

factair



F8100 SAFE-AIR MONITOR OPERATING MANUAL

FAC QAM 221 Issue G 02/24

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Introduction

The F8100 Safe Air Monitor is designed to provide continuous monitoring of breathing-air and compressed-air systems. Once set up the instrument will continue to monitor and data log the air quality at user defined intervals, validating the air quality against a range of alternative international standards. For breathing-air in the UK this ensures complete compliance with the relevant requirements of COSHH L5.

The F8100, is designed primarily for use on airline systems up to 10 bar but can also test high pressure cylinder charging systems when used in conjunction with the F3002 High Pressure Regulator.

The F8100 is supplied in a plastic protective case with storage provision for accessories.

The test is carried out using built in electrochemical cells for carbon monoxide and oxygen; infrared LED sensor for the carbon dioxide and a Photo Ionisation Detector (PID) for Volatile Organic Compounds. The moisture is measured with an electronic dewpoint meter and the instrument also records pressure and ambient temperature. For measuring oil aerosols, Dräger Impactors are used in the side mounted test port (or alternatively the Dräger oil chemical reagent tube). The Dräger Impactors are supplied in packs of 10 and show the degree of oil contamination on the cut glass baffle plate.

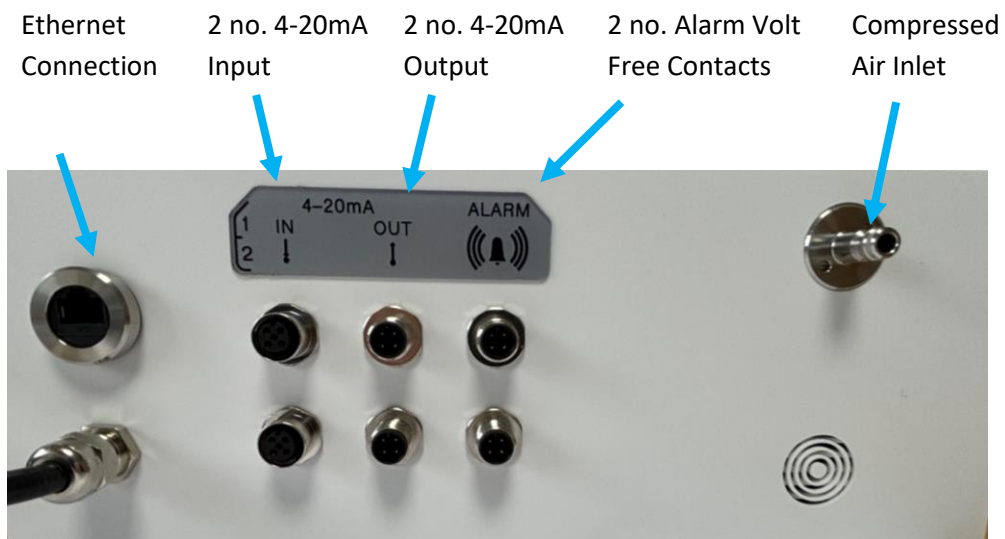
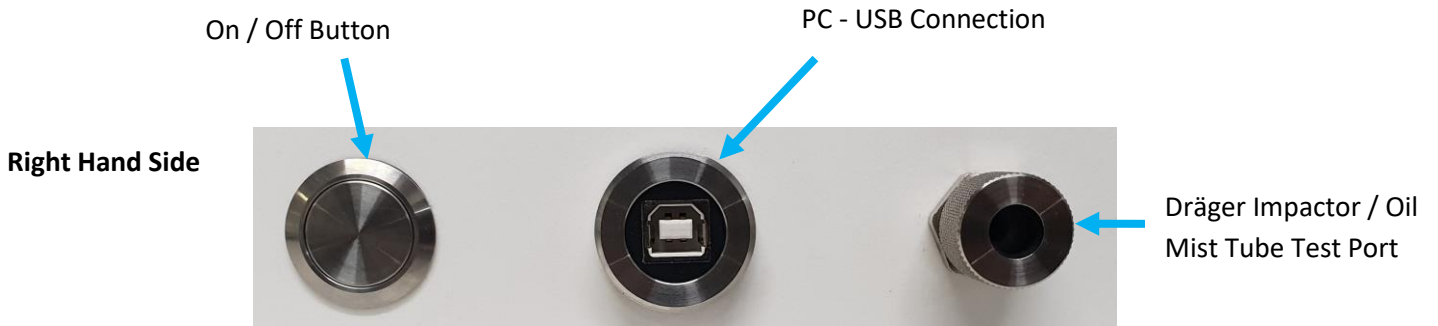
Calibration and Warranty

Safe-Air Monitors leave our factory with a 12-month warranty and calibration certificate. If the instrument is returned to Factair for annual calibration, our standard turnaround is 10-15 working days providing there is no major damage that requires an extensive rebuild. *Note:- Please download all stored data before returning the instrument to Factair.*

Temperature Parameters


Storage: -10/+50°C Operating Range: -5/+40°C


IMPORTANT – IT IS RECOMMENDED THAT YOUR SAFE-AIR MONITOR IS RECALIBRATED AND SERVICED WITHIN 12 MONTHS FROM THE ISSUE DATE OF ITS CALIBRATION CERTIFICATE



Home Screen Display Icons


Sensor Status

 = OK

 = Sensor

Out of Calibration

H_2O only :
Dewpoint close to measurement limit

 = Sensor Fault

 only :



Unlocked



Locked

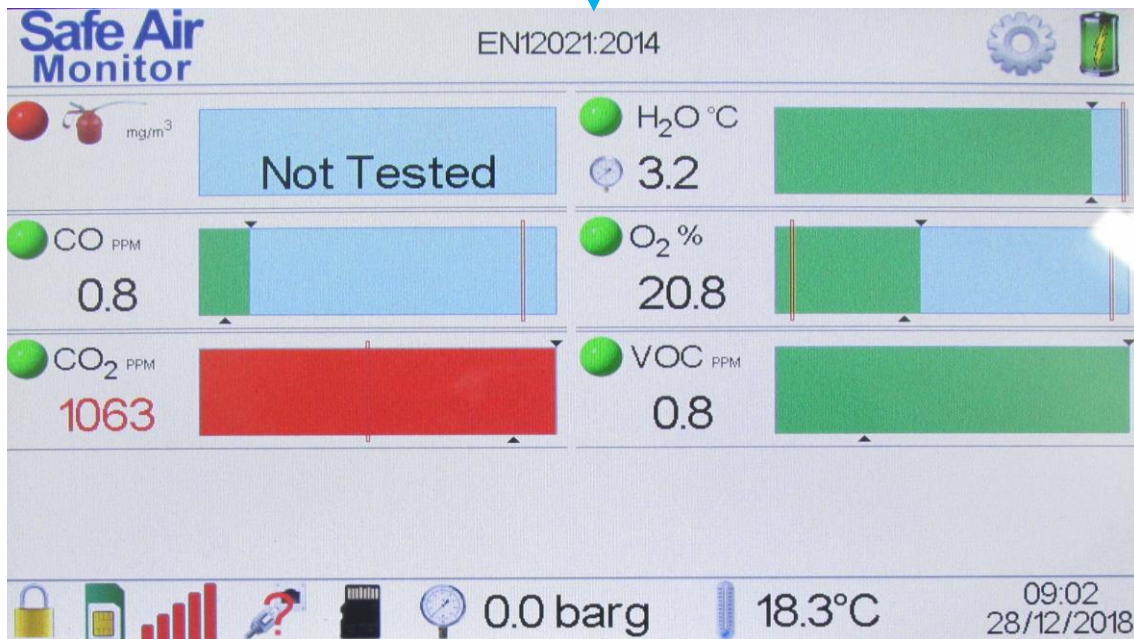
Red – No Signal

Green - Signal

Selected Test Standard

Settings

Battery Charge & Charging Indicator



Installer Access Status

SIM Card Signal

Ethernet Connectivity status

SD Card Memory Status

Supply Pressure

Ambient Temperature

Time and Date

By pressing the icon you can change display units between barg and psig

By pressing the icon you can change display units between °C and °F

By pressing the icon you can adjust the date and time

Standard Equipment List

| |
|---|
| F8100 Safe-Air Tester |
| USB Download Cable |
| Stylus Pen |
| Wall Mounting Plate |
| ASSY0013 supply hose with rectus 21 plug and socket connections |
| F1946 Connection ¼ BSP inlet adaptor with rectus 21 socket |

Optional Extras

| |
|---|
| TUB0053 – 8103560 Dräger Oil Impactor – Box of 10 |
| TUB0003 – 6728371 Dräger Oil Tubes – Box of 10 |
| F3002 High-Pressure Regulator |
| F1946 Connection ¼ BSP inlet adaptor |
| F2193 Safe-Air Tester to Dräger/Scott compatible plug |
| F2194 Connection adaptor terminating in a Rectus Plug |
| F2195 Connection adaptor terminating in a Instantair plug |

Technical Data

| | |
|---------------------------------|--|
| Model | F8100 |
| Minimum Working Pressure | 2 barg |
| Maximum Working Pressure | 10 barg |
| Air Inlet Connection | Rectus Series 21 Plug |
| Internal Rechargeable Batteries | Lithium Ion 3.7V Capacity : 15,600 mAh |
| Supply Voltage | 230V/1ph/50Hz 13A supply |
| Internal Memory | 8 GB |

| Sensors | Range | Sensor Type |
|-----------------------------------|-----------------|----------------------------------|
| Oxygen (O ₂) | 0 – 25% | Electrochemical |
| Carbon Monoxide (CO) | 0 - 20 PPM | Electrochemical |
| Carbon Dioxide (CO ₂) | 0 – 2000 PPM | Non-Dispersive Infrared |
| Volatile Organic Compounds (VOC)* | 0 – 40 PPM | 10.6 eV Photoionisation Detector |
| Moisture | -100°C to +20°C | Ceramic Moisture Sensor |
| | PDP | Dewpoint Meter |
| Pressure | 0 – 10.0 barg | Transducer |

| | | | |
|--|--------------------|--------------------|---|
| Test Port – Compatible with the following Dräger Impactors / Tubes | 8103530 6728371 | TUB0053 TUB0003 | Oil Impactor Oil Chemical Reagent Tube |
|--|--------------------|--------------------|---|

| | |
|------------|--------------------------------------|
| Dimensions | 315 mm (h) x 330 mm (w) x 125 mm (d) |
| Weight | 5 kg |

* Optional 0-3 PPM VOC sensor also available, with this sensor fitted the unit can be pre-set at Factair to display in mg/m³ referenced against isobutylene calibration gas

1. Pre-Use

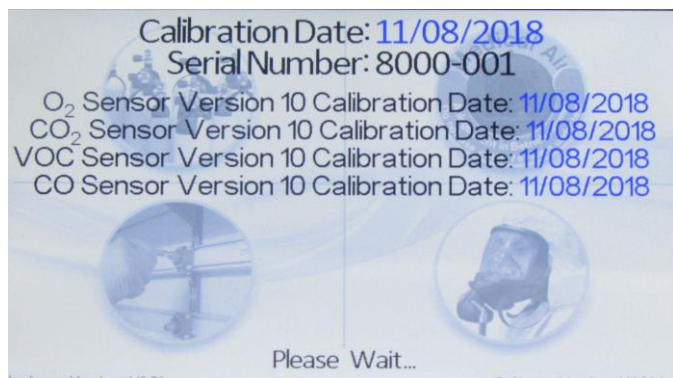
The F8100 is supplied with a mounting plate which enables the instrument to be wall mounted at the most suitable location to test your breathing-air / compressed-air supply. The test location needs to be as close to the breathing-air supply point as possible, in a well ventilated area free from dust and with a 230V mains power supply available. To install the back plate mark the hole locations on the wall and check with a spirit level. Ensure you use the correct fixings to suit the wall.

Once you have installed the back plate mount the F8100 in place and connect the power supply. It is important the unit is free from vibration during use. The F8100 Safe-Air Monitor requires a 230V/1ph/50Hz mains power supply.

The maximum compressed air supply pressure for the F8100 Safe-Air Monitor is 10 barg. If the instrument is intended for use on a high pressure system contact Factair for advice on suitable regulators and connection arrangements.

2. Start-Up

To turn the instrument on press and hold the “on” button, located on the right-hand side of the unit, for approximately 3 seconds.



A stylus pen is provided for use with the touch screen. The display will show the calibration date, serial number and check the status of each sensor. Once each sensor status has been checked follow the touch screen prompt on screen to proceed.

The compressed-air supply can then be connected to the instrument (minimum 2 barg, maximum 10 barg).

3. Continuous Monitoring Display

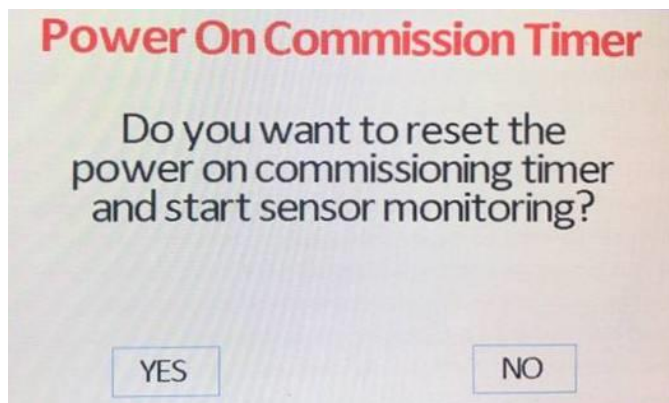


By tapping the calibration date screen, the instrument will then display the home screen.

In the top right hand corner a countdown will commence for a commissioning delay during which time the sensor readings are stabilising and the alarms will be disabled.

The duration of the commissioning delay can be later adjusted in the installer menu.

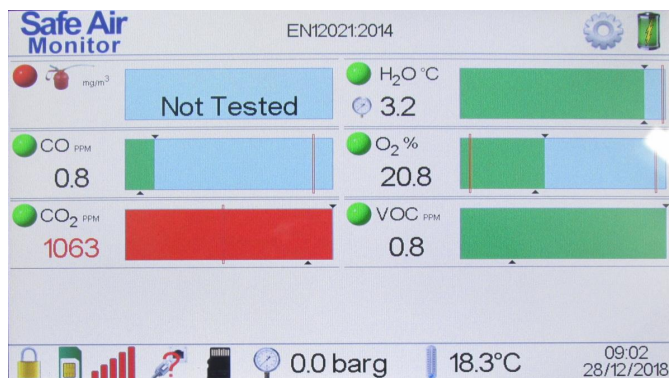
If the sensor readings have already stabilised you can commence immediate sensor monitoring by pressing the "Commissioning Delay" countdown icon.



Once commissioning is complete the home screen will display all live sensor readings.

Individual sensor readings can be further interrogated by pressing on their readings bar.

The number and order of the displayed sensors can be changed in the installer menu.



Tapping on the individual sensors allows you to interrogate their history.

Click on the home button to return.

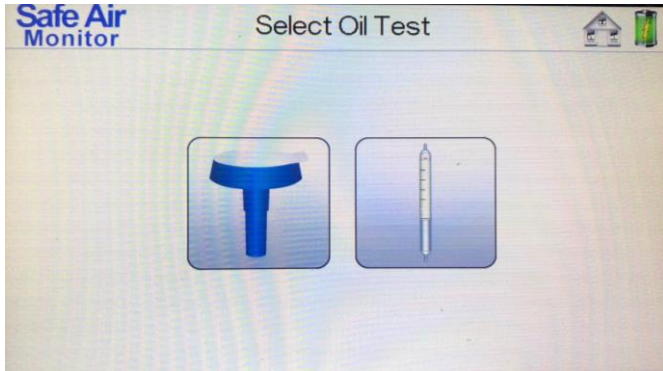


3.1 Completing an oil test using a Dräger Impactor or tube



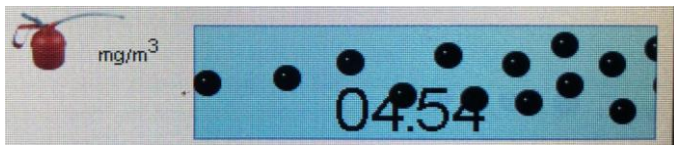
The instrument displays the date and result from the last oil Impactor or tube test.

To undertake a new test tap the result button.

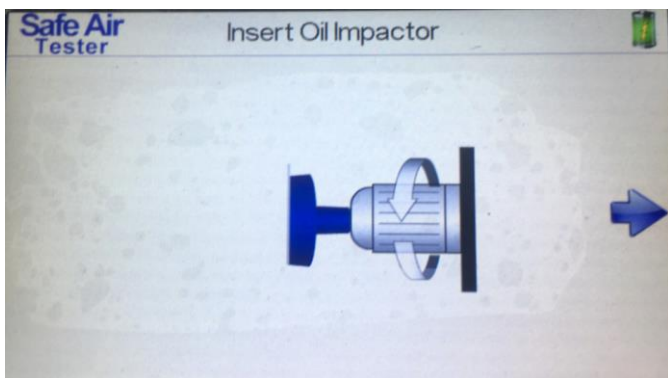


Choose between using a Dräger oil Impactor or Dräger chemical reagent tube in the test port.

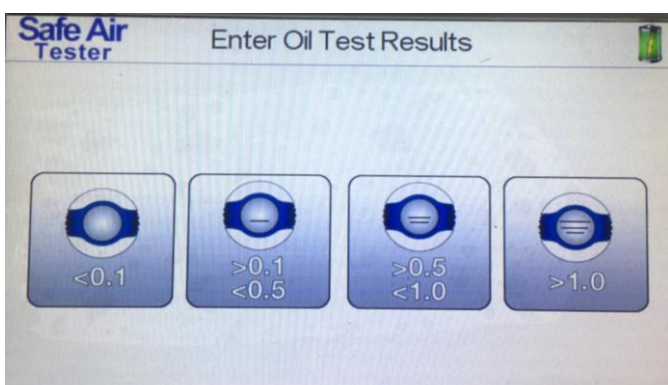
For breathing-air tests the most commonly used option is to select a Dräger oil Impactor. Instructions for using the Dräger tube can be found in appendix 1.



The instrument will now commence a 5-minute purge sequence, during which time an airflow will be passed through the test port. This clears contaminants from previous tests and ensures that a representative sample is being tested.



Once the purge has finished, the Dräger Impactor/oil tube should be inserted into the test port and tightened firmly; ensure the Impactor has an intact protective seal. **This seal must remain in place for the duration of the test.** Press the arrow on the right hand side to start the test.



At the end of the test the Impactor result screen will be shown. The Impactor should now be taken out of the test port, sticker removed and evaluated.

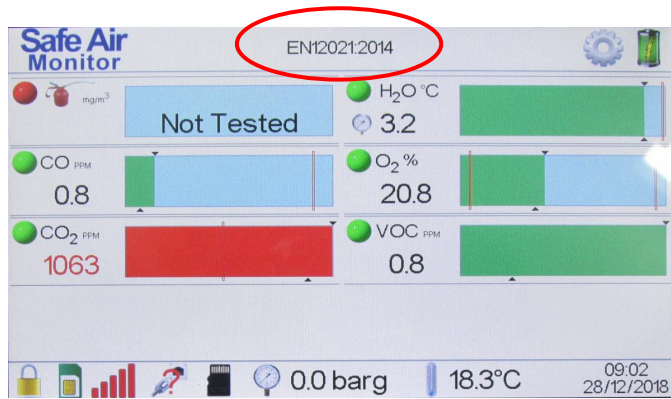
To enter the results press the corresponding icon on the screen.

Note:- Instructions on reading the Impactor can be found in Appendix 2 at the back of the manual.

The test result and date of test will then be displayed on the home screen.

4 Configuring the instrument

4.1 Selecting a test standard



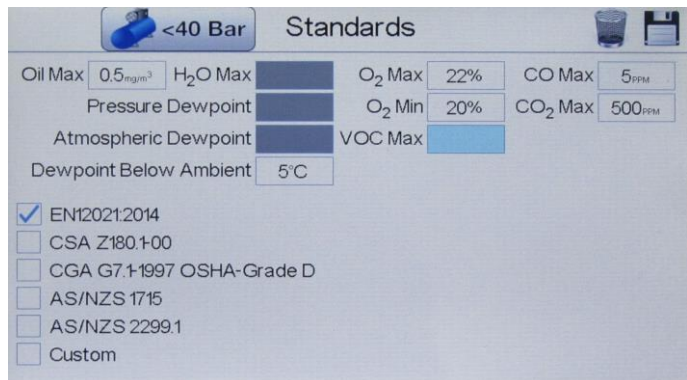
To enter the installer mode press this icon, which is located in the top right hand corner of the screen near the battery icon.



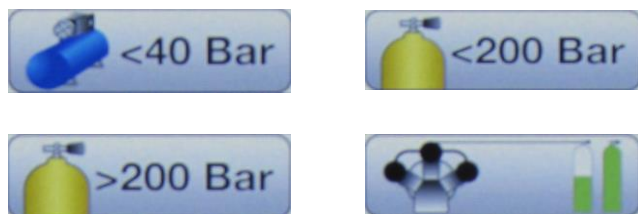
To change the test standard, from the home screen, press on the current standard.



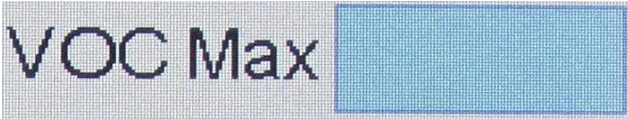
Enter user log in password "installer".



The standards menu will then display the available test standards.



For EN12021:2014 there are 4 different requirements depending if you are testing an airline system <40 bar; Cylinder <200 bar; Cylinder >200bar or direct from a high pressure charging compressor. By toggling the icon at the top of the screen the default limits will be displayed.



If you also want to test for Volatile Organic Compounds then by clicking on the adjacent box you can set a maximum limit. For further guidance on VOCs see appendix 3.

Click on the tick to confirm the VOC value you have entered as a test parameter.



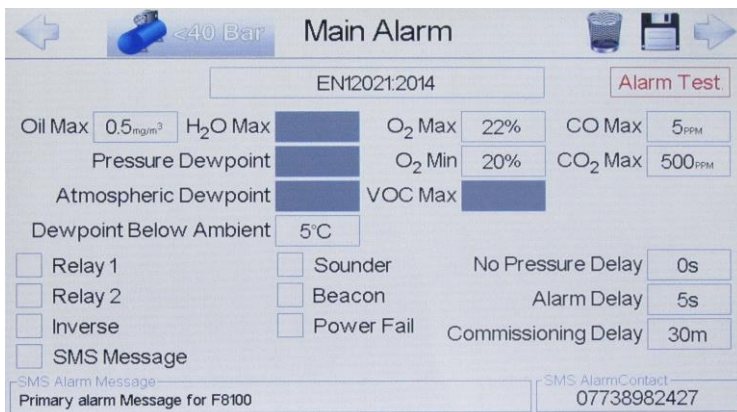
Once you have selected the appropriate standard press the save button to update the change or alternatively to discard press the waste basket icon.

4.2 Configuring the main alarm

To enter the set up mode press this icon, which is located in the top right hand corner of the screen near the battery icon.



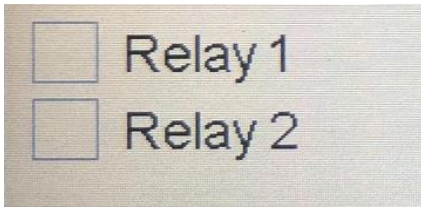
Enter user log in password “installer”.



The F8100 has 2 configurable alarms, a main and pre alarm. Both of the configuration pages are located in the settings pages.

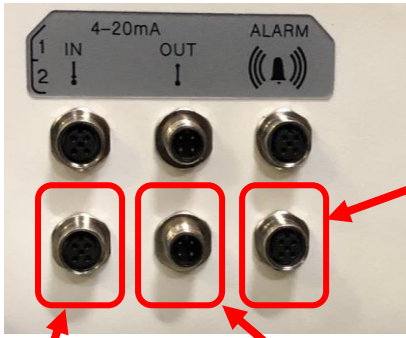
The alarm values are based on the selected alarm standard. The values can be changed from this screen.

If a maximum limit for VOC has been inputted then the alarm will also activate if this is exceeded.



Relay 1 and 2 are used to set each alarm. These correspond with the alarm output connections located at the bottom of the instrument.

If Relay 1 is selected for Main Alarm, only Relay 2 can be selected for Pre-Alarm.



| | |
|---|-----------------|
| 1 | Normally closed |
| 2 | Common |
| 3 | Not Used |
| 4 | Normally open |

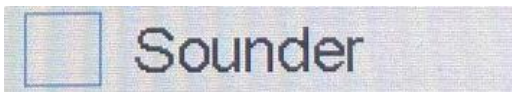
The rating for volt-free contact is 1A at 24VDC/AC

Two matching alarm plugs are provided with each F8100.

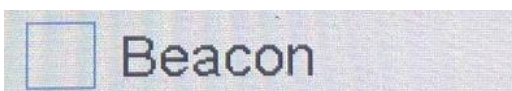
The action of the contacts can be adjusted in the software from active to passive by selecting the Inverse tick box.

| | |
|---|------------|
| 1 | Sensor Out |
| 2 | Sensor V- |
| 3 | Sensor V+ |
| 4 | Not used |

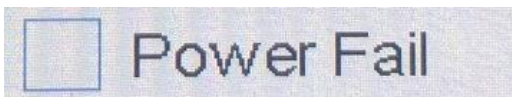
| | |
|---|----------|
| 1 | - |
| 2 | + |
| 3 | Not Used |
| 4 | Not Used |



This is an optional, factory-fitted feature which allows a sounder to be fitted inside or on the unit itself. By selecting the Sounder, an audible tone will be emitted in the event of any of the readings exceeding their minimum and maximum value.



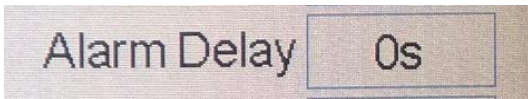
This is an optional, factory fitted feature which allows a beacon to be fitted on the unit itself.



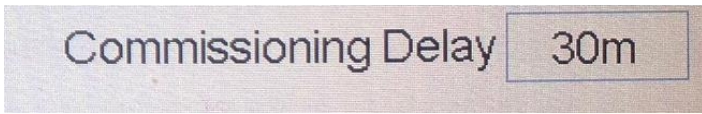
If Power Fail is selected, then in the event of a failure of the mains power supply, it will activate the alarm.



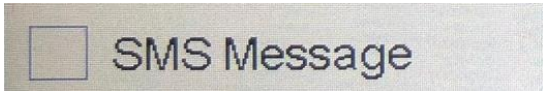
To function correctly the F8100 requires a minimum 2 barg supply pressure (10 barg maximum). In the event the supply pressure falls below 2 barg, the unit will activate its alarm. For situations where the drop in pressure may only be temporary a delay can be added (in seconds) before the alarm is activated.



An Alarm delay (in seconds) may be set, between the sensor values exceeding their minimum/maximum values and when the alarms will be triggered.



A commissioning delay may be set to prevent the unit activating the alarms when the instrument is first turned on, allowing time for the sensors to acclimatise.



If a SIM card is fitted in the instrument the SMS Message feature can be enabled by selecting this tick box. When activated a message will be sent when any of the readings reach their alarm values.



The SMS alarm message can be altered by pressing on the text.



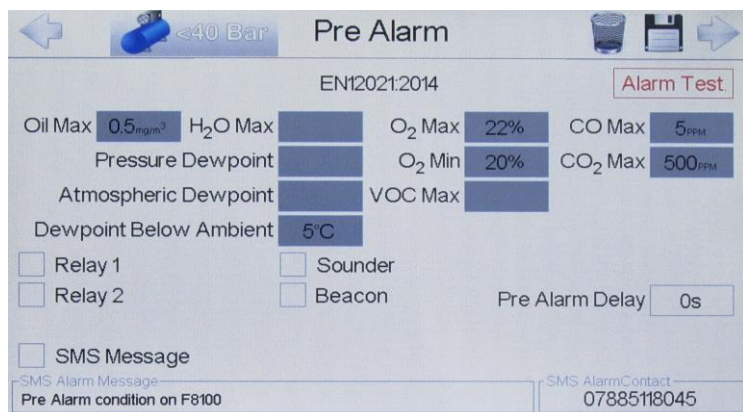
The SMS contact number can be set by clicking on the existing number.

Please refer to section 6 for further details on this feature.



Once you have configured the “Main Alarm” press the arrow button in the top right section of the screen to access the Pre Alarm menu. Alternatively you can save or discard the changes and return to the home screen.

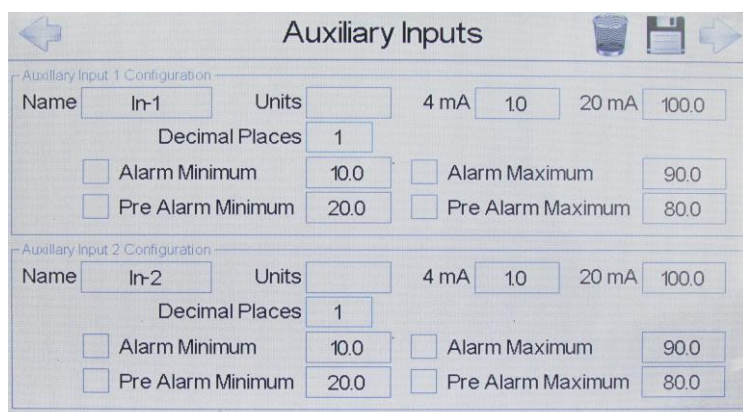
4.3 Configuring the pre alarm



The Pre Alarm screen provides the option to set a lower alarm value which can be used to notify the user before the main alarm values are exceeded.

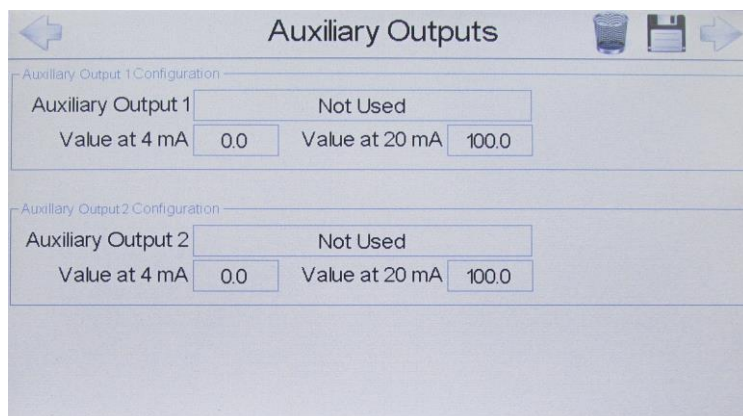
As with the main alarm the pre-alarm has a range of configurable options including an alarm output, sounder, pre alarm delay and if a SIM card is fitted, an SMS message.

4.4 Auxiliary Inputs and Outputs



The F8100 can display readings from external sensors which have a 2 wire, 15V, 4 – 20 mA output.

The description, units of measure and the 4 and 20mA parameters, for the sensors need to be set to match the external device(s).

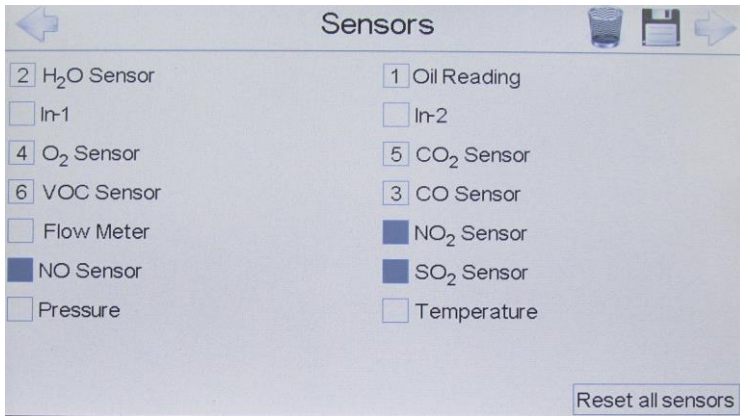


It is also possible to program 4-20mA outputs for 2 of the F8100 sensors. These can be used if you need remote indication for these sensor values.

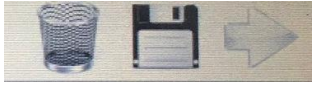
By selecting the Auxiliary Output 1 and Auxiliary Output 2 fields, you can choose which sensors you wish to output.

Both outputs are passive 10-30Vdc

4.5 Sensors



The order in which sensors are displayed on the home screen can be set, you can also choose which sensors you want to be displayed.

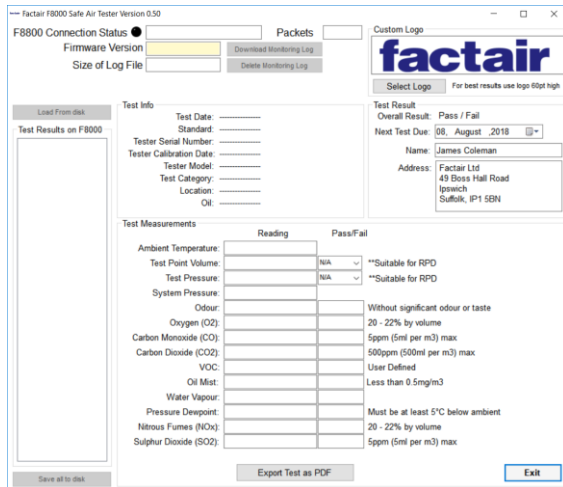


Any changes need to be saved to take effect.

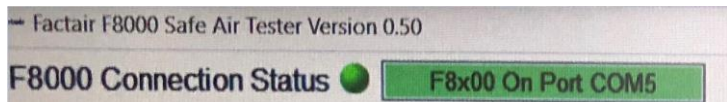
5. Exporting Test Results and PC Software.

To transfer the datalog from the F8100 Safe-Air Monitor to the PC software you must first install the software on your PC. This is available in the download section of Factair's website:

<http://www.factair.co.uk/downloads>



To transfer the datalog from the Safe-Air Tester to the PC software, turn on the F8100, connect the USB cable between the F8100 and your PC and open the Safe-Air Tester Results F8000 series software.

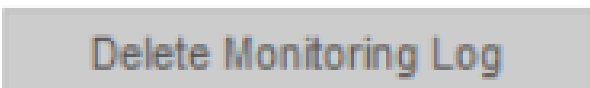


With the F8100 successfully connected the status light will turn green.

The unit will then automatically read the instruments firmware version, saved test results and the size of the data monitoring file.



The data log file can be downloaded by clicking on this button. Results are stored in a CSV format.



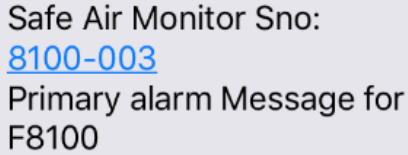
The monitoring log file on the F8100 SD card can also be deleted using this software.

When complete you can save the test result file.

6. SMS text status and alert

If a SIM card is fitted in the F8100 you can set within both the main and pre alarm menus a mobile telephone number for SMS text alerts to be sent to if any of the sensor readings exceed the limits.

An example SMS text alert is shown below:

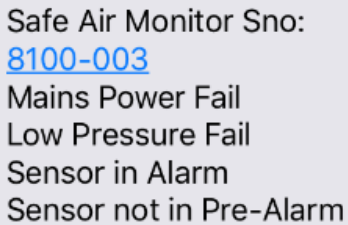


Safe Air Monitor Sno:
[8100-003](tel:8100-003)
Primary alarm Message for
F8100

You can also check the instrument from another mobile number by texting the SIM card number in the F8100 with the text “Status”, an example of this is shown below:



Status



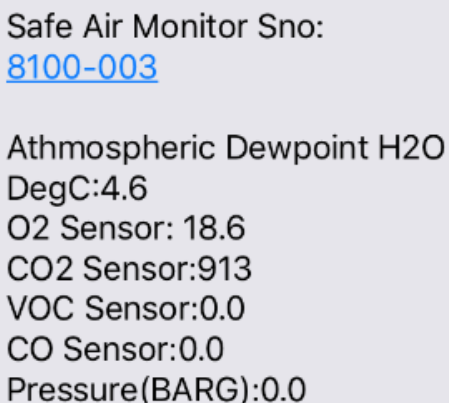
Safe Air Monitor Sno:
[8100-003](tel:8100-003)
Mains Power Fail
Low Pressure Fail
Sensor in Alarm
Sensor not in Pre-Alarm

By texting the SIM card number in the F8100 with the text “Hello” it will respond with an SMS detailing the instrument’s version number and the mobile network signal strength.

By texting the SIM card number in the F8100 with the text “Values” it will respond with an SMS detailing the current sensor readings, an example of this is shown below:



Values



Safe Air Monitor Sno:
[8100-003](tel:8100-003)

Athmospheric Dewpoint H2O
DegC:4.6
O2 Sensor: 18.6
CO2 Sensor:913
VOC Sensor:0.0
CO Sensor:0.0
Pressure(BARG):0.0

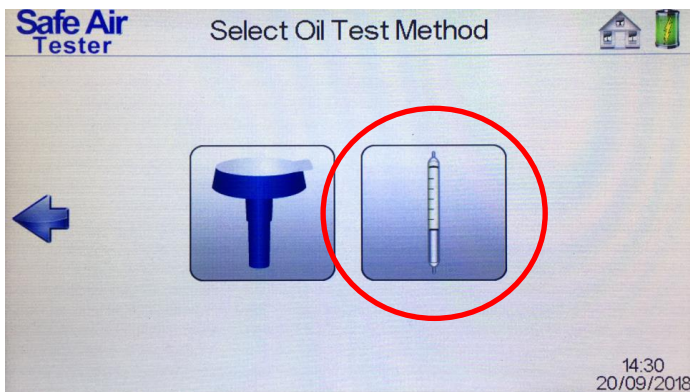
Appendix 1 - Using the test port for the Dräger oil tube

As well as the Dräger oil Impactor the F8100 test port can also be used with the Dräger oil tube.

| Test | Dräger ref. | Factair Part No: | Sensitivity |
|-----------------------------|-------------|------------------|-----------------------|
| Oil (chemical reagent tube) | 6728371 | TUB0003 | 0.1 mg/m ³ |

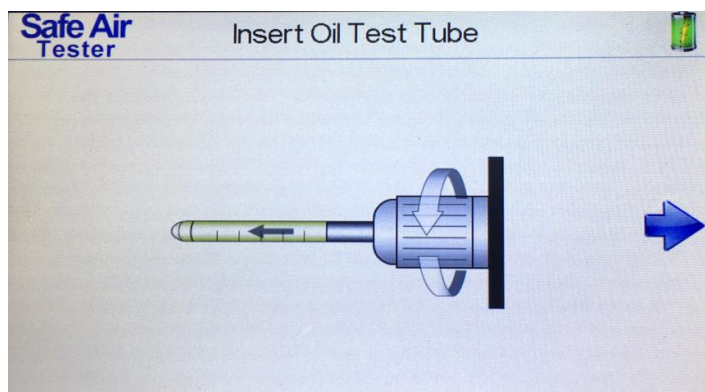
To prepare the tube Factair recommends the F2187 Dräger tube tip cutter.

If you have another Dräger tube, which you wish to use with the instrument, contact Factair for technical advice on its suitability.



To complete a tube test, select a tube test option as shown, press the button to proceed.

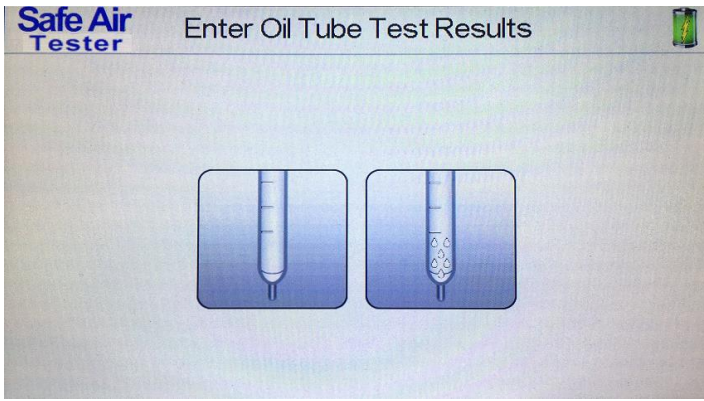
If you can determine with a high degree of certainty the specific compressor lubricant being used, then refer to the “test times” chart provided on Factair’s website marked for the F8100. If you have no knowledge of the type of compressor lubricant being used in the breathing-air system then Factair recommends 15 minutes as this covers the vast majority of lubricants.



Once the instrument has completed its purge sequence you will be prompted to insert the tube into the test port and tighten firmly.

Note: Both ends of the tube should only be cut immediately prior to the test. Ensure the arrow printed on the tube is pointing away from the instrument.

Press the right hand arrow to proceed.



The test will proceed as described in section 4 and at the end of it you will be prompted to enter the result from the tube.

The result will then be displayed on the final test result screen and stored in the instrument's datalog file.

Appendix 2 - Reading the Dräger Oil Impactor and Oil Chemical Reagent Tube

Oil Impactor

The Oil Impactor's protective seal must be kept in place for the duration of the test and only removed after the test has been completed.

With a standard measurement range of 0.1 to 1.0 mg/m³ the Impactor has a limit of detection of 0.05 mg/m³. The Impactor can detect all mineral and synthetic oil mists, it features a series of 3 horizontal lines, each formed by a series of precision manufactured nozzles. These horizontal lines of nozzles are calibrated to a different concentration of oil. When air is passed through these nozzles any oil present in the air is deposited on the glass plate prior to the air being exhausted by vents around its circumference, this allows the user to easily and quickly identify minute quantities of oil.

For tests that pass with an oil concentration of less than 0.05mg/m³, the screen will remain blank. For tests above that read as follows:

The bottom line represents an oil concentration of 0.1 mg/m³. When the oil deposited forms a continuous line then the concentration is in excess of 0.1 mg/m³. The middle line represents a concentration of 0.5 mg/m³, again when the oil deposited forms a continuous line the concentration is in excess of 0.5 mg/m³. The top line represents a concentration of 1.0 mg/m³, again when this forms a continuous line the concentration is in excess of 1.0 mg/m³.



Pass* -
greater
than
0.05mg/m³
but less
than
0.1mg/m³



Pass* -
greater
than
0.1mg/m³
but less
than
0.5mg/m³



Fail* -
greater than
0.5mg/m³
but less than
1.0mg/m³



Fail* -
greater
than
1.0mg/m³

* – The above pass and fail criteria is based on breathing-air standard EN12021

Using the Dräger tube tip cutter

The F2187 Dräger Tube Tip Cutter is an optional extra not provided with the F8100 as standard and is especially designed for cutting the ends of the tube. It has been designed to prevent glass from falling out of the opener by accident. The reservoir for the broken-off tips is easy to empty.

1. Place the end of the tube between the 3 blades, and turn to score the end.



2. Push the tube at an angle to break the tip.



3. Repeat steps 1 and 2 with the other end of the tube

Using the tube tip cutter with the Dräger oil tube

1. Using the Tube Tip Cutter, place the ampoule section in the platform at the bottom. Note: Make sure the tube is against the back wall of the cutter. Line up the black dot nearest the end of the tube with dot on the cutter.



2. With one hand holding the cutter, the other holding the tube and with your thumb against the base of the cutter, apply pressure to the tube, this should break the inner tube.



3. Place your used detector tubes in a safe container until they can be disposed of properly as “sharps” or glass.



Each pack of tubes has its own instruction leaflet but the following notes should help you take readings after the tests have been completed.

Each tube has an expiry date which is located on the back of its storage box.

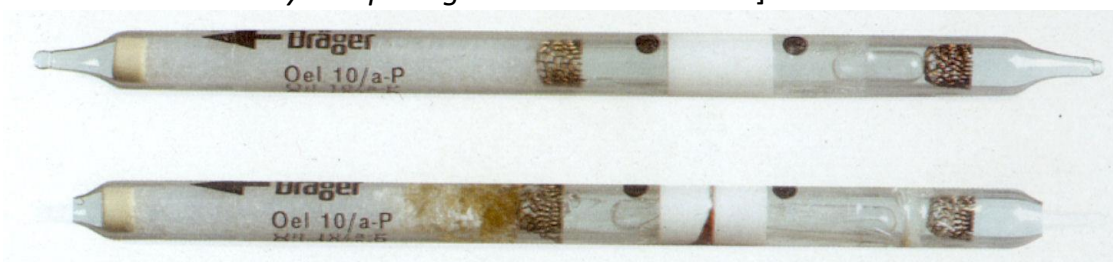
Oil (6728371) -

REQUIREMENT - FOR BREATHING-AIR STANDARD EN12021 THE AIR SHOULD HAVE A MAXIMUM OIL CONTENT OF 0.5 MG/M³ AND SHOULD BE WITHOUT SIGNIFICANT ODOUR OR TASTE.
FOR HTM02-01 THE AIR SHOULD HAVE A MAXIMUM OIL CONTENT OF 0.1 MG/M³

Ensure the oil tube is kept vertical throughout this process.

Satisfactory test: - The white crystals will turn translucent and show at worst a slight discoloration.

Failed test: - (Mineral oil) - The white crystals will show a light brown or darker discoloration.
- (Synthetic oil) - The white crystals will show a yellow discoloration [*Note: best seen by comparing with an unused tube*].



Disposal of Dräger-Tubes

When Dräger tubes have been used, or unopened tubes have exceeded their expiry date, they should be disposed of using one of the following methods:

Used Tubes Submerge the tube(s) in a beaker or metal container filled with water and allow to soak for 24 hours. Treat the residual water in accordance with local authority waste regulations (some tube aqueous waste may require neutralisation prior to disposal). Place the tubes in a “sharps” or glass bin wearing protective gloves and safety spectacles. Dispose of the bin via the company’s normal industrial waste disposal method(s) i.e. landfill or incineration.

OR Place the tubes in a “sharps” or glass bin wearing protective gloves and safety spectacles. Dispose of the bin via the company’s normal hazardous waste disposal method(s) i.e. landfill or incineration.

Unused Tubes Open the Dräger tube at both ends using the special tube opener or the cutter on the hand pump. Break any ampoules where applicable. Dispose of the tubes as stated in Methods 1, 2 or 3.

NOTE: As an alternative a local authority approved waste disposal contractor can be employed to collect used and unused tubes from site and dispose of them in a safe manner.

Appendix 3 - Volatile Organic Compounds

The F8100 incorporates a photo ionisation detector (PID) sensor to detect volatile organic compounds.

The European Union defines a VOC as "any organic compound having an initial boiling point less than or equal to 250 °C (482 °F) measured at a standard atmospheric pressure of 101.3 kPa." Volatile organic compounds are organic compounds with a high vapour pressure at room temperature. Their high vapour pressure results from a low boiling point which causes large numbers of molecules to evaporate or sublime from the liquid or solid form of the compound and enter the surrounding air, a trait known as volatility. Most scent or odours are of VOCs.

Example VOCs include petrol fumes, exhaust gases, paint solvents and dry cleaning products. Harmful VOCs typically are not acutely toxic but have cumulative and often synergistic long-term health effects causing damage to the liver, kidneys and central nervous system.

Using a method of ongoing verification, the PID sensor in the F8100 provides an effective method of monitoring the performance of the activated carbon filter fitted in a breathing-air system.

Suggested Test Limits for VOCs

In EN12021:2014 it states compressed gas for breathing shall not contain contaminants at a concentration which can cause toxic or harmful effects. In any event, all contaminants shall be kept to as low as possible and shall be less than one tenth of a national 8 h exposure limit. For breathing air only the limit shall be less than one sixth of a national 8 h exposure limit. For breathing at hyperbaric pressures greater than 10 bar or exposure times greater than 8 h the levels shall be revised to take into account the effects of pressure and exposure times.

As VOCs can indicate a range of potential contaminants it may be useful to use the limit stated of ≤ 30 ml/m³ (PPM) for diving gas mixtures in tables 6, 7, 8 and 9 of EN12021:2014.

The other alternative reference is the technical specification ISO/TS 16975-1:2016 The International Respiratory Protective Devices – Selection and Use Maintenance Document which has a stated VOC limit of ≤ 25 ml/m³ (PPM) for breathable air used to supply breathable gas RPD.

VOC Alternative Sensors

An alternative 0-3 PPM VOC sensor can be factory fitted in the unit, with this sensor fitted Factair can pre-configure the unit to display the reading in mg/m³ referenced against isobutylene calibration gas.

Appendix 4 – Helpful Tips

General

- Never connect to a non-regulated supply from an HP cylinder or compressor.
- Maximum inlet pressure to the tester is 10 barg. If exposed to an overpressure the Tester will display an overpressure warning necessitating its return to the manufacturer for checking and resetting.
- Pressure Dewpoint is, for a given pressure, the temperature at which water will begin to condense out of air.

With Impactor

- Never remove the sticker before or during the test.

With detector tubes

- Ensure that there are no fragments of glass in the tube test port gland prior to fitting detector tubes, clean if required.
- Always remove the ends of the detector tubes cleanly using the correct tube tip cutter. Do not use pincers or other devices.
- Always remove both ends of the detector tubes prior to fitting.
- Always fit detector tube with the arrows facing outwards.
- Never break the glass ampoule in the oil tube before the test.
- Only use the detector tubes that the Tester is calibrated for.
- Once used, be aware that the tube tip cutter contains ground glass and glass fragments. Take appropriate precautions for the disposal of these. Dispose of as sharps.
- When using the tube tip cutter ensure only a light pressure is applied to the tube whilst rotating for scoring.

For any additional advice and information please contact Factair on: +44 (0) 1473 746400.

Air Quality Testing – Why?

The required quality of breathing air is stated in EN12021 is to provide information on the safe limits of potential contaminant gases within breathing air and to ensure that the life support gas of oxygen is of an adequate level.

Compressed air for breathing normally originates from a compressor system installed or operating at the place of use and there are various factors that can affect the quality and safety of this air.

- The air intake to the compressor can ingest airborne contamination from local processes and vehicle exhaust fumes which are not removed by standard breathing air filtration. Such air borne contamination may not be continuous but the pollution of the air supply may persist for hours or days.
- Malfunctioning compressors, especially reciprocating type, can produce unsafe levels of both carbon monoxide and carbon dioxide.
- Breathing air filtration has a finite life and can fail causing high levels of oil and water contamination to be present in the air.
- The performance of desiccant filters is dramatically affected by operating temperature. Infrequent validation may result in poor quality air being supplied for an extended period
- Failure of the compressed air aftercooling will result in air entering the filtration at too high a temperature, this will cause the filtration to prematurely fail and pass excess levels of oil and water.
- Malfunctioning dryers can disturb the oxygen concentration to outside safe levels within the breathing air.
- High levels of water in breathing air can freeze within RPD demand valves causing the air supply to fail.
- Insufficient air flow or pressure to the RPD will reduce the protection factor of the RPE and potentially expose the user to ingress of external contaminants.
- The effects of contaminants when breathed at elevated pressure can have a much greater effect on users than it would at normal pressure.
- Changes in the performance of compressor and filtration equipment are usually rapid in nature. Any failure affecting outlet air quality may injure users for an extended period if quality validation is infrequent.
- Odour alone is a poor indicator of air quality, toxic as asphyxiant gasses are often odourless, the limits for oil pollution are lower than the threshold detection level that most people will notice.

All employers have a duty of care to their employees to ensure that the breathing air they are supplied with is adequate for the RPD they are using and safe to breathe. The points raised above may form the basis of the risk assessment called for in the European guidance document for the selection and use of respiratory protective devices EN 529.

International Breathing-Air Standards

| | Europe | US | Australia and New Zealand |
|--------------------------------|--|--|---|
| | BS EN12021 & EN12021:2014 | CGA G-7.1-2011 Grade D | AS-NZS 1715: 2009* |
| Odour | The gas shall be free from unsatisfactory odour or taste. | None (No pronounced odour) | No objectionable or nauseous odour |
| Oxygen | (21 ± 1)% | 19.5% - 23.5% | 19.5% - 22% |
| Carbon Dioxide | ≤ 500 PPM | ≤ 1000 PPM | ≤ 800 PPM |
| Carbon Monoxide | ≤ 5 PPM | ≤ 10 PPM | ≤ 10 PPM |
| Oil | ≤ 0.5 mg/m ³ | ≤ 5 mg/m ³ | ≤ 1 mg/m ³ |
| Water Airline <40Bar | Where the apparatus is used and stored at a known temperature the pressure dewpoint shall be at least 5°C below likely lowest temperature. Where the conditions of usage and storage of any compressed air supply is not known the pressure dewpoint shall not exceed -11°C. | Dewpoint ≤50°F (67 PPM v/v), for SCBA use in extreme cold a dew point not to exceed -65°F (24 ppm v/v) or the dewpoint must be 10°F lower than the coldest temperature where the respirator is worn. | |
| Water High Pressure | 40 to 200 bar ≤50 mg/m ³ >200 bar ≤35 mg/m ³ HP Charging Comp ≤25 mg/m ³ | | Contain not more than 100 mg/m ³ for cylinders initially filled to pressure of at least 120 bar. |

Note – Also ensure that the test point volume and pressure is sufficient for the RPD being used. For AS-NZS 1715 the minimum requirement is 170 l/min continuous flow for each person, measured at the respirator.

Above is an extract only for full details refer to the individual standards.

Recording Breathing-Air Quality Test Results

When undertaking breathing-air quality tests, results should be retained. In the UK the regulations COSHH stipulates the information retained should include:

- the name and address of the employer responsible for the RPE;
- particulars of the equipment and of the distinguishing number or mark, together with a description sufficient to identify it, and the name of the maker;
- the date of examination and the name and signature or other acceptable means of identifying the person carrying out the examination and test;
- the condition of the equipment and details of any defect found, including for canister or filter respirators, the state of the canister and the condition of the filter;
- for self-contained compressed air/gas breathing apparatus, the pressure of air/gas in the supply cylinder; and
- for powered/power-assisted respirators and breathing apparatus, the volume flow rate to ensure that they can deliver at least the manufacturer's minimum recommended flow rate.

Records can be in paper or electronic format but should be kept readily accessible and retrievable at any reasonable time for examination by safety representatives or inspectors etc.

In the guideline document Respiratory Protective Equipment, a practical guide (HSG53) it advises results should be kept for 5 years.

A.4.5 Compressed air for breathing apparatus from EN529

A.4.5 Compressed air for breathing apparatus (EN12021)

A.4.5.1 General

A compressor system will have produced the compressed air supplied to a breathing apparatus. The compressor system may be used for filling individual high-pressure vessels or those on a mobile trolley or to supply air direct to breathing apparatus and other air-tools used in the workplace.

Contaminants can mix in compressed air at various stages of its production and supply. Any presence of contaminants in acceptable quantities will render the air unsuitable as “breathable air” and can threaten the health and safety of the respiratory protective device wearer. For this reason quality assured compressed air should be supplied to a breathing apparatus. EN12021 stipulates the minimum quality standards for breathable compressed air and includes the levels for oxygen, carbon monoxide, carbon dioxide, lubricants, water and other types of contaminant and odour.

A.4.5.2 Compressor system

A.4.5.2.1 General

A competent person should be consulted when planning or installing a compressed air system for producing breathable air. This will help to minimise problems associated with compressors and the down stream effects on the quality of the air supplied. Table A.2 provides a summary of the main elements associated with a compressor system for producing breathable air. In addition to the careful and installation of the system it should be maintained by a competent person to ensure the safe operation of the system.

The compressor should be installed in an area providing sufficient space on all side to ensure good ventilation. The area should be cool as possible but avoid place where freezing is possible. The air intake point should be located in open air and away from potential contaminants (e.g. not close to ventilation outlets or in down stream of the outlets or near vehicle exhaust emission points).

A.4.5.2.2 Air purification elements

The air purification elements should be placed in the correct sequence to ensure the delivery of acceptable quality breathing air. These purification elements should be replaced in accordance with the advice provided by the competent person and the manufacturers of these elements.

A.4.5.2.3 Testing and inspection

The volume flow and quality of the supplied air should be thoroughly tested as specified by a competent person after risk assessment.

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COSHH L5 (Sixth Edition 2013)
EXTRACTS FROM CODE OF PRACTICE RELATING TO
RESPIRATORY PROTECTIVE EQUIPMENT (RPE)

178. The maintenance, examination and tests should be in accordance with the manufacturer's instructions. Examinations should comprise a thorough visual examination of all parts of the respirator or breathing apparatus, to ensure that all parts are present, correctly fitted, and the equipment is in good working order. In particular, the examination should ensure that the straps, facepieces, filters and

valves are sound and in good working condition. For powered and power-assisted respirators, tests should:

- be made on the condition and efficiency of those parts;
- ensure that the battery pack is in good condition;
- ensure that the respirator delivers at least the manufacturer's recommended minimum volume flow rate.

179. For RPE incorporating compressed gas cylinders, tests should include the condition and efficiency of all parts, the pressure in the cylinders and the volume flow rate. Frequency of examination and tests

180. The quality of the air supplied to a breathing apparatus should be tested at suitable intervals, depending on the task and the frequency of use. When the air supply is from mobile compressors, the employer should ensure that wherever a compressor is located, the quality of air it supplies is not compromised by nearby contaminants. In every case, the air supplied to a breathing apparatus should meet the relevant quality standard. As it is not reasonably practicable to test for all contaminants, the risk assessment made under regulation 6 should guide what other contaminants will require testing.

181. Thorough maintenance examinations and, where appropriate, tests of items of RPE, other than one-shift disposable respirators, should be made at suitable intervals. The frequency should increase where the health risks and conditions of exposure are particularly severe.

182. In situations where respirators are used only occasionally, an examination and test should be made before their next use and maintenance carried out as appropriate. The person who is responsible for managing the maintenance of RPE should determine suitable intervals between examinations. Emergency escape-type RPE should be examined and tested in accordance with the manufacturer's instructions.

183. Suitable arrangements should be made to ensure that no employee uses RPE which has previously been used by another person, unless it has been thoroughly washed and cleaned in accordance with the manufacturer's instructions.

Suitable records

184. The record of each thorough examination and test of RPE carried out should include:

- the name and address of the employer responsible for the RPE;
- particulars of the equipment and of the distinguishing number or mark, together with a description sufficient to identify it, and the name of the maker;
- the date of examination and the name and signature or other acceptable means of identifying the person carrying out the examination and test;
- the condition of the equipment and details of any defect found, including for canister or filter respirators, the state of the canister and the condition of the filter;
- for self-contained compressed air/gas breathing apparatus, the pressure of air/gas in the supply cylinder; and
- for powered/power-assisted respirators and breathing apparatus, the volume flow rate to ensure that they can deliver at least the manufacturer's minimum recommended flow rate.

Keeping records

185. Employers may keep records in any format, eg on paper or electronically. Records should be kept readily accessible and retrievable at any reasonable time for examination by safety representatives or inspectors etc.

Accommodation for, and checking of, PPE

186. Employers should ensure that accommodation is provided for PPE so that it can be safely stored or kept when it is not in use. The adequacy of the accommodation will vary according to the quantity, type and its use, eg pegs, (labelled) lockers, shelves or containers etc. The storage should be adequate to protect the PPE from contamination, loss or damage by, for example, harmful substances, damp or sunlight. Where quantities of PPE are stored, equipment which is ready for use should be clearly segregated from that which is awaiting repair or maintenance. Where PPE becomes contaminated during use, and especially by biological agents, the accommodation should be separate from any the employer provides for ordinary clothing and equipment. Employers may also have duties under the Workplace (Health, Safety and Welfare) Regulations 1992 to provide accommodation for PPE.¹⁴

187. All PPE should be checked regularly to ensure that it continues to function and provide protection. The types of checks should be suited to that item of PPE and be able to detect significant deterioration. The more likely the performance of a particular item of PPE is to deteriorate, the more often it needs checking. Whoever does this work should be sufficiently knowledgeable and trained to identify deterioration and significant faults. Equipment that has deteriorated significantly or is faulty should be effectively repaired or disposed of safely.

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Respiratory Protective Equipment at Work

A practical guide

HSG53 (Fourth edition, published 2013)

Dos and don'ts

Do's

Always ensure the breathing apparatus is in good working order before putting it on, even when new.

Always look after your supply hose during use – your life may depend on it.

Always use **all the straps** provided, making sure they are correctly positioned and adjusted. Follow the manufacturer's instructions.

Ensure that an adequate clean air supply is available for all users.

Ensure that the compressed air quality meets the minimum requirements of BS EN 12021.15

Always plan your exit from the contaminated area so you don't run out of air.

Ensure the other PPE you need to wear is compatible with the BA.

Don't's

Never place the hose inlet near to potential sources of contamination, eg vehicle exhausts.

Never use the equipment without the waist belt.

Never use a light-duty airline hose where there is any potential for crushing by vehicles or passers-by etc.

Never keep working if the airflow rate drops or any warning devices are activated. Leave the work area immediately.

Appendix 3 Quality of air for breathing apparatus

Air quality

1. Air supplied to breathing apparatus (BA) should be clean and safe to breathe, whether it is supplied via a fresh air hose or a source of compressed air.

Fresh air hose

You should securely anchor the inlet for fresh air hose BA in an area that is free of contaminant. This can usually be achieved by siting the inlet well away from the work area (eg in free air outside the building), and upwind of any local sources of airborne contamination (eg vehicle exhaust).

Compressed air

2. Compressed air for BA normally originates from a compressor system. The maintenance, examination and testing of compressors should be carried out according to the manufacturer's instructions. The siting of air inlets to compressors should follow the same principles as for fresh air hose. However, because compressors themselves can generate and concentrate a wide range of contaminants, you should take extra care in assuring air quality.
3. As the BA wearer's life and health depend on the air supplied by the compressor, you should ensure that the air supplied meets the quality requirements in British Standard BS EN 12021 *Respiratory protective devices. Compressed air for breathing apparatus*,* in addition to the pressure and airflow rate requirements of the BA manufacturer.
4. Compressors which are moved from site to site, such as those used by the emergency services or on construction sites, will require a higher standard of maintenance and should be sited so that the quality of air they provide is not compromised by nearby contaminants.

* BS EN 12021 states: 'Compressed air for breathing apparatus shall not contain any contaminants at a concentration which can cause toxic or harmful effects. In any event all contaminants shall be kept to as low a level as possible and shall be far below the national exposure limit. Combination effects of more than one contaminant shall be taken into account.' (1999) Respiratory protective equipment at work Page 48 of 59

Periodic testing of air quality

5. The purpose of periodically testing air quality is to make sure that the control measures you have put in place are delivering the air quality required by BS EN 12021. You should base the frequency of such tests on a risk assessment, but they should take place at least every three months, and more often when the quality of air cannot be assured to these levels.
6. As part of the risk assessment, if a mobile compressor is being used consideration should be given as to how often the air supply should be checked when the compressor is moved. Testing for these components may be carried out using any appropriate method, eg:
 - simple colour change tubes;
 - on-line gas testers;
 - sample collection for laboratory analysis elsewhere.

7. The supplier of your compressor or BA should be able to advise you on the best method for you. You should keep records of air quality tests for five years.

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