

Instrumentation and Measurement

Lab 1

Lab Number: 1

Title: Introduction to Process Measurements

Date the Lab was performed (mm-dd-yy): 01/12/2024

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Revision: Winter 2024

Submission Instruction:

Review the lab report before submitting and put a check mark (✓) in the appropriate check box on the left if the item has been duly completed in your lab report. The bracket on the right side will be filled out by your instructor with your gained mark.

1. Scan and create .pdf of all pages.
2. Combine ALL pages of your lab report into a SINGLE .pdf file. Meaning, do not submit each Page of your lab report as a separate file
3. The lab report file must be named in the following manner:
"Your First Name_YourLast Name.pdf",
4. Upload and submit the pdf of your lab report in Blackboard.

Marking:

<input type="checkbox"/> Components and symbol identification:	[] / 20
<input type="checkbox"/> Pump Unit:	[] / 40
<input type="checkbox"/> Procedure:	[] / 20
<input type="checkbox"/> Assignment:	[] / 20

Every 20 minutes late is subjected to 10 marks deduction from attendance.

Introduction to Process Measurements

Objective:

- ❖ To become familiarized with process components and pump unit
- ❖ To set up a basic flow circuit

1) Components and Symbols Identification:

- 1-1) P&ID shows the functional relationship between process components, control system components (sensors, Controller and control elements) and process flow.
- 1-2) Instrumentation symbols are used to draw process lines and identify specific elements. The Instrumentation Society of America (ISA) has standardized these symbols and they are called ISA Symbols. Symbols that are relevant to Lab 1 (this Lab) are shown below,



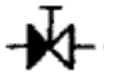




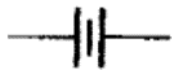




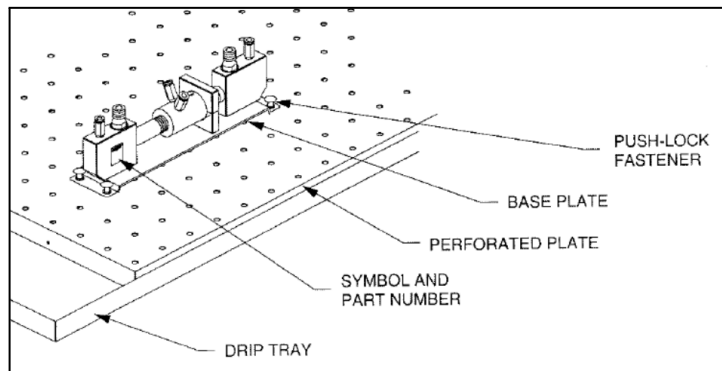
<u>Symbol</u>	<u>Description</u>	<u>Symbol</u>	<u>Description</u>
	HV - Hand Operated Valve (Open Fully)		rotameter, Variable-Area Flow Indicator
	HV- Hand Operated Valve (Close Partially)		Centrifugal pump
	Hand Operated Valve (Close Fully)		Speed Controller
	Three-Way Hand-Operated Valve (Direct Flow Position)		Orifice Plate
	Three-Way Hand-Operated Valve (Cross Flow Position)		Reservoir, Open (containing water)
	Flow direction		Mechanical Connection

Table (L1-1) Process Components

- 1-3) Each process component is attached to a base plate be secured to the work surface using push-lock fasteners.



- 1-4) The sticker on the body of the process components shows its symbol and part number (P/N). Examine the sticker of the process components and draw its symbol in the appropriate box below:










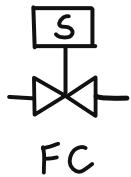



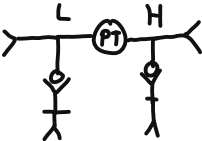



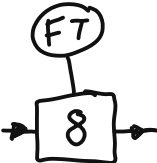


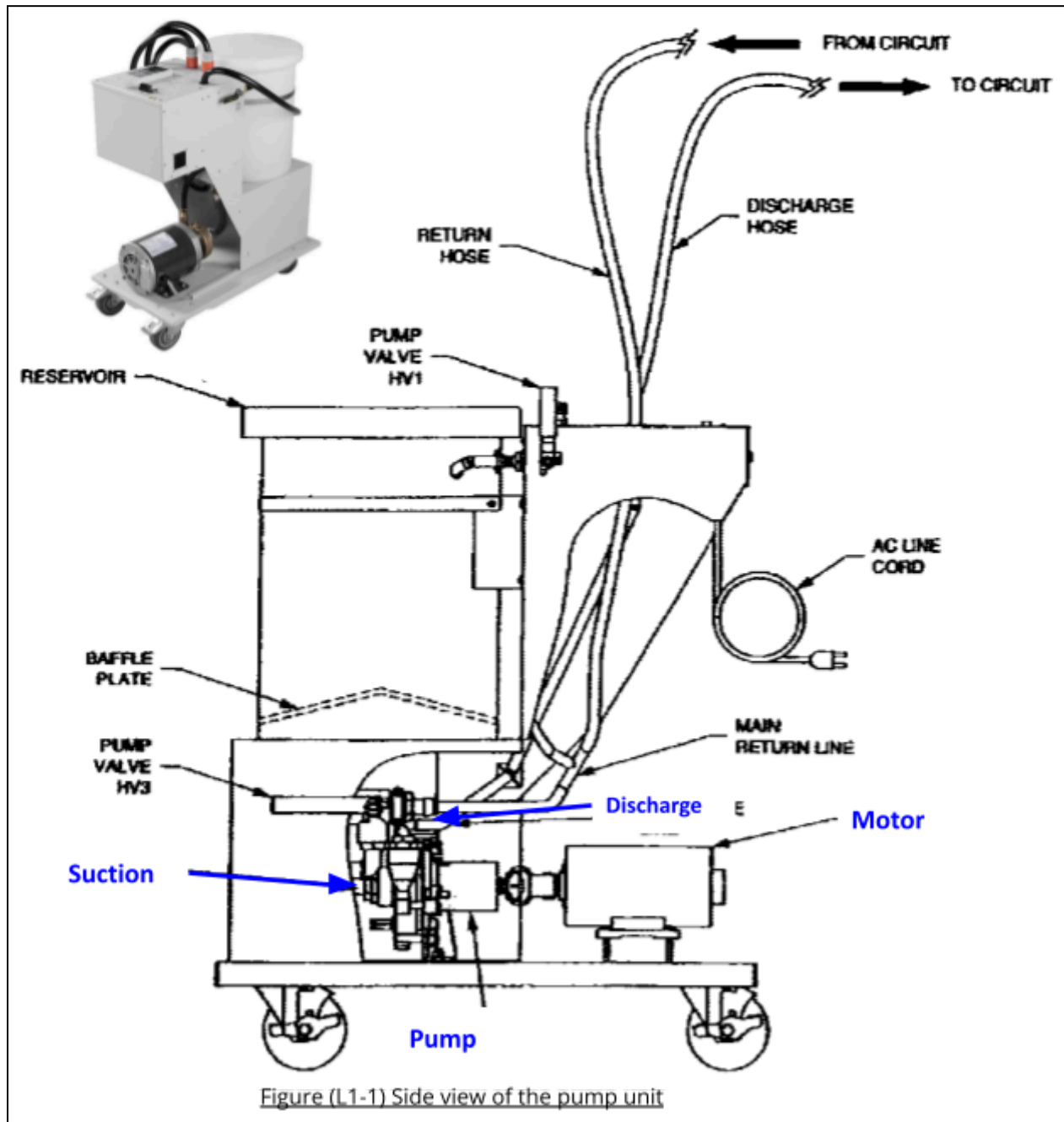
<u>Process Component</u>	<u>Description</u>	<u>Symbol</u>	<u>Process Component</u>	<u>Description</u>	<u>Symbol</u>
	P/N: 6511 Column			P/N: 6550 Rotameter	
	P/N: 6520 Two-way Valve, Manually- Operated			P/N: 6551 Venturi Tube	
	P/N: 6521 Two-way Valve, Solenoid- Operated			P/N: 6552 Orifice Plate	
	P/N: 6540 Pressure Transmitter			P/N: 6553 Pressure Gauge	
	P/N: 6542 Paddle Wheel Flow Transmitter			P/N: 6570 Float Switch	

Table (L1-2) pump unit

When you finish this section , your instructor will ask you to identify the water flow path and identify the pump P&ID elements on the pump unit for assessment.

2) Pump Unit:

- 2-1) The pump unit provides water flow through the system
- 2-2) The pump unit components are illustrated in Figure (L1-1). Look up these components on the unit and identify them. Then look at P&ID diagram on top of the pump unit and identify the drawing elements such as HV1, Reservoir, HV2, Motor, Pump, Speed Controller and HV3. on the pump unit. You can Use Figure (L1-2) for help. The components function are described in following 2-3 and onwards



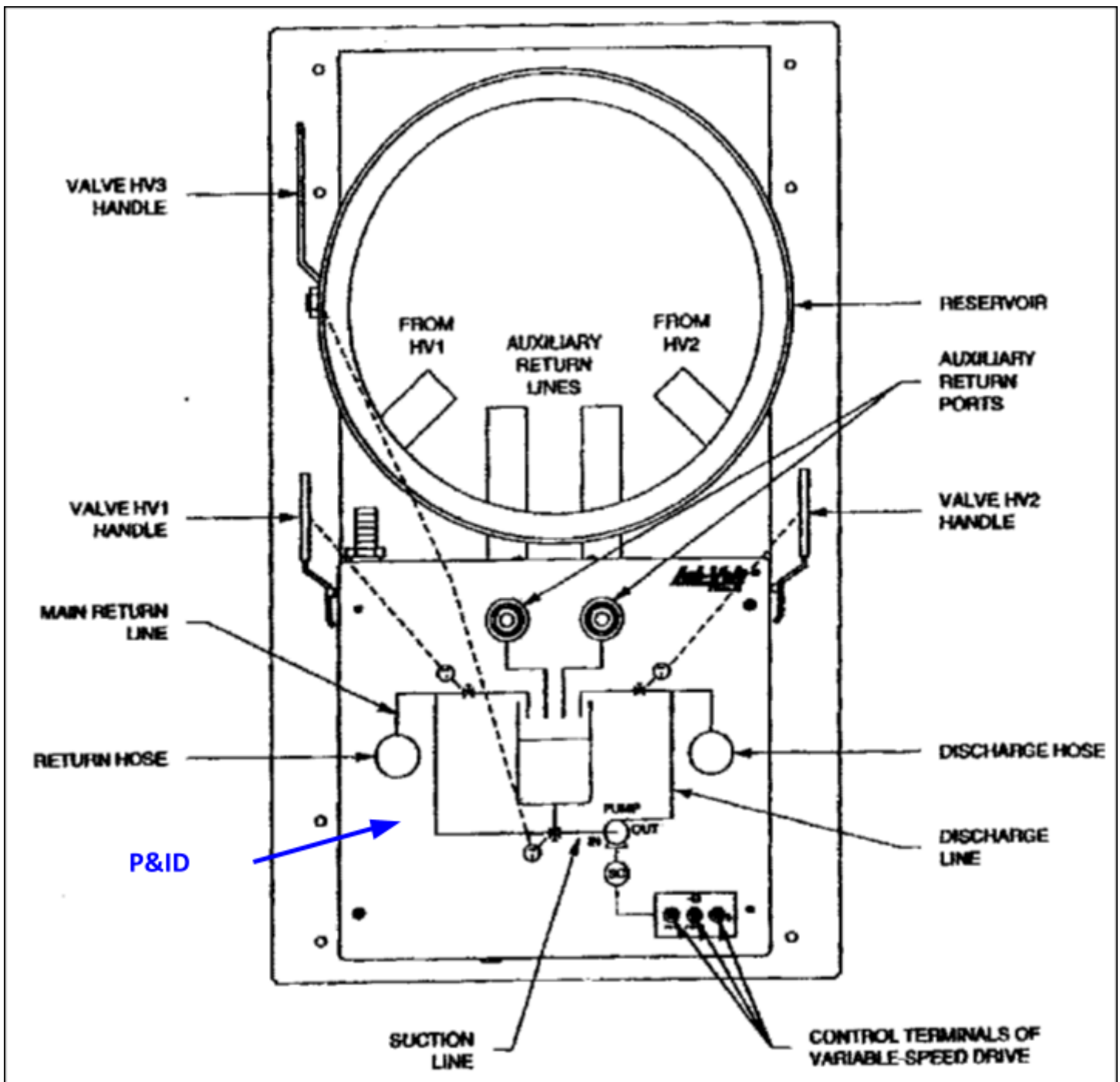


Figure (L1-2) Top view of the pump unit

- 2-3) The electric motor is directly coupled to the shaft of the pump. It rotates the shaft of the pump to create flow.
- 2-4) Variable - speed drive is an instrument to change the speed of the motor and consequently the pump.
- 2-5) For flow, the pump draws water into its inlet through a suction line, then discharges water from its outlet through the discharge line.
- 2-6) Discharge hose is connected to the outlet of the pump and supplies the water to the system
- 2-7) Return hose returns the water to the reservoir of the pump unit. It is connected to the suction line of the pump.
- 2-8) Two auxiliary return ports also return water from system back to the pump unit
- 2-9) Hand-operated valves HV1, HV2 and HV3 control the water flow of pump unit

- 2-10) HV1 controls return flow to the reservoir, HV2 sends a portion of pumped water to reservoir, and HV3 controls flow to pump inlet inlet
- 2-11) Turning HV3 fully counterclockwise causes water from return hose to be sent to the pump inlet
- 2-12) Turning HV3 fully clockwise causes water from reservoir to be sent to the pump inlet
- 2-13) Do not set HV3 at an intermediate position because this will cause the pump to have low flow

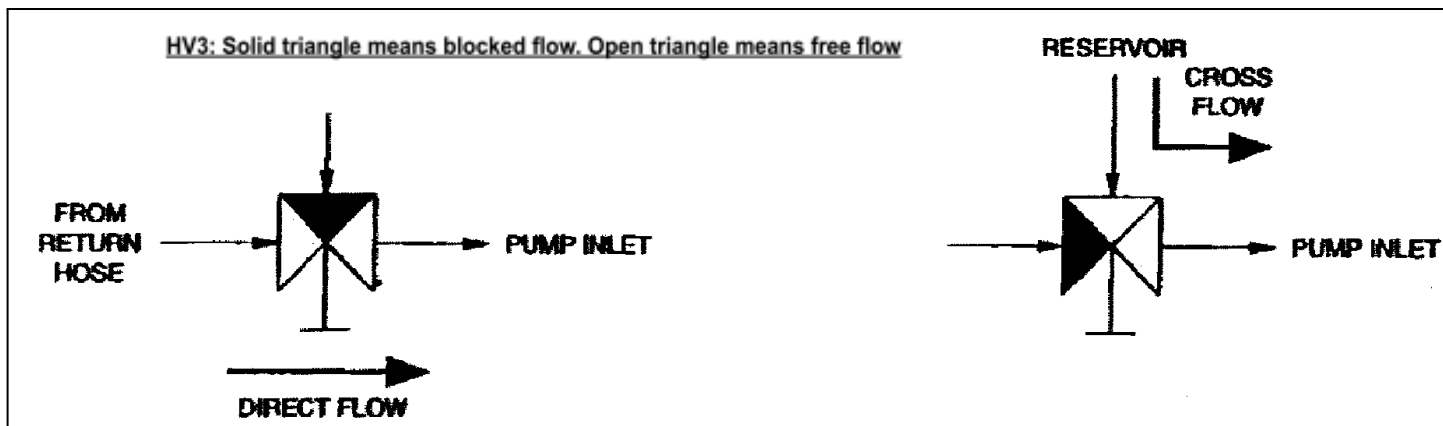
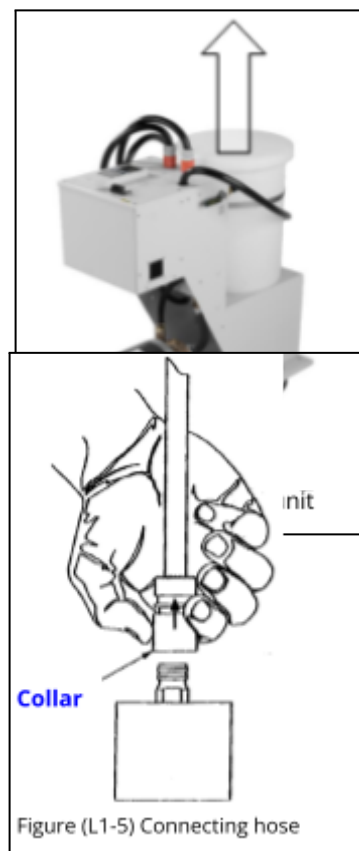


Figure (L1-3) HV3 symbols reading

- 2-14) Removing the reservoir lid (Figure (L1-4)) allows you to see the open ends of four hoses (from HV1, HV2 and the two auxiliary ports on the cover plate of the pump unit) directed into the reservoir.
- 2-15) Baffle plate at bottom of reservoir prevents vortexes from forming and air being drawn into suction line of pump.

Connecting Circuits:

- 2-16) Process Control Training System uses garden type hoses to provide flow connection between the process components.
- 2-17) Hoses are made with quick – connect fittings (Figure (L1-5)) that allow easy connection of circuits
- 2-18) Quick – connect fittings are either male or female
- 2-19) To connect the hose to the component, push the hose collar firmly onto male end.
- 2-20) To make sure hose is firmly connected, pull hose; if it holds, it is properly connected
- 2-21) To disconnect the hose, pull back the collar and pull on the hose.



Instructor signature for the pump unit section

3) Procedure:

- 3-1) Mount the rotameter vertically on the expanding work surface (vertical surface). Look up an arrow which shows how direction of flow should be. The Inlet port is at the bottom of the graduated scale.
- 3-2) Connect the discharge hose of the pump unit to the inlet port of the rotameter
- 3-3) Connect the outlet port of the rotameter to the return hose of the unit
- 3-4) On the pump unit,
 - a. Open HV1 completely (turn the handle fully counterclockwise)
 - b. Close HV2 completely (turn handle fully clockwise)
 - c. Set HV3 for directing the full reservoir flow to the pump inlet (turn handle fully clockwise)
- 3-5) For the electrical connection refer to Figure 1 in the "Using LVProSim_en.pdf" manual in blackboard. The objective is to control the speed of the pump by a 4-20 mA which comes from the LabVolt 9065-B0 box. Connect the 24 VDC power to the LabVolt 9065-B0 interface module and then connect 4-20mA current outputs of the interface module to the 4-20 mA input of the variable-speed drive on the pump unit with the wires. Connect the ground terminal of the LabVolt 9065-B0 interface module to the ground terminal of the variable speed drive.
- 3-6) Disconnect the circuit. Return the components to their storage location.

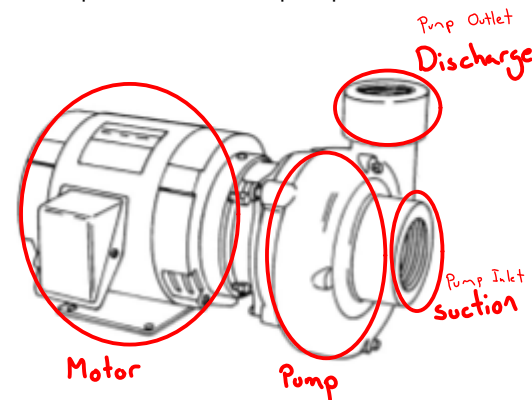
Zero in I/O interface into ground

Show the result to your instructor.

Instructor signature for Procedure Section

Assignment:

1. By changing the motor speed the flow rate inside the hose will change. Based on what is presented on the pump unit, Is this an automatic control or a manual control? Elaborate on your answer.
2. In the figure (L1-6), you see a centrifuge pump similar to your lab pump unit. Identify the following by drawing circle and putting label on the related area:
 - ❖ Motor
 - ❖ Pump
 - ❖ Pump Inlet (Suction)
 - ❖ Pump Outlet (Discharge)
3. Draw control system block diagram for changing the flow rate by the motor speed controller. If you are missing a component for a block, you can put a question mark.



1. it is manual Because of Humans interfering

3.

