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# BUBBLER SYSTEM: Model BS2000

## Description:

The BS2000 is a fully automatic bubbler system, that performs liquid level measurement for water and waste water applications. It is a Dual Compressor System, with Bubbler Tube Purge, Tank Moisture Dump, System Status Indication, and System Fault Alarms. It operates by pumping air down a tube that has one end submerged in liquid, it then measures the back pressure, and provides an analog output representing the liquid level.

## Standard Features:

- 120 VAC input power, with Transient Protection.
- 4-20mA Analog Output signal proportional to Level.
- Analog Output Calibration Zero and Span Adjustments, Field Calibration Range: from 10 ft/H<sub>2</sub>O up to 20 ft/H<sub>2</sub>O.
- Phoenix style Connectors used for easy servicing of Unit.
- Air Compressor Run Indication.
- Air Tank Pressure Bar Graph Display.
- Turns Compressors On/Off based on Air Tank Pressure.
- Air Tank Pressure Adjustment.
- Alternates Air Compressors to provide even run time.
- Detects a Faulty Compressor and makes other Compressor Lead.
- Air Compressor Failure Alarm Indication.
- Clogged Bubbler Tube Alarm Indication.
- Common Alarm Output Relay for the following:
  - Air Compressor Fault Alarm.
  - Clogged Bubbler Tube Alarm.
- Automatic Bubbler Tube Purge and Air Tank Moisture Dump Cycle, performed every 6 hours.
- Attempts to clear a Clogged Bubbler Tube by activating the Purge/Dump Cycle, prior to turning on the alarm.
- Air Compressor Save Mode that limits the run time of the Compressors when a major leak is present.
- Push-Button for Alarm Reset or Manual Purge/Dump Cycle.
- Freezes Analog Output Signal during Purge/Dump Cycle.
- Internal Fuse for each Compressor. Internal Fuse for Purge and Dump Solenoids.

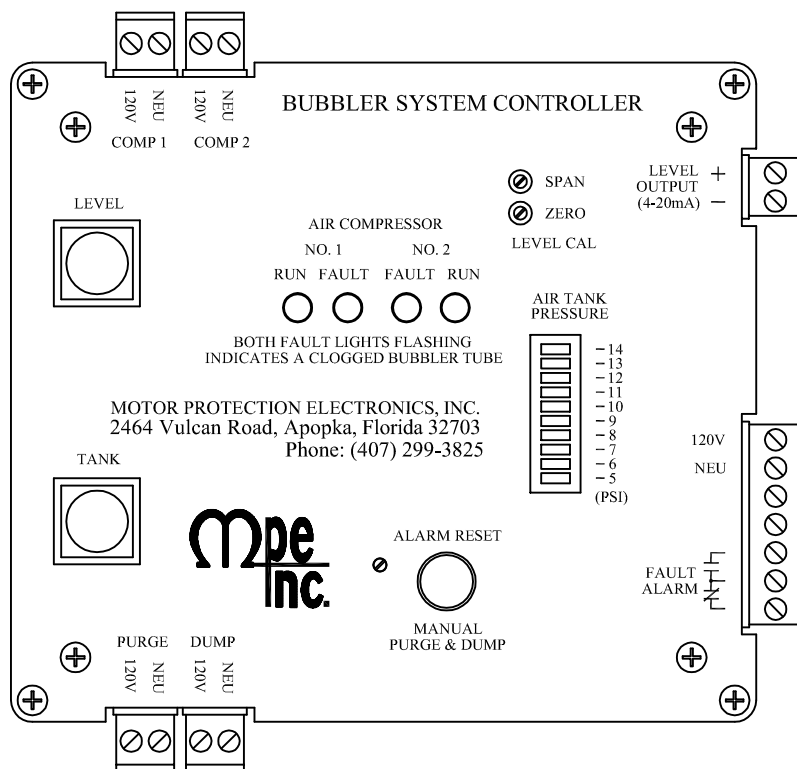
## Specifications:

- Input Power: 120VAC±10%, 60Hz, 60VA max
- Input Power Transient Protection: Metal Oxide Varistor
- External Dimensions: 13.25" x 11.0" x 6.0"
- Agency Approvals: UL 61010C-1, the Standard for Process Control Equipment
- Ambient Operating Temperature: 0°C to +65°C (32°F to 149°F)
- Storage Temperature: 0°C to +70°C (32°F to 158°F)
- Ambient Humidity: Less than 85% (Non-Condensing)
- Air Tank Pressure Display: 10 Segment LED. Displays Tank Pressure from 5psi to 14psi.
- Indicators: LED
- Alarm Relay: 6A @ 120VAC
- Analog Output: Non-isolated, Transient Protected, 4-20mA, will drive up to a 400 Ohm load.
- Analog Output Calibration Range: from 10 ft/H<sub>2</sub>O up to 20 ft/H<sub>2</sub>O.
- Air Storage Tank Pressure Rating: 30 psi Maximum (see Warning in Maintenance Notes)

## Ordering Information:

Model Number: BS2000

When ordering please provide calibration requirements.  
(Unit may be calibrated so that a 20mA output represents anywhere from 10 feet of water to 20 feet of water.)



## SYSTEM STATUS INDICATION

### COMPRESSOR RUN INDICATION

Compressor Run Indication shows which Compressor(s) the Controller is calling to run.

### COMPRESSOR FAULT INDICATION

Compressor Fault Indication shows when a Compressor has failed to bring the Tank Pressure up to the Lead Off Setpoint. The system only tests the Lead Compressor for failure. The Lead Compressor is given 1 minute to bring the Tank Pressure up to the Lead Off Setpoint; if it does not, the respective Fault indicator is turned on, and the other compressor is made the Lead Compressor. The new Lead Compressor will remain Lead Compressor, and the Fault indicator will stay on, until the Alarm Reset Push-Button is pressed, or until control power is lost. A Compressor with its Fault indicator on, may be called to run, but only as Lag Compressor. The Fault Alarm Relay will be de-energized whenever one or both Compressors are faulted. ( The Fault Alarm Relay stays energized as long as there is no fault.)

If both Compressor Fault lights are on steady (not flashing), it means that neither Compressor was able to pump the air pressure up to the Lead Off Setpoint in the time allotted. It is assumed that a significant air leak in the unit exists, so the unit is placed in the Air Compressor Save Mode to prevent the Compressors from over-heating. In this mode each Compressor is only allowed to run for 15 seconds at a time. After a Compressor has run, compressor operation is suspended for the next 15 seconds, then the other Compressor is allowed to run if need. Pressing the Alarm Reset Push-Button exits this mode.

### CLOGGED BUBBLER TUBE FAULT INDICATION

The Controller keeps track of how often a compressor is called in order to maintain pressure in the Air Storage Tank. When the time exceeds 10 minutes, it is assumed that the Bubbler Tube is clogged. The first time this happens, a Purge/Dump cycle is initiated, but no alarm is activated. This gives the system a chance to clear the clog before the alarm is activated. If within the next 15 minutes the clogged Bubbler Tube condition is detected again, the Bubbler Tube alarm is activated, and the system tries again to clear the clogged Bubbler Tube. As long as the Bubbler Tube remains clogged, the system will attempt to clear it every 10 minutes. The alarm is indicated by alternately flashing the Compressor Fault LEDs. The alarm indication will remain on until the Alarm Reset Push-Button is pressed, or until control power is lost. The Fault Alarm Relay will be de-energized whenever there is a Clogged Bubbler Tube Alarm. This alarm may also be activated if the Air Tank Pressure Adjustment is set too low for the depth of water being measured or when the water in the wet well is too high to allow adequate flow through the Bubbler Tube. A clogged Filter / Flow Restrictor Assembly may also cause this alarm. If there is a Clogged Bubbler Tube alarm and the 4-20 mA level output is correct, then a clogged Filter / Flow Restrictor Assembly is the most likely cause.

### AIR TANK PRESSURE INDICATION

The Controller measures the pressure in the Air Tank and displays this information on the Bar Graph Indicator. This information aids the operator in accessing system status. It may be used to help make Air Tank Pressure adjustments, and it is also helpful while checking the system for leaks. The indicator at either end of the Bar Graph will blink when the measured pressure is off the scale.

# PUSH-BUTTON FUNCTIONS

The Push-Button on the Controller serves two functions:

## Alarm Reset

If the Push-Button is pushed while there is a Compressor Fault alarm or Clogged Bubbler Tube alarm, then the alarm will be reset.

## Manual Purge & Dump

If there are no alarms, and the Push-Button is pushed, then the Controller will perform the Bubbler Tube Purge and Air Tank Moisture Dump cycle.

# AIR TANK PRESSURE ADJUSTMENT

## Location

The adjustment potentiometer is located to the left of the Push-Button. It is not labeled and is behind a small hole, to discourage those who would play around with the adjustment, until after they have read this manual.

## Special Tool Required

To perform this adjustment a very small straight-slotted screw driver is required.

## Purpose of Adjustment

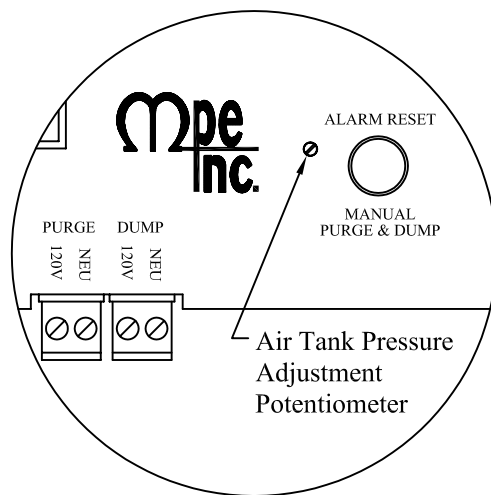
The purpose of this adjustment is to provide the operator with the means of turning down the Storage Tank Air Pressure, in an effort to reduce air usage and so extend the life of the Air Compressors.

## Adjusting Air Tank Pressure

The Factory Setting, of 9 psi, is suitable for a Level Measurement Range of 20 feet. However, if the range is considerably less than 20 feet, then an adjustment of the Air Tank Pressure should be considered. The following table may be used as a guide for determining what pressure to set it on:

**Air Tank Pressure Adjustment Table**

Level Measurement Range	Lead Compressor Turn On Pressure	Tank Pressure Potentiometer Position
18 - 20 feet	9 psi	Fully Clockwise (Factory Setting)
15 - 17 feet	8 psi	_____
12 - 14 feet	7 psi	_____
10 - 11 feet	6 psi	Fully Counterclockwise



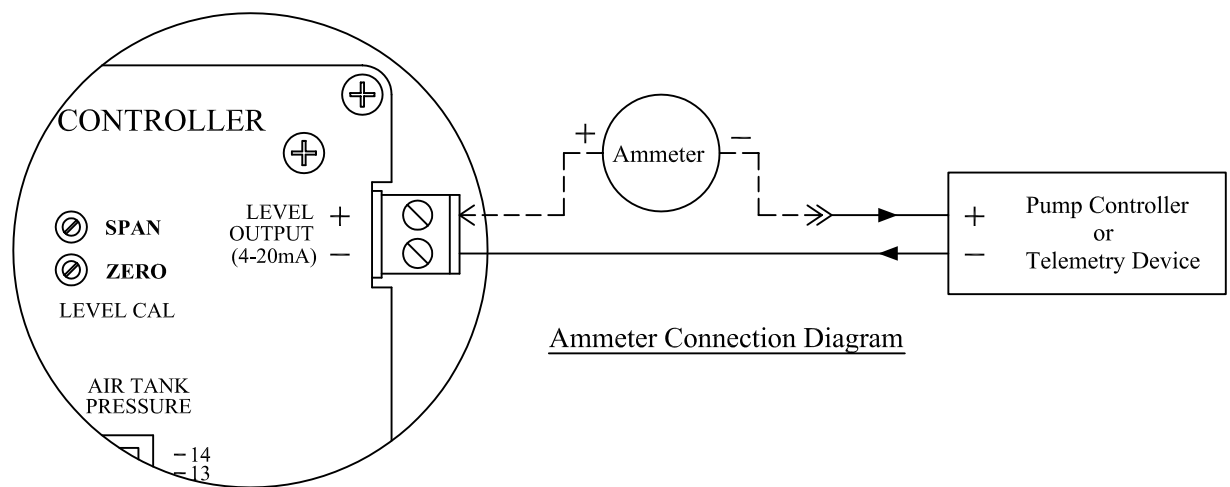
Decrease      Increase

**Level Measurement Range** - The Level Measurement Range shown in the above table, is not the entire depth of the Wet Well, rather it is the distance from the **End of the Bubbler Tube** to the **Highest Measured Point** in the Well. (See Example on Page 5 of this Manual.)

The adjustment of the Air Tank Pressure, must be coordinated with the calibration of the 4-20mA Analog Output, so that there will always be enough air pressure to make level measurement possible across the entire **Level Measurement Range**.



# WET WELL LEVEL ANALOG OUTPUT CALIBRATION



## ZERO CALIBRATION

This adjustment makes the Analog Output produce 4.00mA, when no liquid is covering the end of the Bubbler Tube.

### Calibration Procedure:

1. Place an Ammeter in the Analog Output circuit as shown above.
2. Pull the Bubbler Tube out of the liquid.  
(Alternate Procedure - Disconnect Bubbler Tube from the BS2000.)
3. Turn the ZERO Calibration Potentiometer until the Ammeter reads 4.00mA.
4. Perform the procedure below, to calibrate the SPAN.

## SPAN CALIBRATION

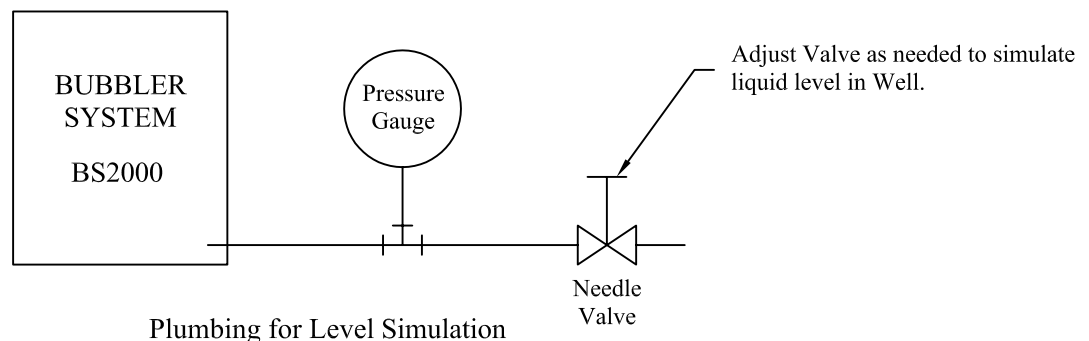
This adjustment makes the Analog Output produce 20.0mA, when the depth of the liquid covering the end of the Bubbler Tube is at the **Highest Measured Point**. See Example on Page 5 of this Manual.

### Calibration Procedure:

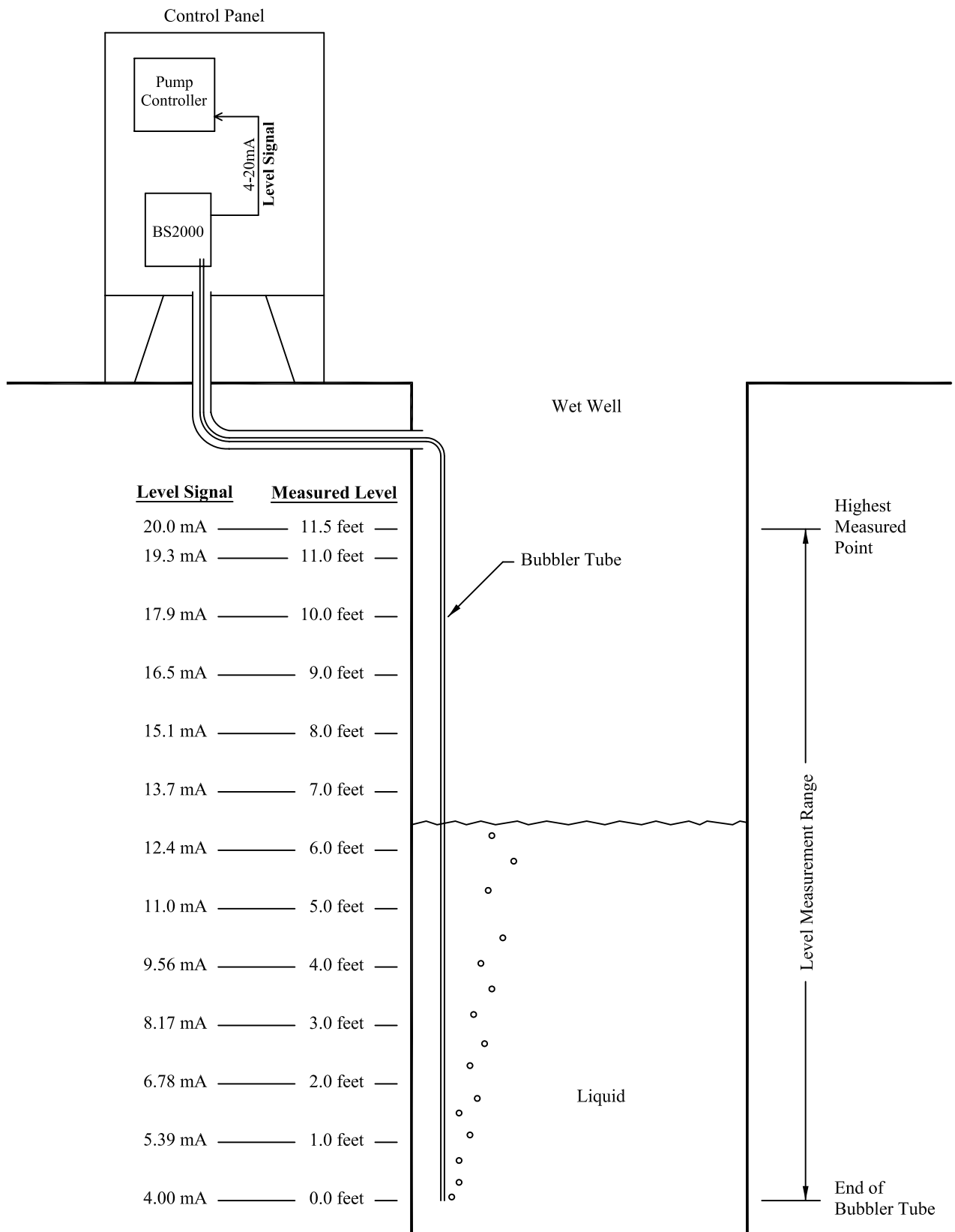
1. Place an Ammeter in the Analog Output circuit as shown above:
2. Allow the Wet Well to fill up to the **Highest Measured Point**, with the Bubbler Tube in place in the Well.  
(Alternate Procedure - Simulate the equivalent pressure using a Pressure Gauge and a Needle Valve. See plumbing diagram below.)
3. Turn the SPAN Calibration Potentiometer until the Ammeter reads 20.0mA.
4. Perform the procedure above, to calibrate the ZERO. (Go back and forth between the ZERO and SPAN calibration procedures until both are correct.)

$$\text{Pressure (psi)} = \text{Level (feet of H}_2\text{O)} \times 0.4331$$

$$\text{Level (feet of H}_2\text{O)} = \text{Pressure (psi)} \times 2.309$$



# LIFT STATION EXAMPLE



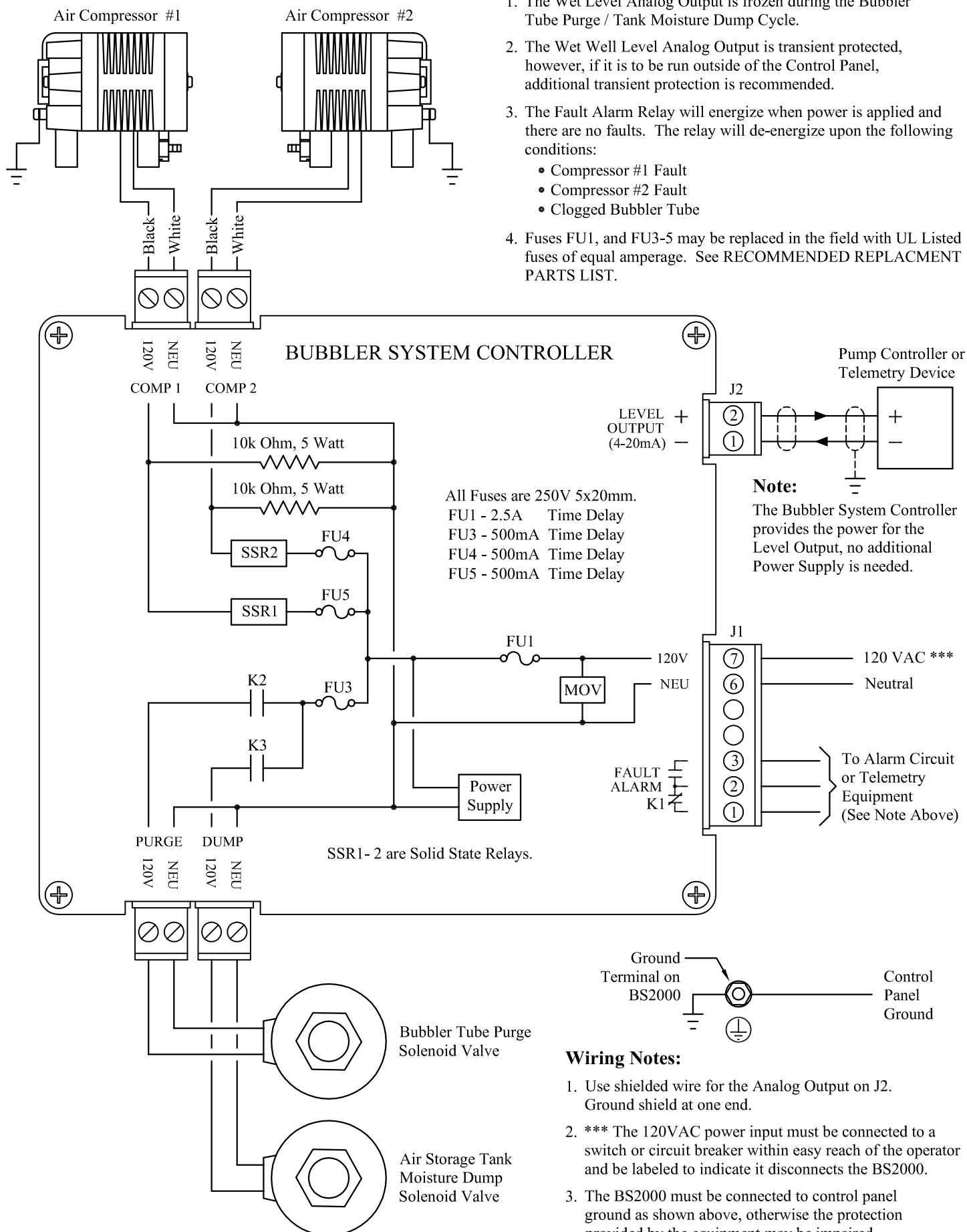
## Notes:

1. The **Level Measurement Range** does not typically extend all the way to the top of the Wet Well.
2. The **End of the Bubbler Tube** is typically placed some distance above the bottom of the Wet Well.
3. The **Measured Level** does not include the distance from the **End of the Bubbler Tube** to the actual bottom of the Wet Well. This relatively short distance is typically disregarded.
4. The **Pump Controller**, in this example, would be set up to display the **Measured Level**. The **Pump Controller** would be calibrated to read 11.5 feet, with an analog **Level Signal** of 20.0mA.

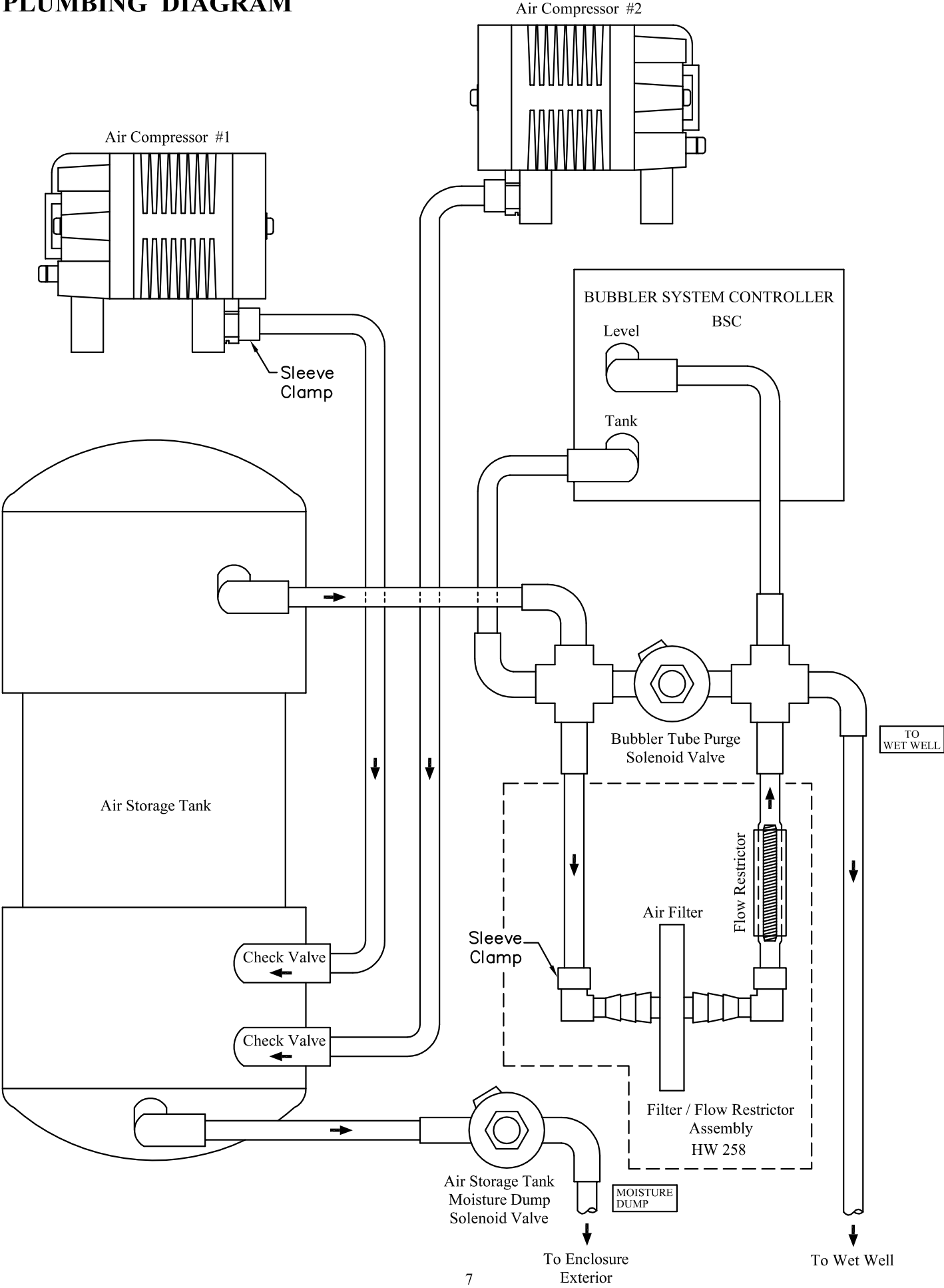
# ELECTRICAL DIAGRAM

## Notes:

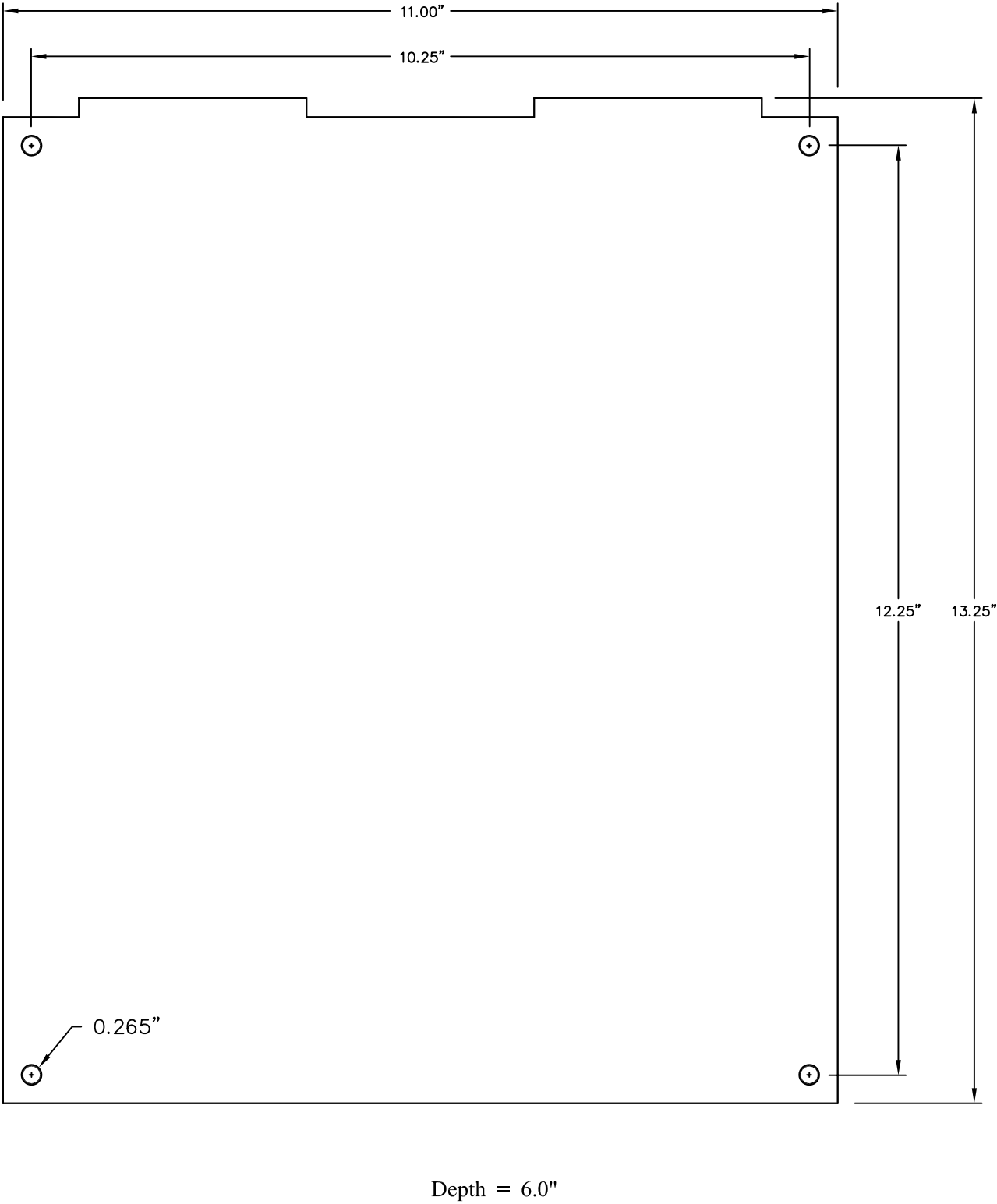
1. The Wet Level Analog Output is frozen during the Bubbler Tube Purge / Tank Moisture Dump Cycle.
2. The Wet Well Level Analog Output is transient protected, however, if it is to be run outside of the Control Panel, additional transient protection is recommended.
3. The Fault Alarm Relay will energize when power is applied and there are no faults. The relay will de-energize upon the following conditions:
  - Compressor #1 Fault
  - Compressor #2 Fault
  - Clogged Bubbler Tube
4. Fuses FU1, and FU3-5 may be replaced in the field with UL Listed fuses of equal amperage. See RECOMMENDED REPLACEMENT PARTS LIST.



PLUMBING DIAGRAM



MOUNTING DIMENSION DIAGRAM



## RECOMMENDED REPLACEMENT PARTS LIST

DESCRIPTION OF PART	MANUFACTURER	MFG. PART #	MPE PART #
Bubbler System Controller	MPE	BSC	BSC
Air Compressor, 14.2 psi, 0.028 CFM, 120VAC	Medo	AC0110	HW 224
Solenoid Valve, Two-Way, NC, Brass, 1/8" NPT, 120VAC 5/32" Orifice	Kip (Norgren)	U141116-120/60	HW 225
Check Valve, S.S., 1/4" Male NPT, 1psi Cracking Pressure	Swagelok	SS-4CP2-1	HW 226
Air Filter (VACU-Guard), 6-10mm Stepped Barb, Box of 10	Whatman	6722-5000	HW 227
Union Elbow 225, Barbed, Brass, for 0.170 I.D. Tubing	Parker	225-4-4	HW 229
Female Cross Fitting, 1/8" NPT, Brass	Parker	2205P-2	HW 228
Close Nipple, 1/8" NPT, Brass	Parker	215PN-2	HW 233
Cable Clamp, 1/4", Nylon, for use with #8 screw	Keystone	7625	HW 235
NYCOIL Polyurethane Tubing, 1/4" OD x 0.040 Wall, Clear 100 ft roll	NYCOIL	63440	HW 178
Sleeve Clamp for 1/4" OD Tubing over Barbed Connection	MPE	HW 257	HW 257
Filter / Flow Restrictor Assembly	MPE	HW 258	HW 258
Fuse, 2.5A, 250V, Time-Lag, 5x20mm	Littelfuse	239 02.5	HW 162
Fuse, 500mA, 250V, Time-Lag, 5x20mm	Littelfuse	239 .500	HW 247
Male Elbow, 1/8" NPT, 1/4" OD Tubing, Acetal Plastic	McMaster-Carr	5785K616	HW 259
	Jaco Manufacturing	40-4-2-C	
Male Elbow, 1/4" NPT, 1/4" OD Tubing, Acetal Plastic	McMaster-Carr	5785K622	HW 260
	Jaco Manufacturing	40-4-4-C	
Female Connector, 1/4" NPT, 1/4" OD Tubing, Acetal Plastic	McMaster-Carr	5785K922	HW 261
	Jaco Manufacturing	25-4-4-C	
Insert for use with Plastic Tubing Fittings, Acetal Plastic	McMaster-Carr	5785K322	HW 262
	Jaco Manufacturing	P-4-C	

Catalog Cut Sheets for all parts are available upon request.

## **REPLACEMENT PART VENDOR INFORMATION**

<b><u>MANUFACTURER - PART</u></b>	<b><u>VENDOR</u></b>	<b><u>PHONE</u></b>
Medo – Air Compressor	CBC Electronics, Inc Sorrento, Florida www.cbcelectronicsinc.com	(352) 735-2242
Parker – Brass Fittings	Orlando Hose Fluid Power Orlando, Florida www.orlandohose.com	(407) 851-3536
McMaster-Carr – Plastic Fittings	McMaster-Carr Atlanta, Georgia www.mcmaster.com	(404) 346-7000
Jaco Manufacturing – Plastic Fittings	Jaco Manufacturing Berea, Ohio www.jacomfg.com	(800) 229-5226
Whatman – Air Filter	Whatman Clifton, New Jersey www.whatman.com	(800) 631-7290
Whatman – Air Filter	Fisher Scientific www.fishersci.com	(800) 766-7000
Nycoil – Tubing	Pneumatic Supply Inc. Clearwater, Florida	(727) 539-6500
Kip (Norgren) – Solenoid Valve	Pneumatic Supply Inc. Clearwater, Florida	(727) 539-6500
Swagelok – Check Valve	Florida Fluids System Technology Mulberry, Florida www.swagelok.com	(863) 425-3222
Littelfuse – Fuse	Newark Electronics www.newark.com	(800) 463-9275

# MAINTENANCE INSPECTION & TESTING

## VISUAL INSPECTION

- Check fault lights for indication of a Compressor Fault alarm.  
A compressor must be able to raise the tank pressure to the turn off point within one minute, if not the controller will turn on the compressor fault light. Due to this method of determining a compressor fault, a significant air leak can cause a compressor fault alarm, even though the compressor is operating properly. If both compressor fault alarms are on, the most likely problem is an air leak. With both compressor fault alarms on, the system will be placed in the Air Compressor Save Mode. See the section in this manual on Compressor Fault Indication.
- Check fault lights for indication of a Clogged Bubbler Tube Fault alarm. (Both fault lights flashing.)  
If this occurs the bubbler tube must be disconnected from the BS2000 and compressed air must be forced down the bubbler tube going to the wet well. If this does not work, the bubbler tube should be inspected for kinks or pinched areas. See Maintenance Notes below.  
If this problem persists, there may be a clog in the Filter/Flow Restrictor Assembly. Check for this problem by following the “Flow Testing The BS2000” procedure found below.
- Check tank pressure indicator for proper range.  
The tank pressure should be between 9 and 12 psi when the tank pressure adjustment is set on maximum or between 6 and 9 psi when the tank pressure adjustment is set on minimum. For more information see the section on Air Tank Pressure Adjustment.
- Check for exposure to corrosive gas.  
Hydrogen Sulfide or other corrosive gases will over time damage the electronic circuits inside the Bubbler System Controller. Corrosive gases will also corrode the aluminum parts and brass fittings. All entry points of corrosive gases must be sealed. Corrosion damage is not covered under the warranty.

## OPERATIONAL TEST

1. Press the Manual Purge & Dump push-button to start the manual bubbler tube purge and tank moisture dump cycle.
2. Verify that both compressors turn on and run.
3. Verify that the tank pressure quickly builds up to 14 psi just prior to the opening of the Bubbler Tube Purge Solenoid Valve.
4. Verify that the Bubbler Tube Purge Solenoid Valve opens, by observing a sudden drop in the tank pressure, and by observing a large amount of air being released from the end of the bubbler tube into the wet well.
5. Verify that the tank pressure quickly builds up to 14 psi just prior to the opening of the Air Storage Tank Moisture Dump Solenoid Valve.
6. Verify that the Air Storage Tank Moisture Dump Solenoid Valve opens, by observing a sudden drop in tank pressure, and by observing air escaping from the Moisture Dump tube exiting the control panel.
7. Verify that the tank pressure rises back to the normal range and that both compressors turn off.
8. Verify that the actual wet well level is close to the level shown on the pump control or telemetry device connected to the 4-20mA level output from the BS2000.

## LEAK TESTING THE BS2000

1. Disable the automatic operation of the lift station pumps by placing the HOA switches in the Off or Hand position.
2. Remove the bubbler tube from the “To Wet Well” connection on the BS2000.
3. Plug the output of the BS2000 to prevent any air from escaping from the “To Wet Well” output. A plug can be fashioned from a short piece of tubing. One end of the tubing must be bent over and tie-strapped to the longer part of the piece of tubing. You will also need a fitting like the one on the bubbler tube.
4. Watch the pressure indicator on the Bubbler System Controller for 2 minutes, and verify that the pressure holds steady. The pressure should not drop more than a pound in 2 minutes. Any more than that and the leak should be found and fixed.



## **FLOW TESTING THE BS2000**

1. Remove the bubbler tube from the “To Wet Well” connection on the BS2000.
2. Connect a short piece of tubing to the “To Wet Well” output of the BS2000, with the other end of the tube held down to the bottom of a container of water.
3. Verify that the tank pressure indicator shows normal pressure.
4. Observe that a steady stream of bubbles is coming from the end of the tube. If not a clog exists in the Filter/Flow Restrictor Assembly. The entire assembly is available from MPE (see the Recommended Replacement Parts List).

## **LEAK TESTING THE BUBBLER TUBE**

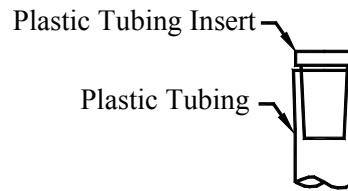
1. First perform the “Flow Testing The BS2000” procedure above.
2. Gain access to the wet well and check to see if bubbles are coming up around the bubbler tube in the wet well.
3. Allow the wet well level to rise to a high level and recheck for bubbles coming up around the bubbler tube.
4. If there are no bubbles this indicates the presence of a leak in the bubbler tube. This leak must be found and fixed. Bear in mind that the deeper the water covering the end of the bubbler tube the fewer the bubbles that will appear. Also the larger the diameter of the bottom section of the bubbler tube, the larger the bubbles that will be formed. The larger the bubbles the fewer there will be. When a 3/4 inch pipe is used as the bottom section of the bubbler tube, and when it is covered with 15-20 feet of water, there may be several seconds between bubbles.

## **MAINTENANCE NOTES:**

- **WARNING! DO NOT APPLY MORE THAN 30 psi air pressure to the AIR STORAGE TANK** even if it is disconnected from the BS2000. **DO NOT** apply pressures significantly higher than 15 psi to the AIR STORAGE TANK while the tank is connected to the BS2000 or damage to the Tank Pressure Transducer could result.
- **WARNING! DO NOT** subject the BS2000 “To Wet Well” output to high-pressures or damage may result. The Pressure Transducers on the BS2000 are designed to operate between 0.0 – 14.5 psi. Subjecting one of the pressure transducer to pressures significantly higher than 15 psi can damage it, or shorten its life and affect its calibration.
- When the bubbler tube has been disconnected from the BS2000 and then reconnected, it will take time for the bubbler tube to pressurize to the point where an accurate level measurement can be made. Forcing the BS2000 to perform the Manual Purge Cycle once or twice will speed up this process.
- All maintenance or repairs to the circuitry inside the Bubbler System Controller (BSC) (with the exception of replacing the fuses) must be performed by Motor Protection Electronics in order to ensure the safe operating condition of the equipment, and to prevent voiding the warranty. The fuses FU1, and FU3-5 may be replace in the field, but only with UL Listed fuses of the same amperage. Please see the Recommended Replacement Parts List for recommended replacement fuses.

## TUBING INSTALLATION NOTES:

- The Plastic Tubing Insert must be placed in the end of the tubing as shown below:



- When attaching the Tubing to a Plastic Fitting, first install the Plastic Tubing Insert as shown above. Then gently but firmly press the tubing, with the Insert, into the fitting while wiggling it until the Plastic Tubing Insert is all the way inside the fitting. Then install the Plastic Nut and tighten it by hand. To make it easier to press the end of the tubing into the Plastic Fitting, a small amount of silicone grease may be applied to the end of the tubing, before installing it into the fitting. Do not use petroleum grease or oil of any kind. Silicone Grease is commonly available at automotive part stores, under the name “Dielectric Tune-up Grease”, made by Permatex.
- When removing the Tubing from a Plastic Fitting, first un-screw the Plastic Nut and slide it out of the way. Next, gently but firmly pull on the tubing while wiggling it from side to side until it comes out.
- The Plastic Tubing Insert may be removed from the tubing easily without damaging the Insert or the tubing. This is done by placing the smooth end of a 1/8” drill bit into the hole in the Plastic Tubing Insert and gently rocking it from side to side until it comes out.