THE SYSTEM FLOW TEST

The System Flow Test has two functions. To evaluate that the pump(s) used can deliver expected flows and to confirm that no leaks are present in the system pathway. It begins automatically at the launch of any experiment and can also be accessed within an experiment via *Instruments->System Flow Test*.

PUMP PERFORMANCE

Rotameter placement to test a pump (PU) will depend on if they are *pushing* or *pulling*.

NOTE: Diaphragm PU create a pulsatile flow. If connected directly to a PU, the rotameter reading will be uneven and greatly elevated due to these pulses. It is important that a buffer chamber (BC), Filter Chamber (FC), whole body chamber (WBC) or combination, is placed between the PU and rotameter to receive a stable and accurate reading.

To test a pushing PU:

1. Add BC, FC, WBC or combination to the PU outflow (Figure 1)

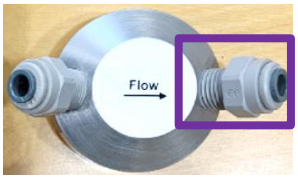

Figure 1. Pump head, connection to rotameter indicated (purple box)

2. The rotameter will be added after the PU and chamber (Figure 2)

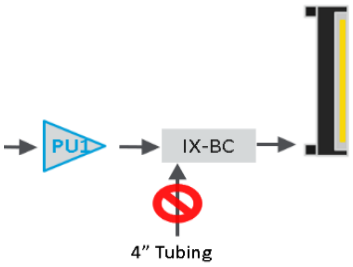

Figure 2. Testing Pushing Pump performance using a BC

3. For a pulling PU, the rotameter will connect to a BC, FC or WBC upstream of the PU (Figure 3)

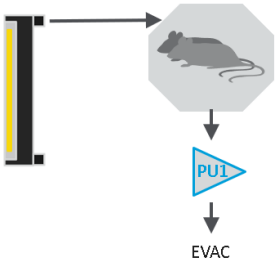

Figure 3. Testing Pulling Pump performance using a WBC

4. Placement of PUs is also indicated in step 3 of the *System Flow test wizard* (Figure 4)
5. At step 3, attach the rotameter as desired.

IMPORTANT: There should be no leak opportunities are possible between the PU and rotameter. If a BC is placed between PU and rotameter, the 4" tubing opening must be

closed firmly using a finger at the end of the tubing or via a clamp along the tubing.

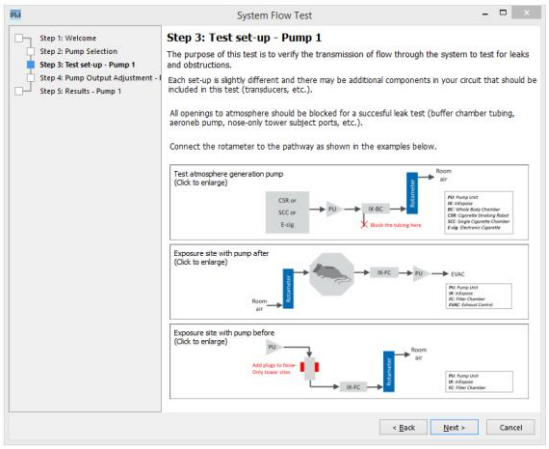

Figure 4. System Flow Test Schematic

6. Once the set up is appropriate, click *Next* to activate the selected pump

7. Review the rotameter scale

» A reading of 58 corresponds to ~3L/min and is the desired value during the system flow test wizard for flexiWare 8.1.3 and earlier

» A reading of 30 corresponds to 1.5L/min and is the desired value for flexiWare 8.2 and later

» Elevated values are indicative of pulsatile air delivery (see NOTE)

» Lower values are indicative of a leak in the air circuit or poor pump performance

8. If flows are low during evaluation, check the connections between the PU to BC as well as BC to rotameter. Replace the tubing, making sure that it is cut cleanly and lightly greased before re-insertion. The tubing should not be easily removable when tugged gently after insertion

9. If PU performance remains poor, close the software, turn off the inExpose base unit and move the PU to a new slot on the inExpose. If a secondary PU is available, attach it to the initial slot placement. Turn on the base unit, re-launch the System Flow test and re-test the first PU in the new location as well as the new PU in the initial slot (if available). This will confirm if low performance follows the PU or slot

NOTE: Directly removing a PU from the inExpose & re-plugging it back in may cause damage to the PU electronics. Any slot movement of PUs must be done with the inExpose in the powered down state.

10. If all PUs perform poorly, regardless of slot position, please reach out to Technical support with details of the tests done to date and serial numbers of all equipment for next steps

THE SYSTEM FLOW TEST AS A LEAK TESTING TOOL

Due to the high degree of personalization possible, each individual system will have nuances requiring assessment of fewer or additional junctures in the flow path. A single configuration is presented below. A rotameter's position indicated by a purple star for simplicity.

A CONCRETE EXAMPLE: *IX-CSRI-WBC3*

These steps use a CSRi system for delivery of mainstream smoke to 3 WBC s.

NOTE: The composure of the system is highly variable. If multiple sites are present, each flow pathways should be evaluated individually.

1.1.1 ASSESS PUMPS

All PUs should be tested before leak assessment. Here, PU 4 (puffing function by default in CSRi profiles) is set up in a pushing configuration.

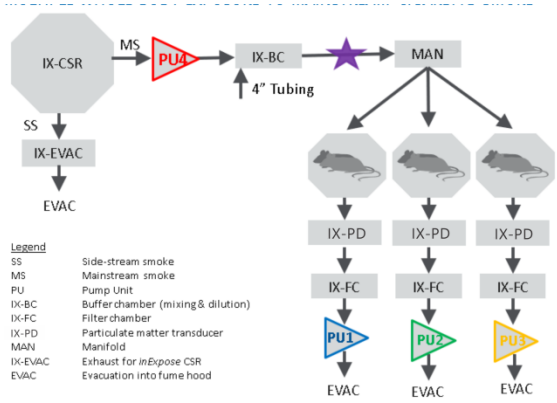

Figure 5. Evaluation of the puffing pump, PU4 activated

Figure 5 shows the rotameter added after the BC & before Manifold (MAN) to evaluate PU4's performance.

PUs 1,2 and 3 are in a pulling configuration. Here, the rotameter may be added before the FC to evaluate performance (Figure 6).

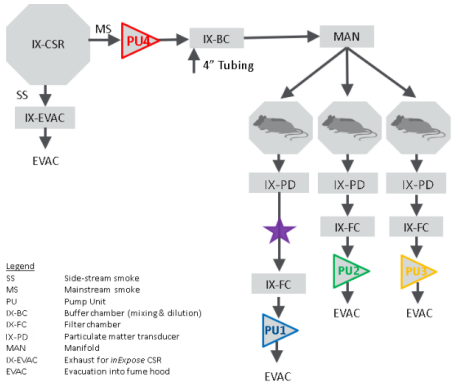

Figure 6. Testing pulling Pumps, pathway1 for WBC1 shown

Each PU must be assessed individually and should provide the expected rotameter reading of 58 (3L/min) or 30 (1.5 L/min) depending upon the software version being used. See previous **Pump performance** section if expected flows are not reached.

1.1.2 SYSTEM CHECK FOR LEAKS

After PU performance has been confirmed, the entire system may be evaluated for leaks. This may be done by adding components to the flow path after each pump or working backwards and moving "upstream".

Where PUs go directly to evacuation, always begin tests upstream of the final PU. Assess each airflow path present individually if splitting to multiple lines via MAN. For instance, here three separate tests would be done, one for each WBC stream (Figure 7).

Figures 8-11 below demonstrate a test moving upstream starting in the WBC1 pathway:

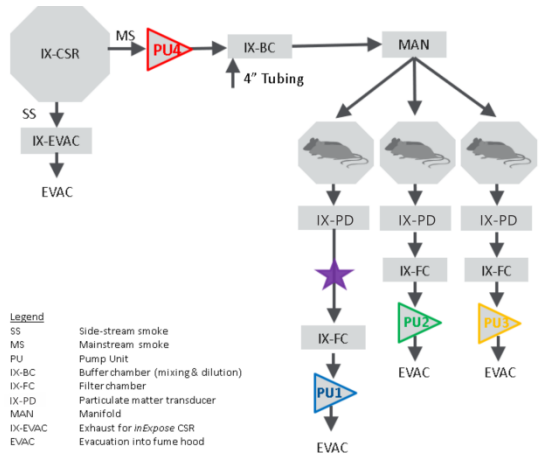

Figure 8. Testing if the leak source is at the FC, PU1 on, *same configuration used during initial PU1 performance check

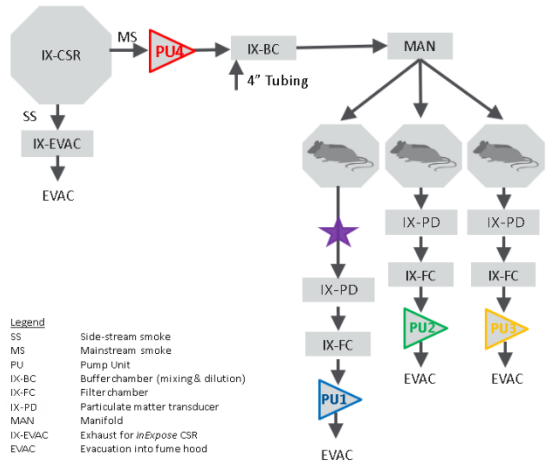

Figure 9. Testing leak presence at the IX-PD1, PU1 active

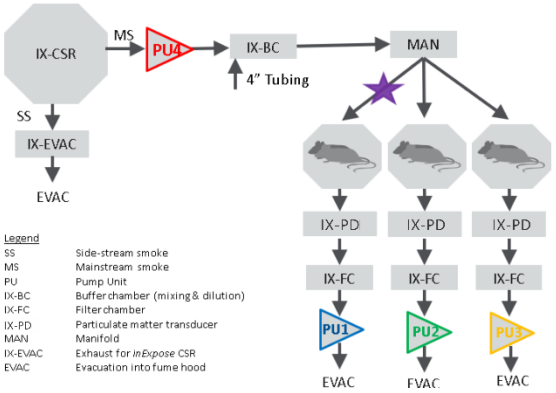

Figure 10. Testing leak presence at the WBC1, PU1 active

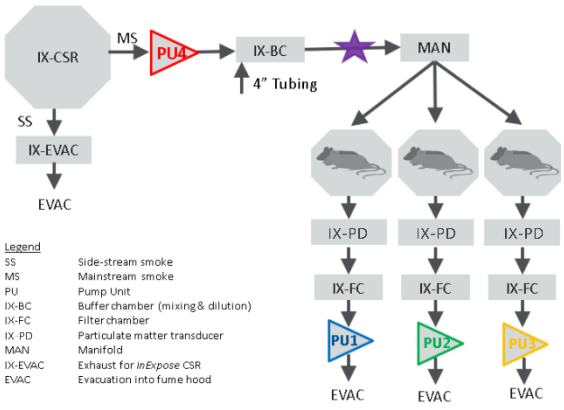

Figure 11. Testing leak presence between upstream BC and the MAN, PU4 active; *same configuration used during initial PU4 performance check

Repeat this procedure for all separate chambers if split flows are used (Figure 12).

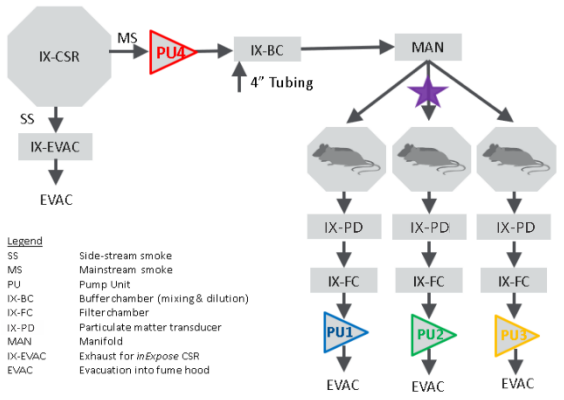

Figure 12. Testing if a leak is present at WBC2, PU2 on

NOTE: If the leak source is arising at the MAN or earlier in the pathway, all downstream chambers should show diminished flows.

» For in-depth steps to resolve leaks, refer to *TechNote 051-Validation of a leak free inExpose* and *TechNote 030-Cleaning and Decontaminating the inExpose®*

SOME COMMON LEAK SOURCES

- Tubing not attached securely
  - Replace tubing
  - Make sure that the cut is smooth and perpendicular (not jagged or angled)
  - Lightly grease the tubing before insertion
- Contamination interfering with seal at juncture points ex. Surrounding o-rings, tubing attachment points, duck bill valves etc.
  - Clean equipment
- White cap on FC not attached

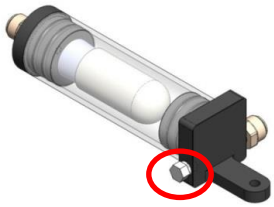

Figure 13. Filter chamber with white cap locaiton highlighted (red circle)

- WBC o-rings and Y-tubing attachments on top and bottom of the chamber not in place / not attached properly
  - Review distribution cap and WBC o-rings

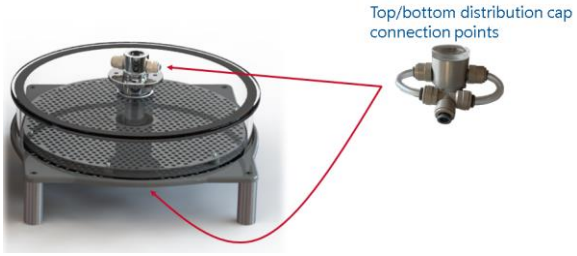

Figure 14. WBC (left) with distribution cap (right). Attachment points indicated (red arrows)

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