Constant Pressure Pump Operation for Receive Mode

Setup and Operation Instructions

TELEDYNE ISCO
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Syringe Pumps Technical Bulletin
TB02

Overview

Receive mode is the operating mode for one set of dual pumps (usually connected using air valves) in a multi-pump system requiring continuous flow (for example, in core flooding tests), where the receiving pumps operate in constant pressure mode, dispensing to waste when filled.

This operating mode is typically used in permeability and porosity testing, such as core flooding.

> ☑ ***Note***
>
> For detailed programming information on continuous flow and independent modes, as well as system dimensions and valve package installation, see also **Technical Bulletin TB01 Dual Pump Systems**.

Typical Setup

Essentially, one pair of pumps functions as a backpressure regulator, backing down at a specified pressure setpoint (Receive mode). This pair of pumps is always programmed and started first.

Another pair of pumps supplies the test fluid (Deliver mode), pumping it through the core while flow rates and pressure drops across the core are measured. From this data, resistance to flow is evaluated.

Often, a fifth pump (Independent mode) is connected to the core holder to simulate the vertical stresses typically found with deep-sea deposits of oil and natural gas.

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 on the constant flow pumps to the supply reservoir.
3. Connect the outlet tee to your apparatus.

> ☑ ***Note***
>
> Once the system is plumbed and operating, do not attempt to reverse the pumping direction (indicated by the arrows in the example below).

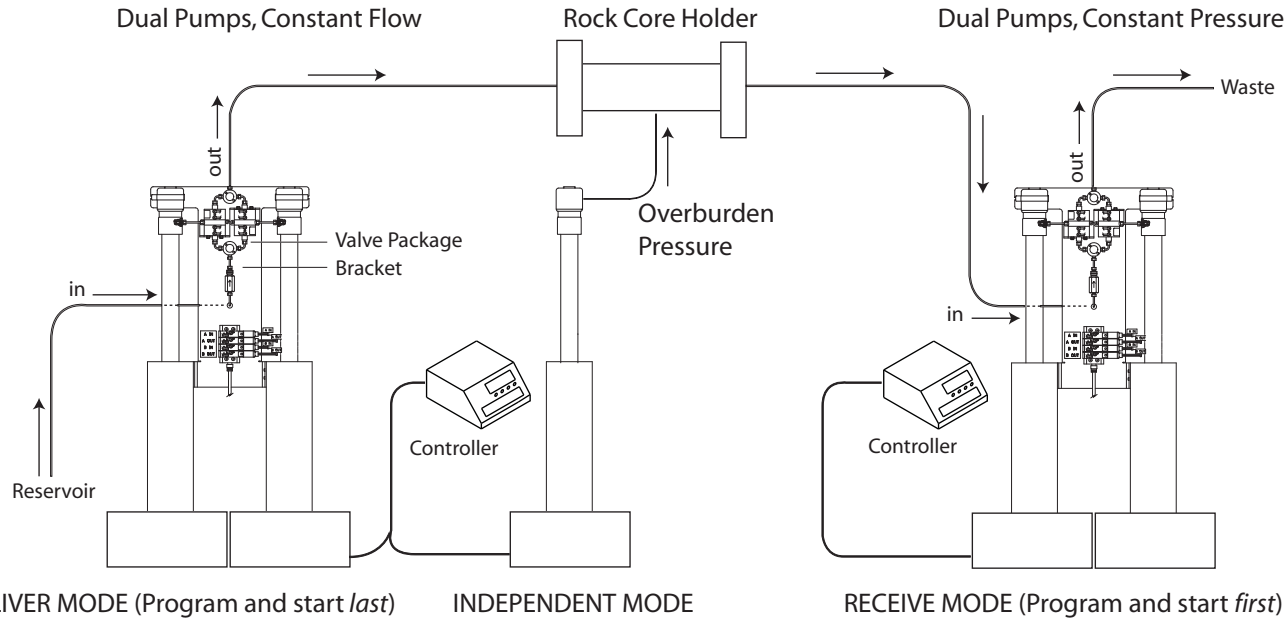

Figure 1: Typical Receive mode configuration

Programming

Controller programming specific to constant pressure is shown in Figures 2 through 4.

The pair of pumps configured for Receive Mode (constant pressure) must be programmed and started before the pair of pumps configured for Delivery Mode (constant flow). **When the Receive pumps reach the setpoint pressure, then start the Delivery pumps.**

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.

Valve specification – The default valve setting is Passive (check valves). To minimize pressure fluctuation at switchover, you must specify the type of valve package you are using.

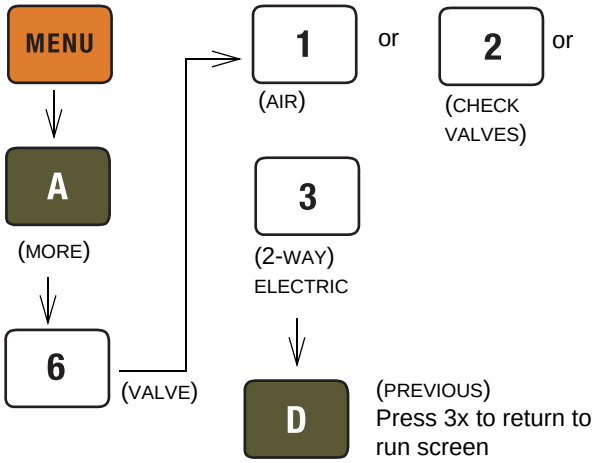

Figure 2: Keystrokes to specify valve type

Note

In older controller versions, only buttons 1 (ACTIVE) and 2 (PASSIVE) are selectable when specifying the valve type being used (Figure 2). *Active* refers to air or electric valves; *Passive* refers to check valves.

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).

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.

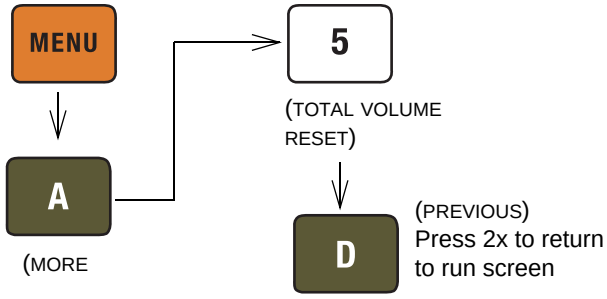

Figure 3: Keystrokes to reset volume totalizer

Programming the Receive Pumps

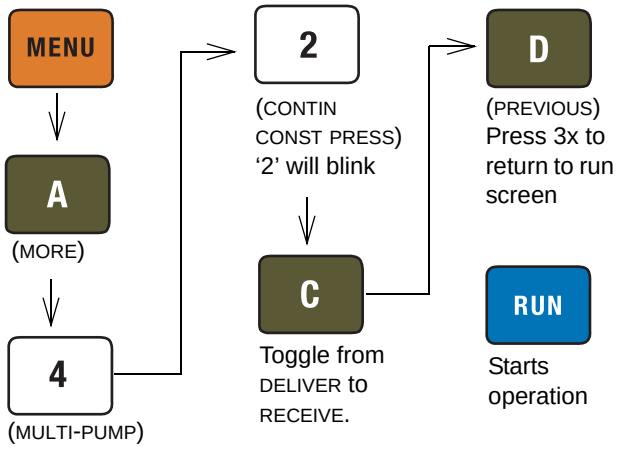

Figure 4: Keystroke sequence to set up constant pressure for RECEIVE mode

Note

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

Important:

After RUN is pressed, the pumps begin delivering, and the system will go through an equilibration phase (see *Equilibration Phase/Switchover* on the following page), where the display shows the words RUNNING, then EQUILIBRATION, then RUNNING again.

Refill the pumps to half capacity.

Programming the Delivery Pumps

Do not run the Delivery pumps until the Receive pumps have reached their setpoint pressure.

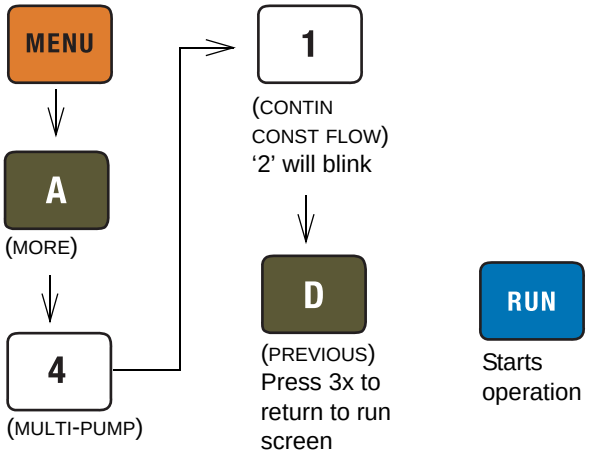

Figure 5: Keystroke sequence to set up constant pressure for DELIVER mode

> ☑ ***Note***
>
> Before pressing RUN, ensure that ON CONT FLOW is displayed on the screen, and that the set flow rates/ pressures are correct.

Equilibration Phase/Switchover

Equilibration – After RUN is pressed, the pumps begin delivering, and the system will go through an equilibration phase. First, both pumps run until reaching half the setpoint flow. RUNNING is displayed.

CPx	X.XXX mL/MIN	XXXXX PSI	XX.XXXXL
RUNNING			XX:XX:XX
XX PSI			A XXX.XX mL
PRESSURE ON CONT FLOW			B XXX.XX mL

> ☑ ***Note***
>
> The screen displays the total flow (both pumps combined). Do <u>not</u> press MENU→SELECT PUMP unless you want to observe only a single pump reading.

At half the setpoint flow, the pumps stabilize their pressures. EQUILIBRATING is displayed.

CPx	X.XXX mL/MIN	XXX XX PSI	XX.XXXXL
EQUILIBRATING			XX:XX:XX
XX PSI			A XXX.XX mL
PRESSURE ON CONT FLOW			B XXX.XX mL

Finally, RUNNING is again displayed.

Receive Mode only – Refill the pumps to half capacity.

Switchover – During operation, when the two pumps switch between emptying and refilling, the run screen again displays the total combined flow and the word RUNNING.

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 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.

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.

Troubleshooting

Table 1 lists some possible problems that may occur during operation, and their likely causes/ solutions. If a problem persists, contact our service department for assistance.

Table 1: Troubleshooting Receive Mode

Problem	Cause(s)	Solution(s)
• Constant Flow pumps start backing up. • Constant Pressure pumps go to the pressure setpoint. • At switchover, the full pump runs at full speed, pushing fluid out the outlet valve.	System is being run in the opposite direction for which it is configured.	Always run the system in the direction for which it was originally configured.
System pumping back into the source tank	Valve package(s) plumbed backwards.	Remove power and properly install the valves.
• Pressure rising/dropping during switchover	Controller(s) reset to Passive valves.	Use the menu to select active (air or electric) valves. See *Defining Operation* on the previous page. Check the valve setting before running the system.
• Constant Flow pumps over-pressurize. • Constant Pressure pumps pressurize & then stop.	The Constant Flow pumps (Deliver) were started before the Constant Pressure (Receive) pumps.	Always start the Receive pumps first and allow them to reach the setpoint pressure before starting the Deliver pumps.
• The pumps do not properly equilibrate; system stops running.	Receive pumps were started with full instead of half-full cylinders. Not enough fluid in the pumps to complete equilibration.	Always start the Receive pumps with the cylinders half-full. Ensure that each pair of pumps is properly filled.
• Pump empties and does not refill. • During equilibration, the transducer readings differ by greater than 300psi (20.7 bar). • System stops running.	Downstream pressure is unstable. Pump running at excessive flow rate during equilibration. (i.e., >65% single pump max. rate for Liquids, >45% single pump max. rate for Liquefied Gases)	Stabilize downstream pressure. For differing transducer readings, calibrate the transducers. For excessive flow rates, set to <65% for Liquids; set to <45% for Liquefied Gases.
• Pump not full following refill. • Air in pump outlet. • Pump stops, or has a sharp pressure change during switchover.	Cavitation may occur inside the cylinder when the liquid is too viscous for the pump, causing the piston to pull a vacuum inside the cylinder.	Several options are available from Isco for handling higher viscosities, such as custom port sizes and slurry mixers. Contact the factory.

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