Multiple Pump Systems for Continuous Flow or Independent Modes
Basic Configurations, Setup, and Operation

Overview
Multiple pump systems can be used in either constant pressure or constant flow mode, and can operate in tandem (2 pumps), or independently (up to 3 pumps), regulated by a single controller. The D Series dual pump system consists of two syringe pumps connected with an air or electric, or check valve package, and one controller.

Valve Packages
The valves may be passive (check valves) or active (air or electric). Electric valves are recommended for the following applications:
- Liquefied gases
- Heated viscous fluids delivered at low pressure from a pressure pot
- Viscous fluids requiring a forced valve closure

For the steps that follow, refer to Figures 2 and 3.

**WARNING**
Risk of injury. The pressure produced could be up to 10,000 psi (700 bar). Use only the appropriate tubing and connections.

Valve Package Installation
1. Position the pump bases 1.3 cm apart.
2. Use the plugs to close the ports that will not be connected.
3. Loosely attach the tubing lengths from the valve assembly to the pumps.
4. Allow the bracket to hang vertically and place the straps around the pressure transducer caps. Tighten the wingnuts.
5. Install the four bracket panhead screws on the bottom of the bracket.

Plumbing Connections
1. Tighten the tubing nuts.
2. Connect the inlet tube to the supply reservoir.
3. Connect the outlet tee to your apparatus.

Electrical Connections
**Electric Valve Package** — The actively controlled electric valve package requires a special interface board mounted inside the controller. Connect the DB-25 cable to the controller rear panel “SFX 220/VALVES” connector, as shown in Figure 2.

**Air Valve Package** — The actively controlled pneumatic valve package requires a pressurized air source of 80-115 psi (552-793 KPa). As shown in Figure 3, connect the two positive (red) wires to any two of the 15VDC terminals on the rear of the controller. Connect the black wire from solenoid #1 (IN) to DIGITAL OUTPUT 1. Connect the black wire from solenoid #2 (OUT) to DIGITAL OUTPUT 2.

<table>
<thead>
<tr>
<th>Power Requirements</th>
<th>100 ±10VAC, Pump A max 1.5A; Pump B max 1.5A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>117 ± 12VAC, Pump A max 1.5A; Pump B max 1.5A</td>
</tr>
<tr>
<td></td>
<td>234 ± 23VAC, Pump A max 0.75A; Pump B max 0.75A</td>
</tr>
</tbody>
</table>

| Line Frequency      | 50 or 60 Hz |

Figure 1: Dual pump system dimensions
Figure 2: Electric valve installation

Electric Valve Package

Optional reducing fitting (for 1/16"

1/8" nut and ferrule (100/260D), or male connector (500D)

Pre-swaged pump connection tubing

Outlet

1/8" nut

1/8" ferrule

Strap (1 of 2)

Outlet

Inlet tee (4 total)

Inlet (customer reservoir)

Bracket pan-head

DB-25 connector to controller "SFX220/Valves"

Controller Rear Panel

To Controller port PUMP A

To Controller port PUMP B

Overhead View

6-32 hex nut

Wing nut

Strap

Controller Rear Panel

To Controller port PUMP A

To Controller port PUMP B

Overhead View

6-32 hex nut

Wing nut

Strap

Figure 3: Air valve installation Requires pressurized air source @ 80-115 psi (5.5 - 7.93 bar)

Air Valve Package

Optional reducing fitting (for 1/16")

1/8" nut and ferrule (100/260D), or male connector (500D)

Pre-swaged pump connection tubing

Outlet

1/8" nut

1/8" ferrule

Strap (1 of 2)

Outlet

Inlet tee (2 total)

Check valve

Inlet (customer reservoir)

Actuator

To controller (Red wires =}
Setting Up Continuous Flow

Both pumps must be operated manually during initial setup, i.e. refill and purging of air. Active (air or electric) valves are switched using the ACC CTRL key. Lights on the air switches indicate which valves are open. Once the valve package is installed and you have ensured that fluid connections are leak free, you are ready to program the system. Press the keys on the controller front panel in the order shown for the desired mode.

**Defining Operation**

**SELECT PUMP** — This menu allows you to select any pump to display its run screen (program and operation data) and to make program changes.

![Figure 4: Keystrokes to specify valve type](image)

**Valve specification** — To prevent pressure fluctuation at switchover, you must specify the type of valve package you are using.

![Figure 5: Keystrokes to reset volume totalizer](image)

**Volume totalizer** — The total volume delivered is displayed in liters at the top right corner of the screen. Refer to the figure below to reset the volume totalizer to zero.

![Figure 6: Keystrokes to set up constant flow](image)

**Constant Flow Mode:**

Before pressing RUN, ensure that ON CONT FLOW is displayed on the screen, and that the set flow rate/pressure is correct.

Always verify the valve settings before running a program. If a controller is reset or moved to a different power source, it will revert back to default settings (Passive).

![Figure 7: Keystrokes to set up constant pressure](image)

**Constant Pressure:**

In older controller versions, only buttons 1 (ACTIVE) and 2 (PASSIVE) are selectable when specifying the valve type being used (Figure 4). Active refers to air or electric valves; Passive refers to check valves. Options 3 & 4 only appear if the electric valve board is installed in the controller.
**Tips for Running Continuous Flow**

**Liquids Checklist:**
1. Degas liquids if appropriate.
2. Purge air from the system:
   a. Fill both pumps completely by pressing REFILL and selecting each pump to fill.
   b. Route the outlet (see Figures 2 and 3) to waste or reservoir and press RUN. Press STOP when fluid comes out of the outlet.
   c. Open the valves to atmosphere by pressing ACC CTRL, then selecting each valve to open.
   d. Zero the pressure in each pump by pressing ZERO PRESS and selecting each pump to zero.
   e. Connect the outlet tubing and fill each pump once more.
3. Reset total volume (see Figure 5).

**Equilibration** — When the pumps begin running, the system will go through an equilibration phase, during which both pumps must be full and delivering fluid.

**Liquefied Gases Checklist:**
1. Open the valves to atmosphere by pressing ACC CTRL, then selecting each valve to open.
2. Zero the pressure in each pump by pressing ZERO PRESS and selecting each pump to zero.
3. Fill both pumps completely by pressing REFILL and selecting each pump to fill.
4. Pressurize both pumps by pressing RAPID PRESS. Maximum flow rate and target pressure value will be displayed. Press D to continue pressurization.
5. Reset total volume (see Figure 5).

**Additional guidelines** — Please become familiar with the following guidelines provided by our research laboratory:
- Pressure limits for constant flow mode are set by the limits of pump A.
- Temperature changes can cause pressure fluctuations, especially if a restrictor is being used for backpressure. For available temperature control options, contact Teledyne Isco.
- For correct overpressure response, shutdown must be set to ON under PUMP LIMIT options.
- Enter the same refill rate separately for pumps A and B.
  
  The refill rate should always be at least twice the flow rate setpoint to allow time for refill and repressurization before the next switchover.
- If the system is operating below 80psi or needs a faster pressurized match, see Table1 for soft key functions.

---

**Table 1: Key Functions in the Multi-Pump Mode**

<table>
<thead>
<tr>
<th>Key</th>
<th>Display Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Normal</td>
<td>Uses a finer (slower) pressure match control when switching from one pump to the other.</td>
</tr>
<tr>
<td></td>
<td>Fast</td>
<td>Uses a coarser (faster) pressure match control when switching from one pump to the other.</td>
</tr>
<tr>
<td>B</td>
<td>Normal Pressure</td>
<td>Uses pressure matching when switching from one pump to the other.</td>
</tr>
<tr>
<td></td>
<td>Low Pressure</td>
<td>Uses no pressure matching when switching from one pump to the other.</td>
</tr>
<tr>
<td>C</td>
<td>Deliver</td>
<td>Sets the pump into the delivery mode of operation.</td>
</tr>
<tr>
<td></td>
<td>Receive</td>
<td>Sets the pump into the receive mode of operation.</td>
</tr>
<tr>
<td></td>
<td>Min/Max Points</td>
<td>Sets the fill and refill marks that are used with both continuous flow modes.</td>
</tr>
</tbody>
</table>
**Independent Control**

One controller can run up to three syringe pumps independently of each other in either constant pressure or constant flow mode, or any combination of the two. Each pump will operate at its defined limit and rate. Programming steps are shown in Figure 8.

**HOLD PRESS** – After a pump in constant pressure mode runs empty, if outlet pressure exceeds the setpoint, this feature causes the pump to restart, returning the system to setpoint pressure.

**NORMAL** – This feature shuts off any pump that runs empty in constant pressure mode.

---

**Figure 8: Keystrokes to set up independent pumps**