FCO220
Microcalibrator

User Guide

Please read carefully before using.

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Safety Notes And Recommendations

Please Read Carefully

1) Do not use the instrument in wet conditions.
2) There are no user-serviceable parts inside the case. Servicing should only be carried out by a qualified engineer.
3) Do not over-tighten the pneumatic connections. The manufacturers recommended method is to screw on the knurled nut until finger tight. The hexagon is to aid release.
4) The air supply must be turned off before carrying out any work on the pneumatic system.
5) The air supply must not exceed that specified on the instrument or in the Test Certificate.
6) If in doubt about any aspect of safety with the equipment then contact Furness Controls BEFORE proceeding.

Introduction

The FCO220 Microcalibrator facilitates fast and accurate control and measurement of low flow rates to simulate leaks in pressure or vacuum pneumatic systems. This enables the FCO220 to be used for calibration, verification and checking of the measurements of leak detectors and flow meters. The FCO220 can also be used to assess the integrity of the configuration and settings of complete leak and flow test systems.

The flow rate is adjustable across the full FCO220 measurement range. The adjustment can accommodate a wide range of test pressures and temperatures.

Closed-loop calibration of Furness Controls leak detectors can be achieved using the FCO220 via the instrument USB communication ports.

The FCO220 is a small and lightweight handheld, battery powered unit enabling it to be used with ease in production environments. It can also be powered by a mains adaptor and features an extending foot to provide a stable base making it equally suited to use in a laboratory environment.

General Description

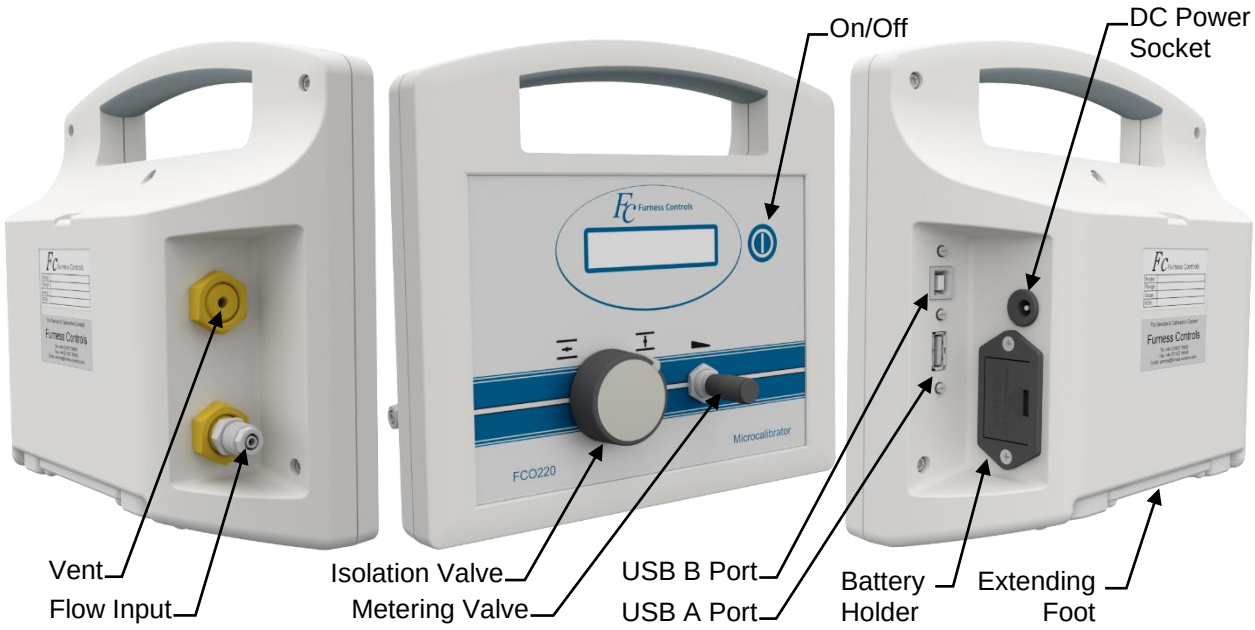
The FCO220 Microcalibrator incorporates an isolation valve and a metering valve to control the flow of air through the instrument to atmosphere. The flow passes through an integrated laminar flow element, generating a differential pressure proportional to flow rate. This pressure is measured by a proprietary Furness Controls transducer. The transducer signal is processed and digital measurements are presented via LCD and USB communication.

Flow measurements made by the FCO220 are temperature compensated and the instrument also features an atmospheric pressure sensor, allowing readings to be corrected to standard conditions.

The instrument indicates positive and negative flow rates and hence can be used on pressure or vacuum test systems in exactly the same way.

Serial communication with other electronic devices is supported via USB ports. A master USB A port allows the FCO220 to communicate with Furness Controls leak detectors allowing automated, closed-loop calibration of Furness Controls leak detectors. A slave USB B port allows a computer to communicate with the FCO220 to make software configuration changes.

Features



Display

The display is an 8 character starburst LCD with a character height of 9mm. The display shows the leak value set by the instrument and also indicates certain operating states of the instrument. If the FCO220 is being used on a pressure system positive readings will be shown. If the FCO220 is being used on a vacuum system negative readings will be shown.

Isolation Valve/Zeroing

The isolation valve has two positions, open to allow flow through the instrument and closed to prevent flow through the instrument.

When the isolation valve is first changed from open to closed the instrument senses that the valve is closed and automatically zeroes its flow reading. The instrument will display ZEROING while it waits for a stable flow. Once the instrument has sampled a stable zero value the display will change to 0000. If zeroing is attempted with the metering valve closed during unstable atmospheric conditions (for instance, on a windy day) the instrument may struggle to sample a stable zero value. If ZEROING is displayed for a prolonged period ensure that the metering valve is open by turning it anti-clockwise.

If the isolation valve is left in the closed position for longer than the time required to zero the reading the instrument will cycle, indicating a succesful zero process and displaying the atmospheric pressure and temperature measurements in turn.

When the isolation valve is in the closed position, the leak set by the metering valve is isolated from the test system. This allows the leak test system to be checked for leak tightness or for the system to be used in normal production without having to disconnect the instrument.

During transition of the isolation valve between its two positions air is vented from the flow input port to atmosphere. This is necessary for the operation of the zero system.

Metering Valve/Flow Adjustment

The metering valve is a precision tapered needle valve which is used to set the required flow rate. Rotating the adjuster clockwise reduces flow and anti-clockwise rotation increases flow.

When resistance is felt while rotating the adjuster clockwise, closing the valve to set zero flow, rotation must be stopped. Applying excessive force to close the valve will result in damage to the needle in the valve.

The metering valve becomes more sensitive as the test pressure is increased, with small adjustments

having an increasingly significant effect on the flow rate. Care is needed to ensure the metering valve is not opened too much because this could cause the flow meter of the FCO220 to be overloaded.

On/Off Switch

The instrument on/off switch has a momentary action, a brief press toggling the instrument power state between on and off.

The instrument features an automatic power-down function to preserve the life of the battery. This will turn off the instrument after a time which can be set via the FCS641 FCO220 Utility software. The auto power down function can also be disabled via the software. The default power-down time is 10 minutes and the timer is reset whenever the state of the isolation valve is changed.

Flow Input Port

The flow input port provides the connection to the test system. The flow input port has an ⅛"BSP female thread. Fittings used to connect to this port must be suitable for leak test systems and leak tight. Use a thread sealant on the screw thread of fittings which don't feature soft seals.

Vent Port

The vent port is only to allow the air passing through the FCO220 to escape to the atmosphere and therefore should always be left open and unrestricted.

USB A Port

The USB A port can be used to connect the FCO220 to the USB B port of a Furness Controls leak detector using a USB A-B cable to enable closed loop calibration of the leak detector. The FCO220 streams flow readings from the USB A port which the leak detector can receive to calibrate its leak measurement.

USB B Port

The USB B port can be used to connect the FCO220 to a computer. This allows configuration changes to the FCO220 using the FCS641 FCO220 Utility software.

DC Power Socket

The FCO220 can be powered using a 9VDC power supply. A suitable mains adaptor is supplied with the instrument. The 9VDC supply should be connected to the dc power socket. Power applied to the dc power socket will not recharge the battery.

Battery Holder

The instrument can be powered from a 9 volt battery. The battery must be fitted into the holder, taking note of the correct orientation. To remove the battery holder simply use the thumb-nail slot to press the holder toward the front of the instrument and then slide it out. To fit the battery holder simply push it in place and allow the spring clip to retain it.

The low operating power of the FCO220 allows a battery life of up to 100 hours (using an alkaline battery). Once battery low is indicated the battery should last for at least another 10 hours. Once the battery voltage is below the level required for the FCO220 to operate correctly the instrument will automatically power down.

The battery should always be replaced with a 9V battery (type PP3/6LR61/MN1604).

Extending Foot

The instrument features an extending foot which can be pulled out at the back of the instrument to provide a more stable base when using the instrument on a desktop. When holding, transporting or storing the instrument the foot can be retracted.

Settings

Instrument settings can be changed using the Furness Controls FCS641 220 Series Utility software. To change settings using the 220 Series Utility a connection between a computer which is running the software and the FCO220 must be made using the USB B port of the FCO220. If a new connection is made between the computer running the software and an FCO220 when the software is already running, the software will have to be restarted to enable communication over that new connection.

Software Installation

USB drivers for the FCO220 USB B port and the FCS641 software are available for download from furness.com/info.

Software Requirements

The minimum requirement to run the software is:

Operating System:	Microsoft Windows XP or above
Hard Disk:	4MB free space
Communications Port:	One USB port

Installation Procedure

1. Download the FCS641 utility from the Furness Controls download site.
2. Double click the Setup.exe file.
3. Follow the prompts to install the software.
4. Once installation has completed there is no need to re-start the computer. You should be able to run the software immediately by clicking on the FCS641 220 Series Utility icon in the 220 Series Utility program group.

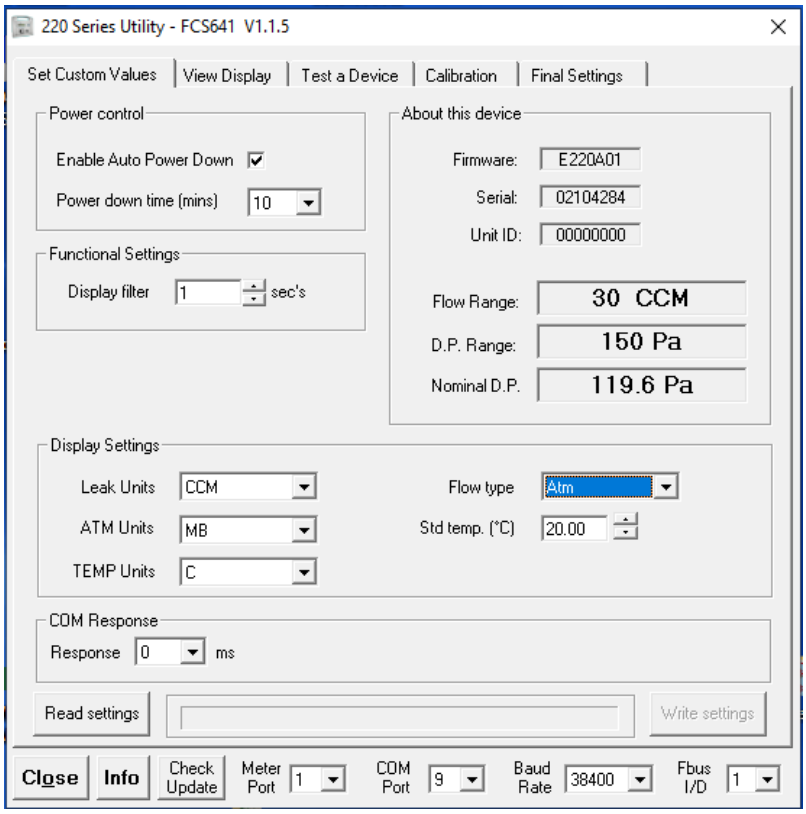
FCS641 220 Series Utility Software

Set Custom Values

The software will always start by presenting the Set Custom Values tab. This is the main screen for accessing the user settings of the FCO220.

Each time the software runs it will attempt to communicate with an FCO220 using the last used USB Port. If communication with an FCO220 cannot be established on that USB port the software will ask if it should scan other USB ports to try to detect an FCO220.

To view or alter the settings of the connected FCO220 you must first click on the **Read from Tx** button. The settings of the connected FCO220 will then be loaded into the Set Custom Values tab.



The port number and the communication baud rate is displayed at the bottom of the software window. Also displayed in this area is a setting for an Fbus ID number. This allows an ID to be set to support Furness Controls Fbus communications via a standalone script or the Furness Controls Fbus Utility software.

• *About this device*

This lists fixed details of the connected FCO220: firmware version, instrument serial number and transducer ID. Also reported here is the flow range of the instruments laminar flow element, the differential pressure range of the transducer and the full scale differential pressure generated by the laminar flow element at full scale flow.

• *Enable Auto Power Down*

Purpose: The auto power down feature can be useful to extend battery life.

Options: **Enabled** The FCO220 will turn off after a set time of inactivity. The power down timer is reset when the zero switch is triggered by closing the isolation valve.

Disabled The instrument will not automatically turn off. This is useful if an external power supply is being used.

• *Power down time*

Purpose: Sets the amount of inactivity time before auto power down.

Options: 10 to 60 minutes

• *FILTER*

Purpose: This feature dampens the transducer response which can be useful to reduce fluctuations when measuring turbulent flows. The setting is a time constant applied such that changes in measured flow are delayed in being shown by the displayed reading. The display filter setting defines the time period for the displayed reading to change by 63% of the measured change in flow. Taking the example of a step change in flow from 1 cc/minute to 2 cc/minute and a filter time of 1 second it will take 1 second for the displayed reading to reach 1.63 cc/minute and it will take 5 seconds for the displayed reading to reach 1.98 cc/minute.

Options: 0.0 to 60.0 seconds

• *Leak Units*

Purpose: Sets the flow display units.

Options: **CCM** (cc/min or cm^3/min)
CCH (cc/h or cm^3/h)
MMS (mm^3/s)
MLM (ml/min),
MLH (ml/h)

• *ATM Units*

Purpose: Sets the atmospheric pressure display units.

Options: **MB** (millibar)
"HG (inches of mercury)

• *Temp Units*

Purpose: Sets the temperature display units.

Options: **°C**
°F

• *Flow type*

Purpose: Sets the temperature display units.

Options: **Atm** The flow readings are corrected back to the current atmospheric pressure and temperature.

STD The flow readings are corrected back to S.T.P (standard temperature and pressure). The standard temperature is defined in the settings. The standard pressure is 1013.25 mbar

• *Response*

Purpose: **COM Response** allows a delay to be set which is applied between a command being received by the FCO220 on its communication port and the FCO220 sending its response.

Options: 0 to 50 milliseconds

Once any changes have been made the new settings can be written to the instrument by clicking on the Write to Tx button.

View Display

The View Display tab provides a method to see what is currently displayed by the FCO220. This can be useful if the instrument has to be placed in an awkward position with restricted view or when needing to enter instantaneous readings into a document on the computer, allowing view of the FCO220 display without looking away from the computer screen. Click on the **Start** button to begin viewing the instrument display in the software. Click on the **Stop** button to end viewing of the display.

The View Display tab also incorporates a keypad simulation, allowing manual viewing and changing of the settings which are accessible on the Set Custom Values tab. Click on **Keypad Simulation Mode** to begin using the software keypad. The enter button can be used to enter the menus and confirm setting changes. The up and down buttons can be used to navigate through the menus and change settings. The back button can be used to leave menus and cancel setting changes.

Test a Device

The Test a Device tab allows system level bit values to be viewed. This can be useful for diagnostic purposes and should only be used in consultation with a Furness Controls engineer.

The **ADC bit limit test** section shows data relating to the flow measurement.

The **External Sensor readings** section shows data relating to the measurement of ambient conditions.

Calibration

The Calibration tab includes settings which can be used to adjust the measurements of the FCO220. Changes to these settings should be made with care because they will effect the accuracy of the measurements.

Operating Procedures

Calibrating a Leak Detector

- Switch on the FCO220. The instrument requires zeroing before use. To zero the instrument turn the isolation valve to the closed position. The display will show “ZEROING” followed by "ZERO" when the instrument has obtained a valid zero. The display will then cycle between the current ambient temperature and atmospheric pressure.

- Set the metering valve to minimum by rotating the adjuster clockwise to the point where resistance is first felt. Do not close the valve beyond this point. Over-tightening will damage the valve.

- Make a leak tight coupling between the FCO220 flow input port and the point where you need to introduce a simulated leak. This could be the test line between a leak detector and a test item (requiring the use of a “T” fitting, refer to Connection Diagram A) or it could be direct to the calibration port of a leak detector (refer to Connection Diagram B).

- Start the leak test with a leak tight test component fitted and check that the leak detector displays zero leak. If a non-zero leak value is displayed, recycle the test without venting the test system and check again for zero leak. If a leak is still indicated take steps to ensure that the test system is leak tight.

- If it is not possible to obtain a leak tight test component the leak reading displayed by the leak detector with the FCO220 closed must be added to the reading displayed on the FCO220 when a leak is set.

- Turn the isolation valve to the open position.

- Start a test cycle and adjust the metering valve of the FCO220 to set the desired leak rate as indicated by the FCO220. The leak should be set during the fill stage, whilst the test pressure is constant.

- Do not move the FCO220 isolation valve during the leak detector test stage. Air is vented whilst the valve is between its open and closed states and this will cause the test to fail.

- Record the leak readings indicated by the FCO220 and the leak detector. Refer to your leak detector manual to determine the most suitable method of altering calibration of the leak detector and make suitable adjustments to correct the leak detector reading to that of the FCO220.

Use as a Flow Meter

- Ensure that the flow test air supply is turned off.

- Fully open the metering valve of the FCO220 by turning the adjuster anti-clockwise.

- Switch on the FCO220. The instrument requires zeroing before use. To zero the instrument turn the isolation valve to the closed position. The display will show “ZEROING” followed by "ZERO" when the instrument has obtained a valid zero. The display will then cycle between the current ambient temperature and atmospheric pressure.

- Open the isolation valve.

- Connect the FCO220 flow input port on the downstream side of the test item with the FCO220 vent port open to atmosphere. The vent port of the FCO220 must always be open to the atmosphere for flow readings of the FCO220 to be in atmospheric flow units.

- Turn the air supply on at the desired test pressure. If unsure of the flow rate that the test pressure will generate start with a low supply pressure and increase it gradually.

- Read the flow rate from the FCO220.

Ensure that the air supply is turned off any time that the FCO220 isolation valve is closed. Closing the isolation valve will result in the test item being exposed to the full test pressure which could cause damage to the test item. It could also result in momentary overload of the FCO220 when the isolation valve is opened.

With the control valve of the FCO220 fully open there is still a pressure developed across the instrument. If the pressure across the test item is quite low, then the pressure drop across the FCO220 may need to be taken into account. Table 1 shows typical values of the pressure developed across the FCO220 for full scale flow.

Table 1 - Typical Pressures for Full Flow

Model	Flow	Pressure
1	3cc/min	100 Pa
2	6cc/min	110 Pa
3	30cc/min	150 Pa
4	300cc/min	1000 Pa

Quick Connect Couplings

If the FCO220 is to be disconnected from the leak test system after calibration and calibration will be performed periodically then it is convenient to use a quick connect fitting in the line. The fitting connected to the test line must be self sealing and suitable for use in leak test systems. A range of suitable inline and panel mounting quick connect couplings are available from Furness Controls.

Connection diagrams A & B show the alternative positions for fitting quick connect couplings.

Care of the FCO220

Unlike liquid filled calibration devices there is no need to store or operate the Microcalibrator in the upright position.

As with all instruments manufactured by Furness Controls Ltd the FCO220 should only be used with clean, dry air.

The metering valve should always be closed when the FCO220 is first connected to a test line to ensure the flow through the unit does not exceed the overload capability of 20 times the flow range.

Do not use solvent cleaner on the instrument case or labels.

Correction to Standard Conditions

The FCO220, by default, displays volumetric flow at atmospheric temperature and pressure conditions.

Using the FCS641 220 Series Utility software it is possible to change the flow type so that the FCO220 calculates and displays flow corrected to standard conditions. To achieve this the FCO220 incorporates a sensor which measures atmospheric pressure and the temperature of the air passing through the instrument. The standard temperature that is used for the calculation defaults to 20°C but can be set via the software to other temperatures in the range 0°C to 50°C. Standard pressure is fixed at 101325 Pa.

The flow type should be changed between atmospheric and standard conditions to match the measurement of the instrument that the FCO220 is being used with.

The calculation that is used by the FCO220 to correct readings to standard conditions is as follows:

$$Q_{std} = Q_{FCO220} \times \frac{P_{atm}}{P_{std}} \times \frac{T_{std}}{T_{amb}}$$

Where:

Q_{std} = FCO220 flow value corrected to standard conditions
Q_{FCO220} = Flow value measured by the FCO220
P_{atm} = Atmospheric pressure measured by the FCO220 in Pa
P_{std} = Standard atmospheric pressure (101325 Pa)
T_{std} = Standard temperature setting in Kelvin (T°C + 273.15)
T_{amb} = Ambient temperature measured by the FCO220 in Kelvin (T°C + 273.15)

Display Messages

The following messages can be displayed to indicate the instrument operation state and in the event of a system or hardware error or failure. Messages which don't fit on the display will scroll across the display.

ZEROING
The isolation valve has been changed to the closed  position and the instrument is waiting for a stable flow reading to set a valid zero.

ZERO
The instrument has obtained a valid zero reading when the isolation valve is in the closed  position. To clear the message open the isolation valve.

NNNNNXXX (where NNNNN is a number and XXX is pressure units)
Displayed periodically when the isolation valve is left in the closed position, this is the atmospheric pressure measurement.

NNNN X (where NNNN is a number and X is temperature units)
Displayed periodically when the isolation valve is left in the closed position, this is the atmospheric temperature measurement.

CAL CKSUM
A calibration data checksum error occurred.

USER CKSUM
A user data checksum error occurred.

EXT CAL CKSUM
An extended calibration data checksum error occurred.

EXT USER CKSUM
An extended user data checksum error occurred.

ADC CONVERSION TIMEOUT
The differential pressure analog to digital converter has become unresponsive.

TEMP SENSOR FAILURE
The differential pressure temperature sensor has become unresponsive or is returning invalid values.

DIAG ADC FAILURE
The diagnostic analog to digital convertor has become unresponsive or is returning invalid values.

DIAG HEAD VOLTAGE
A fault has been detected with the differential pressure measurement.

EEPROM WRITE FAILURE
Writing of data to the EEPROM has failed.

AMBIENT TEMP SENSOR FAILURE
The ambient temperature sensor has become unresponsive or is returning invalid values.

ATMOSPHERIC SENSOR FAILURE
The ambient pressure sensor has become unresponsive or is returning invalid values.

Connection Diagrams

Without Calibration Port

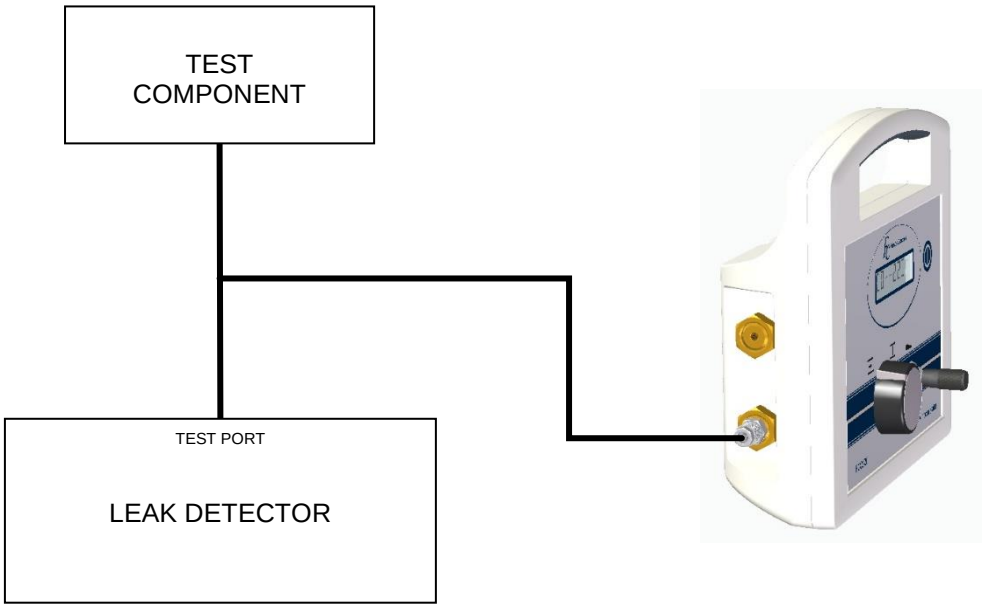


Diagram A

With Calibration Port

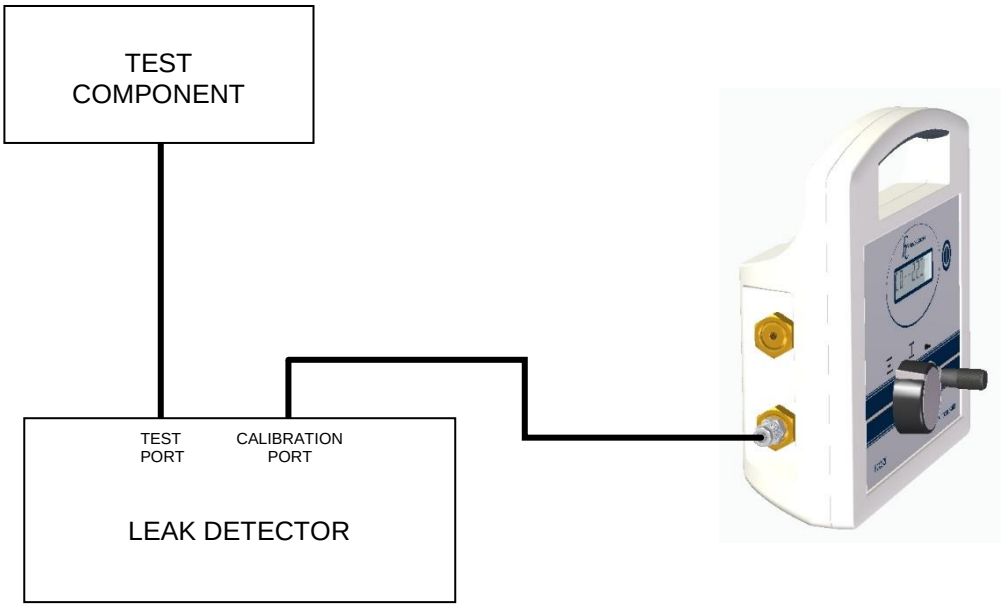


Diagram B

Specification

Flow Measurement

Flow ranges	±3 cc/min	±6 cc/min	±30 cc/min	±300 cc/min
Flow Units	±3.000 cc/min ±180.0 cc/h ±50.00 mm3/s ±3.000 ml/min ±180.0 ml/h	±6.000 cc/min ±360.0 cc/h ±100.0 mm3/s ±6.000 ml/min ±360.0 ml/h	±30.00 cc/min ±1800 cc/h ±500.0 mm3/s ±30.00 ml/min ±1800 ml/h	±300.0 cc/min ±18000 cc/h ±5000 mm3/s ±300.0 ml/min ±18000 ml/h
Accuracy @ 20°C	<1% R + 0.003 cc/min	<1% R + 0.006 cc/min	<1% R + 0.03 cc/min	<1% R + 0.3 cc/min
Temperature Coefficients	Zero: Semi-automatic Zero facility Span: < 0.1% per °C			
Display	8 character LCD			
Long Term Drift (span)	< 1% per year			

Electrical

Power Requirements	9 volt battery (PP3/6LR61/MN1604)
Battery Life	Up to 100 hours
Operating Temperature	0 to 50°C

Pneumatic

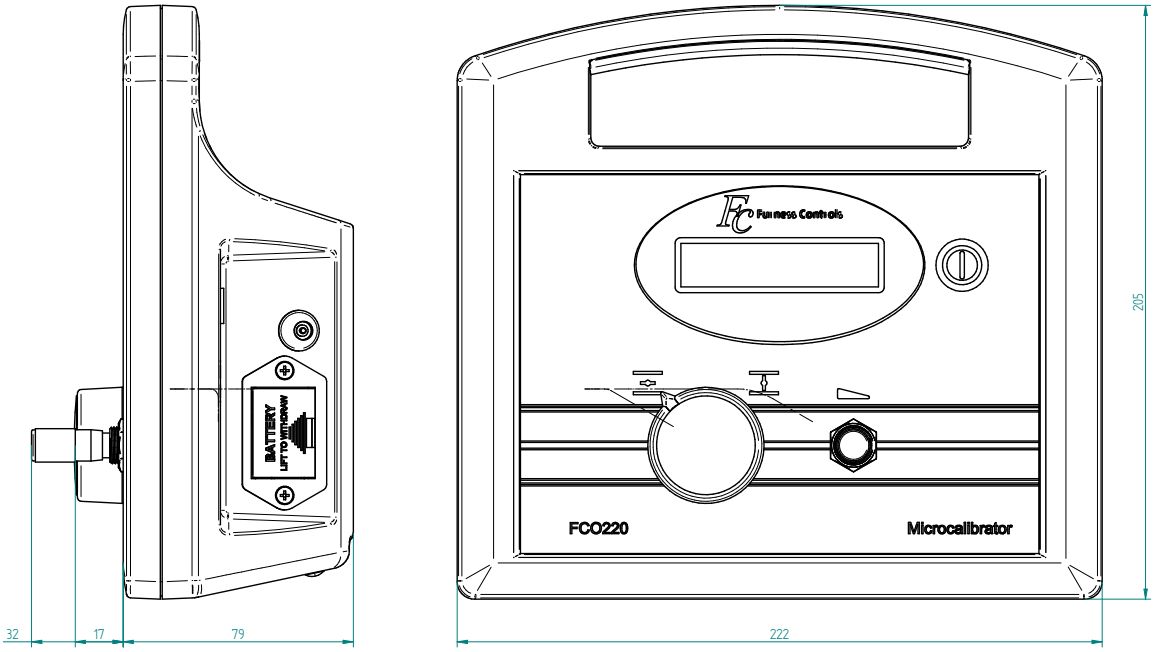
Media Compatibility	Clean dry air or non corrosive gas. Viscosity corrected for air only.
Overload	20 x Range
Pneumatic Connection	⅛" BSP female input (option for Quick Connector)
Vent port	M5 (DO NOT RESTRICT)
Static Pressure	Vacuum to 14 bar gauge
Effective Volume	0.8cc (input port up to control valve)

Construction

Enclosure	ABS Case
Dimensions	222 x 205 x 79mm (W x H x D)
Media Compatibility	Clean dry non-corrosive gas
Weight	1.2kg

All information in this document is provisional and is subject to change without notice.

Instrument Dimensions



Revision Record

Issue	Date	
1	26-10-2021	First release