as follows:

- 600 - 80 gallons per hour
- 1200 - 55 gallons per hour
- 1800 - 30 gallons per hour

Note: Pressure must not exceed 200psi, these are **minimum** values, any flow rates below the above could damage membranes and lead to premature replacement.

12. Concentrate Valve

This valve restricts the flow of waste water exiting the membrane to drain. **Caution! This valve should never be closed completely.** By adjusting this valve, the proper waste/product water ratio is set. Turning clockwise will decrease concentrate flow and increase pressure. Turning counter clock wise will increase concentrate flow and decrease pressure.

13. Recycle Valve

This valve controls of the amount of concentrate being recycled to the feed inlet of the pump. It is also used to fine tune and adjust the system pressure.

14. Pre-Filter

This filter is a 20" sediment filter that removes suspended particles such as dirt or scale down to 5 micron in size.

15. Carbon Filter

This is a 20" granular activated carbon filter. It removes chlorine from the feed water. Chlorine will attack and destroy thin film composite membranes.

16. Inlet Solenoid Valve

This 1/2" normally closed solenoid valve opens to allow feed water into the system when product tank pressure drops below 30 psi and closes when the tank reaches 50 psi.

17. Time Delay Air Purge

When the system is turned on, there is a 60 sec delay before the process pump cuts in. This only happens if there is sufficient feed pressure and the storage tank is not full. The inlet solenoid valve opens and water flows through the pump and membrane purging the trapped air. The time delay also prevents the process pump from cycling on and off if the low pressure switch or storage tank switch hover at cut in pressure ranges.

18. Flush Timer (option)

This timer activates the automatic flush for 60 seconds every 2 hours to flush the membranes. The green flush light will light up during this operation.

19. Automatic Flush Switch (option)

This switch controls the automatic flush modes and has three positions, automatic flush, manual flush and off. When in the automatic position, the unit will flush for 1 minute every 2 hours. If a manual flush is desired, switch to the manual position for desired length of time. When in the off position, the flush mode will not activate.

20. Manual Flush Valve

This 1/4" ball valve can be manually opened when the unit is in operation to fast flush the membranes. The waste water is diverted through a bypass around the waste water valve and recycle valve to drain.

21. TDS Monitor (option)

The TDS monitor measures the Total Dissolved Solids of the product water in PPM (Parts per Million).

22. Motor Contactor

The motor is started and stopped with a 1 hp, 30 amp power relay.

Installation Instructions

Important: The WGR system must comply with all local plumbing, sanitation, and electrical codes. Obtaining permits and meeting codes is the responsibility of the installer.

Location

The WGR system should be positioned in a suitable location near inlet water, drains, and electrical outlet. The unit should be located indoors on a solid level base which can support the weight of the unit. Allow enough space for servicing of the unit and removal of the membranes.

Install the unit away from direct sunlight in a well ventilated location. Ensure that the system is protected from weather or excessive dust.

Dimensions: height -- 50"
width -- 21"
Depth -- 24"

Water Supply Connection

Caution: Use only Non-Ferrous materials when connecting the water supply to the WGR system. Iron is detrimental to the membrane and causes fouling and pre-mature failure of the membrane.

The water supply connection is 1/2" FNPT on pre-filter isolation valve. Run 1/2" softened water supply line to the valve.

Product Water Connection

The WGR system comes with 10 ft of 3/8" tubing running from the product water flow meter. This tubing is to be connected to the storage tank using 3/8" compression tubing fittings.

Reject Water Connections

The WGR system comes with 10 ft of 3/8" tubing running from the waste water flow meter. This tubing should be run to a suitable drain (floor drain or stand pipe) This connection should include a proper air gap to prevent possible back

flow. (Consult local plumbing codes) Ensure that the drain line tubing is fastened securely. When the system goes into fast flush mode, considerable pressure is applied and the tubing may come loose.

Electrical Connections

Verify that the available power exactly matches the voltage, hertz, and phase specified on the systems name plate before connecting any power to the unit.

Caution: Connecting the unit to a power source which does not exactly match the unit power rating exactly may cause damage and void the warranty.

Float Switch Connections

A float switch may be connected to this system for use within atmospheric tank. The control box has a jumper wire between terminal blocks 5 and 6 that can be removed and the float switch wiring installed. A hole will have to be drilled in the side of the control box to allow passage of the wiring through the control box wall. A water tight connector like the ones currently in use on the control box could be used to secure the wiring.

Softener Interlock Connections

A connection can be made to a water softener to allow shutdown of the RO system during softener regeneration. Simply disconnect the jumper wire between terminals 4 and 5 in the control box and attach the wiring from the softener. A hole will have to be drilled in the side of the control box to allow passage of the wiring through the control box wall. A water tight connector like the ones currently in use on the control box could be used to secure the wiring.

Start-up Procedure

Before running the RO system the granular activated carbon filter has to be flushed. To do this place the carbon filter into the first filter housing and leave the second filter housing removed. Place a bucket under the second filter top to catch runoff. Open the inlet isolation valve and flush for 2 minutes. Throw waste water away and place filters back into original housings and retighten housings.

Pre-Start Check List

1. Sediment filter and Carbon filters in place.
2. Minimum inlet pressure 30 psi.
3. Control Switch to "Off".
4. System is plugged into proper electrical supply.
5. Waste valves and recoil valves are fully open. (Counter-clockwise)
6. Waste and Product water lines are connected to drain and storage tank.

Start-Up

1. Open pre-filter isolation valve.
2. Turn the power switch to ON position. A time delay will be initiated which will open the inlet solenoid valve and allow water to flush through the system purging any trapped air from the pump and membranes. If air is not completely purged, the pump will run rough. If this condition occurs, turn power switch to OFF and repeat procedure.
3. Immediately monitor the system pressure gauge to insure that the system does not exceed 200 psi.
4. With pump running, slowly close the recycle valve (clock wise) until the system pressure reaches 150 psi. Observe that as the recycle valve is closed, the system pressure increases. **Note:** To ensure premature failure of membranes will not occur, recycle flow rates should not be lower than those quoted in section 11 of System Components. Slowly close the concentrate valve (clock wise). Observe that as this valve is closed, the system pressure increases. For 50% recovery, slowly close the concentrate valve until the product water flow rate equals the concentrate flow rate. Do not let the system pressure go over 200 psi. If necessary, open the recycle valve to lower system pressure. By continuing this fine tuning process, the desired system pressure and recovery can be achieved
5. To check the operation of the low pressure switch, slowly close the pre-filter isolation valve. The system should shut down at 15 psi. Slowly open the valve and the system should initiate start-up at 25 psi.

6. Leave the system running until the storage tank fills to ensure proper operation of the tank full switch.
7. The system should stabilize after 20-30 minutes of operation.
8. Fill out system start up check sheet to record the baseline operating conditions as a reference for future operation and maintenance.

Maintenance

Pump

The process pump requires no regular maintenance. When the pump becomes noisy or 190 psi system operating pressure cannot be maintained, the pump should be replaced.

Reverse Osmosis Membranes

The condition of the membranes is indicated by comparing the current permeate water quality (TDS) and production to the baseline permeate quality and production values that were established upon initial installation.

Cleaning is recommended whenever the maximum flow is less than 80% of the normal flow, after temperature correction, or when the % rejection drops below 95%.

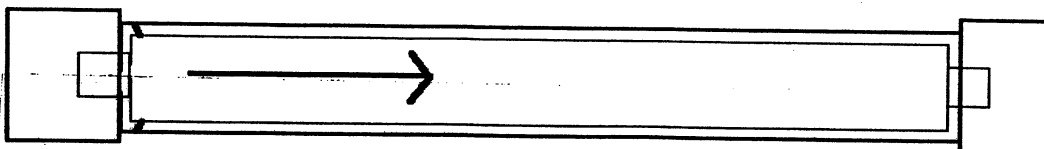
Flushing Membrane

Organic and or mineral sludge tends to build up on the surface of the membrane that can reduce its performance. For units with the manual flush valve, open this valve slowly and let the unit fast flush for five minutes. Units with auto fast flush will be automatically activated on start-up, and every 2 hours thereafter. For the manual units, once a week flushing is helpful. In some cases, once a day flushing may be desired to control odor from organic build up. Replacement is recommended whenever the recovery rates are unacceptable.

Membrane Removal and Replacement

Disconnect all piping connected to the membrane at the point closest to the membrane. Remove the 'U' bolt at the end of the pressure vessel. Remove the end cap carefully. Remove the membrane from the pressure vessel by pulling on the product water tube. If additional force is required, pliers wrapped in tape could be used for removal.

Membrane must be inserted the same direction as the arrow to ensure proper brine seal operation. It must be removed the opposite direction as the arrow. The high pressure end will be the end at the start of the arrow.



Check the internal and external 'o' rings for wear or damage. If damage is evident they must be replaced. Re-install membrane in the same manner as it was removed. Slide end cap back into the membrane and replace the 'U' bolt. Replace all piping that was removed. Test membrane for any leaks by running low pressure water through it. If water is flowing out of the product stream it probably means an 'O' ring has been damaged upon re-installation and must be replaced. Once all leaks are repaired, restart the unit using normal start-up procedures.

TDS Reading

After initial installation, check and note the TDS of the product water using a portable hand held TDS meter. Subsequent readings should be compared to this reading to determine whether any potential problems are developing. Over a period of time, a gradual increase in product water TDS can be expected. Rapid increases require further attention.

Product water TDS can increase by one or more of the following factors;

1. Increase in feed water TDS
2. Membrane is fouled with mineral salts due to a recovery rate that is too high.
3. Carbon filter is exhausted and no longer removing chlorine. Chlorine will permanently damage the membrane.
4. Membrane is fouled with biological contamination such as algae or bacteria.

Filters

When a large pressure differential (7 psi or more) develops across the 5 micron sediment filter and the granular activated carbon filter, they should be replaced.

The activated carbon filter reduces volatile organic compounds and removes chlorine. When the permeate water shows the first sign of objectionable taste or odor, the carbon filter is nearly expended. It should be changed every 3-6 months or sooner if chlorine is detected after the cartridge filter.

Trouble Shooting

Problem	Probable Cause	Solution
R.O. UNIT WILL NOT START	No electrical power to control circuit	Check power supply, circuit breakers, fuses etc.
	Storage tank full	Drain portion of water from storage tank
	Low feed pressure	Check feed water supply
	Pump motor	Check or replace
	Pressure or float switch defective	Check or replace
LOW FEED PRESSURE	Feed water valve turned off	Check
	Feed water solenoid defective	Check or replace
	Obstructed feed line	Check
	Upstream pre-treatment	Check
	Inlet feed pressure	Check
NO HIGH SYSTEM PRESSURE	System pressure gauge broken	Check and replace
	Pump impellers worn	Check and replace
	Low water volume to pump	Check
	Malfunctioning pump	Check, replace if necessary
NO REJECT WATER	Concentrate valve closed	Open
	Clogged drain line	Check and clean
NO PRODUCT WATER	Low pump pressure	Check and adjust
	Membrane plugged	Check, clean, or replace
	Low water temperature	Check
LOW FLOW RATE	Membrane fouled	Check, clean, or replace
	Product water check valve stuck	Replace

HIGH PRODUCT WATER TDS	<p>Membrane expended</p> <p>Insufficient brine flow</p> <p>Increase in feed water TDS</p> <p>Membrane brine seal not sealed against membrane housing</p>	<p>Replace</p> <p>Replace or flush concentrate valve</p> <p>Check</p> <p>Check brine seal, use care when re-installing</p>
BAD TASTING WATER	<p>Filter Cartridges exhausted</p> <p>Tank and system contaminated</p> <p>Tank diaphragm ruptured</p> <p>Cartridge not flushed completely</p>	<p>Replace</p> <p>Replace filters and sanitize the tank</p> <p>Re-sterilize tank</p> <p>Flush one or two tanks of pure water through</p>
CLOUDY WATER	<p>Dissolved air in feed water is concentrated in the product water</p>	<p>Usually clears up as condition of feed water changes. Letting water stand for a few minutes will allow the air to dissipate</p>

Warranty

WATERGROUP COMPANIES warrants that each WGR system has been factory tested to perform in accordance with published specifications at the time of delivery. The company further warrants that a WGR system will continue to make potable water for a period of 1 year with the exception of the membrane which is pro-rated over a period of 24 months, providing the user supplies feed water meeting minimum standards and adopts and implements the maintenance program recommended in the WGR operation manual.

Expendable or consumable products, filter cartridges, chemicals, etc. which by nature have a shorter life expectancy than twelve months are not covered under this warranty.

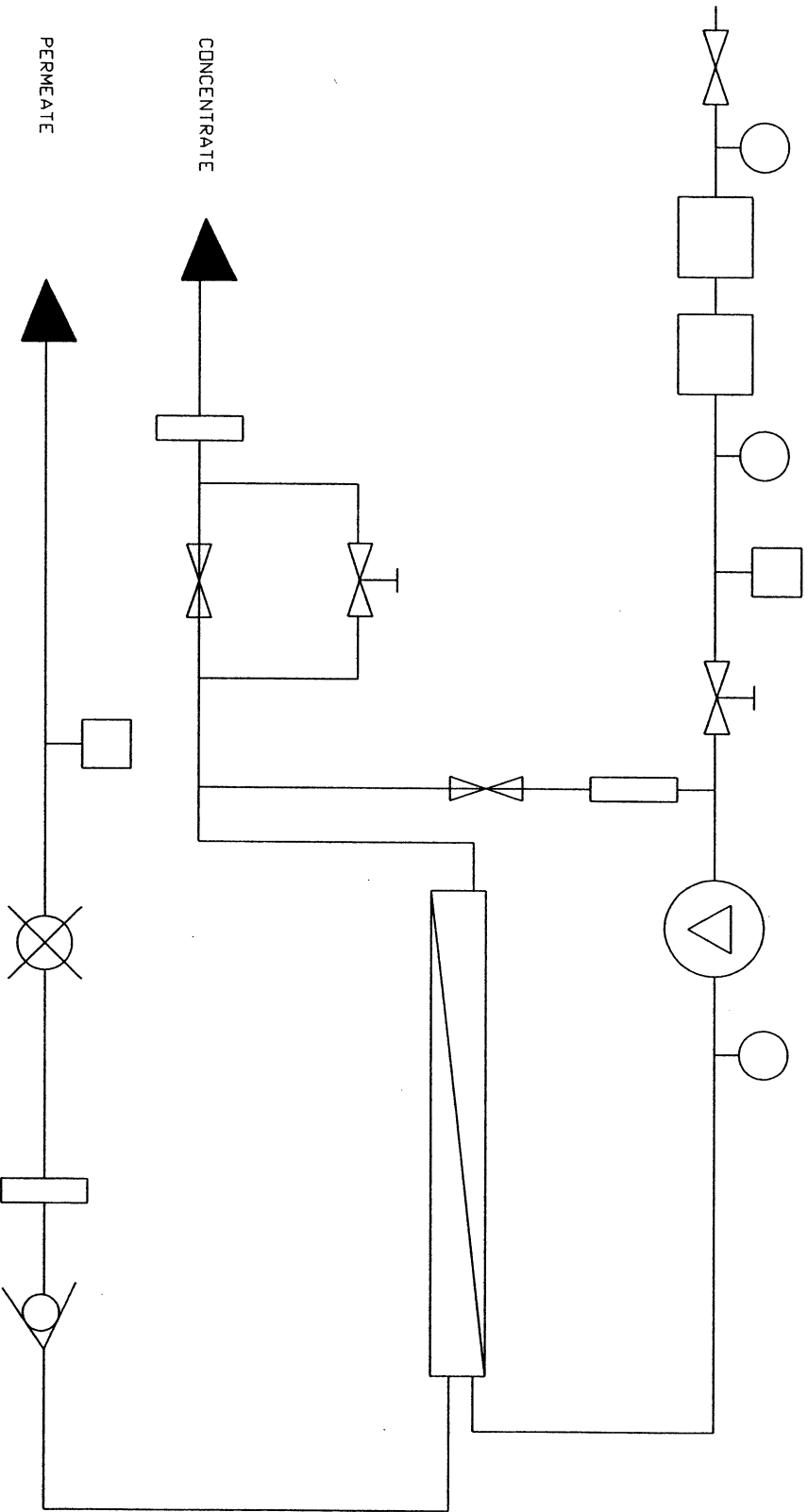
The company's liability under this warranty is limited to the repair or replacement at the company's discretion of systems or components found defective solely as to materials or workmanship during the warranty term. The replacement will be on an exchange basis from the factory direct or arranged through WGR dealer or distributor (no labor, transportation or mileage charges will be reimbursed). If a complete system is returned to the factory (freight prepaid), WATERGROUP COMPANIES will repair or replace the unit at WATERGROUP COMPANIES discretion free of charge (except transportation) if the unit is determined to be defective under this warranty.

This warranty does not extend to any system or components which failed due to (1) damage from mishandling, misuse, substandard feed water, improper maintenance procedures, or neglect, (2) improper installation (3) incorrect electrical supply. This warranty is void if serial numbers are mutilated or missing.

Our obligations under this warranty are limited to repair or replacement of defective parts and we assume no liability whatsoever for incidental or consequential damage.

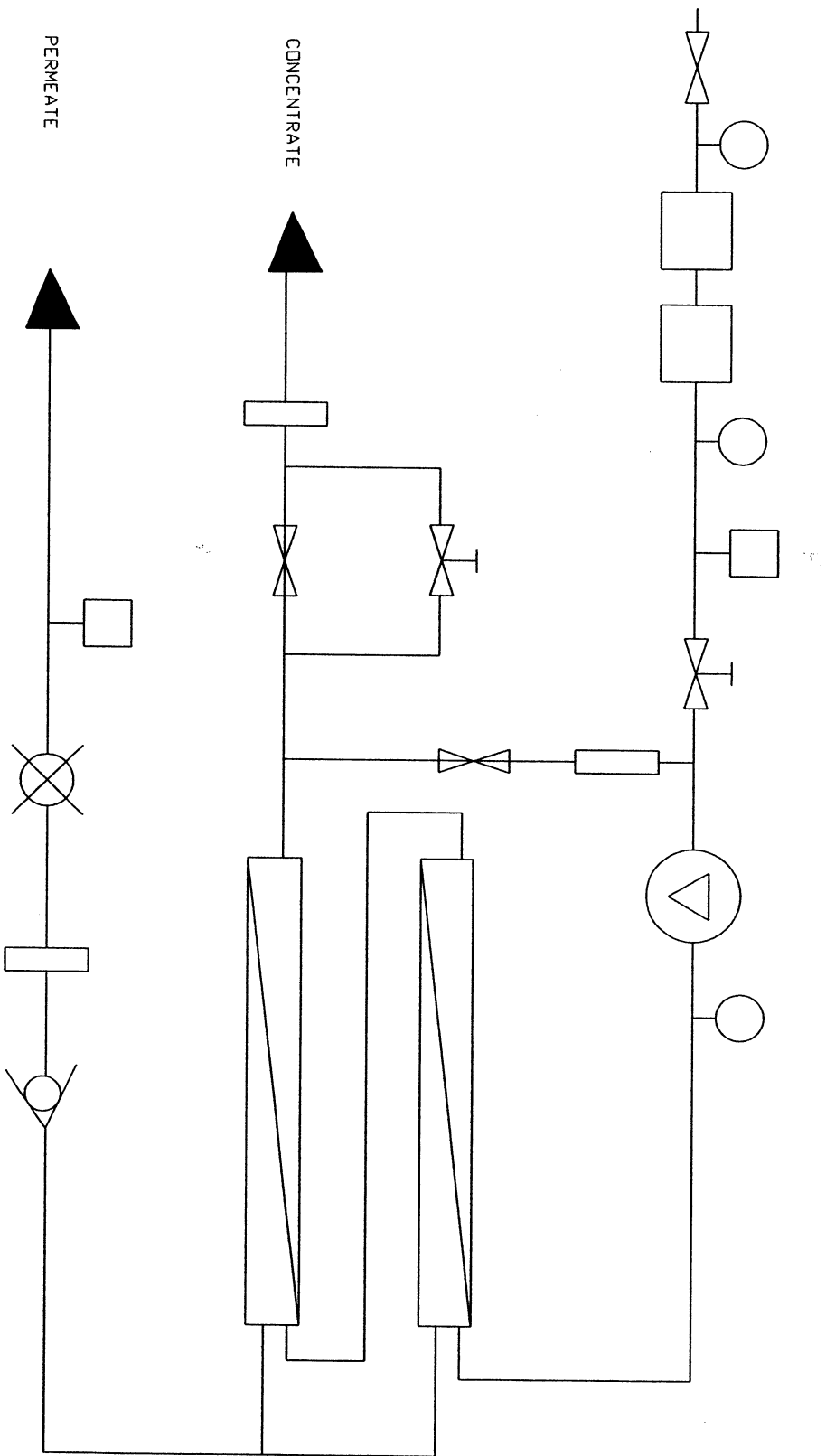
PARTS LIST

Drawing Part #	Description	Item #
1	Control Box	302035
2	Pressure Guage, 0-300psi	101051
3	Flow Meters	27341
4	Pressure Switch, 15-25psi	101031
5	Pressure Switch, 30-50psi	101032
6	Optional TDS Meter	
7	Waste Recycle Valve	303177
8	Recycle Needle Valve	303178
9	Pressure Guage, 0-100psi	101047
10	20" Blue Fitter Housings	92023
11	Radial Flow Carbon Filter, 20"	15506543
12	5 Micron Sediment Filter, 20"	15501605
13	Powder Coated Steel Bracket	92271
14	Membrane, 410" Thin Film Composite	92021
15	Membrane Housing, PVC, 40"	92028
WGR-600	Pump, PO401 Procon	74908
WGR-1200	Pump, PO501	74909
WGR-1800	Pump, PO601	74912
WGR-600	Electronic Motor, 1/2HP	100787
WGR-1200	Electronic Motor, 3/4HP	100788
WGR-1800		
WGR-600-1800	Solenoid Valve	80307
	V-Band Rotary Valve Clamp	74914



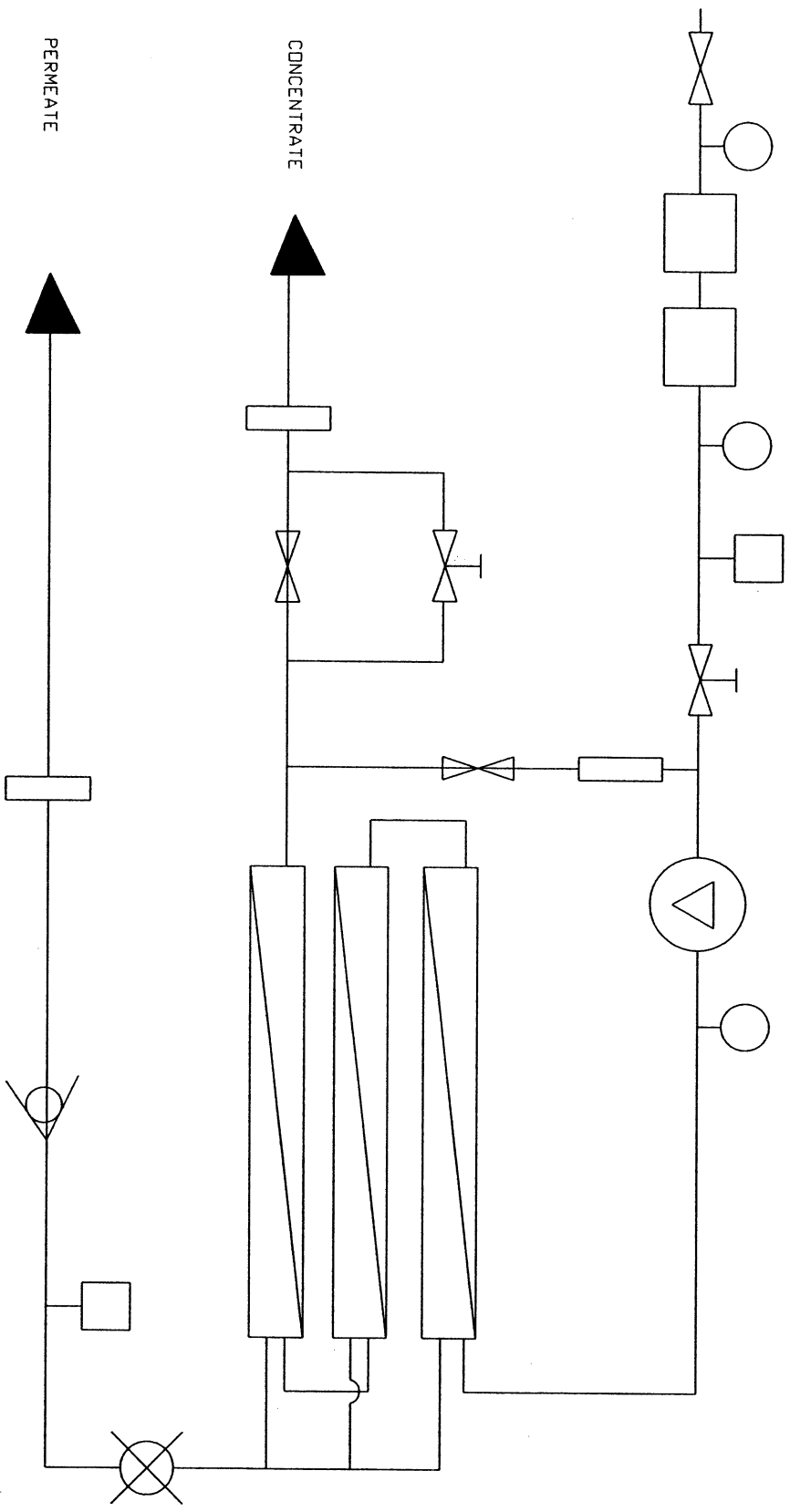
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 - PRESSURE GAUGE
 - ISOLATION VALVE
 - SOLENOID VALVE
 - NEEDLE VALVE
 - PRESSURE SWITCH
 - FLOW METER
 - PRE-FILTER
 - CHECK VALVE
 - CONDUCTIVITY PROBE

DESIGNED BY: T. HUGHES	TITLE: 600 GPD COMMERCIAL REVERSE OSMOSIS PIPING & INSTRUMENTATION
DRAWN BY: J. NICHOLS	
CHECKED BY:	
DATE: 01/07/97	
MATERIAL:	SIZE: NDR-1057 SH. 1 DF. 1 SHEETS REV.
SCALE: NTS	
TOLERANCES:	



- LEGEND**
- PROCESS PUMP
 - PRESSURE GAUGE
 - ISOLATION VALVE
 - SOLENOID VALVE
 - NEEDLE VALVE
 - PRESSURE SWITCH
 - FLOW METER
 - PRE-FILTER
 - CHECK VALVE
 - CONDUCTIVITY PROBE

DESIGNED BY: T. HUGHES	TITLE: 1200 GPD COMMERCIAL REVERSE OSMOSIS PIPING & INSTRUMENTATION
DRAWN BY: J. NICHOLS	
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TOLERANCES:	REV.



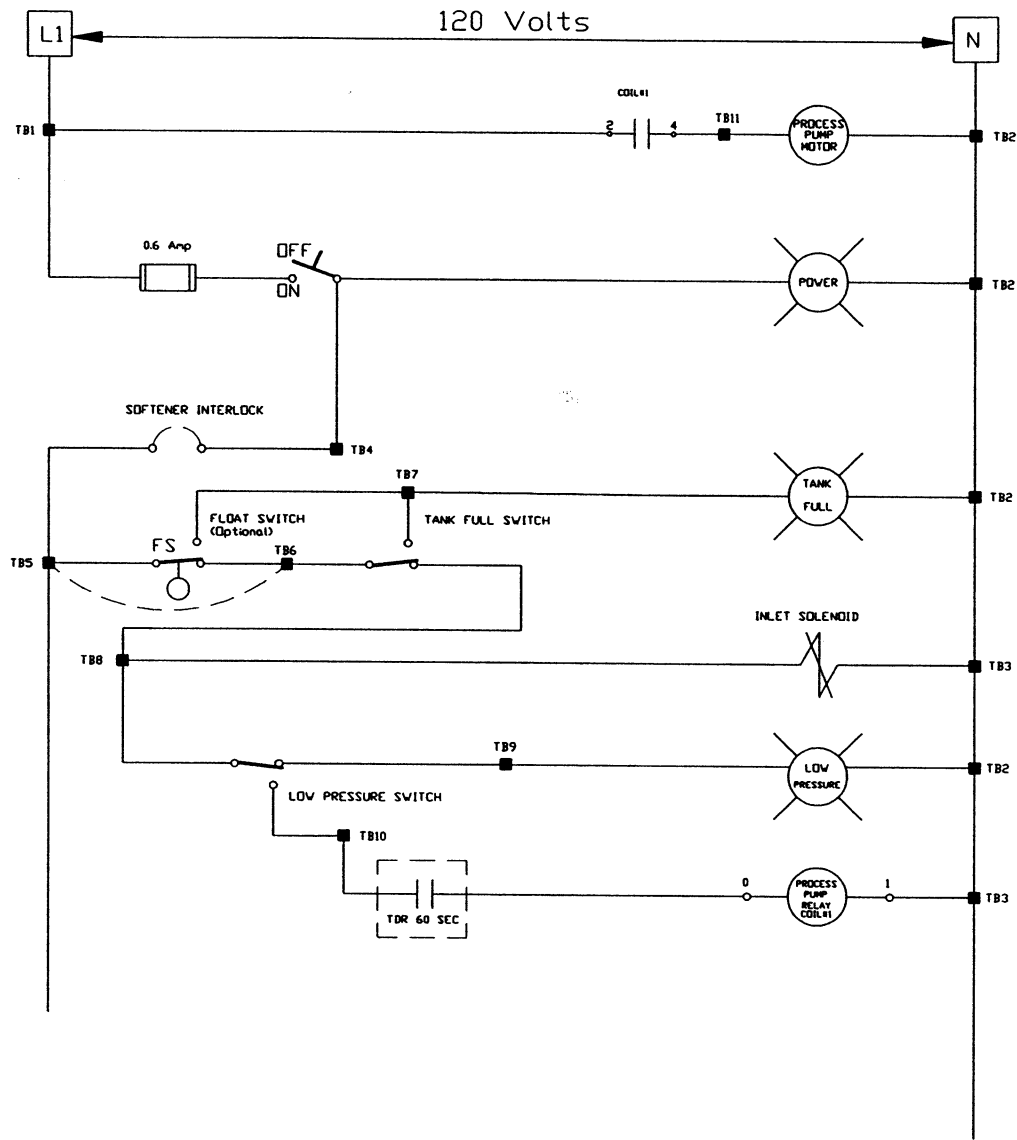
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 - ISOLATION VALVE
 - SOLENOID VALVE
 - NEEDLE VALVE
 - PRESSURE SWITCH
 - FLOW METER
 - PRE-FILTER
 - CHECK VALVE
 - CONDUCTIVITY PROBE

DESIGNED BY: T. HUGHES
 DRAWN BY: J. NICHOLS
 CHECKED BY:
 DATE: 01/07/97

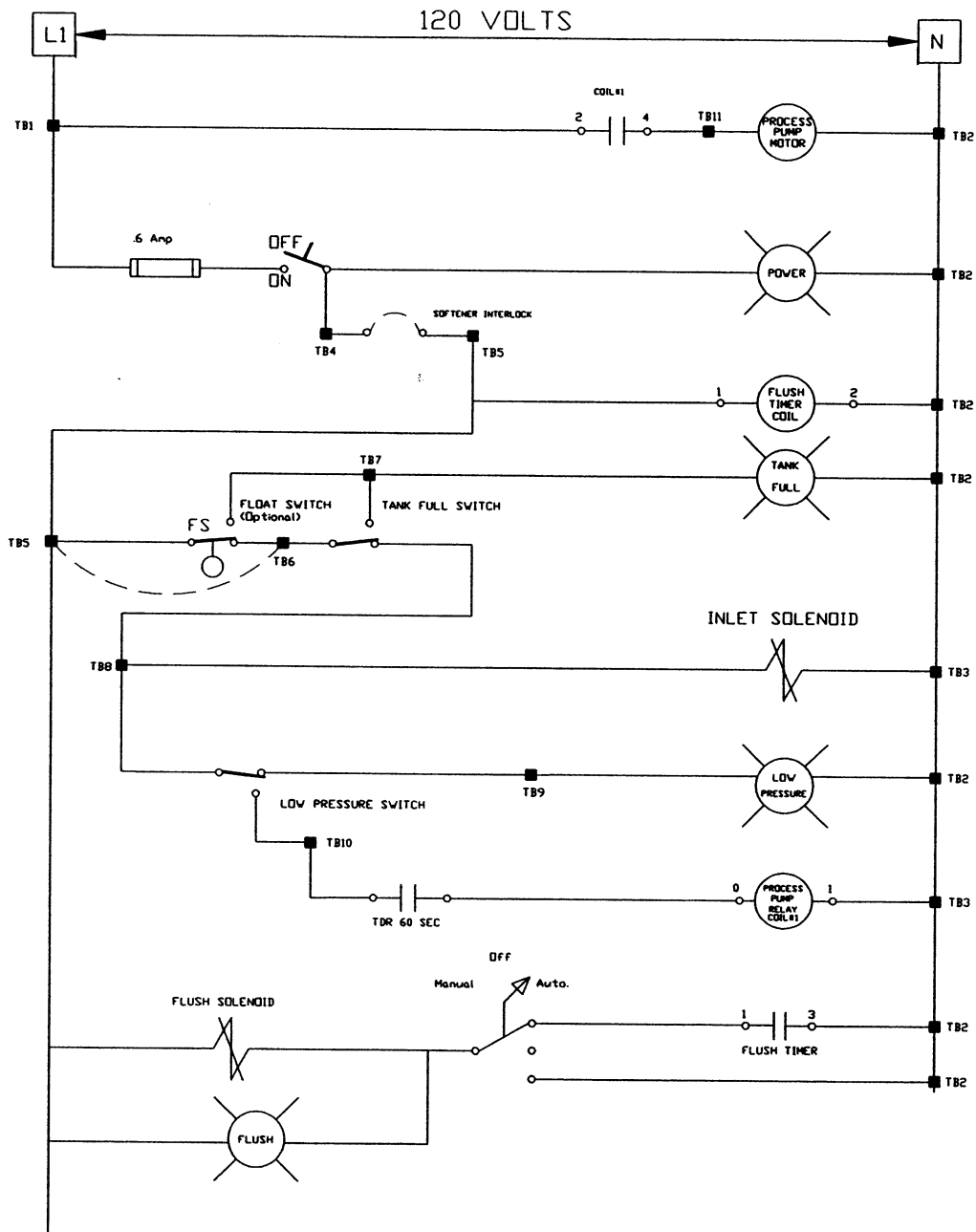
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 PIPING & INSTRUMENTATION

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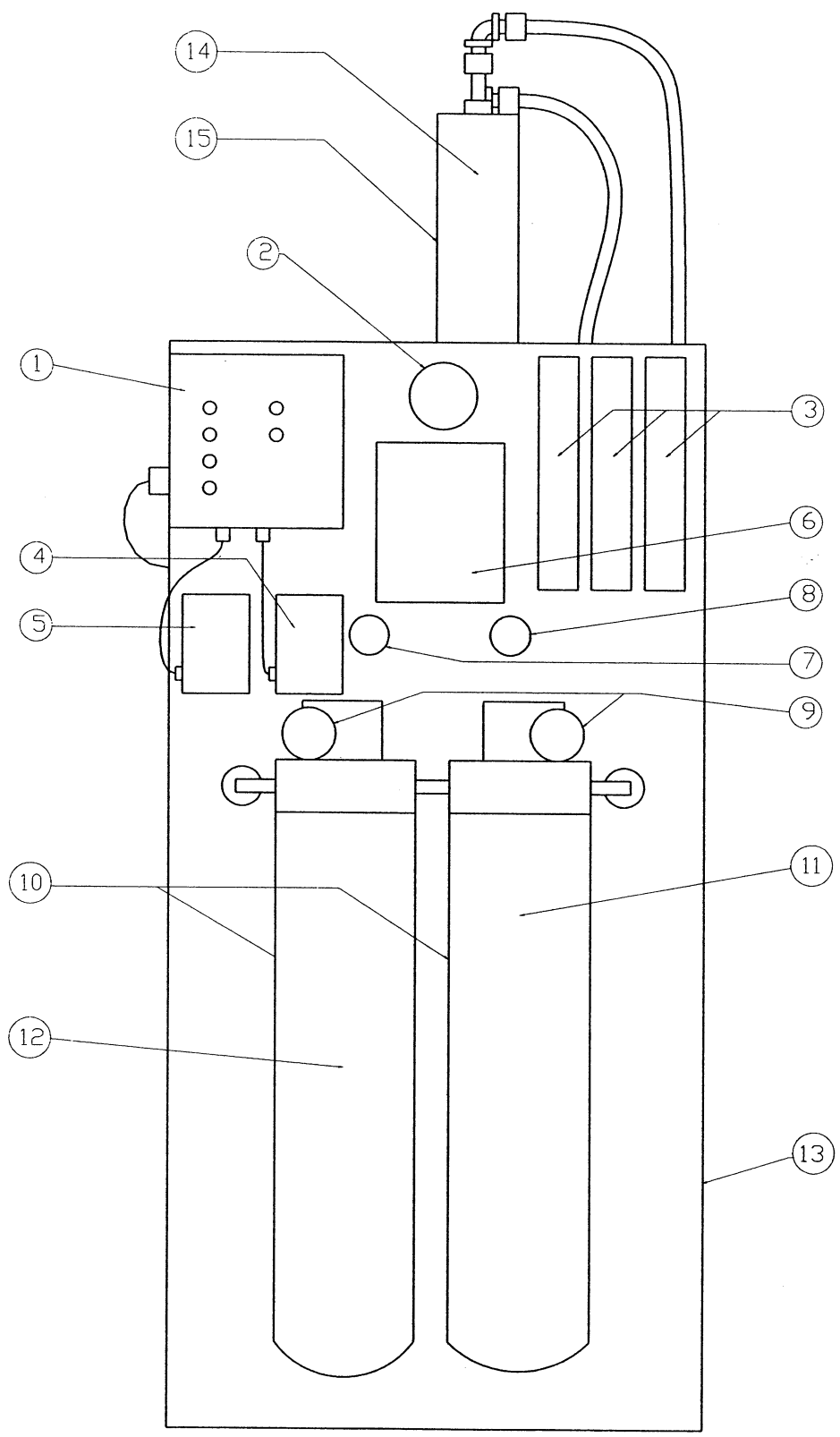
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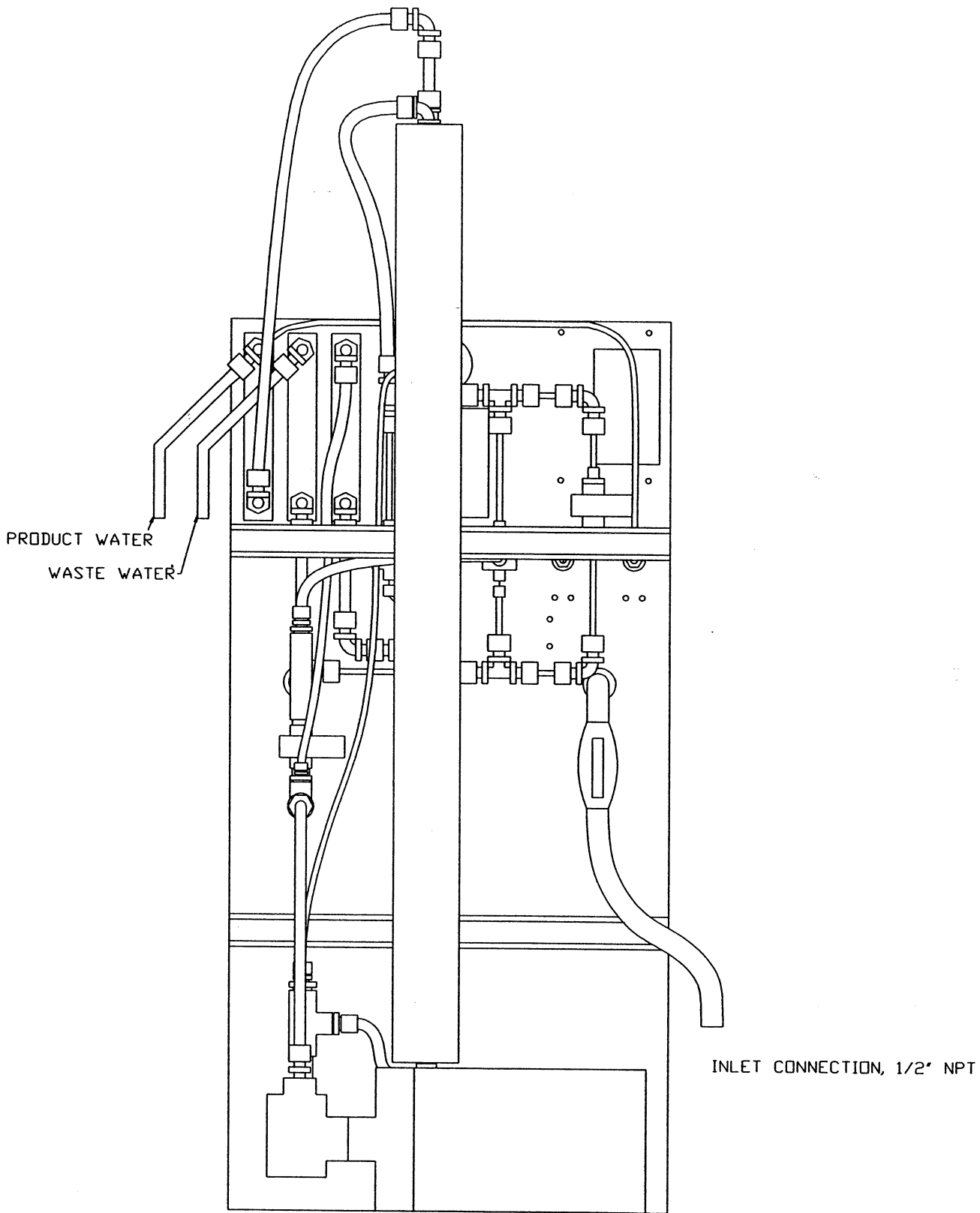
DESIGNED BY: T. HUGHES			
DRAWN BY: J. NICHOLS			
CHECKED BY:			
DATE: 06/10/97			
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SCALE:			
TOLERANCES:	SIZE:	NO. R-1051 SH. 1 OF 1 SHEETS	REV.



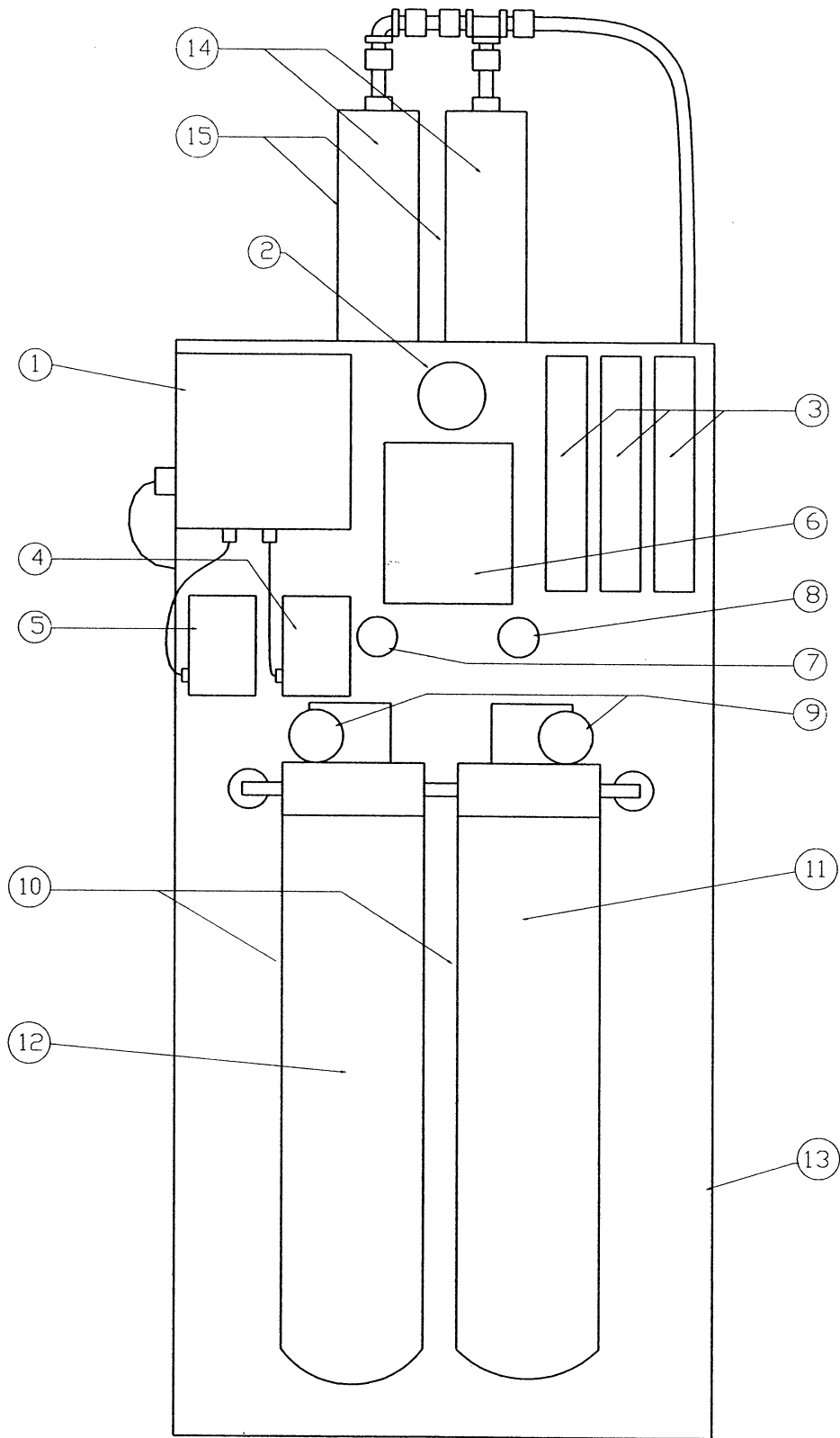
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DRAWN BY: J. NICHOLS			
CHECKED BY:			
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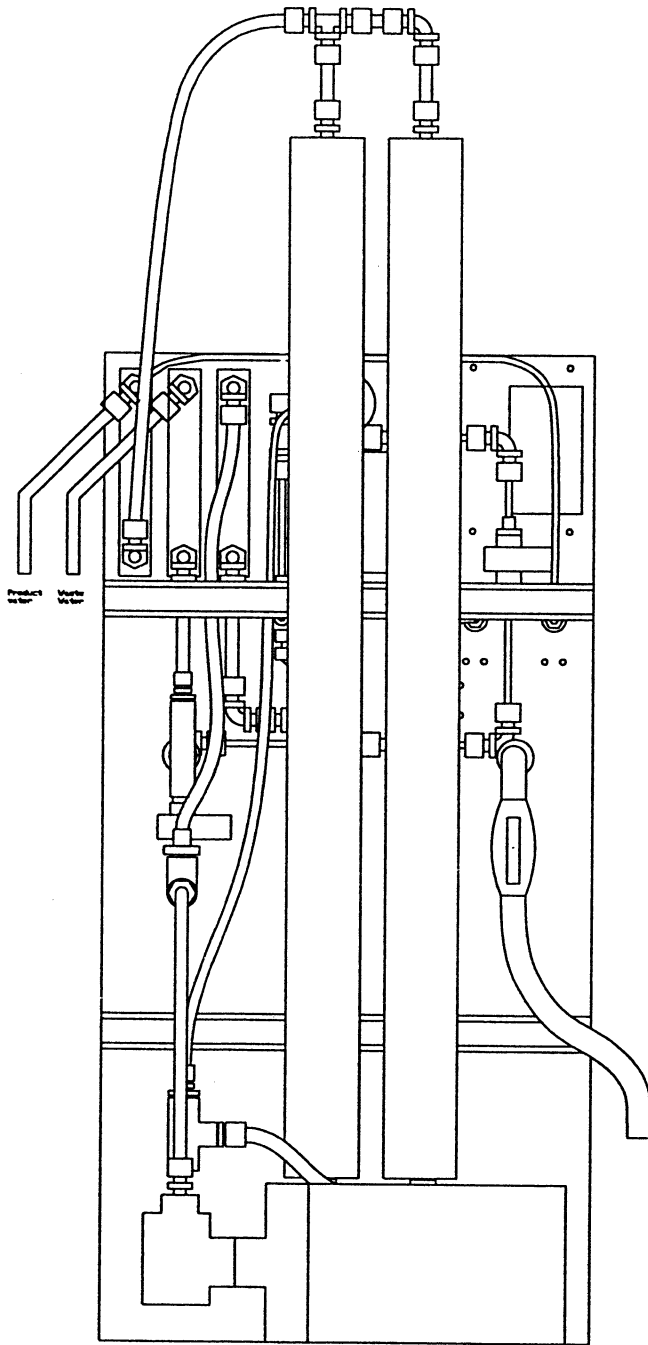
DESIGNED BY: T. HUGHES			
DRAWN BY: J. NICHOLS			
CHECKED BY:			
DATE: 29 JULY, 1997			
MATERIAL:	TITLE: WGR - 600 SCHEMATIC FRONT SIDE		
SCALE: NTS			
TOLERANCES:	SIZE:	NO. R-1083 SH. 1 OF 1	SHEETS REV.



DESIGNED BY: T. HUGHES			
DRAWN BY: J. NICHOLS			
CHECKED BY:			
DATE: 29 JULY, 1997			
MATERIAL:	TITLE: WGR - 600 SCHEMATIC BACK SIDE		
SCALE: NTS			
TOLERANCES:	SIZE:	NO. R-1090 SH. 1 OF 1 SHEETS	REV.



DESIGNED BY: T. HUGHES			
DRAWN BY: J. NICHOLS			
CHECKED BY:			
DATE: 29 JULY, 1997	TITLE: WGR - 1200		
MATERIAL:	SCHEMATIC		
SCALE: NTS	FRONT SIDE		
TOLERANCES:	SIZE:	NO. R-1084 SH. 1 OF 1	SHEETS REV.



DESIGNED BY: T. HUGHES

DRAWN BY: J. NICHOLS

CHECKED BY:

DATE:

MATERIAL:

SCALE:

TOLERANCES:

TITLE:

WGR - 1200
SCHEMATIC
BACK SIDE

SIZE:

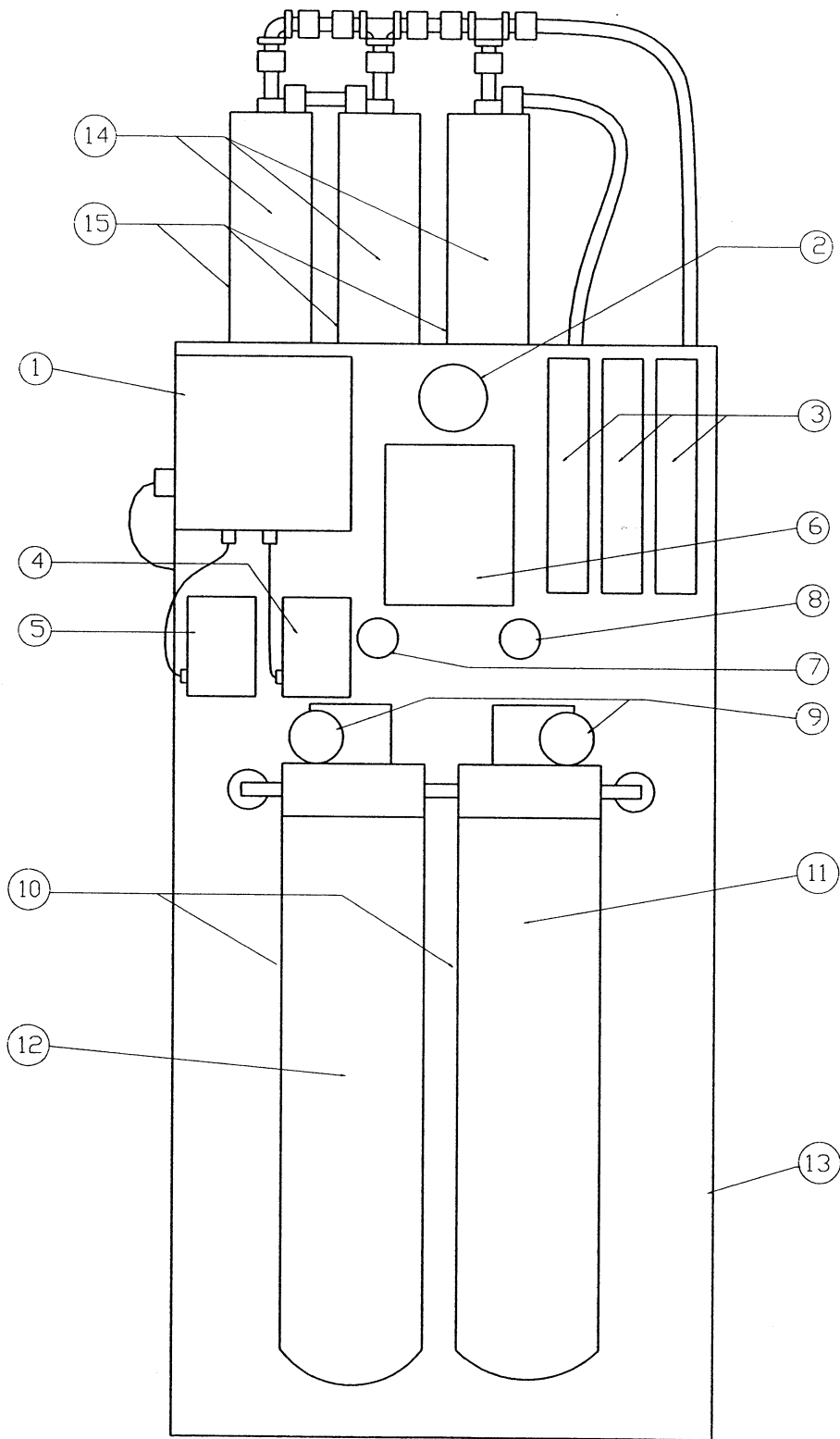
NO.

SH.

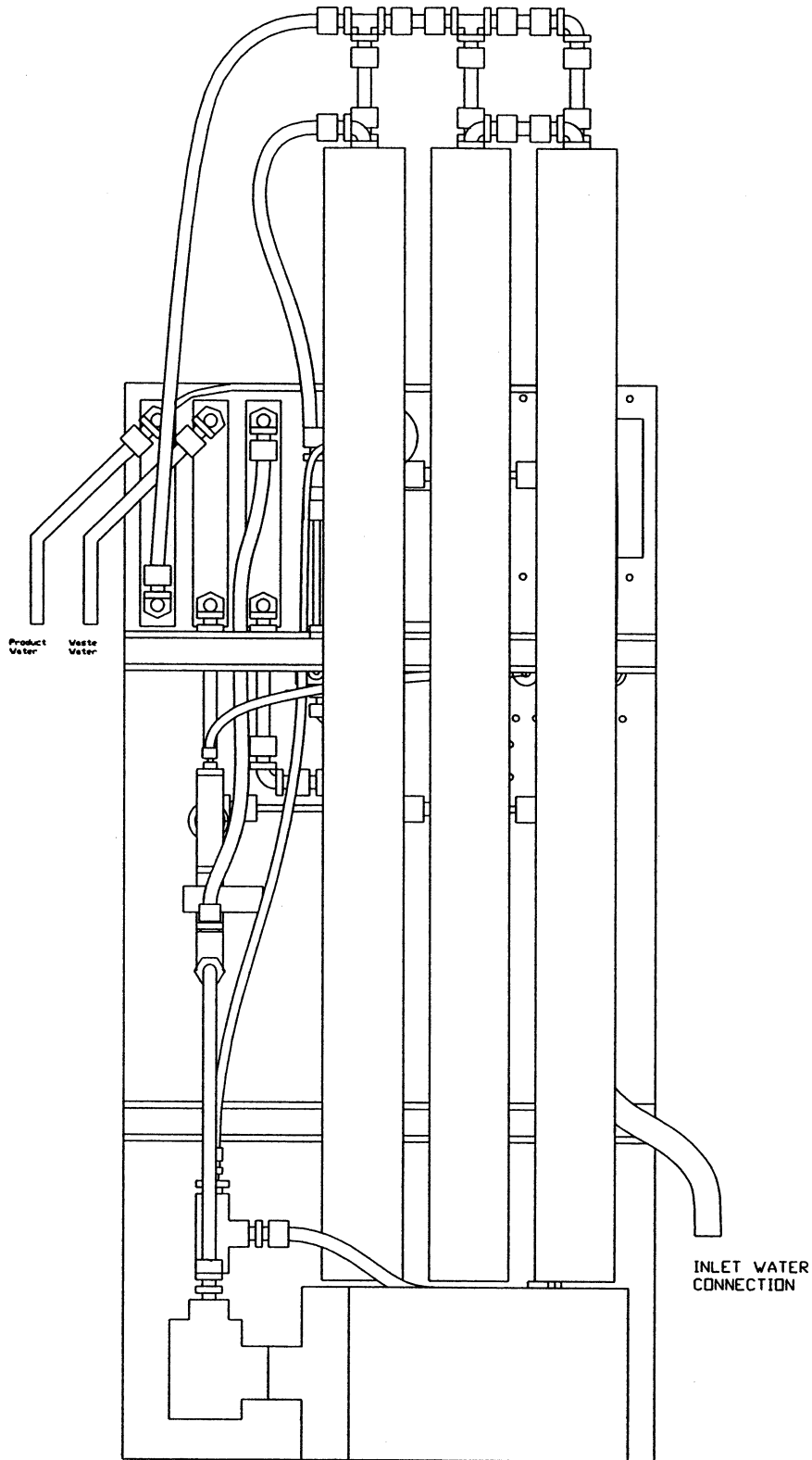
OF

SHEETS

REV.



DESIGNED BY: T. HUGHES			
DRAWN BY: J. NICHOLS			
CHECKED BY:			
DATE: 29 JULY, 1997	TITLE: WGR - 1800 SCHEMATIC FRONT VIEW		
MATERIAL:			
SCALE: NTS			
TOLERANCES:	SIZE:	NO. R-1085 SH. 1 OF 1 SHEETS	REV.



DESIGNED BY: T. HUGHES			
DRAWN BY: J. NICHOLS			
CHECKED BY:			
DATE: 29 JULY, 1997	TITLE: WGR - 1800		
MATERIAL:	SCHEMATIC		
SCALE: NTS	REAR SIDE		
TOLERANCES:	SIZE:	NO. R-1092 SH. 1 OF 1	SHEETS REV.