Water Spray System

for Water Intrusion Testing

Operations Manual

Group 17

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Introduction

This operation manual has been prepared by the group members of Team 17 of the FAMU-FSU College of Engineering 2010-2011 Senior Design course. We ask that you follow the instructions and recommendations in this manual carefully so as to avoid misuse or system damage.

Parts

In order to streamline the assembly process, some liberties were taken regarding the number of parts. Since disassembly of parts joined by cement or nylon type is undesirable, many parts have remained combined. The ease with which the SharkBite fittings attach and detach makes them the ideal disconnection points. The extent to which the system has been broken down was based both on practicality and shipping considerations.

Here is a list of the individual parts that should be included:

Quantity	Part Description
16	90° Aluminum brackets
48	Thin slot connectors with two threaded holes
72	Hex head cap screws
8	Sleeve connections for horizontal bars
8	2' lengths of extruded aluminum with rubber feet
6	5' lengths of extruded aluminum
4	Hollow aluminum bars with attached nozzles
2	H-style piping configuration with Sharkbite fittings
2	Cut-to-fit lengths of PEX tubing
1	1/3 HP Centrifugal pump with inlet and outlet attachments
1	Piping configuration containing solenoid valves, a flow meter, and ball valves
1	Float valve with hose attachments
1	15.5 gallon water reservoir
2	Saw horses
1	Custom shelf for pump and reservoir
2	Thin sheets of Plexiglas
1	Orange Sharkbite 1" Disconnect clip
1	24VAC Relay
1	Electronics box containing control board, proto board, necessary wires, and power supplies

Assembly

As mentioned previously, steps have been taken to streamline the assembly as best as possible. We will start by assembling the structure beginning with the bases. You will notice that the bases have all been labeled as follows: LF (left front), LR (left rear), RF (right front), and RR (right rear). These orientations are from the reference of looking at the system from the pump position. The labels also correspond to the correct attachment point. The vertical beams have also been labeled similarly.

Step 1: Match base with respective vertical beam

Step 2: Attach 2 90° brackets on opposite sides of vertical beam flush with the bottom of the beam using hex head screws and thin slot connectors. One slot connector per bracket plane will be sufficient. (Avoid attaching brackets to labeled side of beam)

Step 3: Connect to base using same method making sure to line up designated attachment points. Tighten all connections.

Step 4: Repeat Steps 1-3 for each base. The finished connection will look like the figure below. Note the alternating screw alignments on bracket.

Figure 1: Base to Vertical Beam connection

Step 5: Using matching sets of bases (RF and RR or LF and LR), attach one of remaining 5’ extruded aluminum beams in the same manner the previous connections were made. The proper height for this horizontal beam has also been designated. Simply match the labels. An example of this connection can be seen in the following figures.

Figure 2: Two views of horizontal beam connection example

Step 6: Connect 2 bar sleeve connectors on the inside of each side of each structure in similar fashion. (Only one screw per corner will be necessary for these attachments) Keep screw connections loose enough to slide sleeves up and down beam so that one hollow aluminum bar with nozzles can be inserted between them and then slide on to beam.

Step 7: With hollow beam inserted between two sleeves, slide to align with designated attachment point and tighten screw connections. Again, simply match the labels for each part. An example of one side of the attachment can be seen below.

Figure 3: Aluminum bar to sleeve to vertical beam connection

****Note: Insert set screw into each sleeve but do not tighten at this time**

The structural part of the system is now complete. At this point, the user should have two structures similar to Figure 4 though with nozzles and back connections already in place.

Figure 4: Example of assembled structure

Now we will begin to connect the piping structure. You will notice that the each piping system has been broken down into 3 major parts: the 2 H-style configurations that connect to the array and the configuration containing the solenoid valves, ball valves, and flow meter. Again, thanks to attachment simplicity of the Sharkbite fittings, this part of the assembly should be relatively easy.

Step 8: Match H-style piping configuration with its appropriate side of the system (joints will be labeled with L or R consistent with base labels).

Step 9: Insert attachments protruding from hollow aluminum bars into Sharkbite fittings of H-style piping section approximately 1". Be sure that Tee-joint is closer to the bottom row of nozzle array. This will be accomplished by matching the labels on the connectors and fittings.

Step 10: Tighten sleeve set screws so that nozzles are either horizontal or slightly angled up. Repeat for both sides of structure

Step 11: Leaving the structures shortly, set up saw horses an appropriate distance so that the custom shelf is supported near the ends of the longer. The shelf edges should fit snuggly into holder gaps of the saw horses.

Step 12: Place pump and water reservoir on shelf in pre-fabricated, appropriately-sized areas with their outlet and inlet, respectively, facing each other. Tightly screw on pump inlet attachments to reservoir outlet. Also, attach float valve through small circular hole in top of the reservoir using provided white hose attachments.

**Note: Connect Plexiglas to the shelf's vertical attachments to protect pump from water from the front and above

Step 13: Attach remaining section of piping containing valves and flow meter to vertical pump discharge using Sharkbite attachment at point labeled P1. This attachment can be seen in Figure 5.

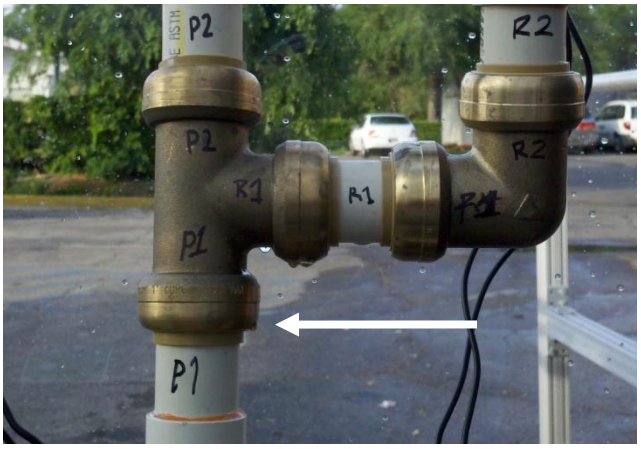

Figure 5: Piping section attaching to pump at joint P1 which is identified

Step 14: Align structures facing each other and separating by a distance of approximately 82”.

Step 15: Using PEX tubing, connect the arrays at the Tee-joint to their respective ball valve. Some rearrangement of the structures will most likely be necessary to join them together but once connected can be moved back to desired positions. (the PEX tubing allows for some adjustability in the system)

The system structure is now complete. Please note that some adjustments might need to be made in the angle of the nozzles and/or distances between the two spray structures.

The remaining assembly concerns the control system wiring.

Step 16: Using brown coated wiring bundle, connect the solenoid valves using the attached clips. Valve 2 refers to the recirculation valve. Valve 1 refers to the valve that leads to the arrays.

Step 17: Next, wire the relay. The positive to the pump (white cord) to the screw terminal labeled 3 on the relay. Connect the positive of the wall power supply to the screw terminal labeled 5. Connect the red cord coming from the proto board to 7 on the screw terminal and the white one to 8 on the screw terminal.

You have now completed the assembly.

Operation

Setting up the Hyperterminal

As mentioned before, hyperterminal comes standard for Windows operating systems XP and earlier. For newer operating systems, the hyperterminal program can be downloaded. Once the program has been downloaded follow these steps to set it up properly.

**Note: the hyperterminal setup will automatically ask for location information multiple times but this can be skipped by simply clicking CANCEL. Steps 2-6 only have to be done once per computer.

Step 1: Connect USB cable to control board and computer with the control board powered.

Step 2: Connect flash drive to computer.

Step 3: Right click on my computer and click on properties.

Step 4: Go to device manager and right click on the USB in the communications port.

Step 5: Go to update software and use the folder called Driver in the flash drive to update.

Step 6: Repeat Step 5.

Step 7: Look at what communications port the USB terminal is connected to in device manager

Step 8: Start Hyperterminal program

Step 9: Name the Connection Description “Serial” and Click OK

Step 10: Select the USB communications port that was found in step 7 and Click OK

Step 11: When asked about the baud rate and stop bits, make sure that it is like figure 6 below.

Step 12: Make sure that the hyperterminal is in call mode.

Step 13: Press RESET on control board to begin interaction with hyperterminal and enter required values.

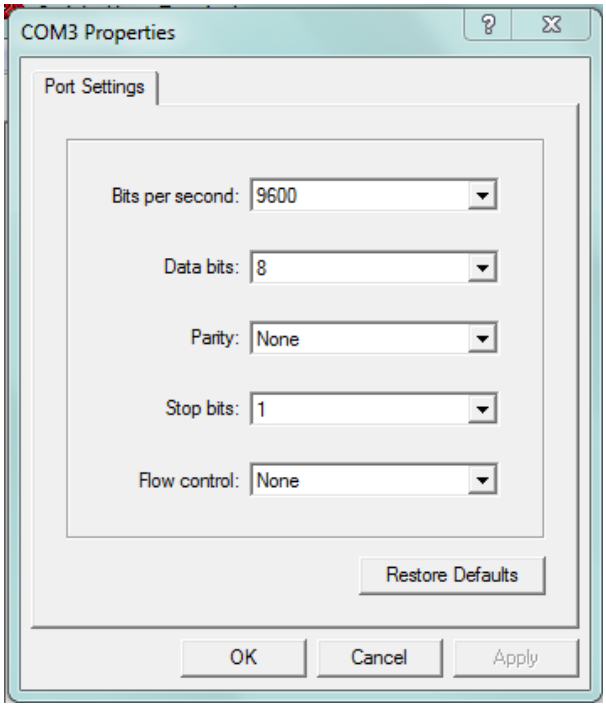

Figure 6: Setup information from Step 11

Before you Begin

Before plugging in all of the power supplies and testing, attach a hose to the water reservoir and wait until it is completely filled. Leaving the hose on as the float valve will cease the flow once it reaches the correct level. The power supplies can then be plugged in (control board, proto board, and pump).

Calibrating the System

If the test being performed requires spray from both sides, ensure that the adjustable knob on the solenoid valve leading to the spray system is fully open. Also, be sure that both ball valves are in the OPEN position (parallel to the pipe).

If the test that is being performed happens to only require spray from one side some calibration will need to be done. First, be sure that the desired ball valve is completely closed. Second, run system for a short test cycle. During the spray cycle, dial down the flow rate by turning the adjustable knob of the solenoid valve until the flow meter reads 6 gpm.

Running the Program

Once the hyperterminal has been configured correctly and RESET on the control board has been pressed, the program will begin prompting the user for inputs.

Step 1: Input desired duration of spray in seconds and press ENTER

Step 2: Input desired frequency between sprays as a time value in minutes and press ENTER

Step 3: Input desired total number of cycles for the given test and press ENTER

The test will then run autonomously and it will output the current cycle the test is on as well.

If there is a problem or the system is not running properly, press RESET on the control board to effectively end the test. The inputs will have to be entered in again though.

Warnings and Cautions

- Do not run the pump dry!
- Avoid water interaction with electrical components
- Keep power supplies unplugged while wiring and until ready to test to avoid shock
- If, at any time, the system does not seem to be operating properly, end the current test immediately by pressing RESET on the control board and address the issue

Maintenance and Repair

- The source code and drivers for the control board can be found on the provided flash drive
    - If for some reason the control board loses the source code data, simply reload it from the flash drive via USB connection with a computer
- If one of the SharkBite fittings or any of the piping fails, use the provided Disconnect Clip to push up on the SharkBite release collar and twist the inserted pipe out.