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STANDARD OPERATING PROCEDURE
Instructions for Use of Nutech 2703 Auto Air Sampling Device

KEY WORDS

air sampling, Nutech 2703 air sampler

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1.0 INTRODUCTION

1.1   Purpose

This standard operating procedure describes how to collect passive air canister samples with the Nutech 2703 auto air sampling device for the Department of Pesticide Regulation's Air Program. These procedures are written for taking a 24-hour sample using a 6-L canister. However, these procedures can be adjusted based on the needs of the study.

For additional information on the Nutech 2703, please refer to the Nutech 2703 Operational Manual.

1.2   Software Installation

The Nutech 2703 controller uses specific software that can be installed on your work issued laptop via the software center. **This is a requirement for our use case scenarios. The software must be installed on your work laptop to properly conduct field sampling.**

2.0 MATERIALS

2.1   List of Equipment

2.1.1   6-L canister

2.1.2   Nutech 2703 controller (located at sampling site in a Shelter One or Campbell Scientific enclosure, shown in Figure 1).

2.1.3   DPR or County Agricultural Commissioner (CAC)-issued laptop with Nutech 2703 installed software.

2.1.4   ALICAT Scientific low flow meter

2.1.5   Calibration tubing and tip (silicone tubing with a series of smaller reducing tubing to connect to 1/8-inch outer diameter PTFE tubing)

2.1.6   Two 9/16" wrenches

2.1.7   Field Data Sheets (FDS)

2.1.8   Chain of Custody forms (COC)

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Figure 1: Nutech 2703 controller inside of a Shelter One enclosure

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2.2   Nutech 2703 Touch Panel and Display Window

2.2.1   The Nutech 2703 touch panel (Figure 2) is used to set up a manual sampling event. The display window will show the specific details related to the sampling event such as, but not limited to, date/time, flow rate, and duration (Figure 3). The display window will show sampling details whether you set it up on a laptop or manually. The components are listed in the next sub-section.
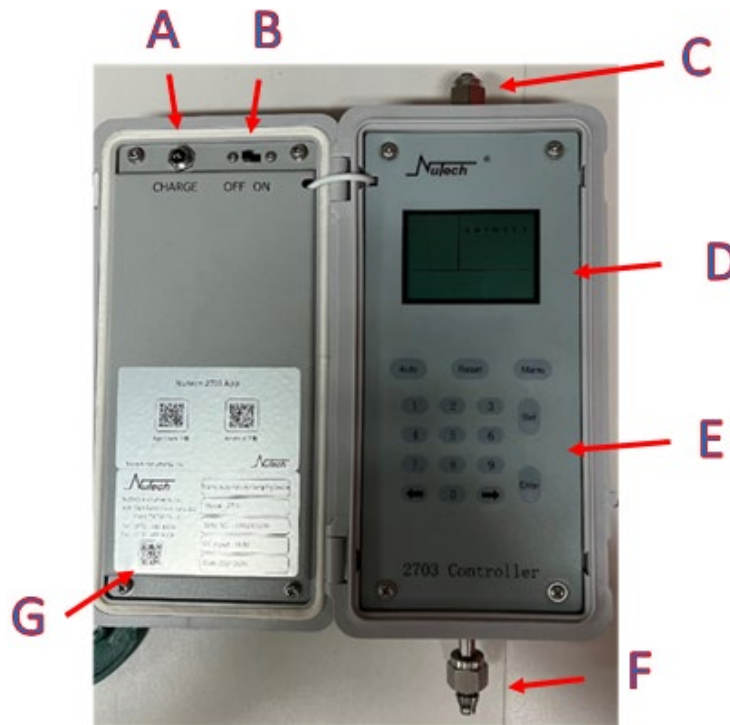

Figure 2: Nutech 2703 controller touch panel.

A. Power charge port

B. Power switch [ON/OFF]

C. Air inlet

D. LCD screen

E. Digital (Numeric) keypad

F. Air outlet

G. QR Code for Nutech's website

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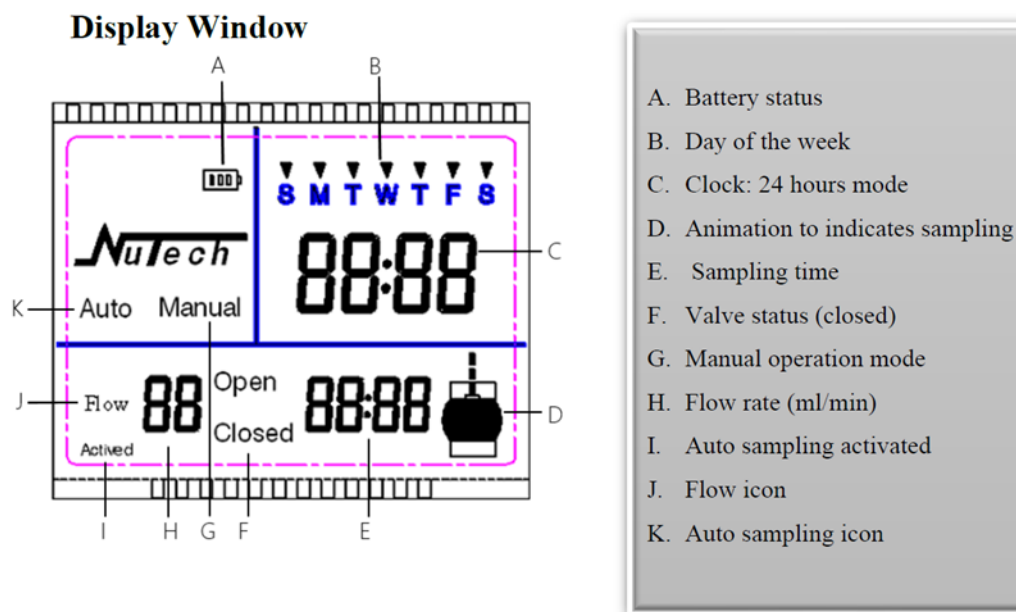*Instructions for Use of Nutech 2703 Auto Air Sampling Device*

Figure 3: Display window of the Nutech 2703 controller.

3.0 PROCEDURES

3.1 Charging the Nutech 2703 Controller

3.1.1   Nutech 2703 controllers are housed in Campbell Scientific or Shelter One enclosures and should be plugged in and left in the **[ON]** position to ensure battery power is not lost during sampling events.

3.1.2   If the controller requires charging, plug the provided power supply into the power charge port on the top left side of the Nutech 2703 controller's open cover. Turn the **[ON/OFF]** power switch to the **[ON]** position (Figure 4).

3.1.3   A **RED** light on the AC power adapter indicates the controller is charging. When the light on the AC adapter turns **GREEN**, the controller has indicated it is fully charged. The instrument must always be connected to a power source when sampling. Turn the unit **[OFF]** when not in use (after sampling is completed) to preserve long-term battery health.

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Figure 4: The Nutech 2703 controller is connected to a power source and is turned ON.

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3.2 Setting Up a 6-L Canister

3.2.1 Remove the brass cap nut from the 6-L canister valve using a 9/16"
combination wrench to attach the Nutech 2703 controller's tubing with nut
to canister. Connect the Nutech 2703 controller tubing with nut to an
evacuated 6-L canister (Figure 5) and manually tighten the nut with your
fingers to ensure the threading is lined up correctly. Use two 9/16"
combination wrenches to tighten down (in opposite directions) the Nutech
2703 tubing with nut to the canister. One wrench should be used on the
nut of the Nutech 2703 tubing, and the other on the Swagelok fitting
below the pressure gauge (Figure 6).

Figure 5: Nutech 2703 tubing connected to a canister.

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Figure 6. Using a second wrench to hold the bottom fitting in place to prevent damaging the valve stem during tightening process.

3.2.2 Once the Nutech 2703 tubing is securely attached to the canister, open the canister valve by hand by turning the blue or green knob on the 6-L canister counterclockwise.

3.2.3 The Nutech 2703 controller may be programmed for a sampling event after it has been attached to a canister. The Nutech 2703 controller can be programmed two ways: Nutech 2703 software installed on a laptop (Section 3.3) and the Nutech 2703 manual touch screen panel (Section 3.5)

3.3 Auto Sampling Operation Procedures with Computer Control – Preferred Method for Set Up

3.3.1 The Nutech 2703 computer software should be installed prior to a sampling event. The software can be downloaded onto your work laptop via the software center. Contact your supervisor or field coordinator to arrange for installation.

3.3.2 Follow instructions in Section 3.2 on how to connect the Nutech 2703 controller to a 6-L canister.

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3.3.3 On the open cover of the device, turn on Nutech 2703 controller (if not already on) by moving the **[ON/OFF]** switch to the **[ON]** position. From that point, the Nutech 2703 timer will stay on for approximately 120 seconds. After that, the Nutech 2703 controller defaults to sleep mode and will not be accessible to put in parameters unless the **ENTER** key is pressed to wake the Nutech 2703 controller out of sleep mode.

3.3.4 A wireless connection must be made between your laptop and the Nutech 2703 controller. The Nutech 2703 controller has a built-in Wi-Fi router. On your laptop, search among Wi-Fi sources for the Nutech 2703 Wi-Fi connection. The connection name will be the serial number of the Nutech 2703 controller (available on the open cover of the device e.g., "N2703-00XX" or a serial number such as "110122013"). Connect to the Nutech 2703 Wi-Fi (Figure 7). **The required password is N2703888. All Nutech 2703 controllers have the same password.**
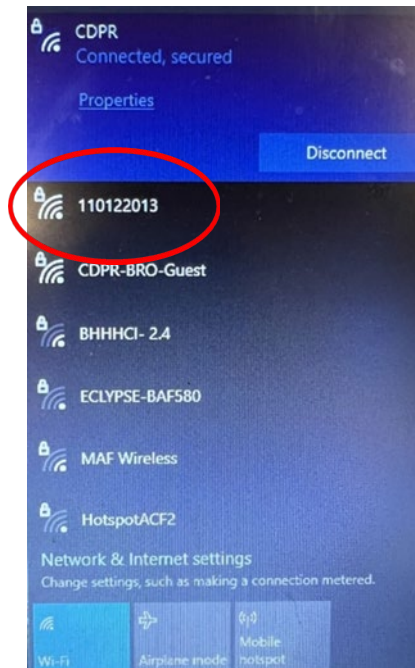

Figure 7: Wi-Fi connection for the Nutech 2703 controller

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3.3.5   Once the connection starts between the Nutech 2703 controller and your laptop, double-click on Nutech 2703 application installed on the laptop. After the software application is opened, if the Wi-Fi connection has linked successfully then the Nutech 2703 icon on the bottom left of the screen will be highlighted in green (Figure 8). If it is not connected, the icon will be orange.

Note: Once you start to make the Wi-Fi connection you can open the application. No need to wait to confirm connection.
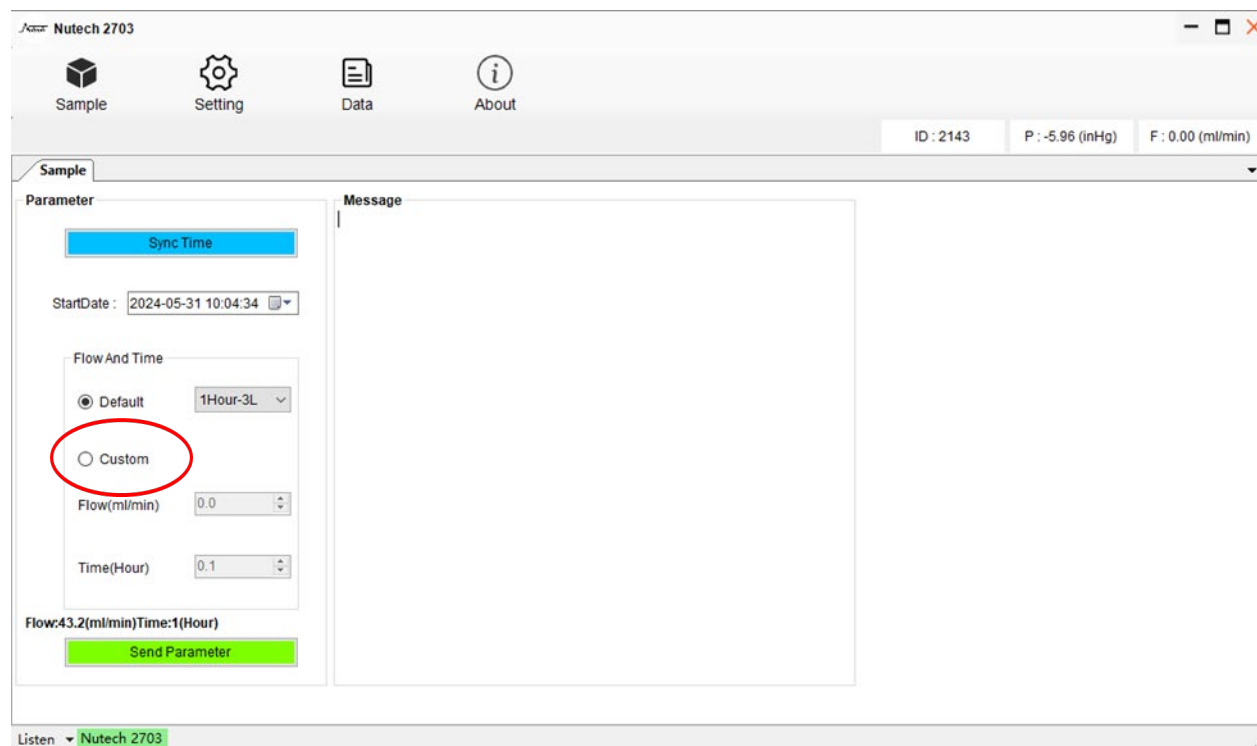

Figure 8: Linked home screen on the software application of the Nutech 2703 controller.

3.3.6   Open the canister valve (if not already open).

3.3.7   From the Nutech 2703 application software's home screen, select **Sync Time**, which synchronizes the time between the field computer and the Nutech 2703.

3.3.8   Select **StartDate**. Select the date and a time two to three minutes from the current time.

3.3.9   In the **Flow and Time** box Select **Custom**. Enter parameters: (3.3 ml/min, 24 Hour).

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    3.3.10   Select **Send Parameter.**

    3.3.11   Based on the time you selected, the Nutech 2703 controller will start running at a flow rate of 3.3 mL/min for 24 hrs. Once the controller starts, a leak check will automatically run. Please allow 2–3 minutes for the leak check to finish and the flow to stabilize before taking a flow reading.

    3.3.12   Use an ALICAT Scientific low flow meter to measure the flow rate. If the flow rate is 3.3 ml/min +/- 10% (2.97 – 3.63 ml/min), the sample set up is now considered complete. Continue to Section 3.6.

    3.3.13   If the flow is out of the acceptable range, continue to section 3.4 to adjust flow.

3.4   Adjusting Flow Rate

    3.4.1   On the Nutech 2703 application software's home screen you will enter the adjusted flow rate based on Table 1. For example, if the initial flow rate was 2.8 mL/min measured using the ALICAT low flow meter, you will enter a new flow rate of 3.9 on the Nutech 2703 application software's home screen. If the measured flows are outside the scope of the table, adjust flow following the same incremental pattern. For example, a measured flow of 4.1 should be adjusted to 2.6 on the device.

      Note: A measured flow outside the range of the table may indicate that the Nutech device needs to be recalibrated. Inform your supervisor of the incident so that steps can be made to replace the device at the site.

    3.4.2   Once the adjusted flow rate has been entered, press on **Send parameter** button.

    3.4.3   The sampler will start a new sampling event and will not account for the previous start time in its data log. The elapsed minutes on the Nutech 2703 controller's display window will start over at 00:00. Make a note on the FDS to ensure clarity.

    3.4.4   Before taking a new flow reading, a leak check will be performed automatically. When one minute has passed, the sample will begin taking a sample. Please wait 2–3 minutes for the flow to stabilize before taking a new flow reading.

    3.4.5   If the flow is within a valid range continue to Section 3.6. If not, repeat the steps in section 3.4.1 to 3.4.4 until a valid flow rate is obtained.

    3.4.6   See Section 3.6 on how to record data on the field data sheet (FDS) at the beginning and end of a sampling event.

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Table 1. Adjusted Flow Rate

Initial Measured Volumetric Flow Rate Using ALICAT Flow Meter (mL/min)	Adjusted Volumetric Flow Rate to be Set on the Regulator (mL/min)
2.0	5.4
2.1	5.2
2.2	5.0
2.3	4.7
2.4	4.5
2.5	4.4
2.6	4.2
2.7	4.0
2.8	3.9
2.9	3.8
3.0	3.6
3.1	3.5
3.2	3.4
3.3	3.3
3.4	3.2
3.5	3.1
3.6	3.0
3.7	2.9
3.8	2.9
3.9	2.8
4.0	2.7

3.5 Manual Auto Sampling Operation Procedures using the Controller's Touch Panel

3.5.1 Follow instructions in Section 3.2 on how to connect the Nutech 2703 controller to a 6-L canister.

3.5.2 Open the canister valve (if not already opened) and turn on the Nutech 2703 controller by turning the **[ON/OFF]** switch to the **[ON]** position located on the front cover panel (Figure 9). The controller will stay on for approximately 120 seconds. After that, the Nutech 2703 controller defaults to sleep mode, and can be wakened only be pressing the **Enter** key.

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Figure 9: ON/OFF button on the Nutech 2703 controller.

3.5.3 Setting the Real-Time/ Clock

3.5.3.1   Press the **Set** key <u>TWICE</u> to set the current time and day of the week (Figure 10). The digits on the screen will start flashing.

3.5.3.2   Using the **numeric keys**, set the clock to military time. If necessary, the **left or right arrow** keys can be used to make a correction.

3.5.3.3   Once the minutes are entered, the day of the week will start flashing. Use the **left or right arrow** key and move the cursor to the desired day.

3.5.3.4   Press the **Enter** key to complete the day and time settings (Figure 10).

Note: During the setup another way to make corrections is by turning the Nutech 2703 controller **Off** and back **On** to start over (this is the easiest way to correct mistakes in the input settings). The time and day of the week needs to be set each time the Nutech 2703 controller is turned on.

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Figure 10: Manually programming the Nutech 2703 controller with the date and time.

3.5.4   Obtaining the Initial Flow Rate/ Adjusted Flow Rate

3.5.4.1   An initial flow rate and/or adjusted flow rate will need to be obtained to start a scheduled sampling event. Follow the setup process from Sections 3.3 and/or 3.4 to program a scheduled run. Once the run has begun, use an ALICAT Scientific low flow meter to measure the flow rate. If the initial flow at the end of the setup is 3.3 +/- 10% (2.97 – 3.63 ml/min), set up is now complete. If the flow rate is not 3.3 +/- 10% (2.97 – 3.63 ml/min) make a note of the reading and use Table 1 to obtain the adjusted flow rate. This will be the value used when setting up the Small Flow Rate in Section 3.5.8 (during the adjusted flow rate set-up).

3.5.5   Setting the Start Time (Valve OPEN)

3.5.5.1   Press the **Set** key ONCE to begin setting the flow rate.

3.5.5.2   When taking a 24-hour sample with a 6-L canister, the flow should be initially set to 3.0 ml/min. To do so, enter "0" followed by "3" on the touch panel. The Nutech 2703 controller recognizes number "03" as a value of 3.0 ml/min flow rate (Figure 11).

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Figure 11: Manually setting the flow rate on the Nutech 2703 controller.

3.5.5.3   Once the flow rate is set, the word "Open" will begin flashing, indicating that we are setting the time to open the valve and setting the opening flow rate. Press **Enter** to confirm open valve function and flow rate.

3.5.5.4   The time will start flashing, indicating that the time is ready to be set. Using the numeric keys, enter the sampling start time. Then use the **left** and **right arrow** keys to select the desired start day, followed by **Enter** to finish setting up the sampling start time. The display will return to the clock setting.

3.5.6   **Setting the Stop Time (Valve CLOSED)**

3.5.6.1   Press the **Set** key <u>ONCE</u> to begin setting the flow rate again for the stop time (we need to set the Flow Rate for both steps of Start and End time).

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3.5.6.2   Set the flow rate to 3.0 ml/min by entering "0" followed by "3" on the screen. Once the flow rate is set, the word "Open" will begin flashing indicating to set the valve function.

3.5.6.3   Use the **left arrow** key to switch to the "Closed" status. Once the word "Closed" appears, Press **Enter** to confirm this function.

3.5.6.4   Next, the time will start flashing, indicating the time is ready to be set. Using the numeric keys, enter the sampling stop time. Use the **left** and **right arrow** keys to select the desired day, followed by **Enter** to confirm the stop time for the sampling event. The display will return to the clock setting.

3.5.7   **Starting and Stopping a Sampling Event**

3.5.7.1   Next, press **Auto** ONCE to start the auto operation.

3.5.7.2   The word "Activated" will be displayed in the bottom left-hand corner of the display panel (See Figure 3 and red circle in Figure 11) indicating that at the set start time and day the valve will open, and sampling will begin. At the set stop time and day, the valve will close automatically, and sampling will end.

   Note: Text "Activated" is quite small.

3.5.8   **Setting a Small Flow Rate (<10ml/min)**

   This step is very important to follow. A manual set-up requires this additional step to accurately set the correct flow rate. If you do not set the small flow rate, the sample will not start.

3.5.8.1   Press **Set** once to begin setting the flow rate. Then, press the **left arrow** key once to enter the small flow rate setting (if you do not press the **left arrow** you will need to start over).

3.5.8.2   The FLOW icon will start flashing, which indicates you have successfully entered the small flow rate setting. Now, 00 means 0.0 ml/min. If you want to set the flow rate to 3.3 ml/min, you will enter 33, which means 3.3 ml/min for the flow rate.

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3.5.8.3   Once you set the flow rate, the word "Open" will start flashing for you to set the valve function. Press **Enter** to confirm this function. The time will begin flashing, indicating that it is ready. Using the digital keys, enter the sampling start time. Use the **right** and **left arrow** keys to select the desired day, followed by **Enter** to finish the sampling start time. The display will return to the clock setting. Then press **Auto**. Set Up is now complete (Figure 12).

Figure 12: Nutech 2703 controller has started a scheduled sampling event.

3.5.9   Based on the date and time you selected, the Nutech 2703 controller will begin running at a flow rate of 3.3 mL/min for 24 hrs. Once the controller starts, a leak check will automatically run. Please allow 2 – 3 minutes for the leak check to finish and the flow to stabilize before taking a flow reading.

3.5.10   Using an ALICAT Scientific low flow meter, measure the flow rate. If the flow rate is 3.3 ml/min +/- 10% (2.97 – 3.63 ml/min) the sample is now set up. Continue to Section 3.6.

3.5.11   If the flow falls out of the acceptable range, make a note of the flow reading and continue with the steps below.

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3.5.12　Stop the sample by turning the Nutech 2703 controller's **[ON/OFF]** switch to [OFF]. The canister valve does not need to be closed.

3.5.13　Use Table 1 to determine the new flow rate. The Initial Measured Flow Rate Using ALICAT Flow Meter (mL/min) column is the one measured with the low flow meter, and the Adjusted Flow Rate to be Set on the Regulator (mL/min) column is the flow rate you will set on the Nutech 2703 controller.

3.5.13.1　For example: If the initial flow rate is reading 2.7 mL/min, the adjusted flow rate should be 4.0 mL/min.

3.5.14　After the adjusted flow rate has been determined the parameter settings should be made in the following order:

3.5.14.1　Turn the Nutech 2703 controller to the **[ON]** position, reconnect to the Nutech 2703 controller's Wi-Fi.

3.5.14.2　Follow the set-up process in 3.5.8.1 onward. Use the adjusted flow rate that was determined in the previous set up when setting up the small flow rate in Section 3.5.8. Once the small flow rate has been entered set up is now complete.

3.5.14.3　Once the leak check is complete and the flow has stabilized a new flow reading can be obtained using the ALICAT low flow meter.

Note: See Section 3.6 on how to collect starting and ending flow rates, and other required information for the FDS.

3.5.15　Do not press any key on the panel once the controller is activated. It may interfere with the parameters you have provided. Once the sampling event has begun and the valve is in the open position (sampling is in progress), the Auto sign will be locked until the event is completed and the valve closes. Please note that it can take several minutes for the flow to increase to the desired levels.

3.6　Recording Information on the Field Data Sheet (FDS)

3.6.1　Procedure for Sample Set Up

3.6.1.1　Record Site Name, Crew, Start Date, Sample Number, Location Code, Time On, Machine ID #, DPR Canister Number, and Flow Meter Serial Number on the field data sheet.

3.6.1.2　Record Starting Pressure on the Canister (should be -30 inHg on the canister's pressure gauge).

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3.6.1.3   Record Starting Sampler Pressure from the. Record the pressure in inHg or psi. The starting pressure must be recorded on the FDS.

3.6.1.4   Starting pressure values will vary, but a valid starting pressure will fall between -30 and -28 inHg. This value is in the top right corner along with sample ID and flow on the laptop application (Figure 8). If a manual set up occurred, you will not have a starting sampler pressure.

3.6.1.5   Pressure units can be changed via the **Setting** tab in the laptop application (Figure 8).

     Note: To convert psi, you can multiply the ending psi by 2.036 inHg (for example: -13.3227 x 2.036 = -27.12 inHg). This value will be your starting sampler pressure.

3.6.1.6   Connect an ALICAT scientific low flow meter affixed with a flow measurement adapter to the inlet of the PTFE tubing (Figure 13). Use the ALICAT low flow meter to Record Initial Flow. A valid flow range should be +/- 10% of 3.3 ml/min (2.97 – 3.63 ml/min) (Remember that a flow of 3.3 ml/min will appear in the LCD screen as a "33".

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Figure 13: Connection of the ALICAT Scientific low flow meter to take initial and ending flow rates.

3.6.1.7 Sign your name in the Sample Started box along with the Date and Time the sample was started. Place the canister inside the enclosure and securely close the door to the Shelter One or Campbell enclosure (site dependent).

3.6.2 **Sample Collection**

3.6.2.1 Return to the site prior to the end of sample period. Using the ALICAT Scientific low flow meter record the final flow reading on the FDS in the same manner that you measured the initial flow reading. Perform the final reading 5 - 10 minutes prior to the sample period ending.

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Note: If you are unable to be on site before sampling ends, ending flow will need to be taken from the sampling data collected by your field laptop (Section 3.6.3)

3.6.2.2   At the end of the sampling period, the Nutech 2703 controller will shut off automatically at 24 hours. The "Open" status will change to "Closed" (Figure 14). Note: The Nutech 2703 will instantly go into a sleep mode once the sample has stopped. To wake the controller, press Enter.

3.6.2.3   Record the final pressure reading from the 6-L canister's flow controller vacuum gauge on the FDS. A valid pressure reading should fall in the range of -4 and -10 inHg, or -2 psi and -5 psi.

3.6.2.4   To record the final sampler pressure, use your laptop to connect to the Nutech 2703 software. the pressure will be displayed in psi or inHg depending on the settings. Record the pressure that is displayed on the sampler software on the FDS. A valid pressure reading should fall in the range of -2 and -5 psi (or -4 and -10 inHg for reference if converting to inHg).

3.6.2.5   Close the canister valve by turning the blue or green knob clockwise.

3.6.2.6   Record any other remaining information required on the FDS (End Date, any applicable Notes related to the sampling event, Sample Finished (date and time), and Sample Transport (date and time). If the sample was set up manually, please note that in the Field Notes section.

3.6.2.7   If a laptop is used to collect sample data, you will need to download the sample data from the Nutech. It will be stored as a .csv file on your laptop and can be viewed with Excel. Please refer to 3.6.3 for download instructions.

3.6.2.8   Turn off the Nutech 2703 controller by turning the **[ON/OFF]** switch to the **[OFF]** position. Keep the Nutech 2703 controller connected to power.

3.6.2.9   Remove the Nutech 2703 controller tubing with nut from canister with two 9/16" combination wrenches and reattach the canister brass cap nut with two 9/16" wrenches.

3.6.2.10   Return with all sampling field-equipment from the sampling site.

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Figure 14: Open and closed screens of the Nutech 2703 controller.

3.6.3   **Downloading the Data using a laptop**

After a sampling event is complete you are required to download the data. Press the **Data** tab and select **+ Add** (Figure 15) on your laptop. Please give an explanatory file name including sample location, number, and collection date when it asks (For example, Delhi_A01286.csv).

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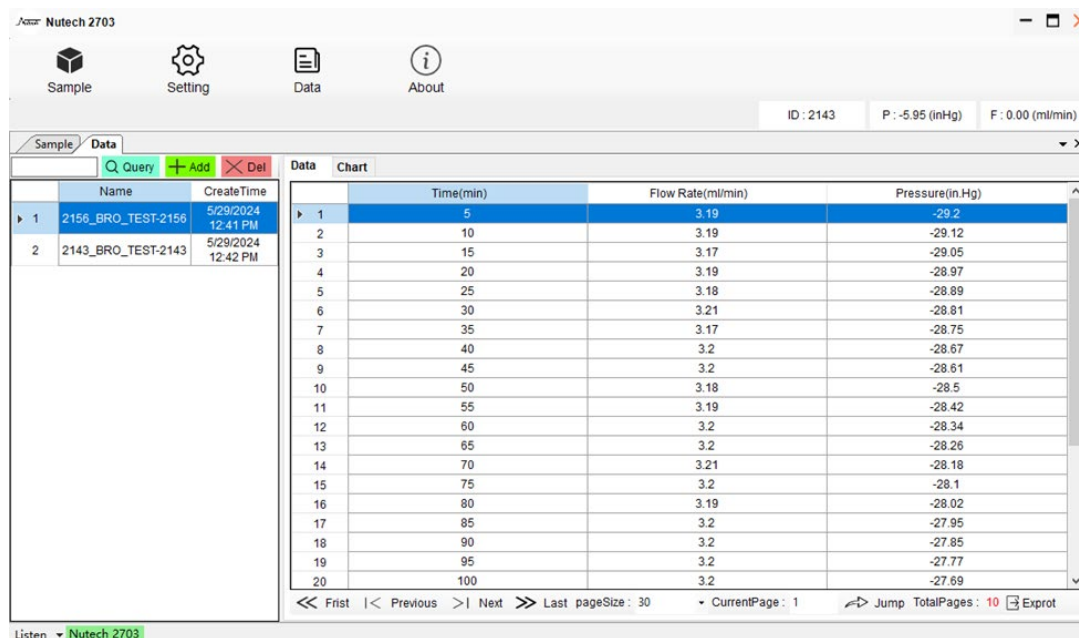
Figure 15: Downloading the flow rate and pressure data.

3.6.3.1   The data and chart in the software will update as the data is downloaded. Data is stored a .csv file and can be viewed via Excel after exporting (Figure 16).

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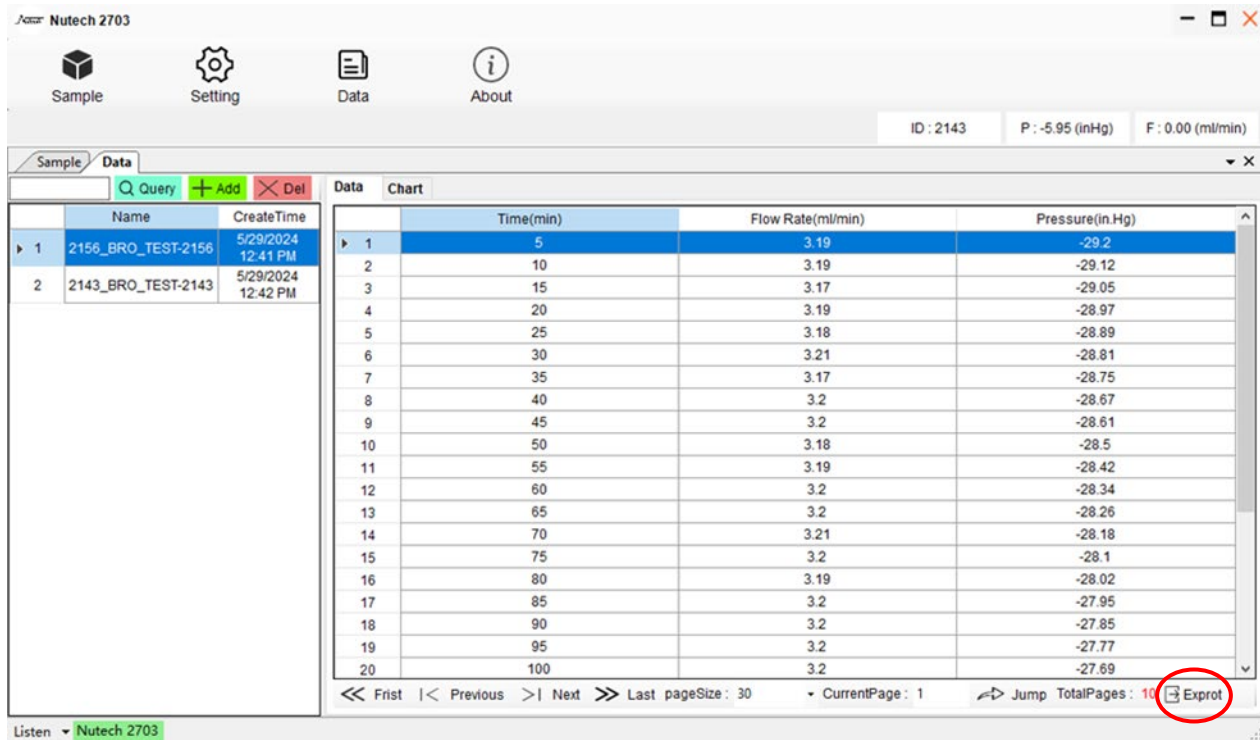
Figure 16: Successful download of flow rate and pressure data.

3.6.3.2   Export the data via the **Export** button on the bottom right (there is a typo in the software, but it is the export function). This will open the file explorer, and you can choose a file name and location. (Figure 17).

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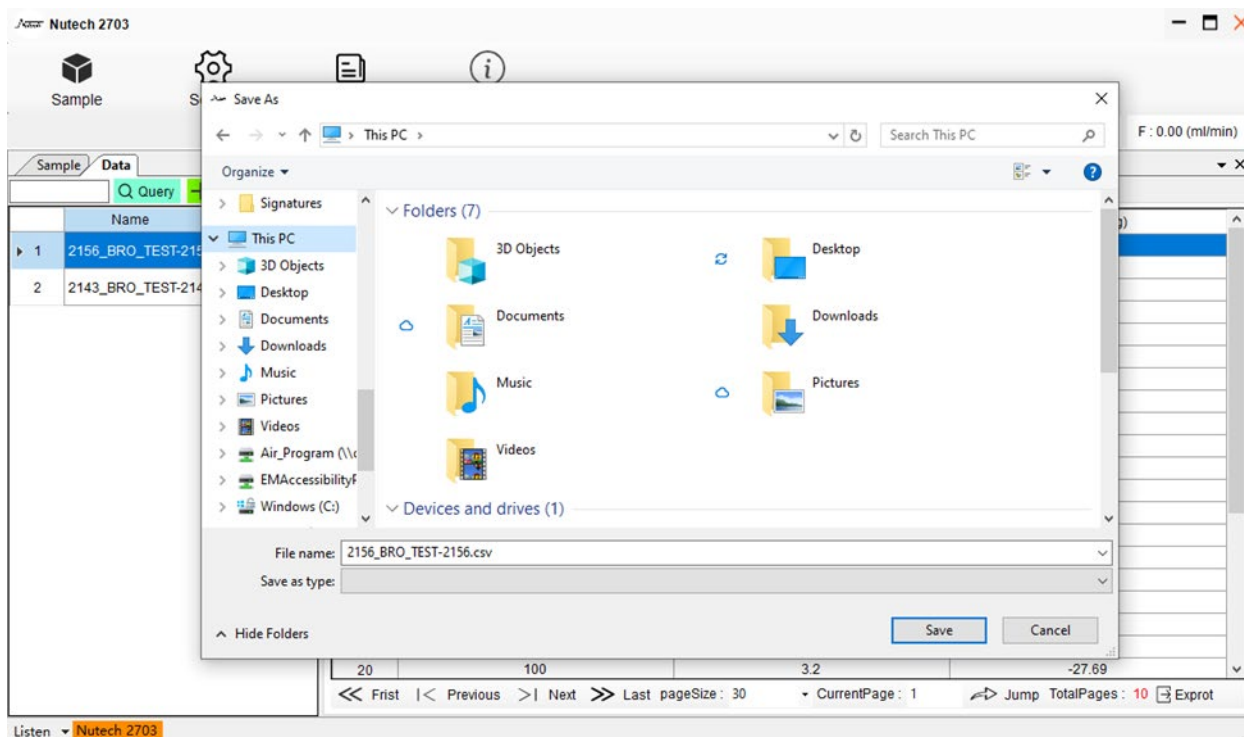
Figure 17: Exporting data files.

3.6.3.3   Next, give the data file a name (Please give an explanatory file name including sample location, number, and collection date when it asks (For example, Delhi_A01286.csv). Once the data is successfully downloaded it can be opened in Excel (Figure 18). This file will need to be sent to the designated data custodian after your sampling trip is complete.

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Figure 18: Downloaded data opened in Excel.

4.0 TROUBLESHOOTING

4.1   The desktop application Version 1.01 of the Nutech software is incompatible with Nutech devices that run on firmware version 1.34 and higher. Staff are required to use the more current versions of the Nutech software to ensure compatibility across the board (includes version 2.0+)

4.2   If the power switch is on and you do not see the time on the panel screen, the Nutech 2703 controller is in sleep mode. Press the **Enter** key and the time will appear on the Nutech 2703 controller's screen.

4.3   If the Nutech 2703 controller freezes, there is no response to the keys, or the clock on the display stops, press the **Reset** button to restart.

4.4   If the screen of the Nutech 2703 controller is entirely dark, it may be due to a lack of power in the battery and it needs to be charged.

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4.5   If Wi-Fi cannot be connected, restart the Nutech 2703 controller, or close out the window and re-open it. If the connection still fails, the Wi-Fi module may be damaged. Please contact the study lead or designated equipment staff member to arrange for repair and/or further troubleshooting.

4.6   If the canister has reached the normal atmospheric pressure before the set time, the Swagelok connections between the canister and the flow controller may be leaking air. You should check whether the Swagelok connectors is tight enough and connected correctly. If there is no air leakage at the connectors, it may be an air leakage inside the instrument. Please contact the study lead or designated equipment staff member to arrange for repair.