User Manual for 1403 Multipoint Sampler and Doser

BE6045-14

Index

1403 Multipoint Sampler and Doser

From serial number: 100-001

February 2018

Safety Considerations

SAFETY CONSIDERATIONS

PLEASE READ THESE SAFETY CONSIDERATIONS CAREFULLY AND MAKE SURE YOU UNDERSTAND THEM PROPERLY BEFORE YOU START OPERATING THE 1403 MULTIPOINT SAMPLER.

EXPLOSION HAZARD

THE 1403 MULTIPOINT SAMPLER IS NOT DESIGNED FOR USE IN POTENTIALLY EXPLOSIVE ENVIRONMENTS.

This means that the instrument must **not** be placed and operated in an area with a potentially explosive atmosphere.

When monitoring potentially flammable or toxic gases it is essential that:

1) the instrument itself is placed in a well-ventilated area **outside** the potentially hazardous zone; and

2) a sufficiently long tube is connected to the "Sampler Waste Air Outlet" so that the sampled gas is carried **away** to the open air or to an extraction and/or filtration unit.

TO AVOID THE POSSIBILITY OF AN EXPLOSION, MONITORING OF FLAMMABLE GASES **IN EXPLOSIVE CONCENTRATIONS** MUST NEVER BE ATTEMPTED.

AVOID WATER CONDENSATION IN THE INSTRUMENT.

Liquids must be prevented from entering the instrument. It is therefore important that warm humid gases are not drawn into a cold instrument because condensation will take place. If such a situation is likely to occur you should ensure that the gases are drawn through water-trap filters before they enter the sampler channels of the 1403. This will remove water vapour in the gases and thus prevent condensation within the instrument. The water-trap filter should be used in the immediate environment of the instrument so it maintains either the same temperature, or a lower temperature than the instrument.

SAFETY CONSIDERATIONS

The 1403 Multipoint Sampler complies with EN/IEC 61010-1 3rd Ed. (2010): Safety requirements for electrical equipment for measurement, control and laboratory use. To ensure safe operation and retain the 1403 in safe condition, note the following:

APPLYING POWER

Before using the 1403 check that the available mains voltage match the specified voltage and frequency for the instrument.

CONNECTING TO THE USB-CONNECTOR

The USB connector is only to be used to connect to Gas Monitor 1512 or 1412i.

SAFETY SYMBOLS

 The apparatus is marked with this symbol when it is important that the user refer to the associated warning statements given in the User Manual.

 Frame or Chassis  Protective earth  Hazardous Voltage

WARNINGS

Before connecting or disconnecting interface cables, switch off the power to all instruments.

To secure that safety is not impaired the instrument is only to be used according to the description in this User Manual BE6045.

Whenever it is likely that correct function or operating safety of the apparatus has been impaired, the apparatus must be made inoperative and secured against unintended operation.

Please be aware that SF6 and Freon 134a both have a TLV of 1000 ppm.
The instrument must be placed in a ventilated area when tracer gas is connected.

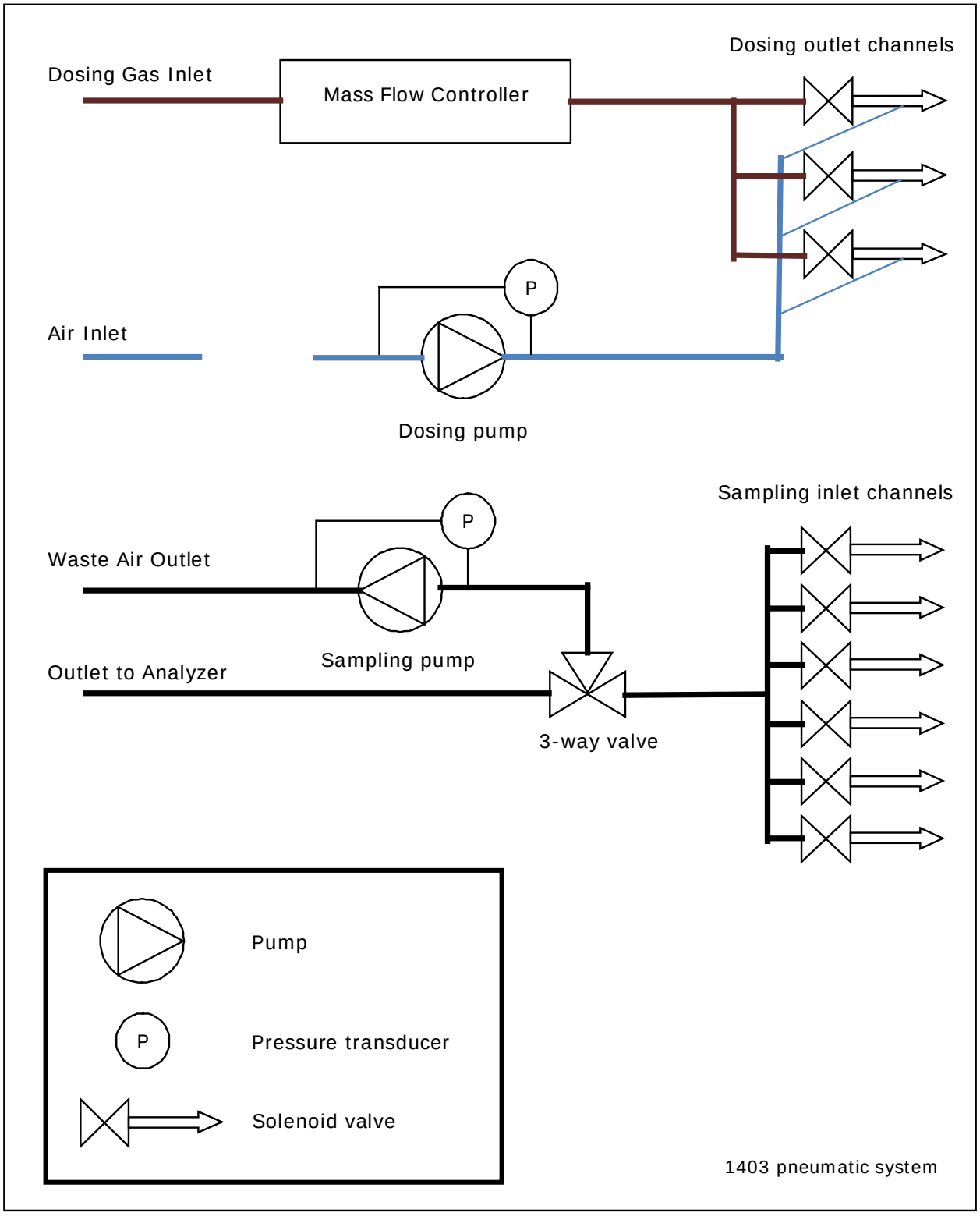
Chapter 1

Description and Functions

February 2018

1.1 Description and Functions

Fig.1.1 The pneumatic system of the 1403



1.1.1 The Sampler System

The pneumatic system of the 1403 is shown schematically in Fig.1.1. The sampler system is constructed of 316 stainless steel and PTFE (Poly Tetra Fluoro Ethylene) tubing to minimize adsorption of samples. The system has 6 inlet channels, each with a solenoid valve. Each inlet channel has a tube-mounting stub on the front-plate of the 1403; 6 tubes of up to 50m length connect each channel to the respective sampling point. The 6 inlet channels converge into one; a three-way valve can then direct the gas sample to the 1512 or 1412i Gas Monitor for analysis, or through the pump to the waste-air outlet on the 1403's back-plate. A pressure transducer checks the efficiency of the sampling pump and allows checks for blocked airways.

It is recommended that an air-filter is attached to the end of each sampling tube to keep the samples free of particles.

1.1.2 The Doser System

The Doser system has 3 outlet channels, see Fig.1.1 , each with a solenoid valve. The Mass Flow Controller supplies a pre-set flow. The flow is distributed to the dosing point through the valve selected in the set-up in the 7650 or 7651 Application Software. One dosing valve can be active at a time. The standard Mass Flow controller supports flow up to 3400 ml/min relative to Nitrogen. The flow for SF6 and Freon 134a is calculated based on calibration data by the 7650 or 7651 Application Software (see user manual BE6046/BE6048).
For more detailed specification on the available Mass Flow controller options see section 3.5 for the standard and section 3.6 for the options.

Each of the 3 dosing outlet channels has a tube-mounting stub on the front plate of the 1403. 3 tubes of up to 50m length connect each stub to the respective dosing point.

2 separate inlet channels mounted on the back plate of the 1403 serve the dosing channels: the Dosing Gas Inlet, and the Air inlet.

The Dosing Gas Inlet channel is pressurized by the tracer-gas supply cylinder, which is connected to the inlet on the 1403's back plate by tubing. The Mass Flow controller's totalizer gives information on the tracer-gas supply; a fine filter ensures that the dosing channels are particle-free. The main valve on the Dosing Gas Inlet channel is used to supply tracer gas to the Mass Flow Controller.

The Air inlet pumps extra air to the dosing outlets to speed delivery of the tracer-gas to the dosing point. This inlet has a coarse air-filter, a pump, and a pressure transducer for checking the efficiency of the pump.

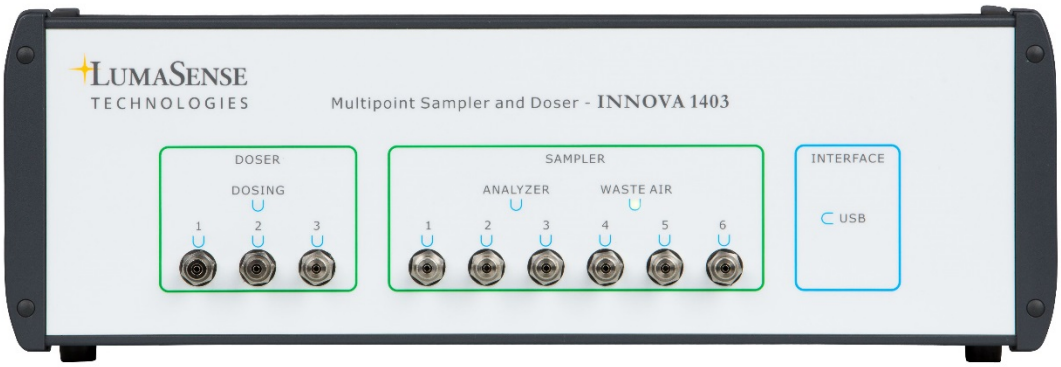
Delivering a dose of tracer-gas to a dosing point 50m distant takes 1 minute.

The dosing system can deliver a continuous dose, that is, an uninterrupted flow of tracer-gas over a period of time.

A dosing time-out of 60 s is stored in the 1403 Firmware. If no communication is detected from the controlling device the tracer-gas dosing will automatically be stopped after this period of time.

1.1.3 Front Panel

Fig.1.2.The front panel of the 1403



Doser: 3 mounting stubs for connection of tubing's (AF0005, red) to the dosing points see section 2.4.1.
Each doser channel is numbered, and has an indication lamp. When the lamp is lit, it indicates that the corresponding dosing valve is open.

Dosing: The Dosing lamp indicates that the Mass Flow Controller is active.

Sampler: 6 mounting stubs for connection of tubing (AF0006, green) to the sampling points see section 2.4.1

Each sample channel is numbered, and has an indication lamp. When the lamp is lit, it indicates that the corresponding sampling valve is open. The **Analyzer / Waste Air** lamps indicate which way the internal 3-way valve is set, see Fig.1.1.

Interface: The lamp indicate that the USB interface is connected to the 1412i or the 1512.

1.1.4 Rear Panel

Fig.1.3.The rear panel of the 1403

AC Mains: A 3-pin connector accepting Power Cable for connection to a single phase AC mains supply with protective Earth.

Mains Voltage: Connect 1403 to mains supply with 100-240 Vac, 50/60 Hz.

Dosing Gas Inlet: Mounting stub for connection of a tracer-gas supply to the 1403 using tubing AF0008. See section 2.4.3.

Outlet to Analyzer: Mounting stub for connecting the sampler system of the 1403 to the inlet of the 1512 or 1412i Gas Monitor via tubing see section 2.4.4.

Waste Air Outlet: Mounting stub for tubing to exhaust air from the 1403's sampler system. See section 2.4.5.

Interface USB: USB interface to connect the Type 1403 to the 1512 or 1412i Gas Monitor.

Air Inlet: The dosing pump inside the 1403 supply all dosing channels with carrier air for the tracer-gas, when the dosing pump is running see Fig. 1.1.

Chapter 2

Preparing to Use the 1403

February 2018

2.1 Preliminary

2.1.1 Environment and Handling

The Type 1403 Multipoint Sampler and Doser is designed for use in environments with temperatures between +5°C and +40°C (+41°F and +104°F) and with up to 80% relative humidity (non-condensing) at 31°C decreasing linearly to 50% relative Humidity at 40°C.
Make sure to leave some space between the Rear Panel and the Wall, or other obstacles, to ensure easy tube connect and access to the mains supply. No other special handling precautions are necessary.

2.1.2 Connecting the Mains Supply

The 1403 is operated from a 50 to 60 Hz single phase AC mains supply. Voltages range 100 – 240 Vac.
Before connecting the mains supply, the following checks and adjustments should be performed to ensure safe operation of the 1403.

2.1.3 Checking the Power Cord

Use the Power Cord delivered with the 1403 or check that the Cord used is rated minimum 10A / 250V.

2.2 Connecting the 1403 to the Gas Monitor

The 1403 is connected to the 1512 or 1412i Gas Monitor by the USB interface, over which the 1403 receives the commands and data, which control it.

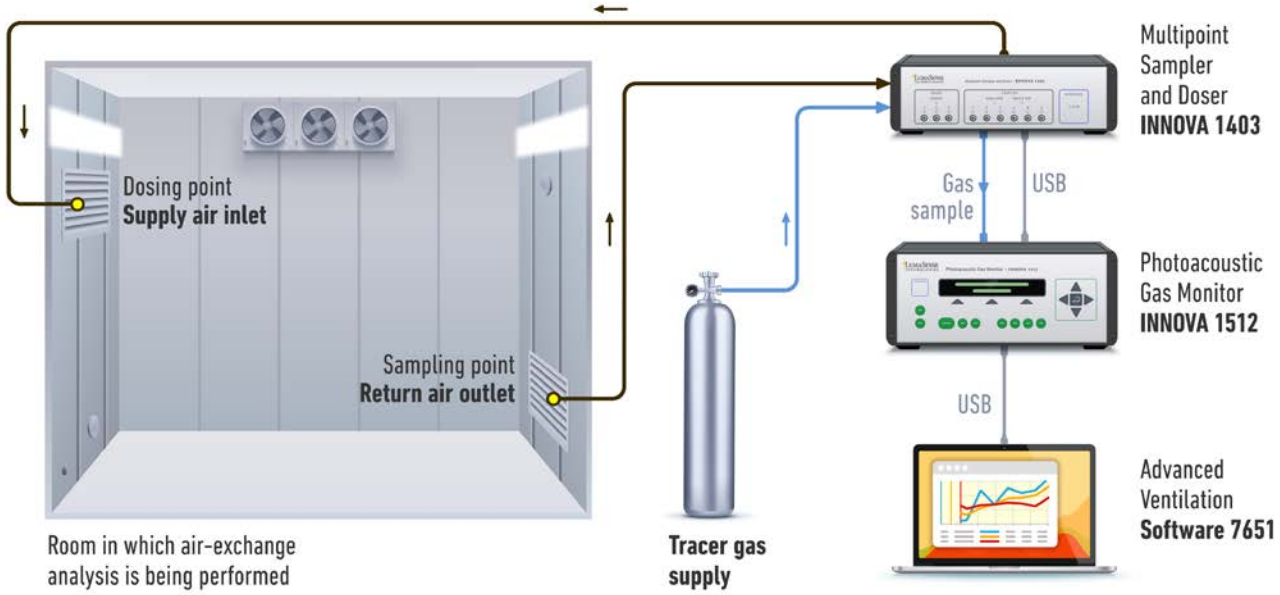
2.3 System Use

The 1403 combines with the 1512 or 1412i Gas Monitor and a controlling computer to provide a system which offers wide-ranging monitoring capabilities. The 1403 makes it possible to perform multi-point air-exchange analyses and multi-point monitoring tasks in many different situations and environments, without changing the system components.

An example air-exchange analysis system is shown in Fig. 2.1. In such a system, the doser/sampler systems of the 1403 are used as follows. The doser system marks the supply-air of the room with a known amount of tracer-gas. The sampler system then takes a sample of the return-air from the room, and delivers the sample to the 1512 or 1412i Gas Monitor for analysis. While the 1512 or 1412i Gas Monitor performs one analysis, the 1403 takes the next sample for analysis from the room. As the

amount of tracer-gas delivered to the room is known, and the remaining concentration of tracer-gas in the samples is determined by the 1512 or 1412i Gas Monitor, the ventilation-system performance can be calculated.

Fig.2.1. *A typical air-change analysis system, shown with an application example. In this case, the aim of the analysis is to determine the size of the air-change in the mechanically ventilated room. The diagram shows only one dosing and sampling point, for clarity. 7650 or 7651 Application Software gives control of all the functions of the system.*



2.4 Connecting Tubing to the 1403

The 1403 is connected via tubing to:

- the sampling points;
- the dosing points (if dosing is required);
- a suitable tracer-gas supply;
- the 1512 or 1412i Gas Monitor being used to analyze the gases that are sampled;
- a suitable exhaust for gases purged from the sampler system.

Note: the performance of the 1403's sampling and dosing systems are specified for sampling and dosing tubing of maximum 50m in length.

Tubing for use with the 1403 is available from LumaSense, as follows:

Sampler tubes, green nylon, LumaSense accessory number AF0006 or Poly Tetra Fluoro Ethylene (PTFE), LumaSense accessory number AF0614.

Doser tubes, red nylon, LumaSense accessory number AF0005 red tubing for dosing.

Tracer-gas supply tubing, nylon, LumaSense accessory number AF0008.

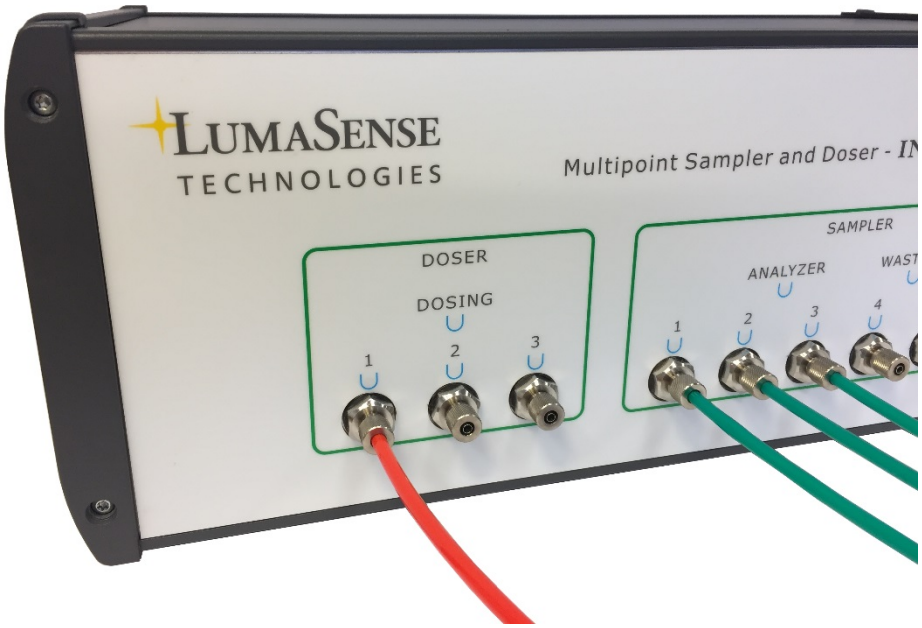
Using these tubing materials minimizes the risk of gases being adsorbed onto the tube's surface, which would result in inaccurate measurements.

2.4.1 Connecting Sampling and Dosing Tubing

Before connecting sampling and dosing tubing to the 1403, you should know approximately where the sampling and dosing points will be in the area to be monitored. This will allow you to estimate the length of tubing you need to connect to the mounting-stubs of the 1403.

To connect sampling tubing, see Fig.2.2.

Fig.2.2. Attaching sampling and dosing tubing to the 1403's mounting stubs



1. Remove the knurled nut from the mounting stub of the sampler channel you wish to use, on the back panel of the 1403.

2. Push one end of the length of the nylon AF0006 or Poly Tetra Fluoro Ethylene PFTE AF0614 tubing through the non-threaded end of the nut.

3. Push the end of the tubing onto the mounting stub as far as it will go, and secure the tube by re-tightening the knurled nut onto the threads of the mounting stub.

To connect dosing tubing:

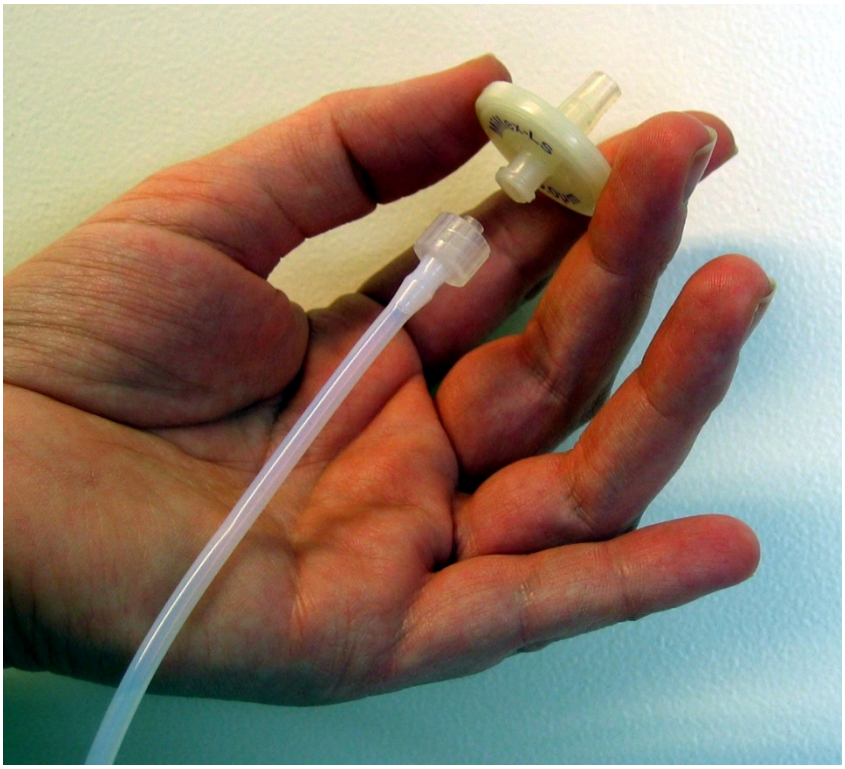
Proceed as described above, using the nylon tubing AF0005.

2.4.2 Connecting External Filters to the Sampling Tubes

The external filters, comprising filter, LumaSense accessory number DS2306, and fitting, LumaSense accessory number UD5041 or the UD5023 external filter unit with replaceable filter-paper (optional accessories), protect the 1403's sampling airways from airborne particles such as dust, thus helping to prevent blockage of the airways. Also, if the 1512 or 1412i Gas Monitor is measuring in the parts-per-billion range, it is recommended that the external filters are always used to prevent degrading of the tubing's internal surface.

The filter unit is attached to the tubing as follows:

Fig.2.3. Attaching Fitting UD5041 and Filter DS2306 to sampling tubing



1. Push the Fitting UD5041 into the tubing.
2. Screw the short stub of the Filter DS2306 into the Fitting.

Fig.2.4. The external air-filtration unit UD5023

UD5023 is attached to the tubing using the knurled nut supplied with the unit.

Changing the fine filter-paper in both the external air-filtration units is explained step by step in section 4.2.

2.4.3 Connecting a Tracer Gas Supply

Tracer gases for use with the 1403 must be supplied from a pressurized cylinder fitted with a suitable pressure-regulator. The regulator ensures that the tracer-gas pressure is constant.

Warning! Do not attempt to connect a tracer-gas cylinder without a pressure-regulator directly to the 1403. Doing this can damage the 1403's internal airways.

The tracer-gas supply cylinder is connected to the **Dosing Gas Inlet** on the rear panel of the 1403 using nylon tubing OD Ø6mm. This tubing is available from LumaSense, accessory number AF0008.

To connect the tracer-gas supply:

1. Attach one end of the tubing AF0008 to the outlet of the pressure-regulator as recommended by the regulator manufacturer.

2. Push the other end of the tubing into the **Dosing Gas Inlet** stub on the rear panel of the 1403.

After connection, slowly open the regulator's valve and allow the pressure to rise. To ensure efficient dosing the tracer-gas supply pressure must be within:

300 kPa (~ 3 bar) absolute +/- 10 %.

The tracer-gas supply tubing is removed from the **Dosing Gas Inlet** stub by pushing on the flange at the end of the stub, and simultaneously pulling the tubing gently.

2.4.4 Connecting the Sampler Outlet to the Gas Monitor

This connection uses the same tubing (PTFE, LumaSense No. AF0614) as for the sampling tubes, section 2.4.1. The tubing is connected to the **Outlet to Monitor** stub on the rear panel of the 1403, and to the **Air Inlet** stub on the rear panel of the Gas Monitor. The tubing is connected as described in section 2.4.1.

2.4.5 Waste Air Outlet

The **Waste Air Outlet** stub, next to the **Outlet to Analyzer** stub on the rear panel of the 1403, exhausts waste air from the 1403's sampler system as a new sample is collected. If you do not wish the waste air to mix with the air in the room where the 1403 is positioned, connect a length of PTFE tubing (LumaSense No. AF0614) to the **Waste Air Outlet** stub and direct the tubing to a suitable exhaust-point: for example, out of a window.

Chapter 3

Operation

February 2018

All tasks performed by the 1403 are controlled over the USB interface from a System Controller using the Application Software 7650 or 7651; there is no other control possibility. This chapter deals with the control of the 1403 from the user's point of view.

For further instruction please refer to the 7650 user manual BE6046 or the 7651 user manual BE6048.

Sections 3.1 deals with switching on and the general principles of controlling the 1403.Sections 3.2 describes the use of the Type 1403 Sampler system. Sections 3.3, 3.4 and 3.5 describe the use of the type 1403 Doser system, tracer gases and Mass Flow Controller. Section 3.6 describes how to replace the Mass Flow Controller.

3.1 Switching-On

The 1403 can be switched on using the **AC Mains** switch on the backplate. After switching on, the 1403 is set as follows:

- All dosing- and sampling- valves are closed.
- Internal three-way valve is set to **Waste Air Outlet**.
- Both pumps are stopped.
- Mass Flow Controller valve is closed

3.2 Using the Sampler System

Using the 1403's sampler system, see Fig.1.1, to deliver a gas sample to the 1512 or 1412i Gas Monitor is a 3-stage process:

1. The required sample valve is opened; all other sample valves are closed automatically.

2. The sample valve is connected to the **Waste Air Outlet** via the internal 3-way valve and the build in sample Pump. The Pump flush the 1403 with a fresh Gas sample from the Sampling point. See Fig.1.1

3. When the 1403 has been flushed with a new sample, the internal 3-way valve is set to direct the sample to the Gas Monitor.
   The pump in the Gas Monitor draws the sample for analysis.
   While the 1512 or 1412i Gas Monitor is analysing this sample, the next sample valve is opened and the channel is flushed to have the next sample ready for analysis.

3.3 Using the Doser system

Using the 1403 Doser system, see Fig.1.1, to deliver the tracer-gas to the dosing point is a 5 stage process:

1. The tracer-gas is connected to the Dosing Gas Inlet with a supply pressure from 300kPa +/- 10%.
2. The required Dosing channel is open and all other dosing channels are closed.
3. The Mass Flow Controller is set to the required Dosing Gas flow.
4. The build in Dosing pump supply carrier-air to help deliver the tracer-gas to the dosing point.
5. The amount of tracer-gas delivered is calculated by the Mass Flow Controller.

3.4 Tracer Gases

The system is delivered with Mass Flow Controller calibration data for SF6 and Freon 134a.

The selected tracer-gas is attached to the Dosing Gas Inlet on the back panel of the 1403. For the system to be able to set the correct flow it is very important that the attached tracer gas is selected in the set-up in the Application Software 7650 or 7651, please refer to user manual BE6046/BE6048.

3.5 The Mass Flow Controller

The 1403 is as standard equipped with a Mass Flow Controller calibrated for the following flowrates:

UM1124 Standard flow.

Nitrogen:	306-3400	Nml/min.
SF6:	85-1050	Nml/min.
Freon 134a:	90-1100	Nml/min.

3.6 Replacing the Mass Flow Controller.

The Mass Flow Controller, in the following referred to as the MFC, can be replaced if other flowrates than the standard flowrate is required.

The following MFC's are available as options.

UM1126 For Low flow.
Nitrogen: 63-700 Nml/min.

UM1127 for high flow.
Nitrogen: 495-5500 Nml/min.

3.6.1 MFC Replacement procedure

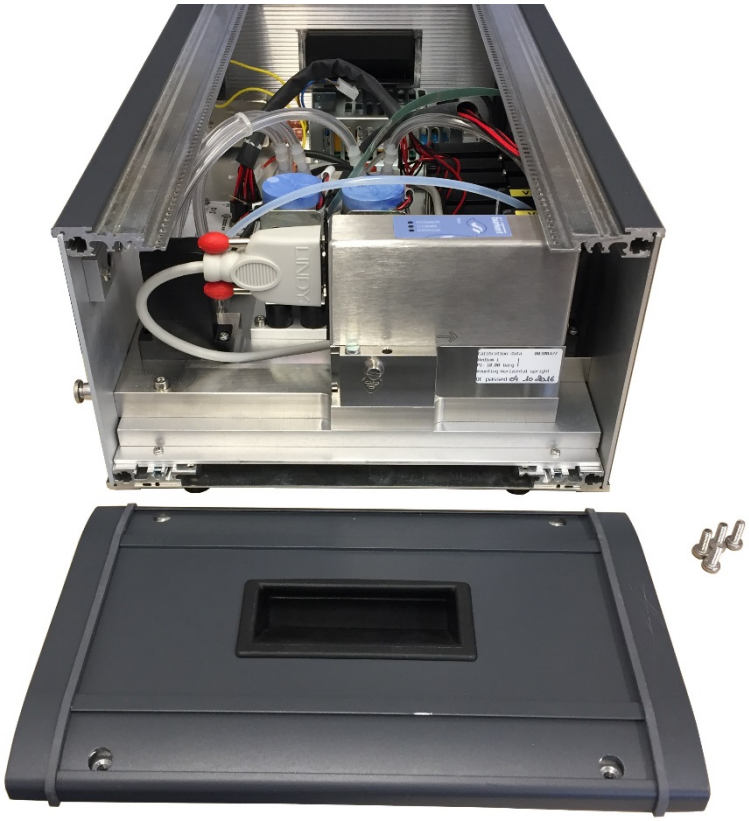
Caution:
Electrical shock hazard. Disconnect Mains supply before dismantle.
Refer servicing to qualified personnel.

The 1403 contains sensitive electronics and must only be serviced with appropriate ESD protection.
The replacement of the MFC should be carried out in a dust free environment following these instructions.

1. Disconnect Mains supply.

2. Gently remove the two Green rubber décor strips on the left hand side of the instrument. Use a small flat headed screwdriver.

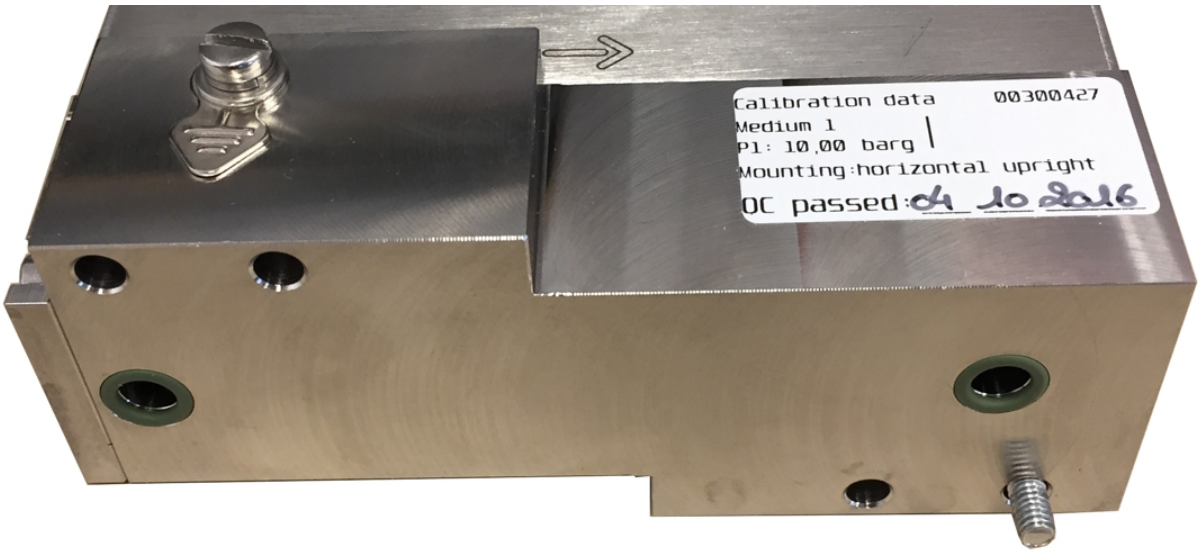
3. Undo the 4 screws on the side panel with a Philips screwdriver.
4. Remove the left hand side panel gently.
5. Remove the top panel.



6. Undo the Interface cable from the MFC.
7. Undo the screws securing the MFC with a flat headed screwdriver.

8. Gently remove the MFC and pack it in a dust free bag.

9. Unpack the new MFC and inspect the O-rings.



10. Install the new MFC in reverse order.

The new MFC will be detected by the 7650/7651 Application Software.

Chapter 4

Maintenance

February 2018

4.1 Cleaning the instrument

It is recommended to clean the Instrument using a soft damped cloth.

4.2 Changing the Filter-paper in the UD5023 External Air-filtration Unit

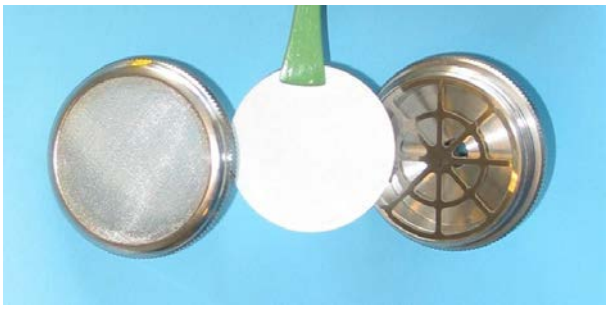
Tools and equipment required:

Acetone (analytically pure)
Spare fine filter-paper DS 0759
Tweezers with Teflon coating
Cotton buds

To change the filter-paper:

Switch off the Monitor.
Pull the external fine air-filtration unit off the end of the Teflon® sampling tube. Hold the stub-end of the external air-filter unit between your thumb and fingers, and unscrew the coarse air filter from the end of the unit.
Remove the used (old) filter-paper and the retaining disc from the unit using the tweezers. Refer to Fig.4.1.

Fig.4.1 The parts of the external air-filtration unit UD 5023



Moisten a cotton bud with pure acetone and use it to clean the surfaces of the unit, the retaining disc and the coarse air-filter. Refer to Fig.4.1.

Caution: Make sure that no cotton fibres remain on the mesh of the retaining disc otherwise they could be sucked up into, and block the measurement system when the analyser is operated.

Reassemble when the acetone has completely evaporated from the cleaned surfaces.
Note: Each of the fine filter-papers DS 0759 are packed between two pieces of packing paper. The fine filter-paper is always white in colour.

4.3 Service and repair

The Type 1403 Multipoint Sampler and Doser is designed and constructed to provide the user with many years of safe, trouble-free operation. However, should a fault occur which impairs its correct function and operating safety, then it should be immediately disconnected at the mains source and secured against further operation. For repair contact your local LumaSense Technologies A/S service representative. Under no circumstances should repair be attempted by persons not qualified in the service of electronic instrumentation.

4.3.1 MFC recalibration

It is recommended to have the MFC recalibrated once a year. The MFC can be dismantled as described in section 3.6.1. The MFC can then be send to Lumasense Technologies A/S for recalibration.

Chapter 5

Error and Warnings

February 2018

1403 monitors the function of the following parts. If any error is detected the error will be reported in the Application Software 7650/7651 during operation please refer to user manual BE6046/BE6048.

Error and Warning flags	
1403 flag	**Flag Description**
R	Reset Done Flag
P	Power Fail Flag
S	Sampling System Flag
D	Dosing Pump Flag
C	Sampling Channel Flag
J	Job Specification Error
E	Software Error Flag
M	MFC failed
O	MFC Flow out of range

Reset Done Flag
Indicates that the 1403 has completed a reset, following either the **R**eset_**S**ystem interface job or switching-on the 1403. This flag is reset when the Warning Flags are read-out from the 1403.

Power Fail Flag
Is set if the 12Vdc power supply is out of specifications. This flag is reset when the voltage is back within the above range, or by resetting the 1403, or switching the 1403 off/on. If the error is persistent, have the 1403 serviced.

Sampling System Flag
Is set if, during the self-test if the pressure across the sampling pump is less than 40kPa. This indicates that either the pump is not working correctly, or that the sampler system is not sufficiently air-tight. This flag is reset by the next self-test routine (if the results of the test are satisfactory), or by resetting the 1403, or switching the 1403 off/on. If the error is persistent, have the 1403 serviced.

Dosing Pump Flag
Is set if the pressure generated by the carrier-air pump is less than 10kPa above ambient pressure. This indicates that the carrier-air pump is not working correctly. The flag is reset when the pressure generated by the pump is over 15kPa above ambient pressure, or by resetting the 1403, or switching the 1403 off/on. If the error persists, have the 1403 serviced.

Sampling Channel Flag
Is set during the self-test or when drawing a sample with the 3-way valve set to **Waste Air Outlet**, if the pressure across the sampling pump is above 25kPa. This indicates that the sampler-system airways may be blocked. The flag is reset by reading-out the Error Flags, or by switching the 1403 off/on. If the error persists, have the 1403 serviced.

Job Specification Error
Is set if an interface job sent to the 1403 is not recognized. This can be due to an incorrect job header, incorrect syntax, or incorrect or missing data. A job cannot be carried out by the 1403 if this flag is set. The flag is reset by reading-out the Error Flags, or by switching the 1403 off/on.

Software Error Flag
Is set when the 1403's software develops an error when running. When this flag is set, the 1403 is reset automatically. The flag is reset by reading-out the Error Flags, or by switching the 1403 off/on. If the error persists, have the 1403 serviced.

MFC Failed
This is set if the 1403 fails in the communication with the build in Mass Flow Controller.

MFC Flow out of range
This flag is set if the MFC detect that the specified set flow is out of range. This could be caused by too low supply pressure of tracer gas to the system.

1403