FL-1000
FLEC Air Control

Instruction Manual

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1 Introduction

1.1 Description of the FL-1000 FLEC Air Control Unit

Figure 1. The FL-1000 FLEC Air Control Unit

The FLEC Air Control Unit FL-1000 (Figure 1), is designed to control the flow, humidity and purity of air supplied to the Field and Laboratory Emission Cell –FLEC.

Even though the FLEC Air Control Unit incorporates a high capacity charcoal filter it must be supplied with compressed dry and clean air. (Synthetic air is recommended.)

The humidity of the air supplied by the FL-1000 is controlled by mixing two flows, one of dry and and one of 100% humidified air. Approximate measurement of the individual dry and humid air flows is provided by two rotameters on the front of the unit. Access points are also provided for accurately measuring the dry, humid and combined air streams using independent flow meters.

1.2 Scope

The objective of this manual is to facilitate trouble-free operation of the FL-1000 FLEC Air Control Unit. It includes a description of key system components, detailed installation and operating instructions and guidance on routine maintenance.

1.3 Warnings and precautions

Do not install or dismantle the FL-1000 before you have read this manual

WARNING

Note that the system may be pressurised. Never attempt to dissemble the filter via the top fitting. Never attempt to dissemble any part of the Air Flow Controller, if pressure is shown on the gauge on the front of the unit. Always disconnect the entire filter assembly using the connectors beneath the unit (see Section 6.1.) The pressure inside the filter is continually displayed on the gauge at the front of the unit.

WARNING

Valves should never be left in the middle (vertical) position as this blocks the flow of air causing the pressure to increase in the system and the Safety Valve to open. In some circumstances this can lead to breakage of the humidifier.

In the event that the Safety Valve has opened, the inlet pressure to the Air Control Unit must be turned down to zero using the pressure regulator on the FL-1000.

1.4 FL-1000 Specifications

Weight	9.0 kg
Dimensions	560 mm high x 310 mm wide x 225 mm deep
Material in contact with humid air	Acid-resisting stainless steel, Teflon (PFA) and glass
Connections to air supply	1/8” Swagelok, 1/8” copper tubing
Connection to FLEC Cell	1/4” Swagelok, 1/4” PFA tubing
Pressure regulator	0 to max 7 BAR (100 PSI)
Flow range per channel	0-250 ml/min
Total flow range	0-500 ml/min
Flow-meters	0-250 ml/min
Flow-controllers	0-535 ml/min
Relative humidity	0-90% RH
Humidifier / Condenser	Glass. 400 and 75 ml respectively
Safety	A safety valve opens if the pressure in the humidifier exceeds 1 BAR / 14 PSI. Reseals at 0 BAR.
Filter	Replaceable assembly. Packed with high-capacity activated charcoal.

1.5 System requirements

Air Supply	Clean and dry air (synthetic air), at 2 - 10 BAR (28-140 psig)
Water	Pure water is required for the humidifier.

2 Controls and Components (Front)

2.1 Pressure regulator
2.2 Pressure gauge
2.3 Charcoal filter
2.4 Dry air flow controller
2.5 Dry air flow meter
2.6 Dry air valve
2.7 Dry air outlet
2.8 Humid air flow controller
2.9 Humid air flow meter
2.10 Humid air valve
2.11 Humid air outlet
2.12 Combined air valve
2.13 Combined air outlet
2.14 Combined air outlet to FLEC

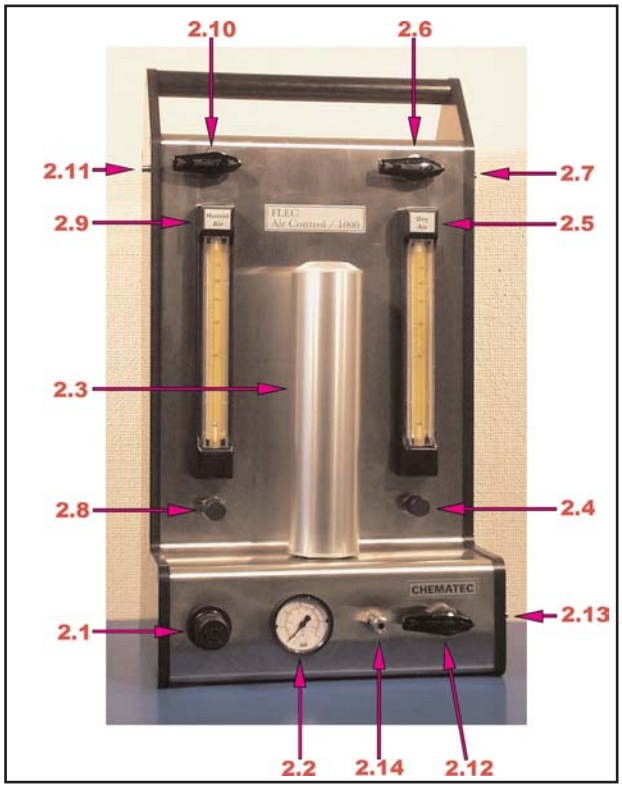


Figure 2. Front Controls and Components

3 Controls and Components (Back)

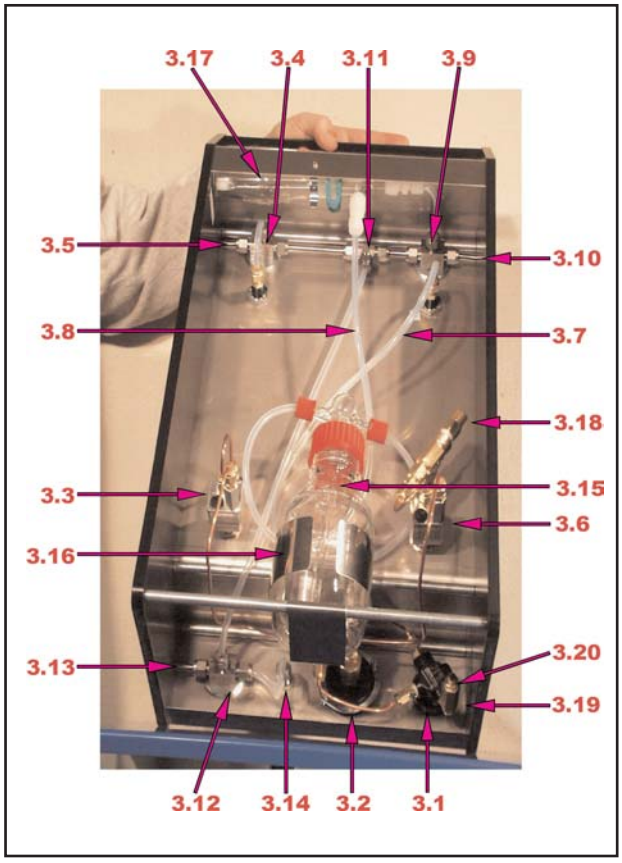


Figure 3. Back Controls and Components

3.1 Pressure regulator
3.2 Pressure gauge
3.3 Dry air flow controller
3.4 Dry air valve
3.5 Dry air outlet
3.6 Humid air flow controller
3.7 Humidifier inlet tubing
3.8 Humidifier outlet tubing
3.9 Humid air valve
3.10 Humid air outlet
3.11 Air mixer unit
3.12 Combined air valve
3.13 Combined air outlet
3.14 Combined air outlet to FLEC
3.15 Humidifier unit
3.16 Humidifier clamp
3.17 Condenser unit
3.18 Safety valve
3.19 Check valve
3.20 Air supply connection

4 INSTALLATION

4.1 Unpacking Instructions

Retain all packaging until you are sure that the FL-1000 is undamaged and is working properly. Please contact your distributor immediately if any problem is identified.

Carefully remove all the tape used for keeping the glassware in place during shipping.

4.2 Air supply.

Locate the coil of 1/8th-inch copper tubing shipped with the Air Control Unit and connect it to the air supply inlet (see 3.20.) The other end should be connected to the main air supply line.

IMPORTANT: When opening the pressure regulator on the FL-1000 for the first time, do so very slowly such that the pressure inside the charcoal filter increases gradually (see 5.1.)

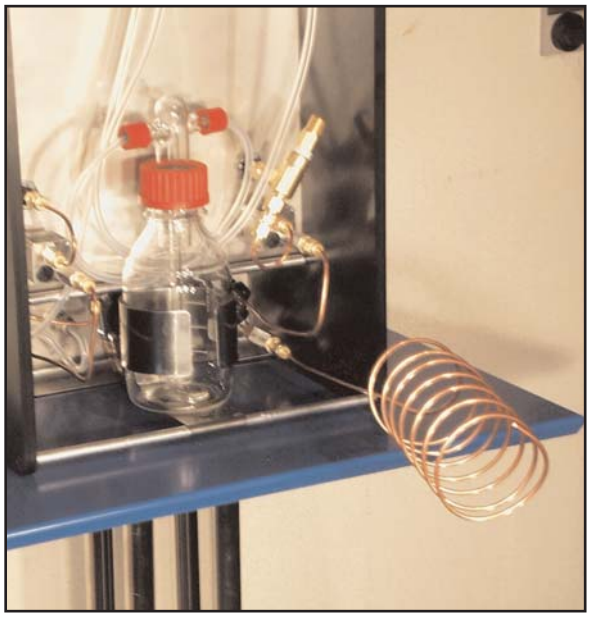


Figure 4. Air Supply Line connected to Air Control Unit

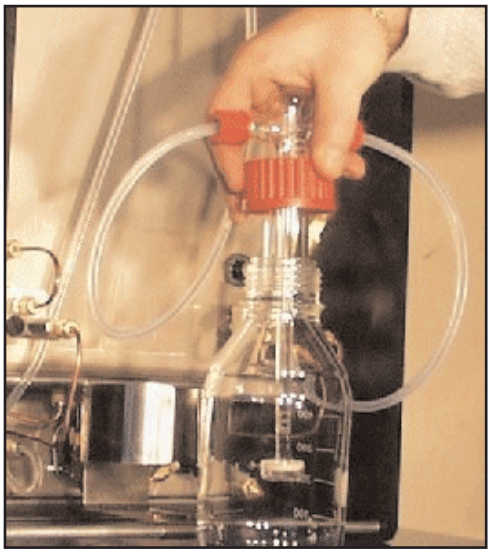
4.3 Humidifier

Pull the humidifier bottle out of its clamp and unscrew the red cap. Visually inspect the bottle to make sure it is clean and, if necessary, rinse out with pure water. Pour in 400-ml pure (distilled) water, reseal and replace it in the clamp.

Note that in routine use, the humidifier bottle should be cleaned thoroughly (using conventional washing procedures for laboratory glassware) and refilled with fresh pure water on a weekly basis.

Figures 5 & 6

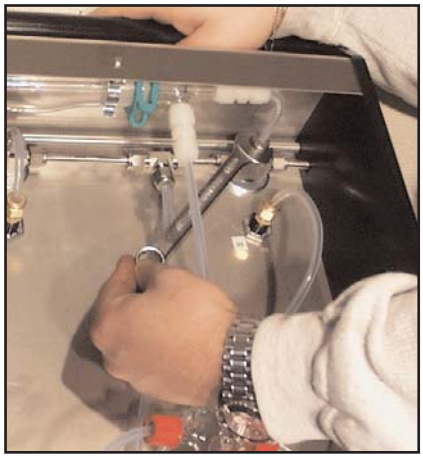
Removing the humidifier bottle

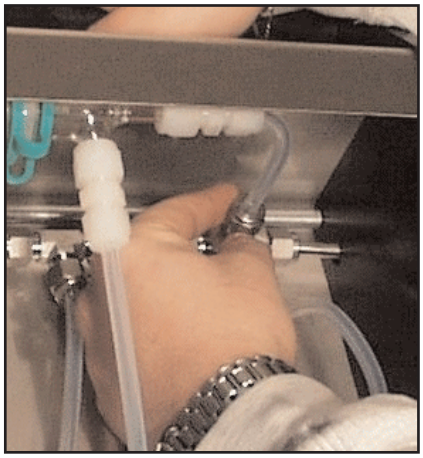


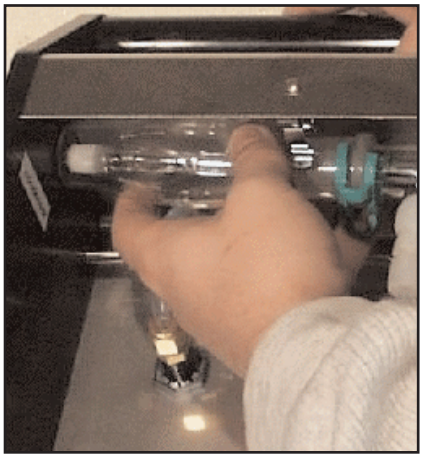
4.4 Condenser unit

The condenser ensures that water particles do not get into the air stream supplying the FLEC.

Check and, if necessary, clean the condenser each time you refresh the humidifier. To access the condenser, loosen the nut on the humid air valve (3.9) and gently remove the glassware from its clamp. The unit must be dissembled before cleaning using conventional procedures for laboratory glassware.







Figures 7, 8 & 9. Removal of the condenser unit for cleaning

5. SYSTEM OPERATION

5.1 Setting the Pressure

The pressure regulator (2.1) is locked in position when the knob is depressed. (Figure 10.)

Pull the knob towards you to release it and then turn gradually clockwise until the desired pressure is shown on the pressure gauge (Typically 2 BAR.) [The working pressure should be set a *minimum* of 0.5 BAR below that in the air supply line.]

Push the knob back in to lock the pressure regulator in position.

IMPORTANT: When opening the pressure on the air supply for the first time, do so very slowly such that the pressure inside the charcoal filter increases gradually.

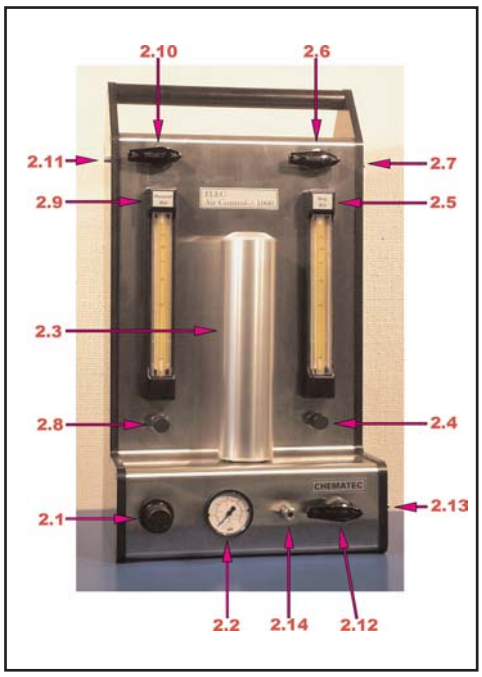


Figure 10. Adjusting the Flow / Humidity

5.2 Setting the Flow and Humidity of the Air

The flow of air supplied by the Air Control Unit to the FLEC cell is determined by the sum of the dry and humid air flows. The humidity of the air supplied depends on the ratio of flows of the individual dry and humid air streams. For example, by adjusting the flow controller on the dry air supply (2.4) to 100 ml/min and that on the humid air supply (2.8) to 100 ml/min a combined air flow of 200 ml/min with a relative humidity of 50% is supplied to the FLEC cell.

The total flow of air supplied to the FLEC cell from the Air Flow Controller should normally be set at around 125% of the total flow of air being pumped from the FLEC cell onto 1 or 2 sorbent tubes. For example:

> If 2 pumps are being used to simultaneously sample onto 2 sorbent tubes at 80 ml/min each, the total flow of air supplied from the FL-1000 to the FLEC should be in the order of (80 + 80) ml/min x 125% - i.e. 200 ml/min. The surplus air flows through the outlet between the two tube connections on the FLEC.

Note that the rotameters on the Air Control Unit provide only an approximate guide to the dry and humid flows delivered. Access points to each individual air flow (2.7, 2.11) and to the combined air flow (2.13) are provided for independent measurement of flows using appropriate instrumentation if fine adjustments are required (see below.)

The combined air flow to the FLEC (2.14) is proportional to the air velocity in the FLEC cell. As the volume of the FLEC cell is 35 ml, an input of 200 ml/min gives an air exhange rate of 200/35, i.e. 5.71 times per minute, (342.6 times/hour). The distance that the air must travel is 7.5 cm, thus the air velocity is then: 7.5 x 5.71 = 42.83 cm/min, (0.714 cm/sec, 0.007 m/sec). If one pump is being used to sample air to only one sorbent tube at 100 ml/min then the total flow of air supplied to the FLEC cell should be 125 ml/min as a mimimum. This in turn leads to a lower air velocity in the FLEC cell.

5.3 Valves and Flow Measurement

By turning the dry air valve (2.6) to the right, the dry air flow is passed to the dry air outlet for measurement. By turning it to the left, the dry air flow is redirected to the air mixer unit.

By turning the humid air valve (2.10) to the left the humid air flow is passed to the humid air outlet for measurement. By turning it to the right the humid air flow is redirected to the air mixer unit.

By turning combined air valve (2.12) to the right the combined air flow is passed to the combined air outlet for independent measurement.

By turning it to the left the combined air flow is directed through the ¼-inch PFA tubing to the FLEC.

WARNING

Valves should never be left in the middle position as this blocks the flow of air causing the pressure to increase in the system and the Safety Valve (3.18) to open. In some circumstances this can lead to breakage of the humidifier.

In the event that the Safety Valve has opened the inlet pressure to the Air Control Unit must be turned down to zero using the pressure regulator.

6 ROUTINE MAINTENANCE

6.1 Charcoal Filter Replacement

The Air Control Unit has a large capacity charcoal filter designed cope with high (1-5 L/min) flows and to work reliably for one year under normal conditions.

WARNING

Never dismantle the filter assembly itself or attempt to undo the top fitting.

Figure 12, 13 & 14. Replacing the charcoal filter assembly

Disconnect the entire filter assembly using the connections under the Air Control Unit as shown in the figures 12-14 and return it as a complete assembly to your distributor for reconditioning or replacement.

Replace the charcoal filter by reversing the procedure shown in the series of illustrations on this page.

6.2 Accessing the Humidifier Insert

WARNING

Incorrect connection of tubing to the Humidifier can force water from the Humidifier into the air flow path thus contaminating the system.

The humidifier insert only needs occasional cleaning. To access the insert, undo the connections to the inlet and outlet tubing and gently pull the insert upwards and out of the main humidifier bottle cap.

Reconnect the Humidifier Inlet Tubing (3.7) to the side arm that leads to the frit at the bottom of the Humidifier unit.

Reconnect the Humidifier Outlet Tubing (3.8) to the other side of the humidifier assembly.

Ensure that both connections are finger tight.

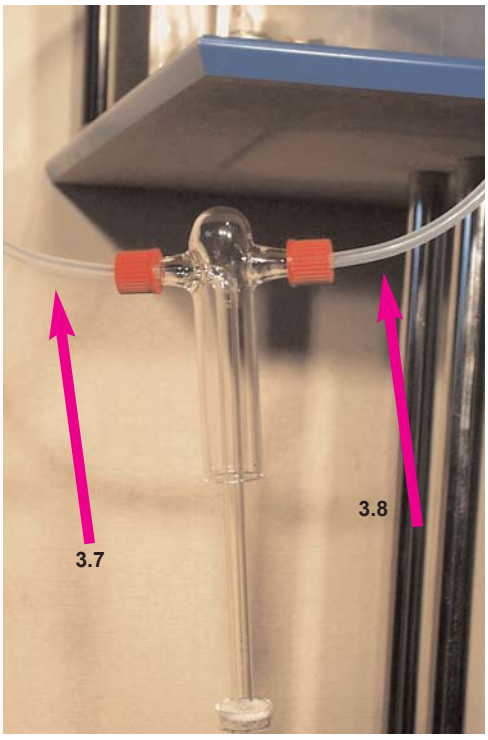


Figure 14 Accessing the Humidifier Insert