invitrogen

Bigfoot Cell Sorter
Canopy Connection
Installation and Calibration

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DOCUMENT CONTROL
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Revision history DT00153

Revision	Date	Description
A	July 2, 2021	Original Release
B	April 22, 2022	Changed description of product to Biosafety Enclosure
C	April 26, 2022	Updated figure 2 to instrument with Invitrogen logo. Changed select inflow air volume measurements (cfm) to inflow air velocity measurements (fpm) for clarity.

1. PURPOSE

This document provides instructions for the calibration of the optional canopy connection for the Bigfoot Integrated Biosafety Enclosure.

2. MATERIALS/EQUIPMENT

The following calibrated instruments are required.

2.1. Equipment

2.1.1. Direct Volumetric Air Flow Meter (DIM) with Capture Hood. Minimum size of capture hood is 16” x 8”.

2.1.2. Clamp and ring stand

2.1.3. Hot wire anemometer

2.1.4. 3mm Hex Key

2.2. Software

2.2.1. Bigfoot SQS software version 1.12 or later installed

2.3. Firmware

2.3.1. Firmware version 667 or later installed

3. INSTALLATION

3.1. Reference the following resources to select appropriate duct components to connect to the Bigfoot Canopy Connection. The Bigfoot Canopy Connection requires a dedicated damper to adjust the pressure at the canopy connection. Adapting to a 4-inch diameter balancing damper is highly recommended.

3.1.1. Bigfoot Installation Dimensions – DP00173

3.1.2. Bigfoot Installation Requirements

3.2. Adapt the facility exhaust to the 6 inch Nordfab QF angle flange, or replace with a different duct such as a 90 degree elbow.

4. CALIBRATION

4.1. Balance Inflow, Downflow, and Exhaust

4.1.1. Request from the User/Owner to log out, but to not close the Bigfoot software SQS. The instrument must be in a “running” state. From the log-in screen, look in the right-hand side bar. If the option is available, select “Startup” as seen in Figure 1. If the option “Shutdown” is available, then do not take any action as the instrument is already started up.

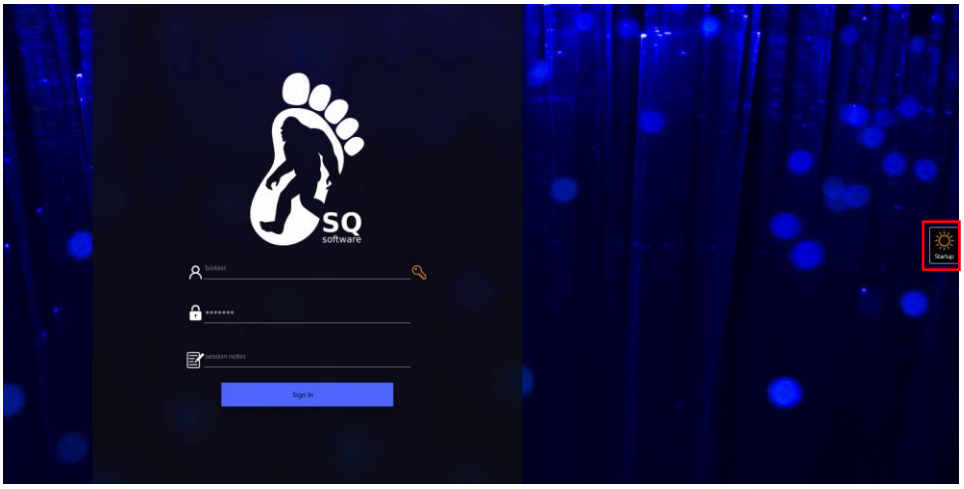

Figure 1: The log-in screen. On the right-hand side of the screen is the Startup option

4.1.2. Log into software with the following credentials:

4.1.3. Username: “biotest”

4.1.4. Password: “biotest”

4.1.5. Locate the two quarter turn fasteners of the top of the front cosmetic cover as shown in Figure 2. Remove with a 3mm hex key. Locate the two quarter turn fasteners on the bottom of the front cosmetic cover. Remove with a 3mm hex key. The front cover is now only being held in place by four magnets. Hold the top and bottom of the cosmetic cover and gently pull the cover forward. The cover must be moved roughly 18 inches forward before it can be set on the ground. Make sure the keyboard tray and monitor are out of the way before starting.

Figure 2: Location of four quarter turn fasteners to remove top front cosmetic cover.

4.1.6. Locate the recirculation damper on the left side of the sliding sash. Loosen the M4 nut circled in Figure 3. Adjust the damper position to -11, towards more recirc. This is a good starting value.

Figure 3: Recirculation to exhaust ratio damper. The circled M4 nut must be loosened to adjust the ratio. Arrows on the indicator show the appropriate direction of adjustment.

4.1.7. With the sash up, insert a clamp and ring stand and hot wire anemometer. Place the anemometer 4 inches below the downflow diffuser, and 4 inches in front of the rear access door. Center the anemometer left to right. Turn on the anemometer such that it measures the downflow velocity.

4.1.8. Adapt a DIM (Capture Hood) to the lower workface opening with the sash slid all the way up.

4.1.9. In the software, in the **Biosafety Enclosure** panel, select **Override**. Select **Control by Fan Speed**. Adjust the biosafety enclosure fan speed to 72%. In the **Aerosol Management System** panel, select **Override**. Set the Aerosol Management System fan mode to "**Normal**". See Figure 4.

Figure 4: Correct settings to begin canopy connection calibration.

4.1.10. Do not change the biosafety enclosure or Aerosol Management System fan speed during this step. Adjust either the facility exhaust fan speed or the facility damper until the pressure drop at the canopy connection is in the range of -0.060 to -0.080 in H2O as measured by the canopy connection pressure sensor.

4.1.11. Adjust the enclosure fan speed up/down from 72% and adjust the damper position from -11 until both an inflow velocity of 105 +/- 3 fpm and a downflow velocity of 57 +/- 3 fpm is found. **Additional resources to calculate the inflow velocity and balance the inflow air velocity, downflow air velocity, and canopy connection pressure are presented in Section 5**.

4.1.12. Turn off the facility exhaust, or completely close the facility damper. Adjust the biosafety enclosure fan to 96%. For acceptance, the inflow must by greater than 105 fpm.

4.1.13. If the inflow velocity is less than 105 fpm when the facility exhaust is off, and the biosafety enclosure fan is at 90%, then decrease the pressure of the facility exhaust as measured by the canopy connection by 0.010 – 0.020 in H2O.

4.1.14. Repeat steps 4.1.10 – 4.1.13 until the following criteria are met.

- When the facility exhaust is on, Inflow is 105 fpm +/- 3 fpm
- When the facility exhaust is on, Downflow is 57 fpm +/- 3 fpm
- When facility exhaust is off and biosafety enclosure fan speed is 96%, inflow is at least 105 fpm.
- A canopy connection pressure measurement of 0.040-0.100 in H2O.

4.1.15. In the instrument software, select **Record Current Inflow Pressure as Setpoint**. Wait 30 seconds. The inflow pressure will be measured, averaged, and set as the new set point.

4.1.16. Confirm that the **Inflow Pressure** was applied to the **Inflow Pressure Set Point** as shown in Figure 5. The two values boxed in red should be within 0.005 in H20 of each other. If it was not applied, repeat 4.1.15.

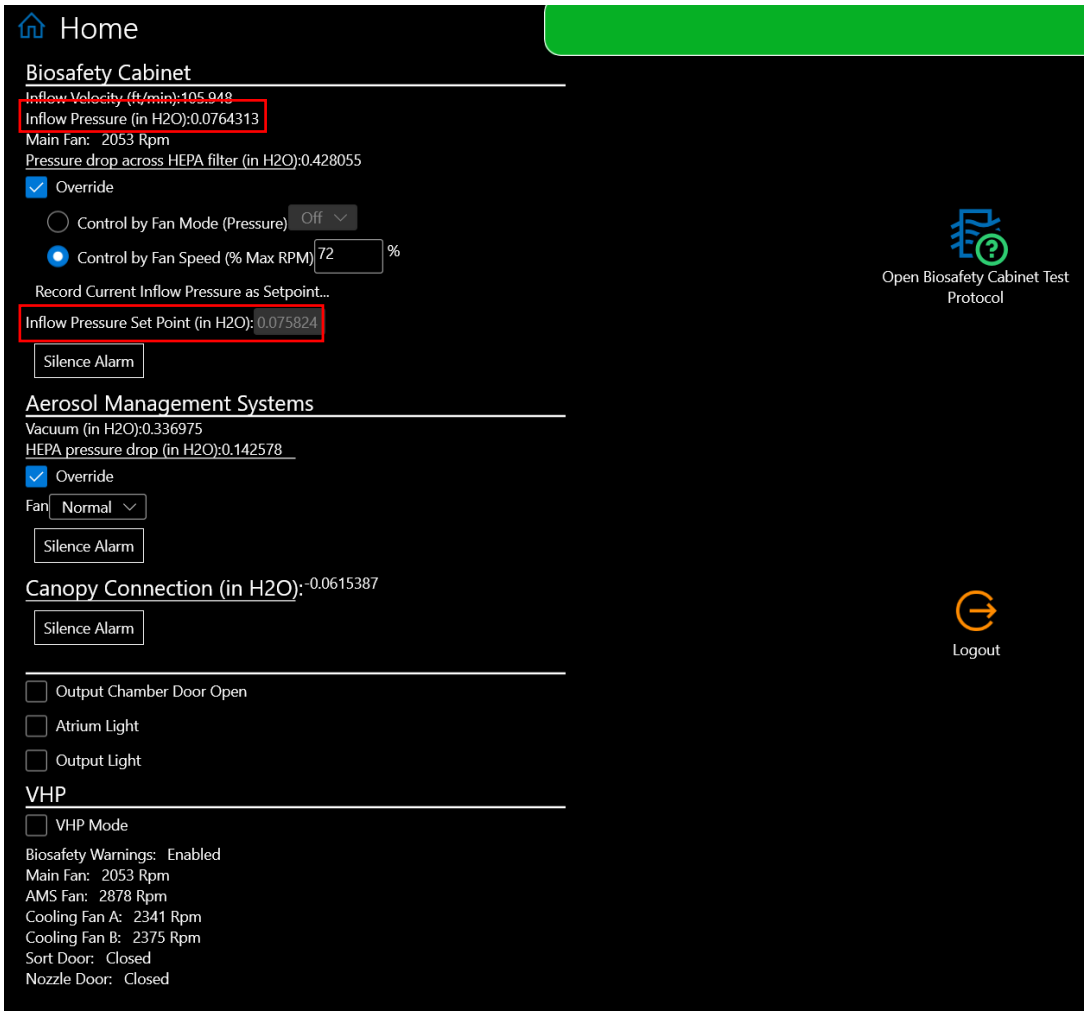

Figure 5: Display showing the inflow pressure setpoint was applied.

4.1.17. Select **Log Out**. This command will save and apply the inflow pressure setpoint.

4.1.18. Replace front cosmetic cover if not immediately proceeding to DT00149, Canopy Connection Tests.

4.1.19. Procedure complete

5. **ADDITIONAL RESOURCES**

5.1. The three components of the system that are controlled are:

5.1.1. The Biosafety Enclosure fan speed

5.1.2. The Biosafety Enclosure damper position

5.1.3. The facility exhaust air volume. The facility exhaust air volume is a function of the facility exhaust fan speed and facility exhaust damper position.

5.2. The three values that are measures are:

5.2.1. Inflow air volume

5.2.2. Downflow air velocity

5.2.3. Canopy Connection Pressure (proportional to facility exhaust air volume)

5.3. The inflow air velocity must be measured with a Direct Volumetric Air Flow Meter (DIM). To find the inflow air velocity, the inflow air volume must be measured, and then corrected based on the local air density as a function of temperature and elevation. Consult your instrumentation manuals for appropriate correction factors. After a corrected inflow volume rate $\mathbf{Q}_I$ is found, divide by the cross-sectional area of the workface to determine the actual inflow velocity $\mathbf{V}_I$.

$$(\mathbf{V}_I, \text{fpm}) = (\mathbf{Q}_I, \text{cfm}) \div (0.74, \text{ft}^2)$$

5.4. The goal of the calibration is to balance the inflow air velocity, downflow air velocity, and canopy connection pressure. To assist in this calibration, see Figure A.1 and A.2. The Biosafety Enclosure and the facility exhaust are a coupled system. Changes in any of the three fans or two dampers will change airflow in the rest of the system. Figure A.3 presents a step-by-step method to perform this calibration.

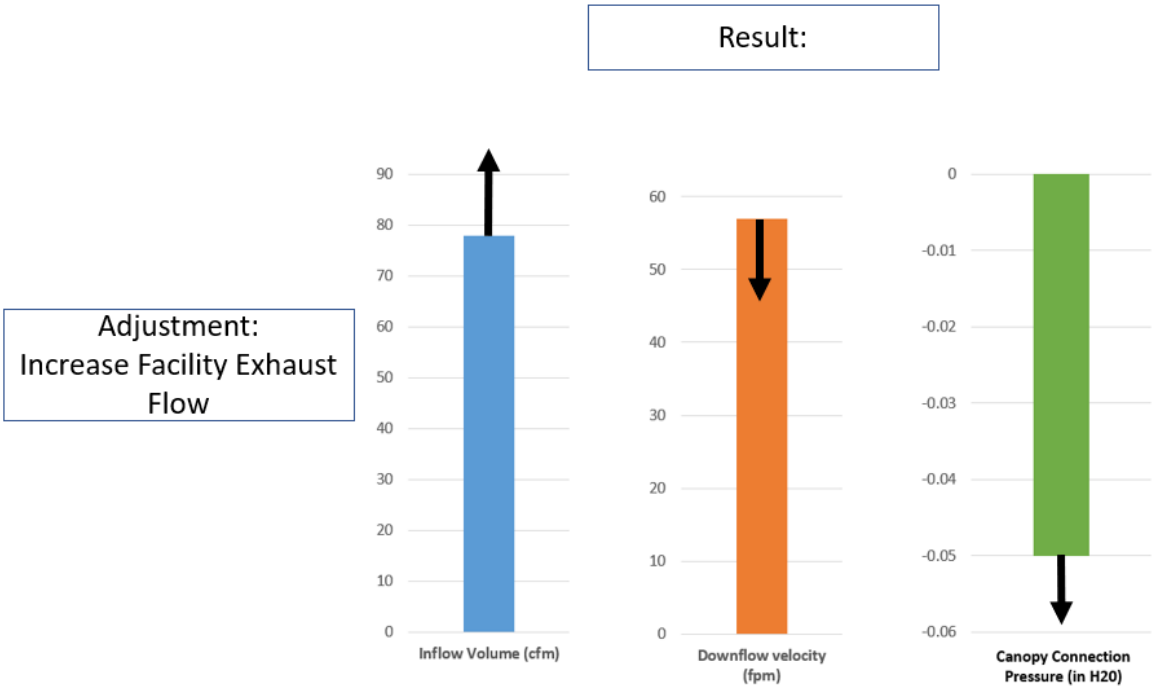

Figure A.1: A visual representation of the impact of increasing the facility exhaust flow on the inflow volume, downflow velocity, and canopy connection pressure.

Adjustment	Result Intake Air Volume	Result Downflow Air Velocity	Result Canopy Connection Pressure
Increase Biosafety Enclosure Fan Speed	+	+	+ (More positive direction)
Decrease Biosafety Enclosure Fan Speed	-	-	- (More negative direction)
Move Biosafety Enclosure Damper in "More Recirculation" Direction	-	+	- (More negative direction)
Move Biosafety Enclosure Damper in "More Exhaust" Direction	+	-	+ (More positive direction)
Increase Facility Exhaust Flow	+	-	- (More negative direction)
Decrease Facility Exhaust Flow	-	+	+ (More positive direction)

Figure A.2: A chart of the results of each of the six possible adjustments to the biosafety-enclosure -facility-exhaust system.

Step	Step Description	Measure	Goal	Actions
1	**Setup**		Start calibration in known state	Biosafety Enclosure Fan: 72% Biosafety Enclosure Damper Position: -11 AMS Fan: Normal Set Offsets to Zero Pressure Sensors Write to Flash
2	**Find initial canopy connection pressure**	Canopy Connection Pressure	Canopy Connection Pressure: -0.060 to -0.080 in H2O	Adjust facility exhaust damper until goal is met
3	**Check state: Inflow volume**	Measure and adjust inflow air volume	Inflow volume: 78 cfm +/- 0.5 cfm	**If inflow is equal to the goal, continue to step 4** If inflow is less than the goal, then increase Biosafety Enclosure fan speed If inflow is greater than the goal, then decrease Biosafety Enclosure fan speed
4	**Check state: Downflow velocity**	Measure downflow velocity	Downflow velocity: 57 fpm +/- 3 fpm	**If downflow is equal to the goal, continue to step 6** If downflow is less than the goal, then adjust damper position in the "more recirculation direction". Repeat Step 3 If downflow is greater than the goal, then adjust damper position in the "more exhaust direction" Repeat Step 3 If the required change to the damper position is less than -13 (far to the more recirculation side). Continue to step 5
5	**Adjust Facility Exhaust**	Canopy Connection Pressure	Change Canopy Connection Pressure: +0.010 to +0.020 in H2O	If the required change to the damper position is less than -13 (far to the more recirculation side), then the facility exhaust flow is too high. Reduce the facility exhaust flow until the canopy connection pressure changes by +0.010 to +0.020 (for example, from -0.075 to –0.055). Repeat steps 3 and 4. The lowest acceptable facility exhaust flow rate is when the canopy connection pressure is –0.040 in H20.
6	**Facility Exhaust Failure Check**	Measure inflow air volume	Inflow velocity >= 105 fpm	Note the current facility exhaust position. Turn off the facility exhaust flow. Increase the Biosafety Enclosure fans speed to 96%. **If the inflow air velocity is greater than or equal to 105 fpm, then the balancing is complete. Continue to step 7.** If the inflow air velocity is less than 105 fpm, then the damper position is too far towards the recirculation direction. Keep the Biosafety Enclosure fan speed at 96%. Slowly adjust the damper towards the "more exhaust" direction until 105 fpm inflow velocity is reached. Restore the facility exhaust to its previous canopy connection pressure. Repeat steps 3-5 without adjusting the damper position.
7	**Final Checks**	Inflow, Downflow, Canopy Connection Pressure	See to the right	When the facility exhaust is on, Inflow is 105 fpm +/- 3 fpm When the facility exhaust is on, Downflow is 57 fpm +/- 3 fpm When facility exhaust is off and Biosafety Enclosure fan speed is 96%, inflow is at least 105 fpm. A canopy connection pressure measurement of -0.040 to -0.100 in H2O.

Figure A.3: A method to balance the inflow air velocity, downflow air velocity, and canopy connection pressure.