ORIGINAL INSTRUCTIONS

Installation and Operation

Water Filtration System

WFS – 101545

Serial Number: _____

HST Spindles, LLC.

1357 Route 3A

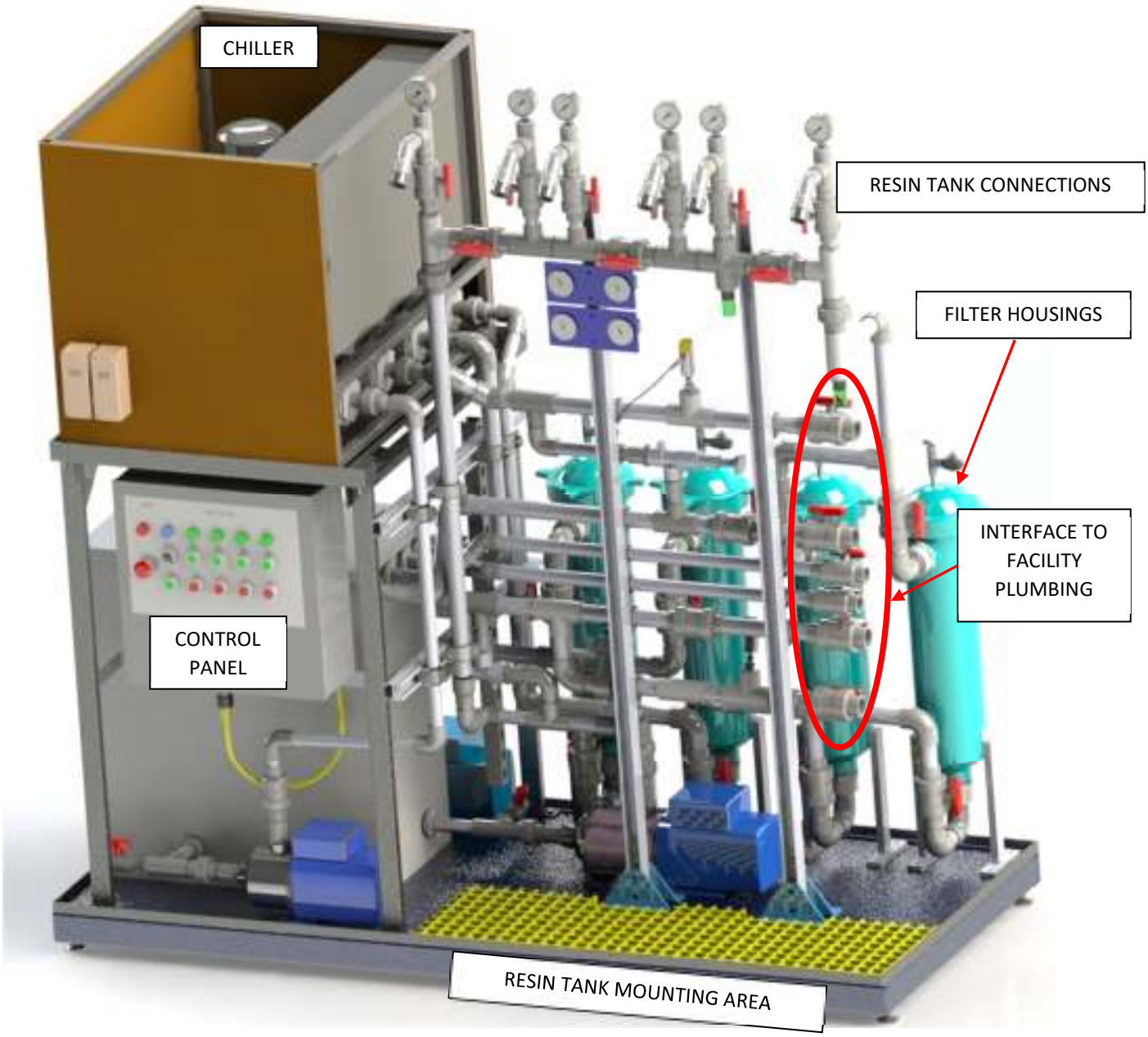
Bow, NH 03304 USA

www.highspeedtechnologies.com

WFS 101545 Operations Manual

TABLE OF CONTENTS

SECTION I OVERVIEW



WFS 101545 OVERALL VIEW

FIGURE 1

1. OVERVIEW

The WFS 101545 filtration system was specifically engineered to provide temperature-controlled water for wafer dicing and similar processes. The system permits re-use of process and cooling water used for dicing or grinding semiconductor wafers.

Although specifically designed for the semiconductor industry the unit can be applied to any process that requires refrigerated, filtered and deionized water.

The WFS 101545 provides economies in two ways:

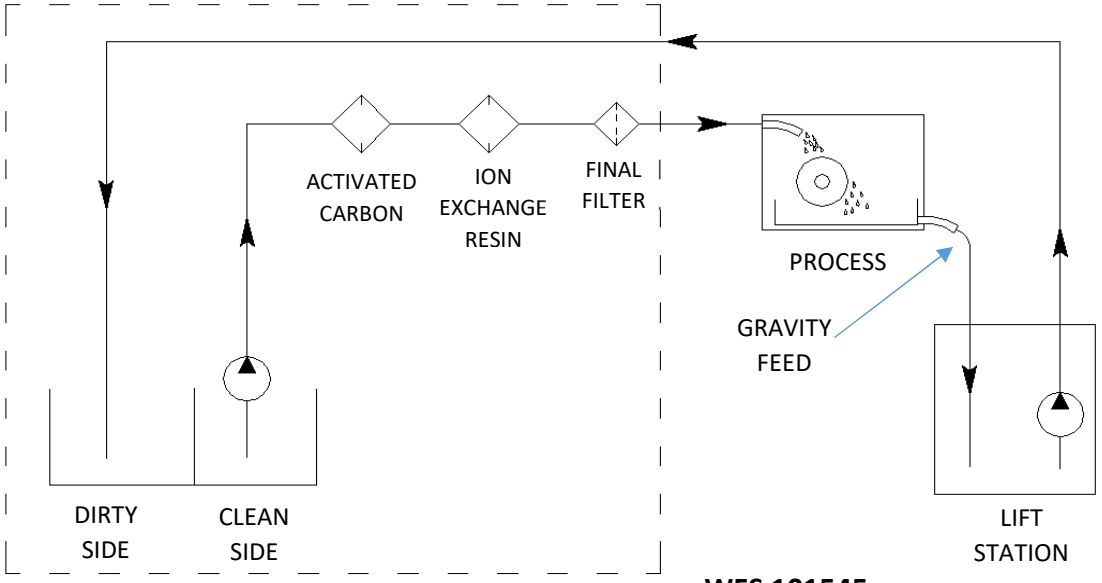
- Significantly reduces DI water consumption by reconditioning and reusing the water.
- Eliminates or reduces contaminated or hazardous liquid waste disposal by filtering out contaminates into a removable cartridge. The cartridge can be dried and the waste material can then be handled as solid waste.

The system provides two (2) separate cooling circuits. One is specifically for cooling the dicing or sawing process. The other provides cooling water to the spindle motors. Used process water is cooled by refrigeration, filtered and deionized. Used spindle cooling water is cooled by refrigeration in a separate circulating loop.

The system has three water circulating loops; Process Loop, Spindle Loop, and Internal Circulating Loop. Additionally, a separate Lift Station pump is provided to return process water back to the WFS.

a. Process Loop
The Process Loop recirculates temperature controlled, filtered and deionized water for dicing and grinding.

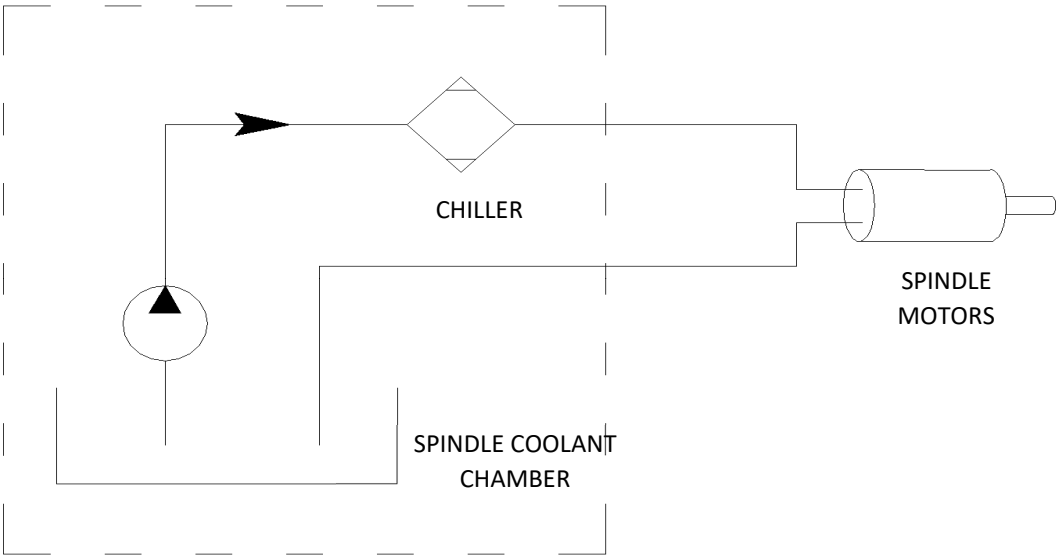
SIMPLIFIED SCHEMATIC OF THE PROCESS LOOP



WFS 101545

b. Spindle Loop
This loop recirculates water cooled by refrigeration for the dicing spindle motors.

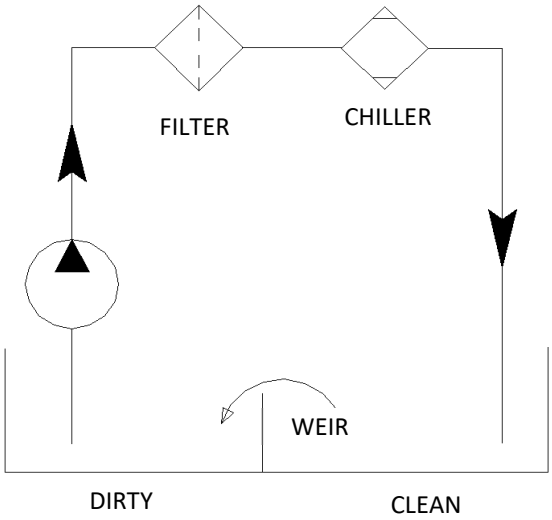
SIMPLIFIED SCHEMATIC OF THE SPINDLE LOOP



WFS 101545

c. Internal Recirculating Loop
This loop constantly recirculates process water returned from the lift station through filters and cooling

SIMPLIFIED SCHEMATIC OF THE INTERNAL RECIRCULATING LOOP



WFS 101545

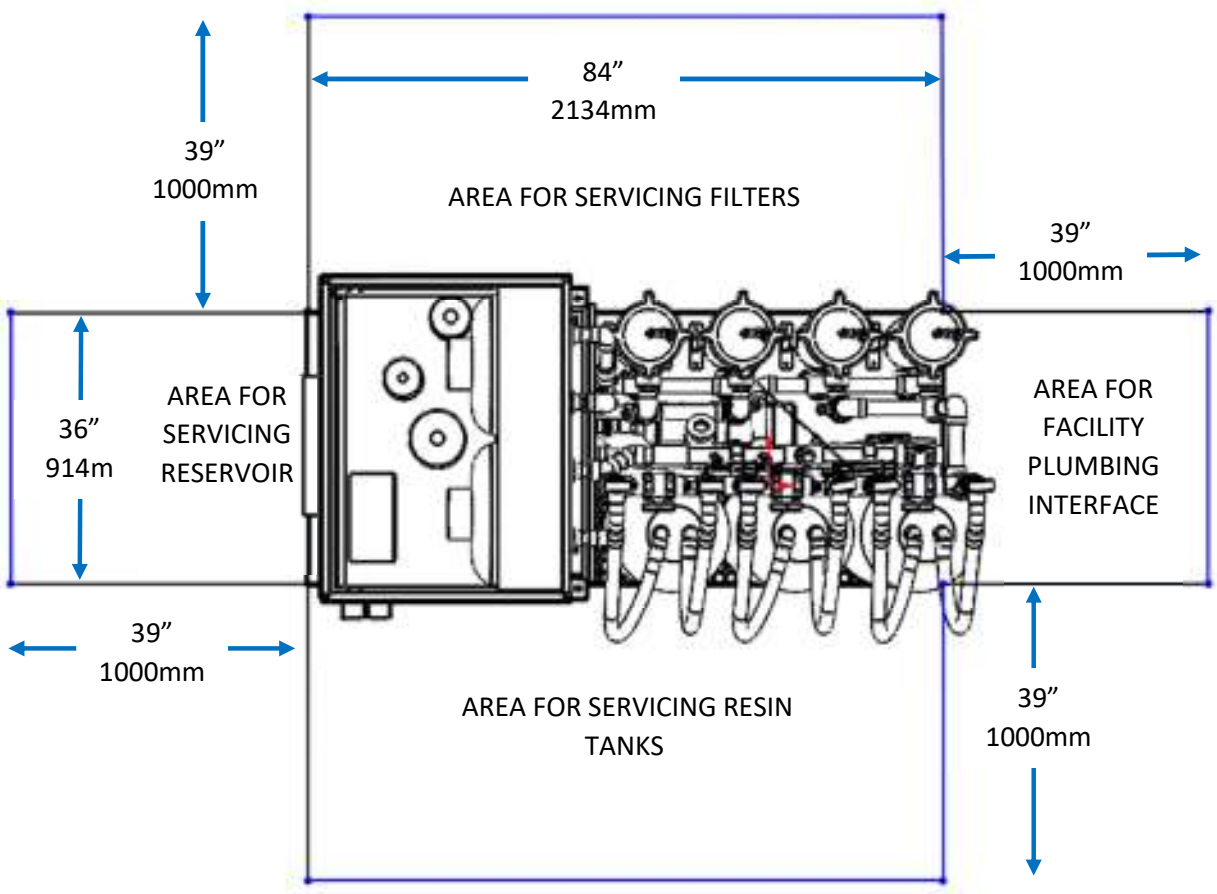
d. Lift Station
The lift station returns contaminated water from the dicing process to the WFS.

In addition to the built-in filtering and refrigeration capabilities, the WFS has provisions to accept three (3) customer supplied 2.5 cubic foot (70.8 liter) resin tanks for additional filtering and/ or deionization. See SECTION III 8.

2. SETUP

a. Floor Space

Prior to installation consider the space required for proper servicing. Figure 2 provides recommended clearances for servicing the various components on the WFS 101545.



RECOMMENDED FLOOR SPACE FOR SERVICING THE WFS 101545

FIGURE 2

b. Uncrating

NOTICE: Inspect “Tip and Tell” and shock indicators mounted on the outside of the crates for indication of mishandling and potential damage during shipment.

The outside of the crate should be inspected for damage prior to uncrating. Additionally, "Tip and Tell" and shock indicators are attached to the exterior. They should be inspected prior to uncrating. If these indicators are missing or indicate that the crate has been subjected to damaging shock loads or tipped, you should notify your carrier prior to uncrating.

The refrigeration unit is shipped in the smaller crate. The WFS base assembly and the Isolation Valve Sub-Assembly are both contained in the larger crate.

Inspect both crates and report any damage to the carrier and the OEM before proceeding. Figure 3 shows the minimum door height clearance required to accommodate passage of the main WFS platform prior to assembly.

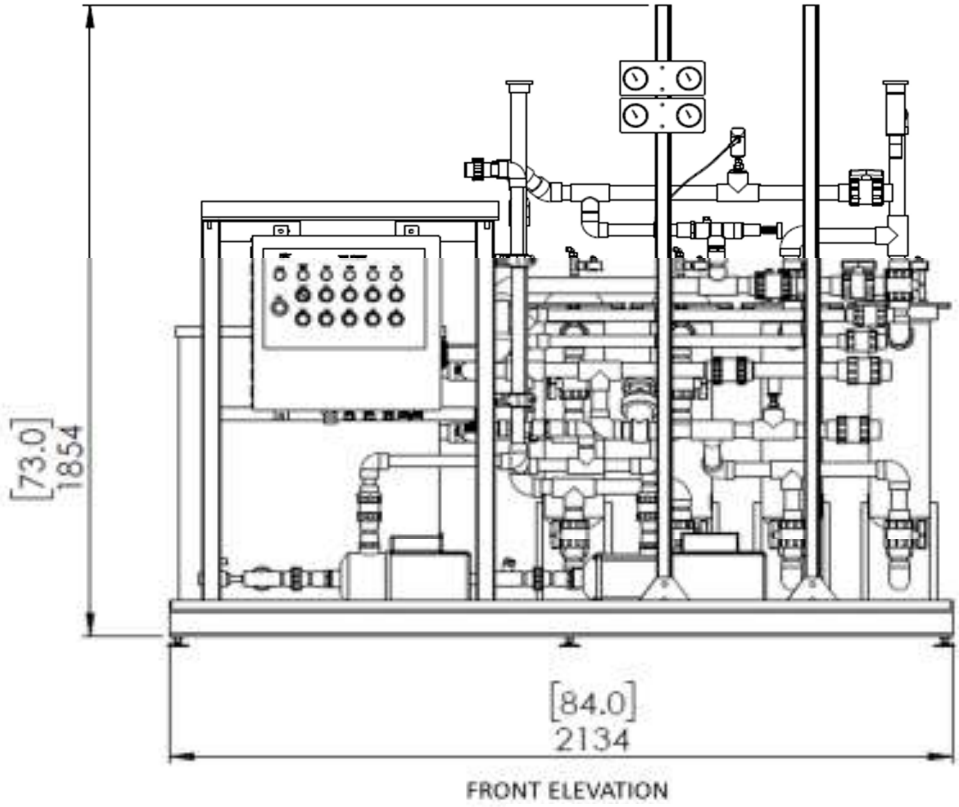


FIGURE 3

c. Electrical Power Requirements

WFS requires the following:
3 phase 40 amp circuit
230 VAC 50 hz or 220 VAC 60 hz

The Lift Station requires the following:
115 VAC 50/60 hz
7.5 Amps

See manufactures design data in appendix

d. Leveling Base

Prior to assembly the base must be properly leveled and supported at six (6) points. Figure 4 shows the leveler location. A standard spirit or bubble level will provide sufficient accuracy for leveling the unit.

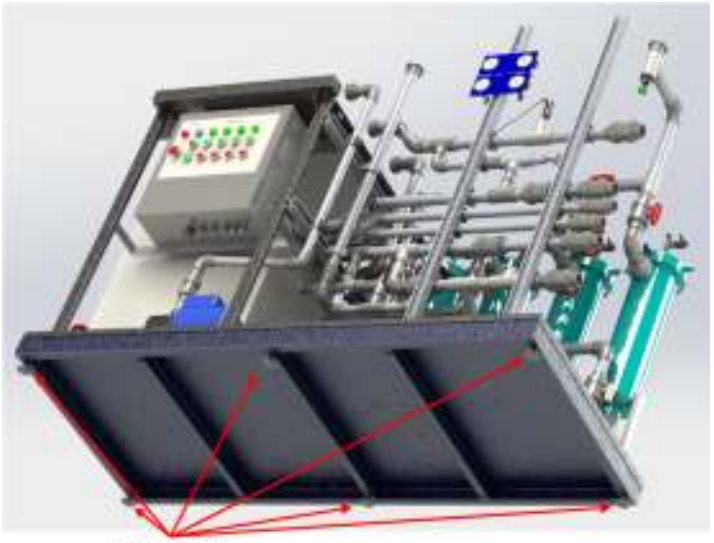


FIGURE 4

Before verifying that the platform is level, insure all six of the leveling legs are firmly on the floor. If any leg is not touching the floor, adjust by loosening the [visible] copper plated leg lock nut and winding this ½ - 13 nut in a clockwise direction. Once the leg is firmly on the floor, wind the upper locknut (above the underside of the equipment base) in a clockwise direction until tight. Complete by winding the exposed ½-13 (copper plated) locknut 'up' in a counter-clockwise direction until tight. Next, using a bubble level or similar leveling tool, measure the level of the equipment base. Place the level-tool in an unobstructed surface of the equipment base. If the equipment is off-level by less than ¼ bubble, no adjustment is necessary. However, if more than ¼ adjust the respective legs accordingly. Ensure all leg locknuts are tight.

e. Assembly

The chiller unit is shipped in a separate crate and must be installed after leveling the base unit. The installation requires lifting the chiller unit and placing it on the drip pan such that the four (4) unions line up with the mating parts on the base unit. See Figure 5. Check to make sure that the O-ring for each union is in place. Carefully move the chiller until the all of the union faces are in contact with the corresponding face on the base unit.

Use caution when tightening the union nut to avoid "cross threading". Do not over tighten. Check for leaks during commissioning of the system. See Figure 5

i. Chiller Installation

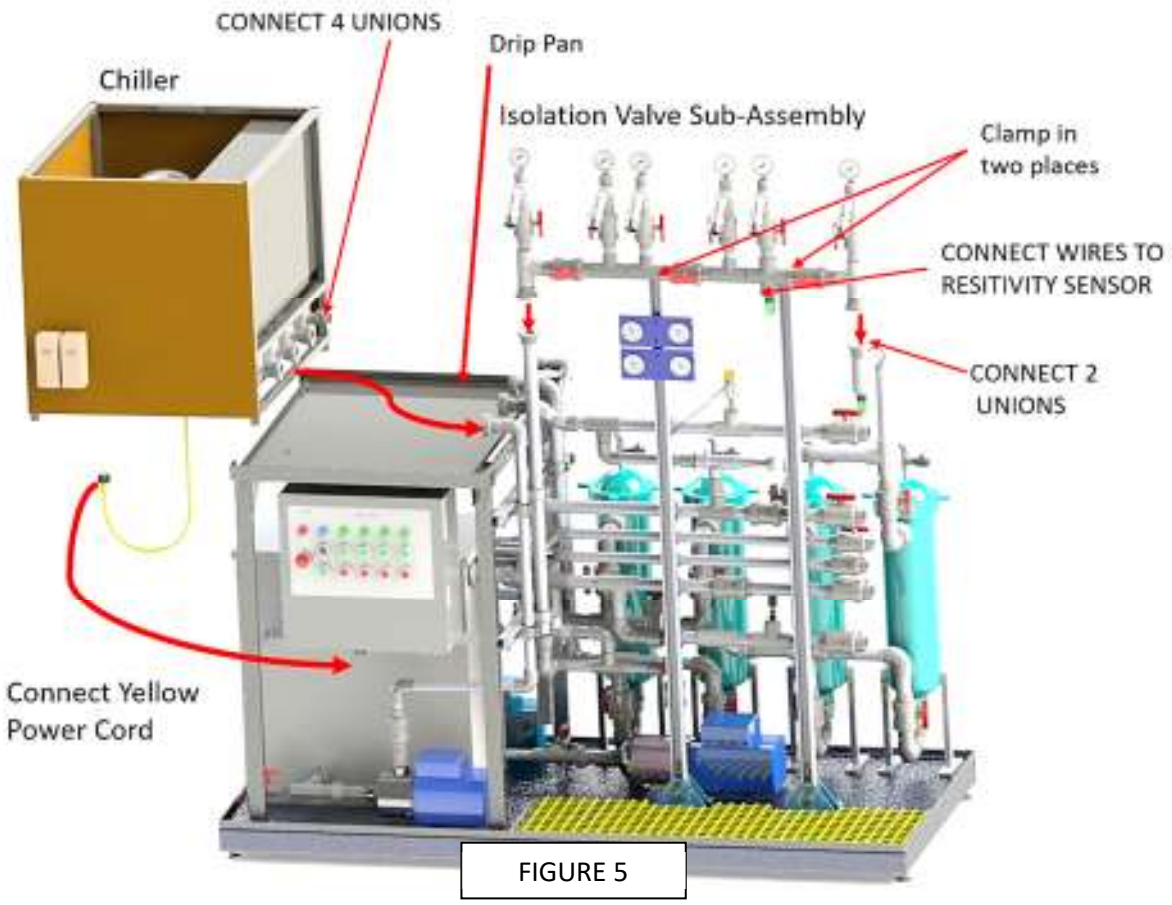


FIGURE 5

Connect the yellow power cord to the round receptacle on the bottom of the Control Panel.

ii. Isolation Valve Sub-Assembly Installation

The Isolation Valve Sub-assembly is shipped in the same crate at the WFS base.

The Isolation Valve Sub-assembly must be mounted and clamped to the two vertical upright and the unions connected properly. See Figure 5.

After the Isolation Valve Sub-Assembly is clamped and plumbed in, plug in the resistivity sensor to mating electrical connector. See Figure 6

Figure 6

f. Facility Interface

i. Plumbing Connections

There are six (6) facility plumbing connections to the WFS Unit.

- Make-up Water for the Spindle Coolant Circuit
- Make-up Water for the process Cooling circuit
- Spindle Cooling Supply
- Spindle Cooling Return
- Process Cooling Supply
- Process Cooling Return

Figure 7 shows the approximate location of the plumbing connections.

The connection for the for the Spindle Coolant Make-Up Water is 1" NPT. The water source can be provided from clean ordinary tap water.

The connection for the for the Process Coolant Make-Up Water is 1" NPT. This water source can be from water deionized by another source or from clean ordinary tap water.

The connection for the Spindle Cooling Supply is 1-1/4" NPT. This provides water cooled by refrigeration to cool the spindle motors. This is a "closed-circuit" loop circuit and does not require a lift station.

The connection for the Spindle Cooling Return is 1-1/4" NPT. This connection directs return water from the spindle cooling loop back to the reservoir.

The connection for the Process Cooling Supply is 1-1/4" NPT. This provides water filtered, de-ionized[1] and cooled by refrigeration to cool the cutting, grinding or dicing process. This process is normally "open-loop". Therefore, a separate "Lift Station" is required to return the water back to the WFS. The customer is responsible to collect and direct the process water to the lift station pump.

The connection for the Process Cooling Return is 1-1/4" NPT. This connection directs return water from the Lift Station back to the reservoir.

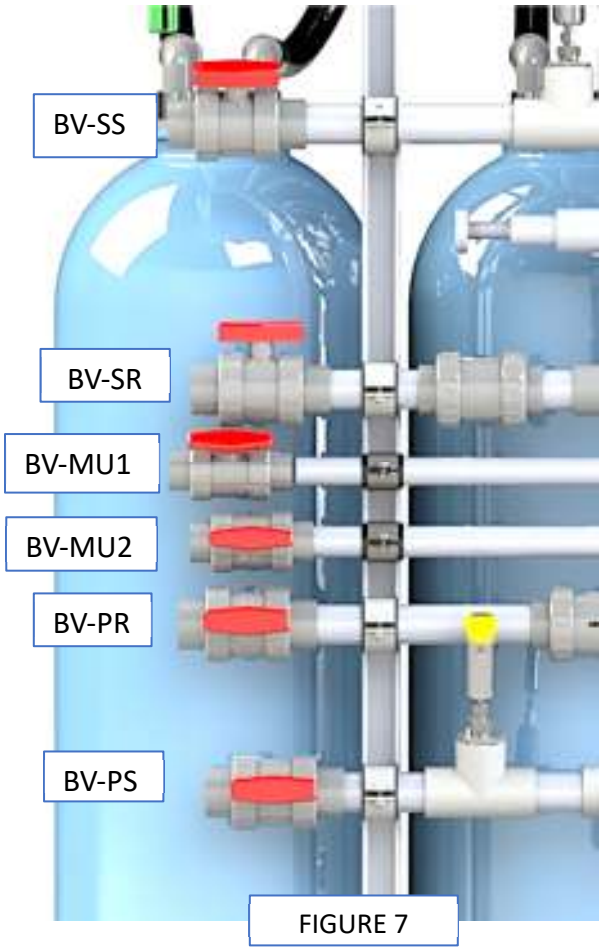


FIGURE 7

ii. Electrical Hook-Up

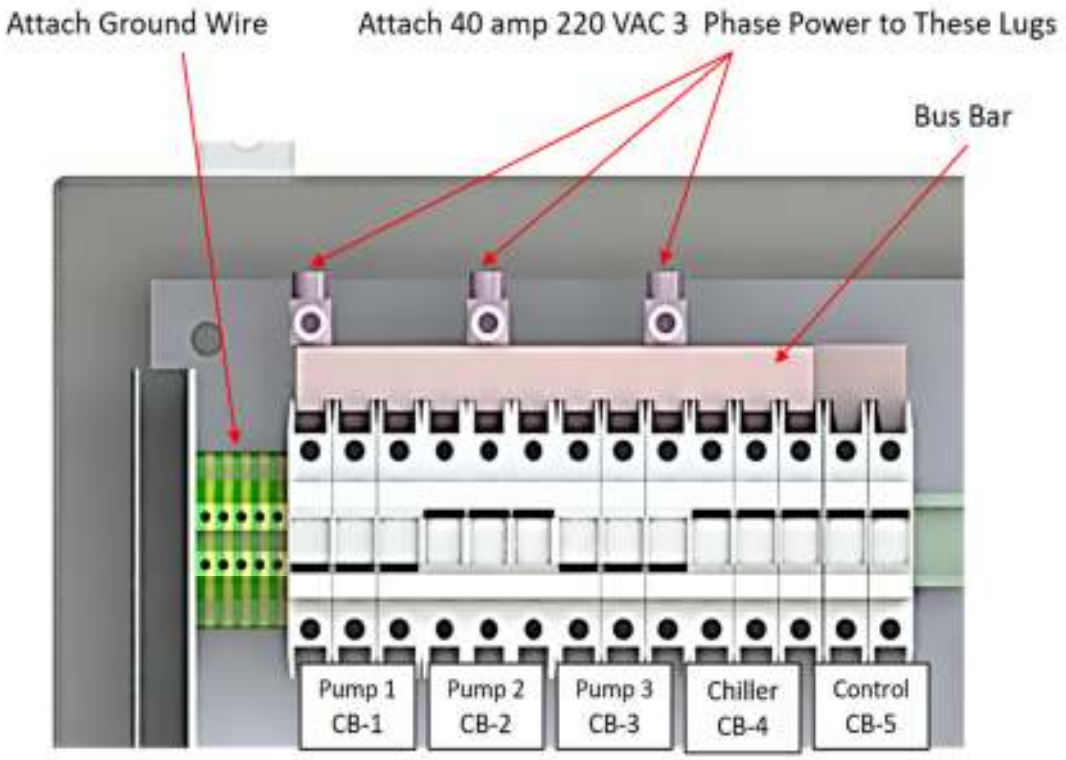
[1] Deionization is accomplished by customer supplied resin tanks.

The unit requires three (3) phase 220 VAC 60 Hz 40 Amp or 230 VAC 50 Hz 40 Amp power with grounding wire.

The power wires attach to the three lugs provided on the top of the distribution bus bar. The ground wire must be attached to the grounding terminal to the left of the bus bar. See Figure 8.

CAUTION: Installation wiring must comply with local and national electrical codes.

WARNING: Only qualified and licensed personnel should install facility wiring.



View Inside of Control Panel

FIGURE 8

3. **PUMPS**

The WFS – 101545 utilizes separate pumps for the three (3) different recirculating loops. The pump construction uses 316 stainless steel for all wetted surfaces.

a. Pump 1 Recirculating
- Gould # 5HM04N11T6PBQE
- 25gpm

- 33psi

b. Pump 2 Cutting Process Water

USA ONLY

- Gould # 3HM07N11T6PBQE
- 1.5hp
- 15gpm
- 75 psi max. (regulated to WFS operational specification)

EU ONLY Gould # 3HM10N151T6PBQE

- 2.0 HP
- 15gpm
- 75 psi (regulated to machine operational specification)

c. Pump 3 Spindle Cooling

- Gould # 3HM04N05T6PBQE
- 10gpm
- 50psi

NOTE: See Manufacturer's Information in appendix

4. FILTERS

The WFS uses four (4) Pall or FSI X100 filters for filtration of the process water.

a. Filter Housings
The filter housings are manufactured from talc filled polypropylene and rated for 100 psi maximum pressure and 110° F degrees maximum temperature. Each of the water circuits have pressure limiting valves to protect the housings from accidental over-pressurization.

b. Filter Elements
Each filter housing is designed to hold three cartridge type filter elements. The housings accept filter cartridges of various composition and filtration rating. The customer must determine the type of filter element to best satisfy their requirements.

c. Gauges
Four (4) pressure gauges are located on a panel visible from the front of the WFS. These gauges numbers 1 – 4 display the pressure inside of each corresponding filter housing.

d. Housing and Plumbing Arrangement
The filters are arranged in two (2) groups of two (2). (See figure 9)

Filters FH-1 and FH-2 make up Group 1 and provide final filtration of the DI water as it is pumped out to the process after the resin tanks. These filters are situated so as to take out and any stray resin beads or carbon that might escape the resin beads.

Filter FH-3 and FH-4 make up Group 2. This group provides the initial filtration of contaminated water returning from the process. Water is constantly pumped from the "Dirty Side" of the reservoir through the filters and into the "Clean Side".

The two filters in a group are arranged in parallel. It is intended that only one (1) filter from each group to be employed at any time while the dormant filter remains on stand-by. Each filter can be isolated or employed by using the ball valves associated with the particular housing.

When the pressure reading exceeds a predetermined amount the stand-by filter can be

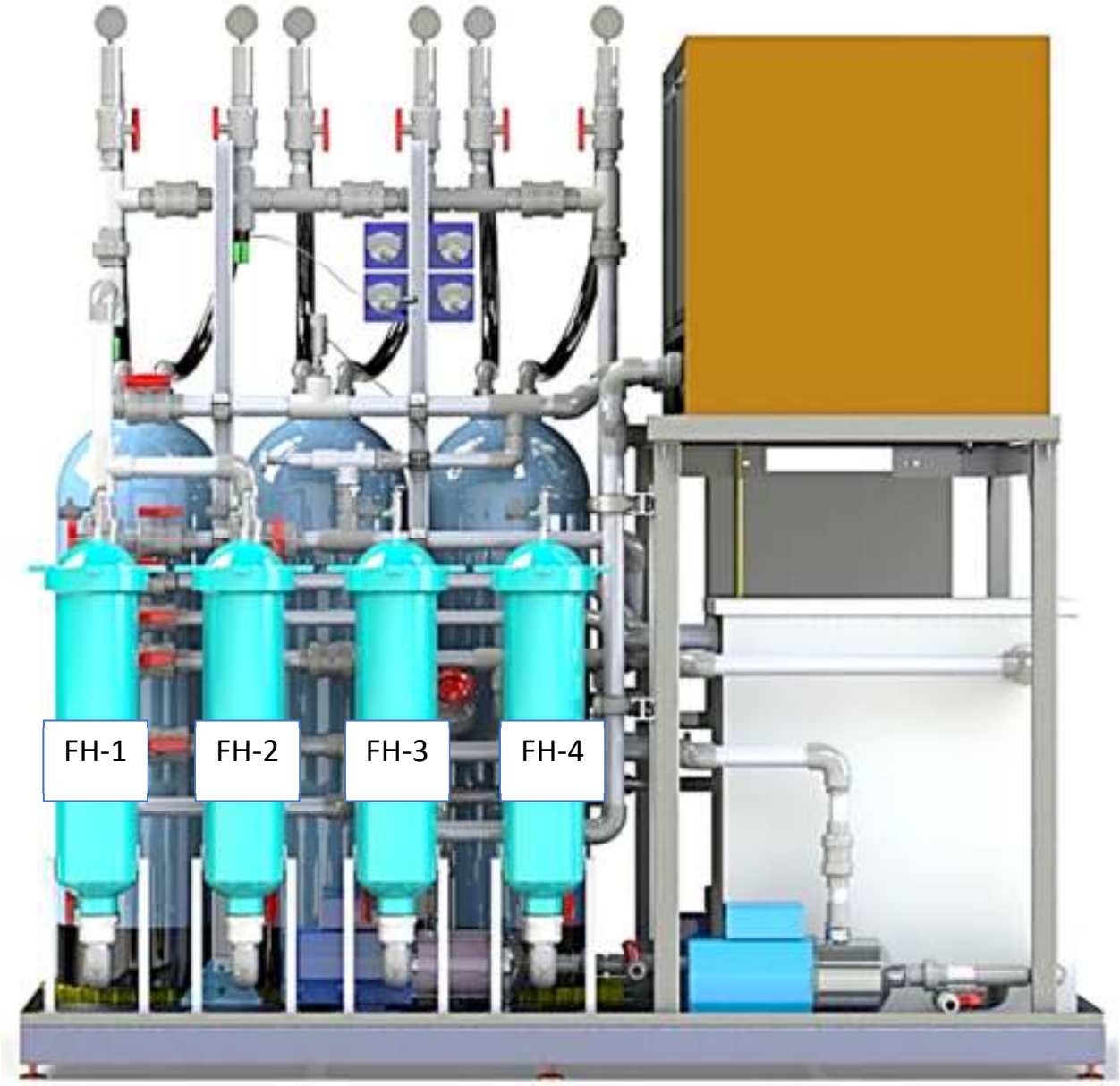


FIGURE 9

brought online and the spent filter can be isolated. The filter elements can then be changed out without interruption to the process.

NOTE: For detailed information concerning the filter housing see manufacturer's design data in the appendix.

5. RESERVOIR

The reservoir is a three (3) chambered polypropylene tank. The reservoir allows return water accumulation to prevent pump cavitation. It also provides a certain amount of dwell time to allow heavy particulate to settle out.

a. Spindle Coolant Chamber
   The maximum brim-full capacity of the Spindle Coolant Chamber is 15.8 gallons (60 liters).
   The chamber has three (3) penetrations.
b. Dirty Process Water Chamber (Dirty Side)
   The maximum brim-full capacity of the Dirty Side chamber is 8 gallons (30 liters)
   The chamber has two (2) penetration. Additionally, water cascades over a weir from the Clean Side
c. Filtered and Cooled Process Water Chamber (Clean Side)
   The Clean Side chamber has a brim-full capacity of 14.7 gallons (55.6 liters).
   The chamber has two (2) penetrations.

6. CHILLER

WFS 101545 chiller units are specifically designed and built for dicing and other semiconductor processing requirements. They use a Copeland FFAP-030Z condensing unit with two (2) custom made evaporators. It requires 3 Phase 208 -220 VAC 50-60 hz electrical power.

The chiller unit has one (1) compressor and two (2) solenoid controlled evaporating units. The evaporator coils are enclosed in schedule 80 PVC housing and make up two (2) independently controlled heat exchangers. The evaporator coils are titanium making the heat exchangers impervious to the effects of DI water.

For specific detailed information concerning the Copeland condensing unit see the design data page in the appendix.

7. FLOW SENSOR

The Process Circuit and the Spindle Circuit each have IFM SA4110 flow sensors to monitor and verify flow through each circuit. These sensors provide a digital readout of the flow through each circuit. The need to make the WFS 101545 footprint as small as possible reduces the accuracy of these sensors and especially at low flow rates. As such, the sensor provides an approximation of the actual flow. It is not intended to be a calibrated meter.

The flow sensors can also be programmed to read water temperature.

For additional information and programming guide see the Design Data section in the appendix.

8. LEAK DETECTOR

An Omron 61F-GPN-V50 leak detection system will shut down all pumps and the chiller in the event that a leak is detected. The sensing strip is applied down the center of the base. If even a small amount of water is detected the system initiates an E-Stop. (See Figure 10)

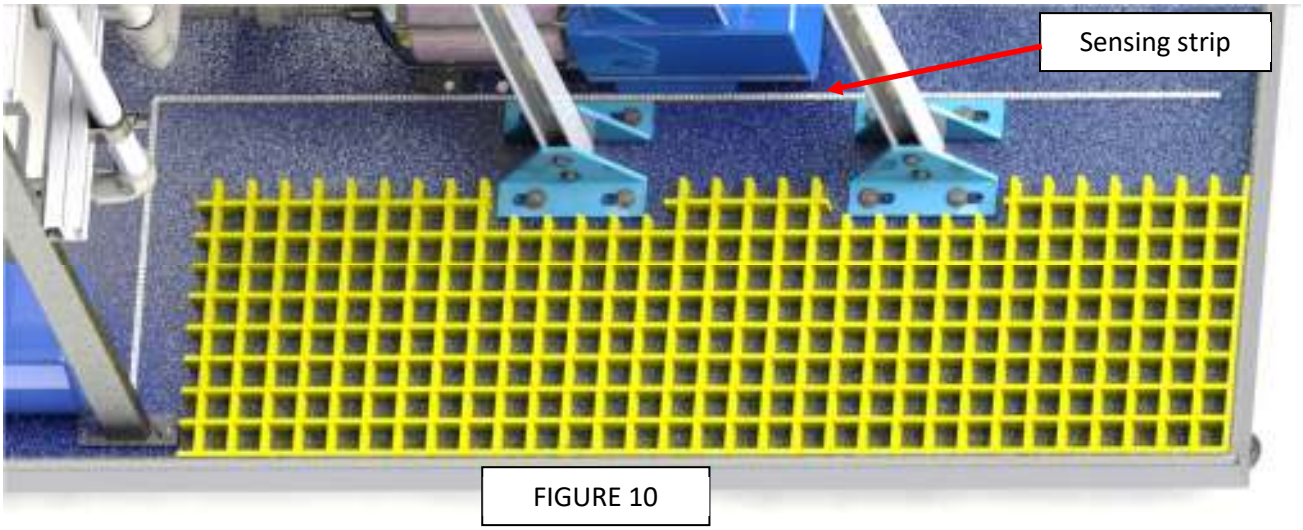


FIGURE 10

NOTE: For additional information see the Design Data section in the appendix.

9. RESIN TANKS

The WFS 101545 can accommodate three (3) customer supplied resin tanks up to 15" in diameter. These tanks interface with the Isolation Valve Sub-assembly. The interface connection is 1" NPT . See figure 11

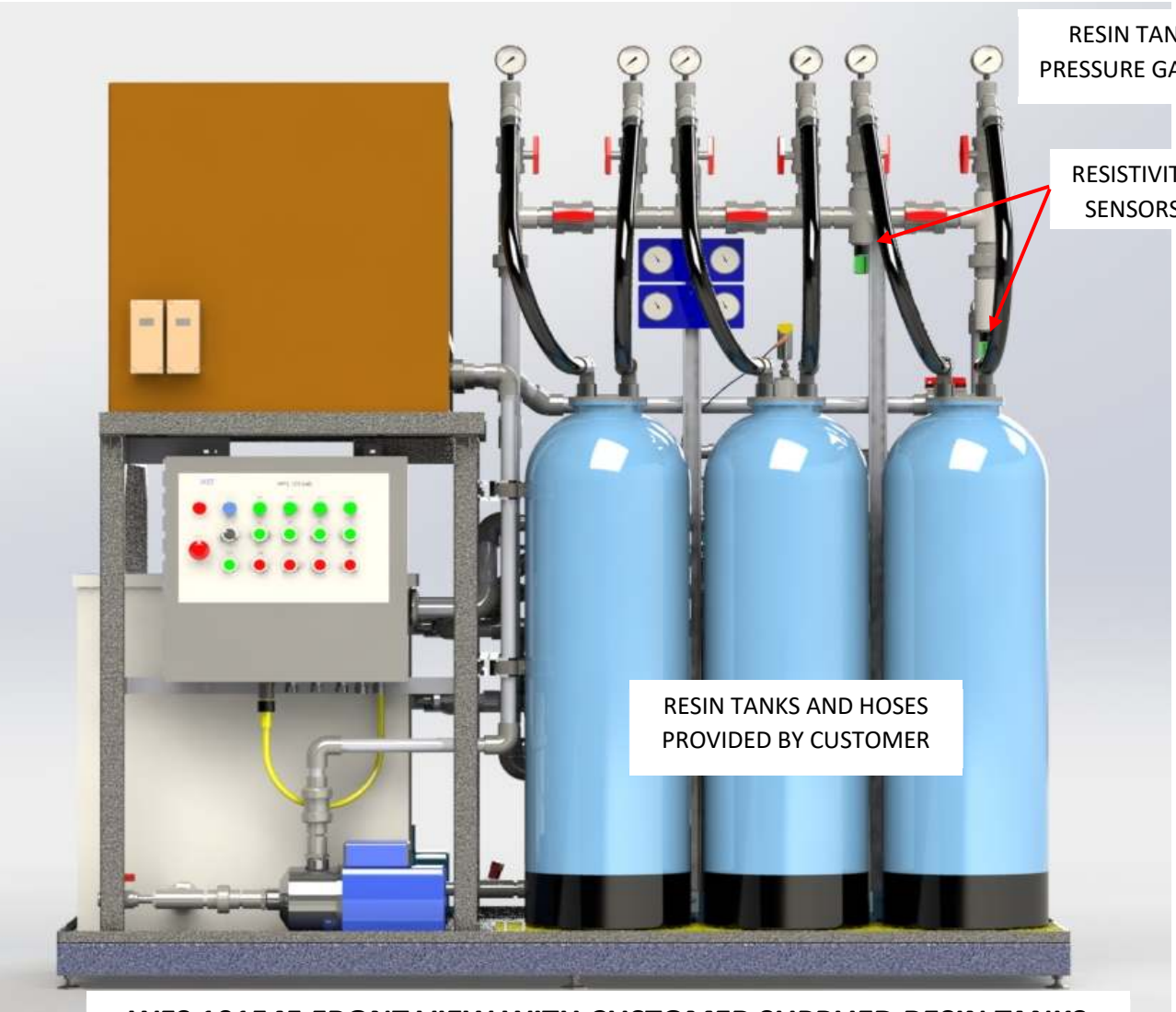
It is anticipated that the customer will utilize two (2) ionic exchange resin beds and one activated carbon vessel. (Collectively these are all referred to as resin beds or resin tanks unless specifically speaking about the activated carbon filter)

10. RESISTIVITY SENSOR

Two (2) Resilite RES7130 resistivity sensors are provided to monitor water condition to the Process Circuit. These sensors have a fixed setting of 1 Meg Ohm. They will indicate resistivity in excess of 1 Meg Ohm with a green light. If resistivity becomes less than 1 Meg Ohm the light will change to red.

These sensors provide an indication as to when to change out the customer supplied resin beds. See figure 11

NOTE: For additional information see the Design Data section in the appendix.



WFS 101545 FRONT VIEW WITH CUSTOMER SUPPLIED RESIN TANKS

FIGURE 11

11. FLOAT VALVE

Two Hudson Float Valves maintain proper reservoir level and compensate for evaporation and minor leaks. One float valve controls the water level in the Dirty Side Tank and one valve controls the level in the Spindle Circuit Tanks.

NOTE: For additional information see the Design Data section in the appendix.

12. RANCO ELECTRONIC TEMPERATURE CONTROLLER

The temperature for the Spindle Circuit and the Process Circuit are each controlled by their own RANCO ETC111000020 Electronic Temperature Controllers.

NOTE: For additional information see the Design Data section in the appendix.

SECTION II COMMISSIONING

COMMISSIONING

Commissioning the system after all of the proper connections and set-up have been completed consists primarily of filling the system including all plumbing lines with water and bleeding air from the tanks. This is accomplished in the following steps:

- Filling the Spindle Cooling Circuit
- Filling the Recirculating Circuit
- Filling the Process Water Circuit

Each of these steps is an iterative process requiring starting and stopping the various pumps while maintaining sufficient water level to prevent pump cavitation.

1. **Commissioning Pre-requisites**
   Verify and check the following:
   a. Close the ball valves for the six (6) facility plumbing connections to the WFS Unit. See Figure 7 SECTION I.2.F.i
   b. All plumbing connections to saws and lift station are complete.
   c. Spindle motor circuit is closed loop.
   d. Lift Station is installed and proper facility power is on. The lift station will not run until a certain water level in the holding tank is reached.
   e. Process cooling water is gravity drained and collected into the lift station. The lift station discharge is connected to the Process Water Return connection.
   f. Facility water supply is open to both Water Make-Up lines for the Spindle Cooling Circuit and Water Make-up for the process Cooling circuit. (BV-MU1 & BV-MU2 See Figure 7 SECTION I.2.F.i)
   g. Verify that the proper three (3) phase electrical power with ground is connected.

2. **Filling the Reservoir**
   Obtaining and maintaining the proper operating level in all of the reservoir chambers is an iterative process. It requires starting and stopping pumps until all components in the system are fill with water and the system is at equilibrium. The description herein assumes that the system is starting with all of the filter housings, chiller chambers and process lines empty.

   WARNING: The pumps can pull water from the reservoir much faster than the make-up lines can restore. For that reason, the reservoir filling process requires careful observation until equilibrium is achieved.

   WARNING: If the water level in the reservoir is too low, air will be drawn into the pump inlet and can cause damage.

   a. Spindle Coolant Circuit
      i. Remove the reservoir cover so water level can be observed.
      ii. Open all water valves or activate solenoids for saw spindle cooling lines.
      iii. Open the ball valve BV-MU1 for the Spindle Cooling Circuit Make-Up. The reservoir chamber will begin to fill. The filling will stop automatically at a preset level. (See Figure 7 SECTION I.2.F.i)
      iv. Open ball valves BV-SS and BV-SR (See Figure 7 SECTION I.2.F.i)

v. Once the water level in the reservoir reaches the fill level, turn Power Selector Switch to “ON” position (See figure 12)
vi. Press Reset Push Button. Blue Control Power indicating light should come on.
vii. While someone observes the pump rotation “jog” Pump 3 for two seconds. (i.e., depress the Pump 3 Start Push Button, then the Pump 3 Stop Push Button.) Verify that the rotation of the pump is in the direction indicated on the pump housing. If the pump rotation is not correct, have a qualified electrician correct the wiring on the incoming line as indicated in the note below.
viii. Start the pump and observe the water in the chamber. Stop the pump when the water drops to 5 inches (130 mm) from the bottom. Allow reservoir chamber to fill. This procedure will fill the customer supplied plumbing and the spindle cooling circuits.
ix. Repeat process until water is observed returning to the reservoir indicating that all of the lines and spindle motors are full. The make-up valve will be able to compensate for any minor losses due to leakage or evaporation.
x. Once water begins returning to the reservoir from the saws allow pump 3 to continue to run until the water level stabilizes. At this point the house plumbing circuit is full and the spindle circuit has reached equilibrium.
xi. After reaching equilibrium stop Pump 3.

FIGURE 12

CAUTION: Use caution to avoid allowing water level to sink too low. Stop pump if there is any indication that air is getting into the pump inlet.

NOTE: TO BE PREFORMED BY QUAIFIED ELECTRICIAN ONLY.
If the pump rotation is in the wrong direction turn off all electrical power to the WFS from the source. Verify that there is no electrical power in the control cabinet. Switch any two (2) power wires at the connection terminals. See figure 8 SECTION I.2.F.ii

DO NOT switch the motor connections at the motor or to any individual motor. All pumps and chiller are synchronized. Once the power phases for Pump 3 are correct all other motors will be correct.

b. Recirculating Supply Circuit
Two (2) Reservoir chambers along with two (2) pumps work together to supply filtered and cooled DI water for process cooling. These chambers are referred to as the "Dirty Side and the "Clean Side". Both chambers must be at equilibrium before continual process can be maintained.

This process fills the reservoir for initial starting of the Process Water Circuit. It also fills filter housings FH-3 and FH-4 along with the cooling evaporator housings.

The filling process described herein assumes that the customer has properly installed three (3) resin tanks and the tanks are configured so that Tank 1 is an Activated Carbon filter. Tanks 2 & 3 contain Ion Exchange Resin.

The filling process will require many pump starts and stops to reach equilibrium.

It is assumed that the Filter Housings FH-3 and FH-4 are empty.

i. Remove reservoir cover so water level can be observed.
ii. Open the ball valve BV-MU2 for the Process Water Circuit Make-Up. The reservoir chamber Dirty Side will begin to fill. The filling will stop automatically at a preset level.
iii. Verify that all four (4) ball valves associated with Filter Housings FH-3 and FH-4 are in the open position. (BV-F3B, BV-F3T, BV-F4B, BV-F4T See Figure 14)
iv. Partially open the Air Bleed Valves on top of filter housings. (See Figure 13 and Air Bleed Valve Warning)
v. Turn Power Selector Switch to "ON" position
vi. Press Reset Push Button. Blue Control Power indicating light should come on.
vii. Depress Pump 1 start button and observe the water in the chamber. Stop the pump when the water drops to 5 inches (130 mm) from the bottom. Allow reservoir chamber to re-fill. Do not re-start the pump until reservoir reaches the fill line.
viii. Close air bleed valves when water starts coming out.
ix. Repeat process. Water will eventually begin to fill the clean side. Repeat until water is overflowing the reservoir Clean Side weir and spilling back into the Dirty Side. Allow to run for 10 minutes. This will allow the two tanks to reach an equilibrium. At this point the chiller evaporator tube housings are full as well as FH-3 & FH-4.

FIGURE 13

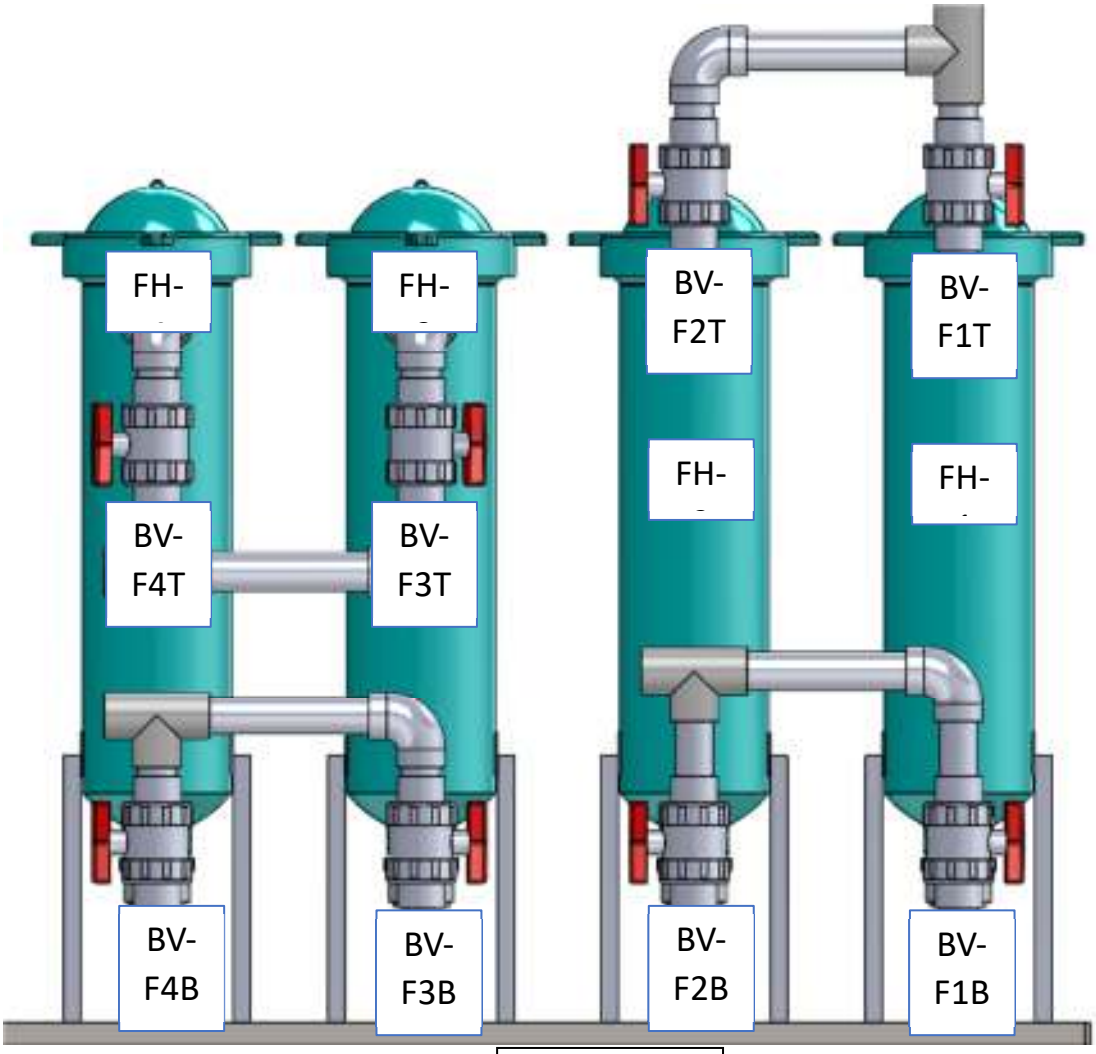


FIGURE 14

WARNING: Water from the air bleed valves may come out at high velocity. Keep personnel from their opening. If sensitive equipment is in the vicinity attach appropriate fittings and hose to direct water to safe container.

c. Process Water Circuit
   i. Verify that the Lift Station is properly connected and has 110VAC power. The lift station pump automatically starts and only runs when sufficient water has accumulated in the Lift Station holding tank.
   ii. Open all 4 ball valves associated filter housings FH-1 and FH-2 (i.e. BV-F1T, BV-F1B, BV-F2B, BV-F2T)
   iii. Partially open the Air Bleed Valves on top of filter housings.
   iv. Configure Isolation Valves as required. See Figure 15

Suggested start configuration uses Resin Tank 1 (Activated Carbon) and Resin Tank 2 (Ionic Exchange Resin). Resin Tank 3 (Ionic Exchange Resin) is left dry on standby. (See Section III.8. Resin Tank Change Out). NOTE: System can operate correctly with only one (1) ion exchange resin tank.

- Close BV-BP1
- Close BV-BP2
- Close BV-T3I
- Close BV-T3O
- Open BV-T1I
- Open BV-T1O
- Open BV-T2I
- Open BV-T2O

v. Open BV-PR and BV-PS. See Figure 15
vi. Open valves on all connected saws that allow process water to flow.
vii. Start Pump 1 and allow to reach equilibrium. Water will start cascading over the Clean Side weir.
viii. Start Pump 2. This will quickly draw down water in the Clean Side Reservoir as it fills the resin tanks and then the filter housings. Stop Pump 2 when the water drops to 5 inches (130 mm) from the bottom. Keep Pump 1 running. Allow reservoir chamber to re- fill.
ix. When water starts cascading over the Clean Side weir and reaches the fill line level repeat step xv.
x. Close air bleed valves when water starts coming out.
xi. Continue process until water begins returning from the Lift Station.

As the system reaches equilibrium water will begin to cascade over the weir from the Clean Side to the Dirty Side and the level in the Dirty Side tank will level out at the Blue Fill Line.

CAUTION: Use caution to avoid allowing water level to sink too low. Stop pump if there is any indication that air is getting into the pump inlet.

CAUTION: Water from the air bleed valves may come out at high velocity. Keep personnel from their opening. If sensitive equipment is in the vicinity attach appropriate fittings and hose to direct water into a safe container.

CAUTION: Water from the air bleed valves may wet the Leak Detection Strip and stop all pumps. See SECTION I.8

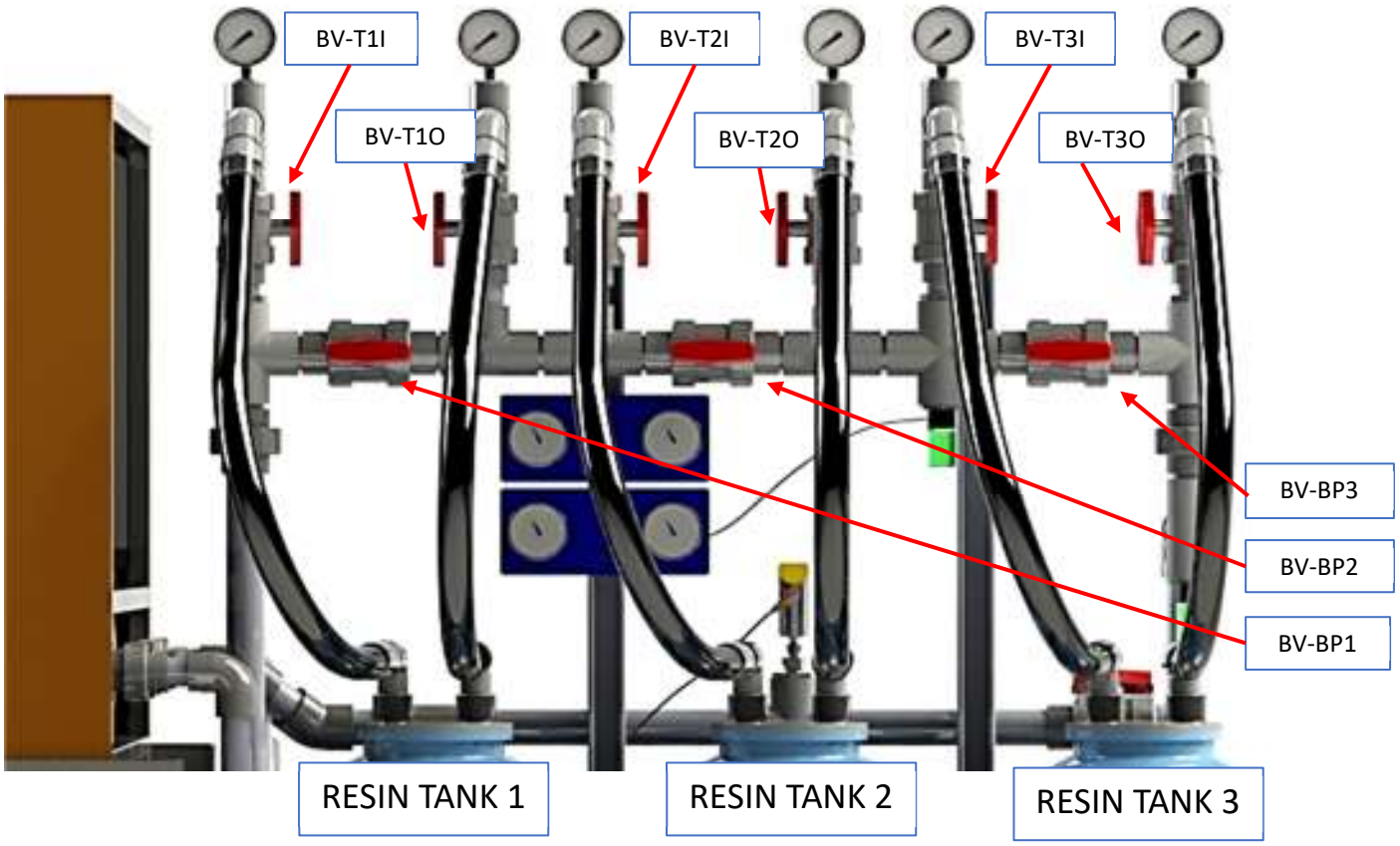


FIGURE 15

3. STARTING THE CHILLER

The chiller provides cooling by refrigeration for both the spindle water and the saw (or process) water. Each side is individually controlled by a separate RANCO Electronic Temperature Controller mounted on the front of the WFS above the control cabinet.

The controllers are labeled Stage 1 and Stage 2. Stage 1 controller regulates the water temperature for the Process Water Loop. Stage 2 controller regulates the temperature for the Spindle Cooling Circuit.

With all three (3) pumps running depress the Chiller ON push button. The chiller will be powered up. The RANCO controllers will illuminate and display the current temperature settings. After a few seconds the chiller compressor will start up and begin to regulate the water temperature.

CAUTION: Do not operate the chiller unless the circulating pumps are running.

SECTION III NORMAL OPERATION

Installation and plumbing configurations can vary significantly from one facility to another. For that reason, the procedures outlined herein are generic and may require “fine-tuning” to accommodate facility specific operation.

1) **Start-Up Check List**
   Prior to starting day to day operations, the following conditions should be verified:
   a. Water level in reservoirs is at or above fill lines
   b. That all facility interface ball valves are open
   c. Make-up water ball valves BV-MU1 an BV-MU2 are open and supply water is available to them
   d. Lift Station has power
   e. All appropriate valves on the dicing saws are open
   f. Ball Valves in the Isolation Valve Group are properly configured for your application
   g. Ball Valves for all filter housings are properly configured for your application
   h. E-Stop push button is pulled out

2) **POWER-UP**
   Turn Power Selector Switch to On. Red Alarm indicating light should illuminate. Press green Reset Push Button. Blue Power indicating light should illuminate.

3) **PUMP AND CHILLER START-UP**
   When properly powered up all pumps and chiller are started by depressing the associated green push button. Each pump or chiller can be stopped independently by depressing the associated red push button. All pumps and chiller can be stopped simultaneously by depressing the E-Stop button.

   a. Start Pump 1
      This will begin the recirculating loop. The water level in the Dirty Side chamber may drop for a few seconds. Depending on facility specific conditions the water on the Dirty Side may overflow into the Clean Side when the system is shut down. Allow Pump 1 to run for 3-5 minutes to assure that the water in the clean side is properly filtered.

   b. Start Pump 2
      This will start the Process Cooling loop. The water level in both the Clean Side and Dirty may drop and the cascading may also stop for a few seconds. Within a few seconds the Lift Station should begin to return Process Water back to the Dirty Side chamber.

   c. Start Pump 3
      This will start pumping water out to cool the spindle motors. This is a closed-loop system. Water should begin returning back to the reservoir within a few seconds.

   d. Start Chiller
      The cooling fans will start up immediately and the RANCO controllers will illuminate and display current settings. After a few seconds the condensing pump will start up and start cooling water for the Process and Spindle Motor loop.

The temperature for each loop can be independently regulated by the settings on the RANCO controllers. Raising or lowering the temperature setting is simply accomplished by the use of the Up or Down push buttons on the RANCO units.

4) **SHUT-DOWN**

The chiller and all pumps can be started or stopped by depressing the appropriately marked push button. All start push buttons are green and all stop push buttons are red.

a. Stop the chiller

b. Stop Pump 2
The Lift Station is controlled by an automated float sensor and can continue to return water to the Dirty Side reservoir for a period of time. This may cause the Dirty Side to overflow. The Lift Station will stop automaticity shortly after Pump 2 is stopped.

c. Stop Pump 3

d. Stop Pump 1

e. Close Ball Valves BV-MU1 and BV-MU2
We recommend closing the make-up water ball valve when the system is not in use. This is to prevent accidental overfilling in the event of a leaking float valve.

5) **FILTER PRESSURE GAUGES**

Four (4) pressure gauges that correspond to the associated filters are mounted on vertical supports and face the front. These pressure gauges can be used to determine when a filter requires change-out.

The pressure readings on the gauges associated with filter housings FH-3 and FH-4 provide an accurate indication of the filter condition.

The pressure readings on the gauges associated with filter housings FH-1 and FH-2 read the back pressure for the complete process loop. To acquire an accurate indication of the filter condition the filter condition GV-1 must be opened by turning the valve handle clockwise. This will temporarily take the process loop offline as it diverts the process water directly back to the Dirty Side chamber. It is not necessary to close any facility interface ball valves. See Figure 16

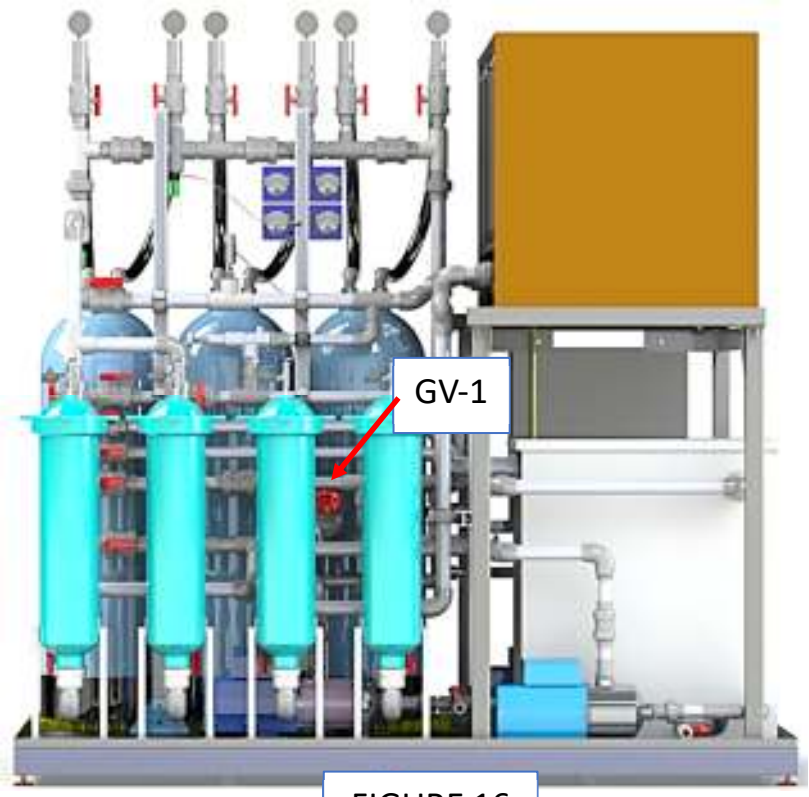


FIGURE 16

With GV-1 fully open Gauges1 & 2 will accurately display the filter pressure. Close GV-1 to bring the process cooling loop back on-line.

6) **FILTER CHANGE OUT**

Filter change out is recommended when the pressure drop through the filter housing exceeds 50 PSI. The filter housings are arranged so that filters can be changed without interruption to the process. To bring a particular stand-by filter "online" and take the active filter "offline" is a simple matter of opening and closing ball valves. This can be accomplished with all pumps running.

WARNING: Always bring the clean stand-by filter online before taking the active dirty filter offline.

Example: FH-3 is active and the pressure reading on the associated pressure gauge exceeds 50 PSI. FH-4 is clean and on stand-by.

a. Bring stand-by filter FH-4 online. Open BV-F4T and BV-F4B.
b. Take active filter FH-3 offline. Close BV-F3T and BV-F3B.

Once a filter is offline, relieve any pressure in the housing by opening air-bleed valve on top prior to removing cover. It is recommended that the customer install a hose to the air-bleed valve to direct any leakage off of the base structure.

WARNING: Use caution to avoid water splashing onto the base structure. If the leak detecting strip gets wet all of the pumps and chiller will stop. See SECTION I.8

7) **RESIN TANK GAUGES**

There are two gauges associated with each resin tank. By subtracting the high pressure reading (discharge side) from the lower pressure (in-let side) a delta pressure reading is obtained. This delta pressure is the actual pressure drop through the resin tank and indicates the condition of the resin bed.

8) **RESIN TANK CHANGE-OUT**

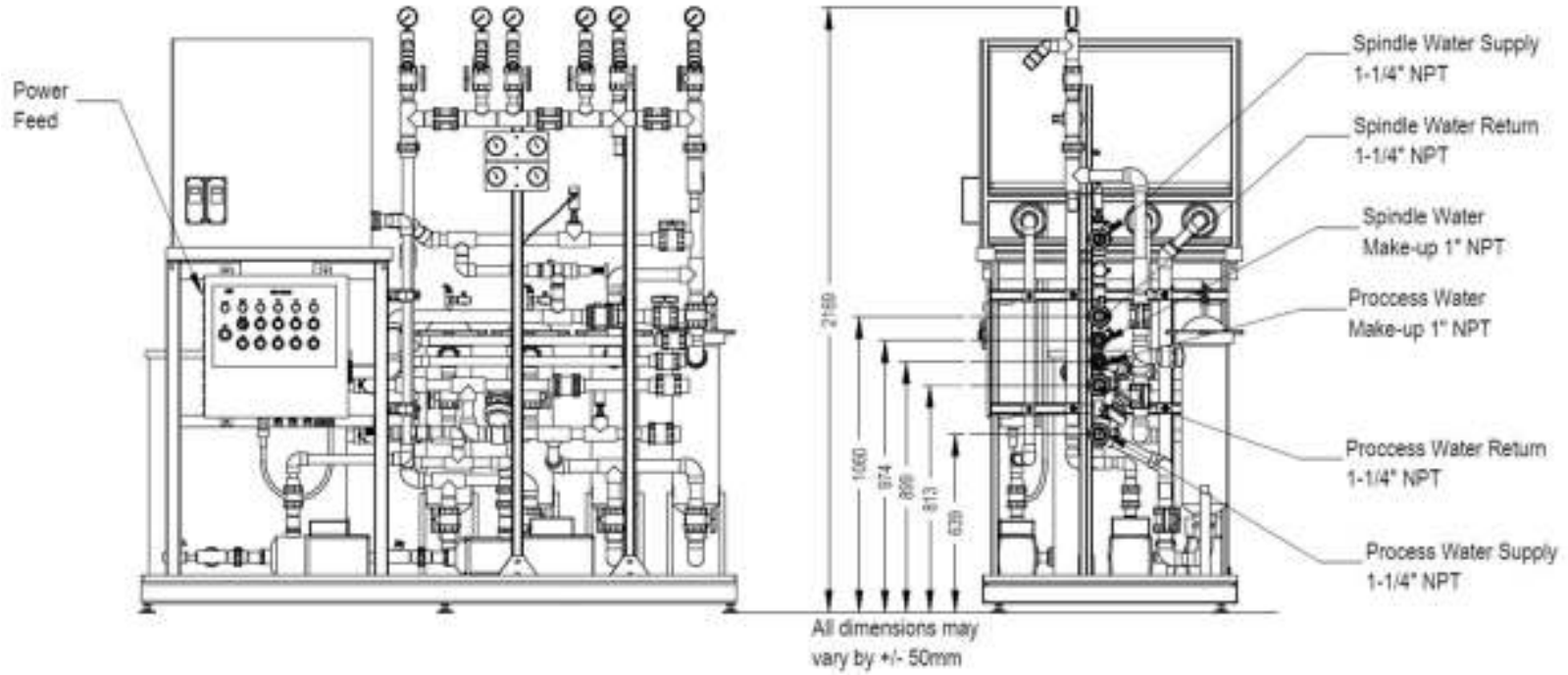
The customer supplied resin tanks can be changed out without interruption to the process. Two (2) resistivity sensors provide indication when a particular resin bed has reached end of life and requires change-out.

Changing out a particular resin tank is accomplished by first bringing the stand-by unit online and then taking the active unit offline.

Example: Resin tank RT-2 is active and resin tank RT-3 is on standby. Both resistivity sensors are red indicating that RT-2 has reached end of life. If RT-3 is dry slightly crack open BV-T3I and BV-T3O. This will allow the resin tank to slowly fill with water while still maintaining flow to the process loop. After 10 minutes fully open BV-T3I and BV-T3O. Close BV-BP3 and open BV-BP2. One (1) resistivity sensor should turn green after a few minutes. Close BV-T2I and BV-T2O. Resin tank RT-2 can now be removed.

WARNING: Use caution to avoid water splashing onto the base structure. If the leak detecting strip gets wet all of the pumps and chiller will stop.

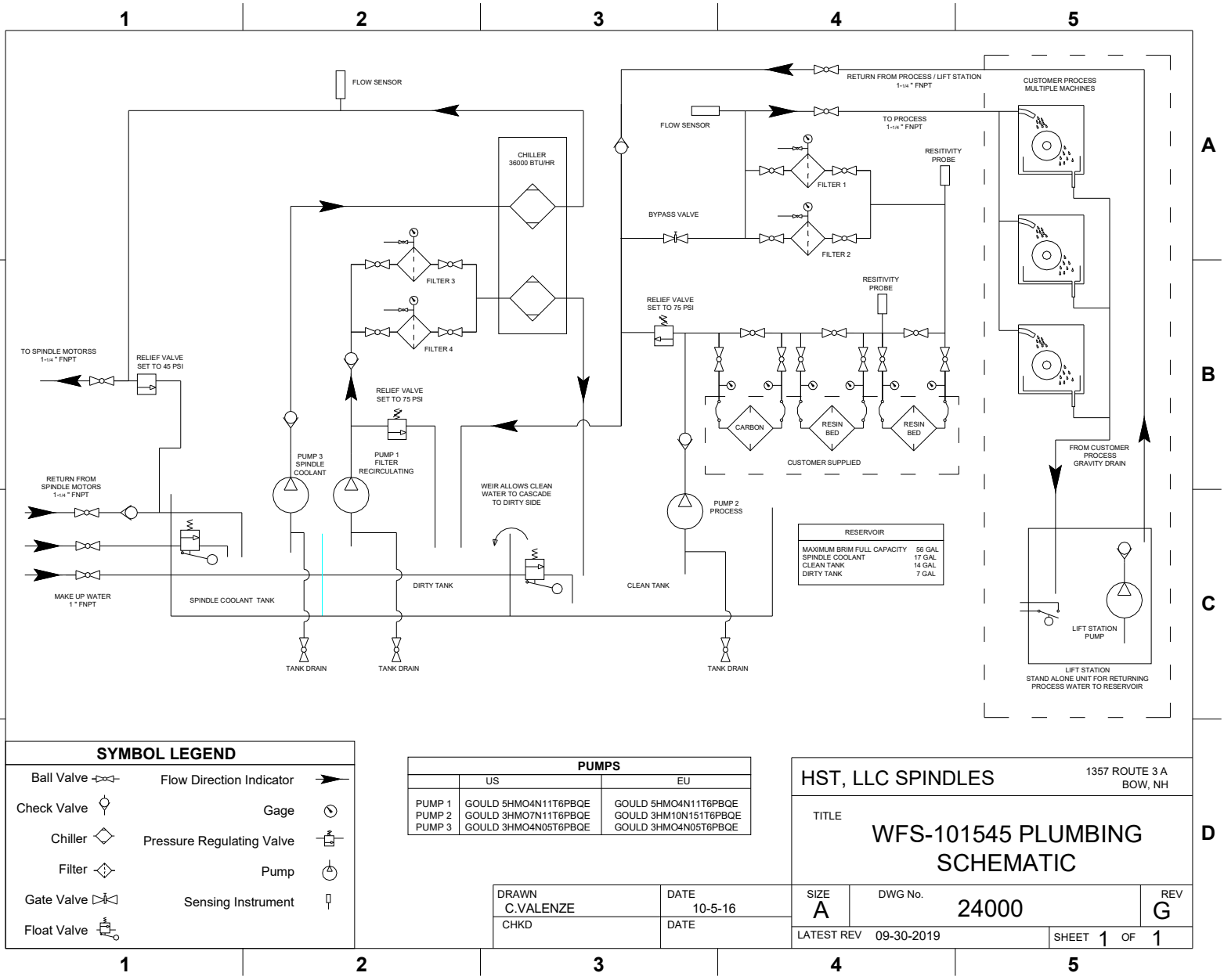
PLUMBING INTERFACE



FRONT ELEVATION

RIGHT SIDE

PLUMBING SCHEMATIC



RESERVOIR	
MAXIMUM BRIM FULL CAPACITY	66 GAL
SPINDLE COOLANT	17 GAL
CLEAN TANK	14 GAL
DIRTY TANK	7 GAL

SYMBOL LEGEND

Ball Valve	Flow Direction Indicator
Check Valve	Gage
Chiller	Pressure Regulating Valve
Filter	Pump
Gate Valve	Sensing Instrument
Float Valve	

PUMPS

	US	EU
PUMP 1	GOULD 5HMO4N11T6PBQE	GOULD 5HMO4N11T6PBQE
PUMP 2	GOULD 3HMO7N11T6PBQE	GOULD 3HM10N151T6PBQE
PUMP 3	GOULD 3HMO4N05T6PBQE	GOULD 3HMO4N05T6PBQE

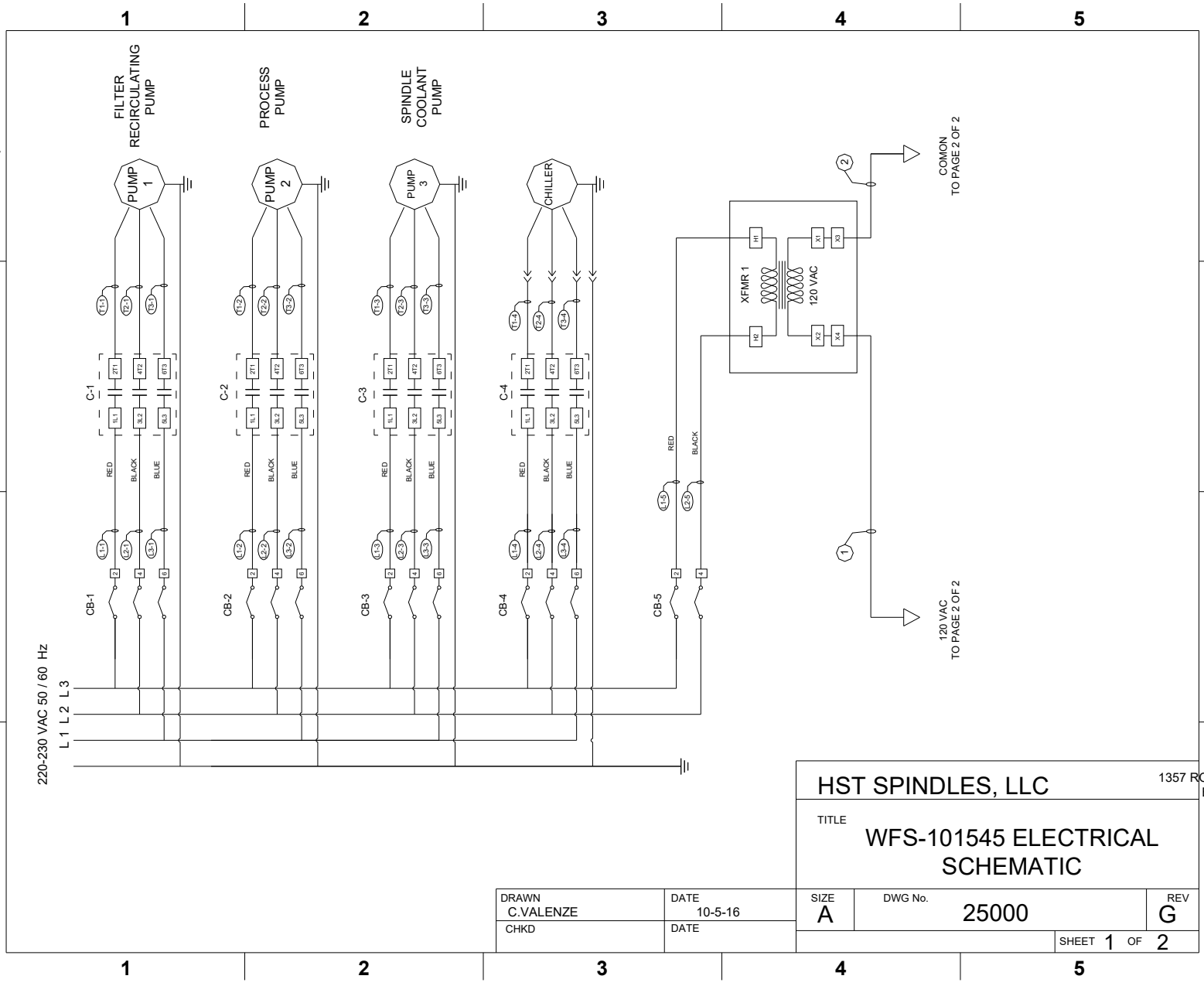
HST, LLC SPINDLES
1357 ROUTE 3 A
BOW, NH

TITLE
WFS-101545 PLUMBING SCHEMATIC

DRAWN	DATE	SIZE	DWG No.	REV
C.VALENZE	10-5-16	A	24000	G
CHKD	DATE	LATEST REV 09-30-2019	SHEET 1 OF 1	

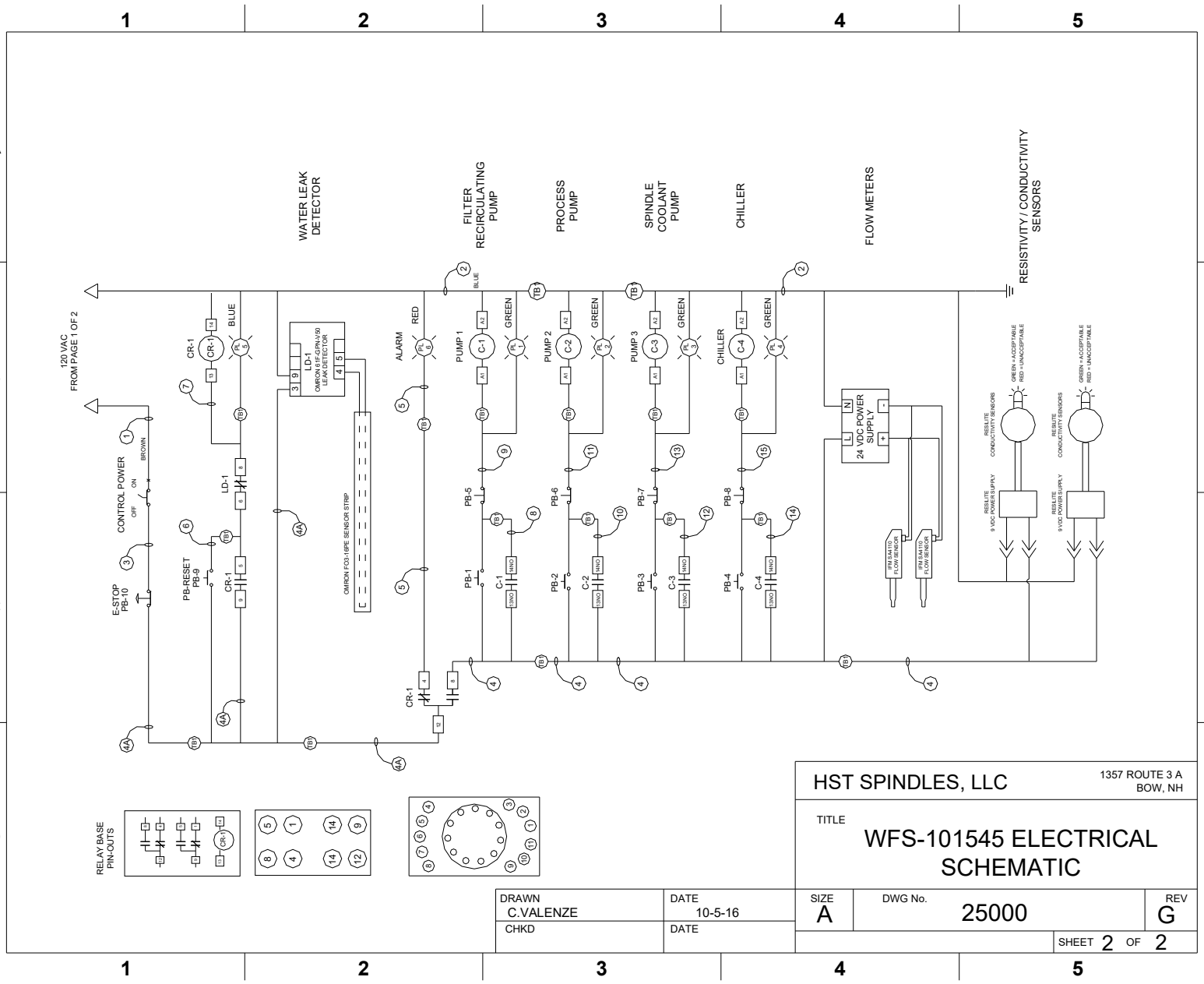
ELECTRICAL SCHEMATIC

SHEET 1 OF 2



ELECTRICAL SCHEMATIC

SHEET 2 OF 2



TROUBLESHOOTING

PROBLEM	POTENTIAL CAUSE
Pumps and Chiller will not operate	E-Stop Button in depressed detent Reset Push Button not depressed Leak Sensing Strip is wet Facility Power is off
Chiller will not start	Chiller Circuit Breaker is off Chiller Freon is low
Chiller cycles rapidly	Hysteresis setting on RANCO controller too small.
Water Temperature varies significantly	Hysteresis setting on RANCO controller is too large
A particular pump will not start	Pump circuit breaker is off
Lift Station does not return water	No power to Lift Station Internal Float switch failed
Water overflows reservoir	Float Valves jammed open with debris
Reservoir runs dry	Float Valves jammed closed with debris

DESIGN DATA

PRODUCT	LINK
Gould HM Pumps	https://s3.amazonaws.com/pumpproducts/pdf/547800_5_Goulds+e-HM+Multistage+Pump+Technical+Brochure.pdf
FSI X 1000 Filter Housings	http://www.fsifilters.com/assets/files/literature/x100-convertible-filter-housing.pdf
Copeland Air-Cooled Condensing Unit	https://climate.emerson.com/documents/copeland-scroll-air-cooled-refrigeration-condensing-units-en-2884068.pdf
IFM SA4110 Flow Sensors	https://www.ifm.com/us/en/product/SA4110
Resilite RES 7130 Resistivity Sensor	https://www.servapure.com/assets/images/PDF/Resilite%20Red-Green%20Purity%20Lights.pdf
Hudson Float Valve	http://www.sharkpw.com/Upload/CPDCategoryDocuments/Shark%20Hudson%20Float%20Valve_1407.pdf http://hudsonvalve.com/products/
Omron 61F-GPN-V50 Leak Detection	http://www.ia.omron.com/data_pdf/cat/61f-gpn-v50_ds_e_5_5_csm10.pdf?id=566
Ashcroft Pressure Gauge	http://ashcroft.com/drawingsandmodels_pdf/upload/drawing-industrial-gauge-10-100s-02l.pdf
RANCO ETC-111000	http://www.rancoetc.com/ranco-etc-111000-000-digital-temperature-controller