

factair

F8000 SAFE-AIR TESTER



OPERATING MANUAL

FAC QAM 219 Issue B 04/20

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Introduction

Safe-Air Testers are designed to provide a quick and easy method for carrying out accurate periodic testing of breathing-air supplies. From the touch screen display the appropriate breathing-air standard can be selected for your test.

The F8000, is designed primarily for use on airline systems up to 10 bar but can also test high pressure charging systems when used in conjunction with the F3002 High Pressure Regulator.

The F8000 is supplied in a hard weatherproof case with storage provision for a wide range of accessories and equipment.

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 airflow rate, pressure and ambient temperature. For measuring oil aerosols Draeger Impactors are connected through a test port (or alternatively the Draeger oil chemical reagent tube). The Draeger Impactors are supplied in packs of 10 and show the degree of oil contamination on a screen.

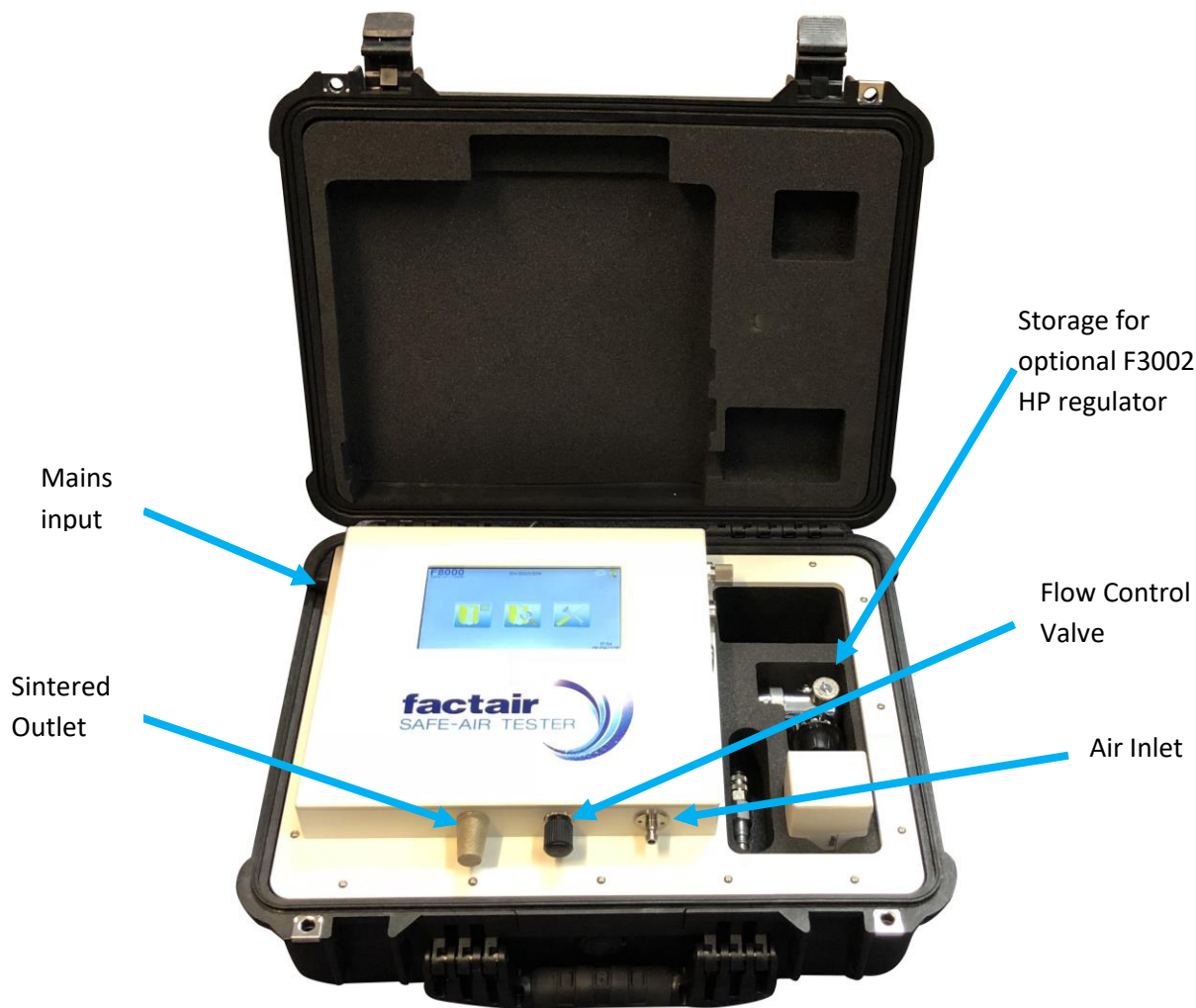
Calibration and Warranty

Safe-Air Testers leave our factory with a 12-month warranty and calibration certificate. Our standard turnaround on annual calibration 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 Tester to Factair.*

Temperature Parameters

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

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



On / Off Button

PC - USB Connection

Draeger Impactor /
Oil Tube Test Port

Standard Equipment List
F8000 Safe-Air Tester
Mains Power Supply Cable
USB Download Cable
F2193 Safe-Air Tester to Draeger/Scott compatible plug adaptor
Stylus Pen

Optional Extras
TUB0053 – 8103560 Draeger Oil Impactor – Box of 10
TUB0003 – 6728371 Draeger Oil Tubes – Box of 10
F3002 High-Pressure Regulator
F1946 Connection ¼ BSP inlet adaptor
F2194 Connection adaptor terminating in a Rectus Plug
F2195 Connection adaptor terminating in an Instantair Plug

Technical Data

Model	F8000		
Minimum Working Pressure	2 barg		
Maximum Working Pressure	10 barg		
Air Inlet Connection	Rectus Series 21 Plug		
Internal Rechargeable Batteries	6 no. Lithium Ion 3.7V 15,600 mAH		
Supply Voltage	230V 50 Hz 1ph 13 amp		
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	-65°C to +20°C	Ceramic Moisture Sensor	
	PDP	Dewpoint Meter	
Flow	0 – 600 l/min	Orifice Pressure Differential	
Pressure	0 – 10.0 barg	Transducer	
Test Port – Compatible with the following Draeger Impactors / Tubes	8103530	TUB0053	Oil Impactor
	6728371	TUB0003	Oil Chemical Reagent Tube
Dimensions	500 mm long x 400 mm wide x 190 mm high		
Weight	10 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

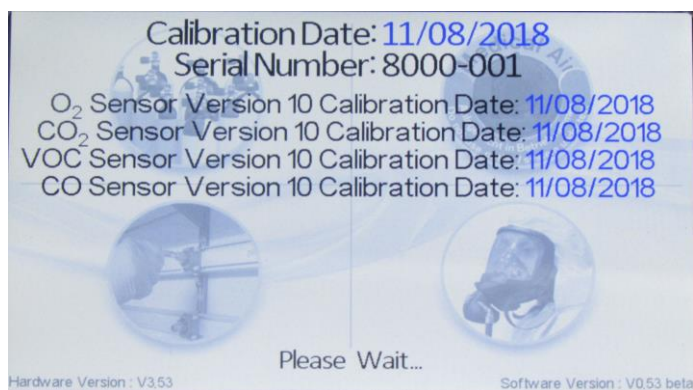
F8000 Safe-Air Testers are supplied with internal rechargeable batteries, when fully charged these are sufficient for approximately 10 tests.

Following start up the battery level is displayed on the screen; if they are reading low then the instrument should be switched off and a mains power supply connected. The batteries will then be recharged and you can continue to use the instrument.

If the Tester is to be used adjacent to a power socket, the mains power supply cable can be used. Please note the unit should be switched off prior to connection or disconnection of the mains supply.

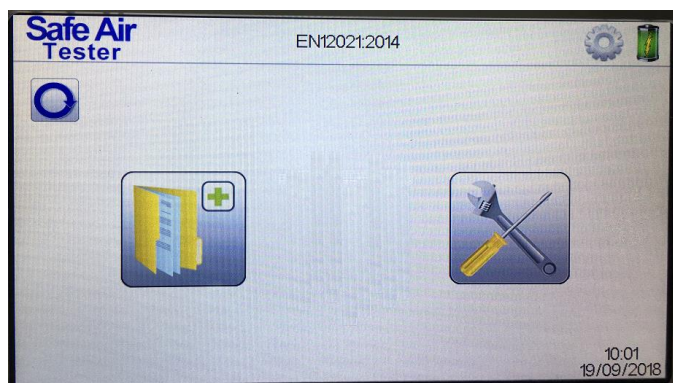
2. Start-Up

To carry out a test first switch on the machine by pressing and holding the “on” button, located on the right-hand side of the unit, for approximately 3 seconds.



A splash screen will be displayed which shows the instruments hardware and firmware versions. Periodically the firmware is upgraded, as part of the recalibration process, as improvements are identified. The sensors status will also be checked during this start up process.

A Stylus pen is provided for use with the touch screen. The display will show the, date last calibrated, 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.



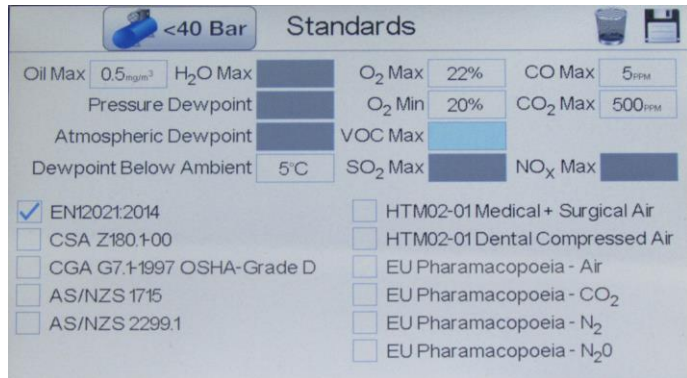
If there are no previous test results saved in the instrument the home screen has 2 main icons the left one is to Begin Test and the right hand is for Set-Up Menu.

Each of these sub-menus are described in further detail below

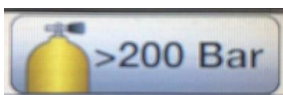
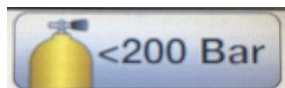
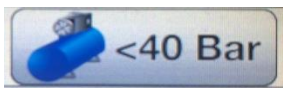
3. Test Standard Selection



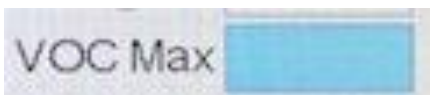
To select the appropriate test standard press this icon.



The standards menu will then display the available test standards.

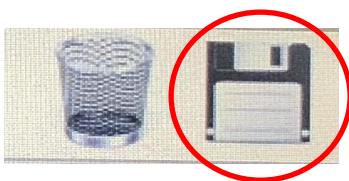


For EN12021:2014 there are 4 different requirements depending if you are testing an airline system <40 bar; Cylinder <200 bar; Cylinder >200bar or direct from a high pressure charging compressor. By toggling the icon at the top of the screen the default limits will be displayed.



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

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



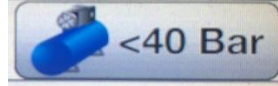
Once you have selected the appropriate standard press the save button to update the change or alternative to discard press the waste basket icon.

4 Beginning a New Test

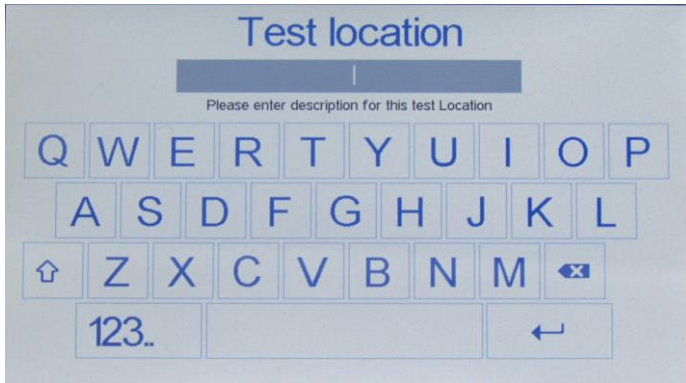
4.1 Completing an airline test up to 10 bar



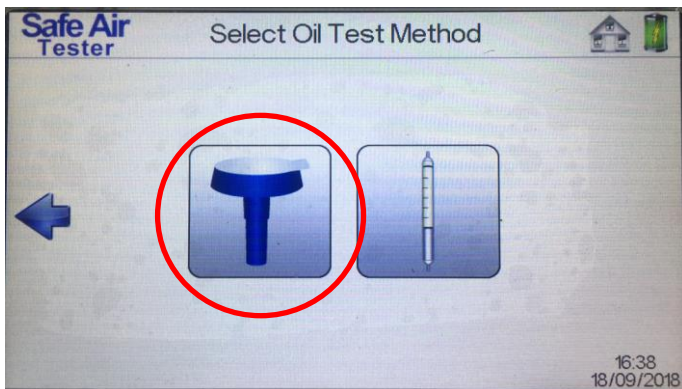
First ensure you have selected an airline test in the test standard selection menu



Then from the home screen press the “begin test” icon.



You now have the option of entering a description for the test location, if you wish to use numbers press the “123..” button. Push the return button when you are ready to proceed.



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

For breathing-air tests the standard option is to select a Draeger oil Impactor.



With the flow control valve in the closed position connect to the air supply to be tested. Ideally this should be done by using the hose which normally supplies the breathing apparatus. Fit the appropriate adaptor to the Tester first and then connect the supply hose to the adaptor.

A test can be carried out at any pressure between 2 and 10 bar.

Note:- If the unit is over-pressurised it will automatically shut down and display an overpressure warning; it will then need to be returned to the manufacturer for checking and resetting.

Input pressure will be displayed on the measured pressure bar graph and the adjacent display. System pressure will automatically default to this reading.

Note:- The pressure dewpoint at the end of the test will be calculated on the recorded system pressure.

For the majority of applications the system pressure can be left at this default setting, however if the breathing-air system is distributed as breathing air at a different pressure to that being displayed this should be entered at this stage.

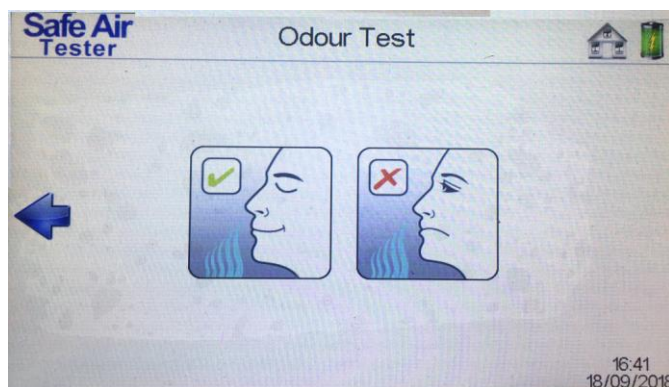
To enter press the right hand side (Set) icon use the keypad to enter the required value, press the right arrow to return. The (Reset) button will automatically reset the system pressure back to the measured pressure.

Press the arrow key to proceed.

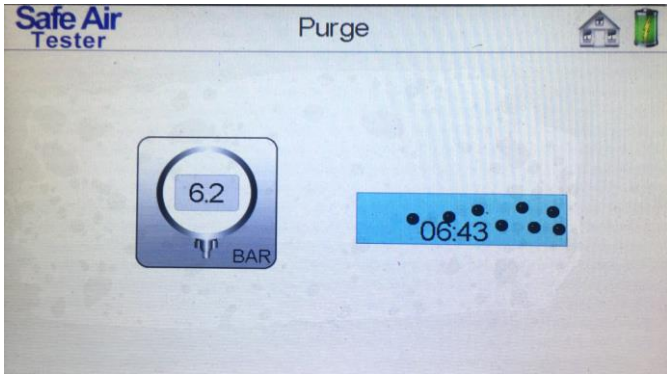


We can now confirm the flow and pressure is adequate for your respiratory protective device. Adjust the system's flow control valve so that the flow meter registers the required level*, check the pressure is sufficient for the breathing-air equipment being used. It is recommended that this flow is left running for the duration of the test to simulate the conditions of use. Press the arrow key to proceed if the flow and pressure meet the minimum requirements for your RPD.

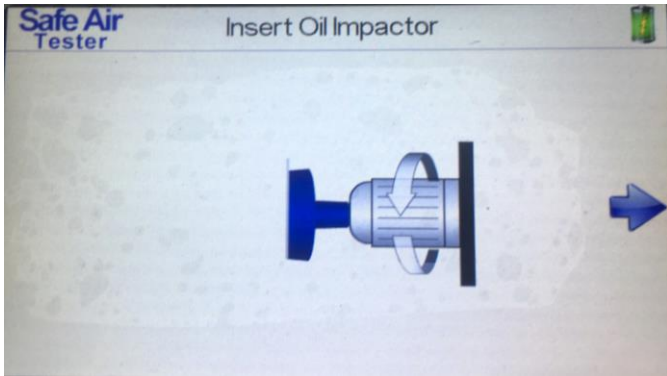
**Note:- At high flow rates hearing protection should be considered.*



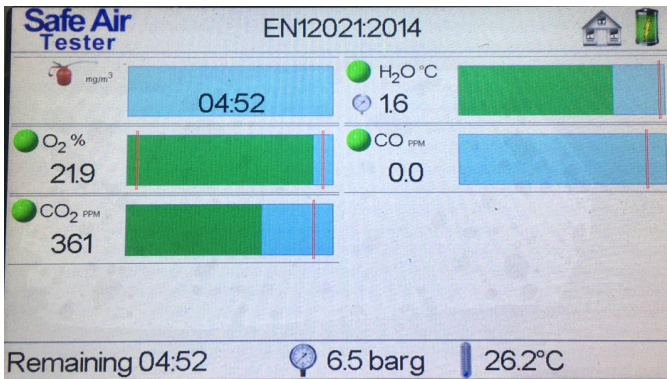
Carry out the odour test and smell the air exhausted from the sintered outlet. If there is a serious odour problem, fail the sample at this point of the test by pressing the 'fail' button. Initiating flows of seriously contaminated air could result in damage to the instrument. If the odour test is satisfactory, press the 'pass' button.



The instrument will now commence a 7-minute purge sequence, during which time an airflow will be passed through the test port and across the electronic cells. This clears contaminants from previous tests and ensures that a representative sample is being tested.



Once the purge has finished, the Draeger Impactor 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 button in top right hand corner to start the test.

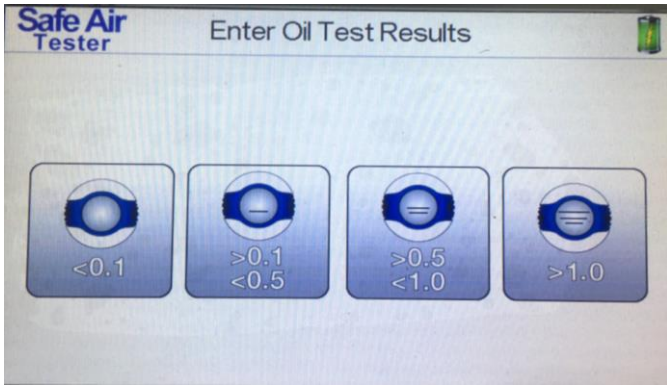


The test will now commence and the duration will be displayed as a countdown, together with pressure, flowrate, ambient temperature, carbon dioxide, carbon monoxide, oxygen and pressure dewpoint. If selected the VOC content will also be displayed.

During the test the flowmeter should be set to simulate the requirements of the respiratory protective device RPD.

The unit can be left until the test time has elapsed.

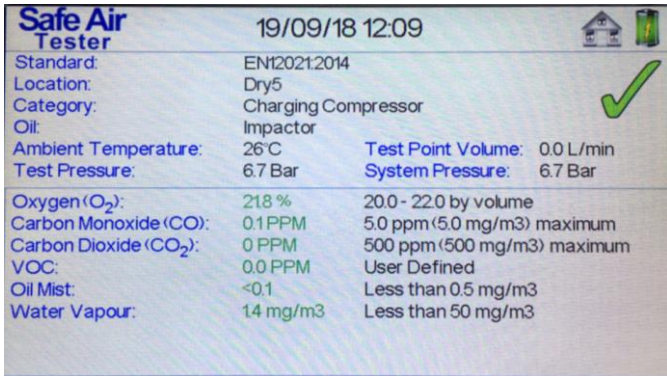
If the instrument detects that the dewpoint meter's rate of change is still too high (>0.2°C per minute) it will automatically continue the test until this stabilises (maximum test time 15 minutes).



Once the test is complete the Impactor result screen will be shown, close the flow control valve. 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.



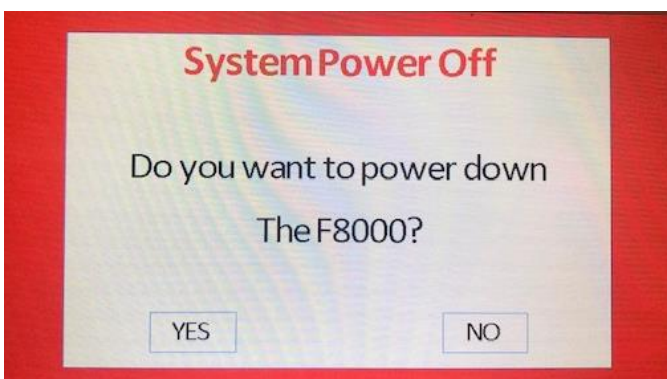
The “test complete” screen displays all the measurements recorded during the test. And automatically determines whether the test was a pass or fail against the standard displayed. The water content on low pressure tests is displayed as a pressure dewpoint. The test result is recorded in the instrument’s memory, which can store up to 21 previous tests.

For airline systems less than 40 bar the pressure dewpoint, i.e. the point at which water will begin to condense into a liquid form in the airline, must be at least 5 degrees centigrade below the lowest temperature at which the system will be used. The F8000 automatically calculates the pressure dewpoint from the measured water content and system pressure, it then compares this to the ambient temperature to determine whether it was a pass or fail.

This test result is automatically recorded in the instrument’s memory, which can store up to 21 previous tests. To view these tests return to the main menu and press the “Review Tests” button. Test results are stored accordingly to the date and time they were completed. From this menu previous tests can be viewed or deleted as required.

To disconnect the Tester from the system make sure you leave the inlet adaptor on the instrument and only disconnect at the end of the supply hose. The adaptor can then be disconnected afterwards if required.

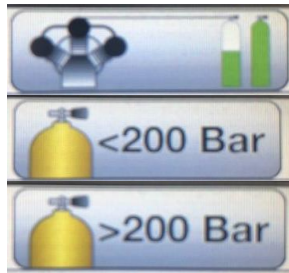
To turn off the Tester, hold the power switch in for two seconds and follow the on screen prompt.



Note:- Tester will power down after 10sec, unless “NO” is pressed on the screen.

4.2 Completing a High Pressure Test

For high pressure tests there are 3 different test options available in the standards selection menu. All of the high-pressure tests require the use of the F3002 regulator which has a DIN connector which can accept input pressures of up to 300 bar.



High-pressure charging compressors

High-pressure cylinder less than 200 bar

High-pressure cylinder greater than 200 bar

Note: For cylinder tests please ensure the test is carried out on a recently filled, fully charged cylinder.

Note: For the high-pressure charging compressor test a DIN to DIN adaptor ref: F2158 is required to connect the F3002 high-pressure regulator to a charging hose.

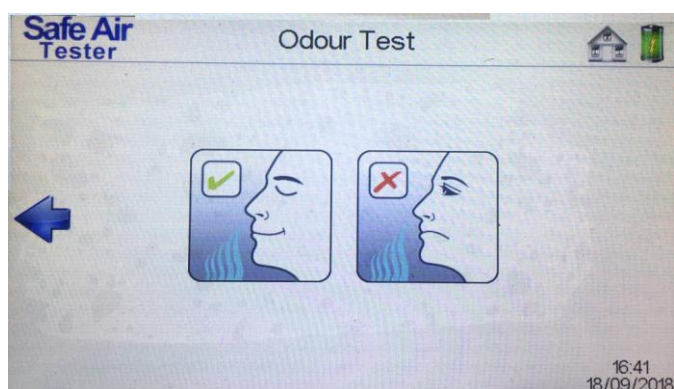
To carry out a test press the appropriate button.



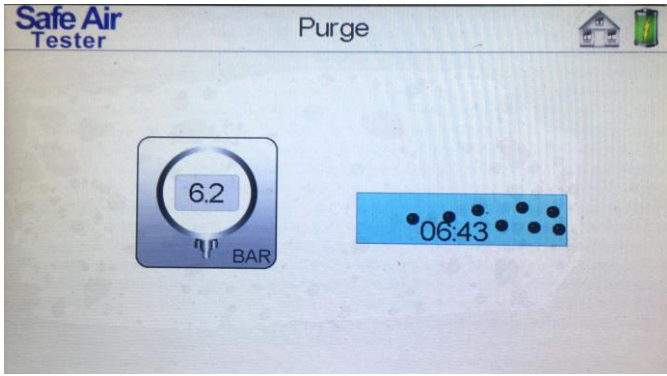
Ensure that the flow control valve is fully closed and then connect the F3002 high-pressure regulator assembly to the cylinder or charging hose to be tested, ensuring that the regulator has the correct type of connector for the cylinder. Connect the regulator hose coupling to both the regulator and the inlet of the Tester.

Open the cylinder valve and check that the cylinder is fully charged by reading the contents gauge on the regulator. (A partially discharged cylinder can give an incorrect water result.) The pressure displayed on the tester will be that of the regulated supply from the cylinder and must not exceed 10 bar. Press the button on the right hand side to proceed.

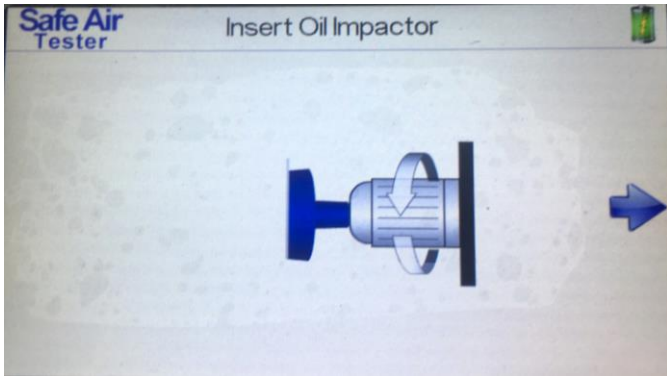
Note:- if the unit is over-pressurised it will automatically shut down and display an overpressure warning; it will then need to be returned to the manufacturer for checking and resetting.



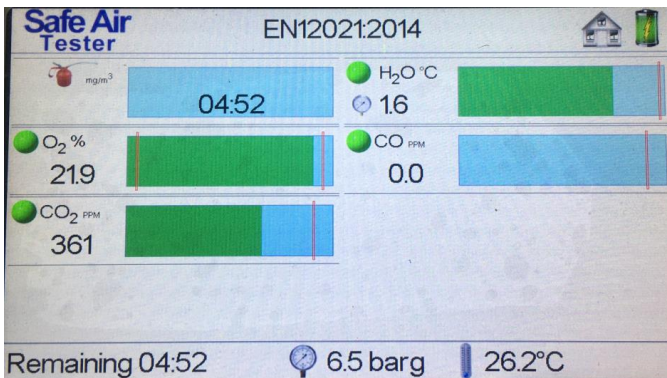
Carry out the odour test by gently opening the flow control valve and smelling the air exhausted from the sintered outlet, then close the valve. If there is a serious odour problem, fail the sample at this point of the test. Initiating flows of seriously contaminated air could result in damage to the instrument. If the odour test is satisfactory, press the 'pass' icon.



The instrument will now commence a 7-minute purge sequence, during which time an airflow will be passed through the test port and across the electronic cells. This clears contaminants from previous tests and ensures that a representative sample is being tested.



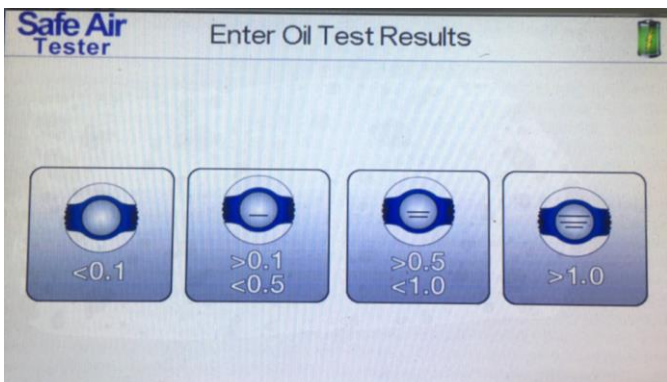
Once the purge has finished, the Draeger Impactor should be inserted into the test port and tightened firmly; ensure the Impactor has an intact protective seal. **This seal must remain in place for the duration of the test.** Press the arrow on the right hand side to start the test.



The test will now commence and the duration will be displayed as a countdown, together with pressure, flowrate, ambient temperature, carbon dioxide, carbon monoxide, oxygen and pressure dewpoint. If selected the VOC content will also be displayed.

The unit can be left until the test time has elapsed.

If the instrument detects that the dewpoint meter's rate of change is still too high (>0.2°C per minute) it will automatically continue the test until this stabilises (maximum test time 15 minutes).



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.

Safe Air Tester		19/09/18 12:09	
Standard:	EN12021:2014		
Location:	Dry5		
Category:	Charging Compressor		
Oil:	Impactor		
Ambient Temperature:	26°C	Test Point Volume:	0.0 L/min
Test Pressure:	6.7 Bar	System Pressure:	6.7 Bar
Oxygen (O ₂):	21.8 %	20.0 - 22.0 by volume	
Carbon Monoxide (CO):	0.1 PPM	5.0 ppm (5.0 mg/m ³) maximum	
Carbon Dioxide (CO ₂):	0 PPM	500 ppm (500 mg/m ³) maximum	
VOC:	0.0 PPM	User Defined	
Oil Mist:	<0.1	Less than 0.5 mg/m ³	
Water Vapour:	14 mg/m ³	Less than 50 mg/m ³	

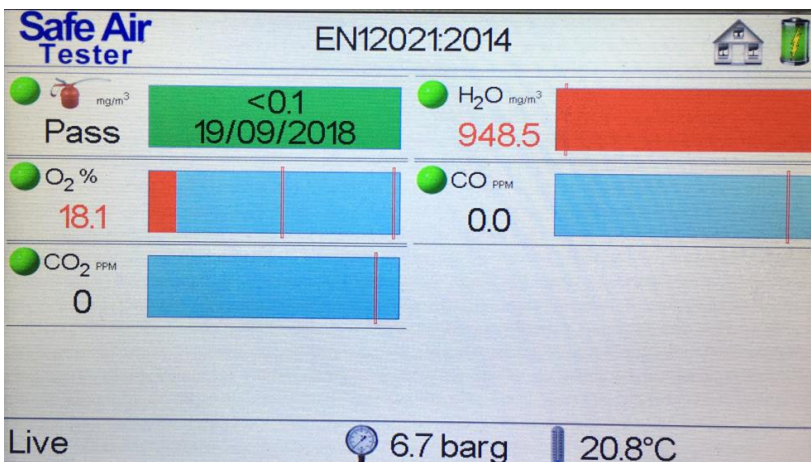
The “test complete” screen displays all the measurements recorded during the test. And automatically determines whether the test was a pass or fail against the standard displayed. For water content on high pressure tests both the measured value in mg/m³ and the atmospheric dewpoint are provided.

The test result is automatically recorded in the instrument’s memory, which can store up to 21 previous tests. To disconnect the Tester from the cylinder firstly turn off the cylinder valve, open the flow control valve until all the air is exhausted then close the valve. It is now safe to disconnect the connection hose and cylinder regulator.

4.3 Continuous air quality monitoring mode



The F8000 has a continuous air quality monitoring mode, to access this, from the home screen press the continuous test icon. The instrument will then display live sensor readings.



Whilst the instrument is operating in continuous air quality monitoring mode the readings will be datalogged at 5 minute intervals as a .CSV file. This file can be downloaded using the PC download software, see section 6.

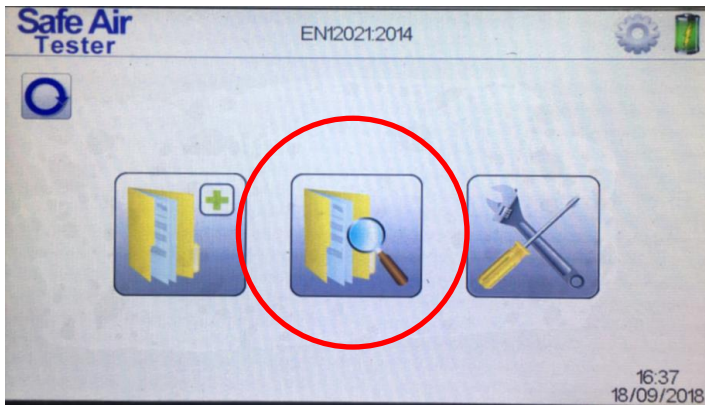
If you are running for an extended time in this operating mode we recommend you use the instrument on mains power. Additionally please note that the dewpoint sensor is specifically designed for accuracy over a short duration fixed test period. For systems with a dewpoint of $\geq -55^{\circ}\text{C}$ PDP the instrument will continue to provide accurate measurements.

However, if you are running a continuous test on sources drier than -55°C PDP there is the potential for the sensor to go outside its firmware range and may begin to show dewpoint measurements drier than the actual conditions.

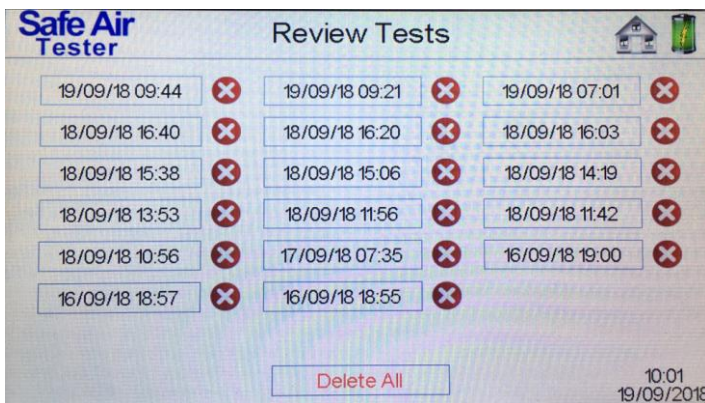


To exit this mode press the home screen button.

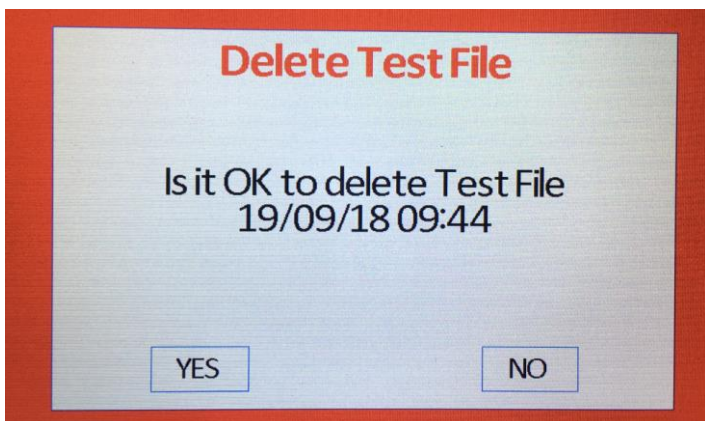
5. Reviewing Test Results



Once you have tests saved on the instrument the review test button will be available on the home screen. Press this button to access previous tests.



The F8000 can store up to 21 test results and each individual test is titled by the date and time when the test was completed.



Individually tests can be reviewed by clicking on them, or deleted by selecting their adjacent icon and then acknowledging on the confirmation screen.

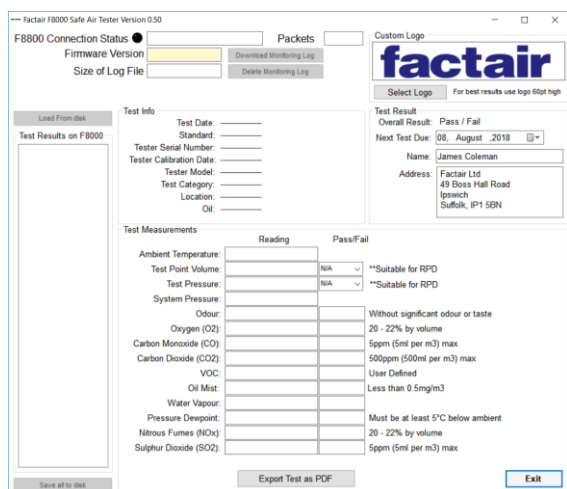
All tests can be deleted by pressing the Delete All icon and then again acknowledging on the confirmation screen.

Note: Once the instrument has saved 21 results you will unable to complete further tests until you have removed at least 1 of the stored tests.

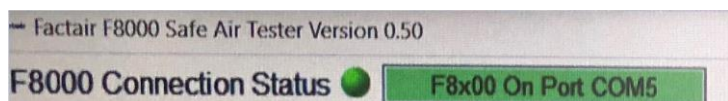
6. Exporting Test Results and PC Software.

To transfer test results from the F8000 Safe-Air Tester 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>

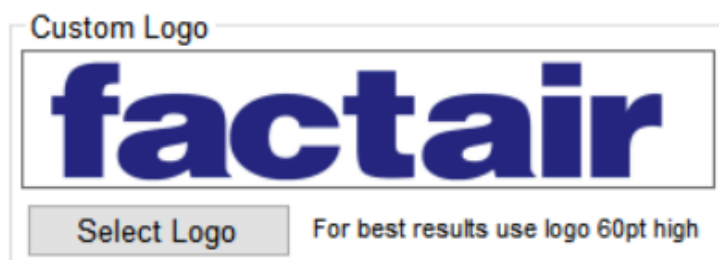


To transfer test results from the Safe-Air Tester to the PC software, turn in the F8000, connect the USB cable between the F8000 and your PC and open the Safe-Air Tester Results F8000 series software.

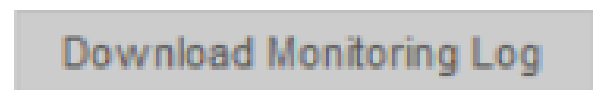


With the F8000 successfully connected the status light will turn green.

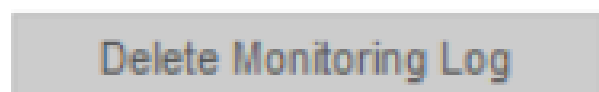
The unit will then automatically read the instruments firmware version, saved test results and the size of the data monitoring file.



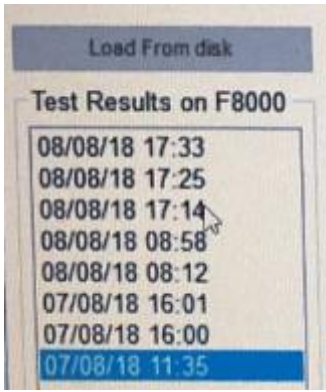
The software includes a feature to add your own logo to the saved test results.



If the instrument has been operated in the Continuous Air Quality Mode the datalog file can be downloaded by clicking on this button. Results are stored in a CSV format.



The monitoring log file on the F8000 SD card can also be deleted using this software.



Test results are stored in a date/time format and with the instrument connected to the software they are automatically read you can also then save them to another location and load them into the software.

Clicking on individual tests will display its full readings.

For each “Airline” test you will need to confirm whether the recorded test volume and pressure was sufficient for the RPD by selecting pass or fail as appropriate.

Note:- In addition there is an option of entering N/A against these categories. In this instance the resultant test certificate will only validate air quality and exclude validation of the pressure and flow.

Next Test Due: 29, August ,2018

Name: Test Engineer

Address: Factair Ltd
49 Boss Hall Road
Ipswich
Suffolk, IP1 5BN

Details on when the next test is due and the person/company who completed the test can be added.

Export Test as PDF

Test results can be exported into a PDF format.

When complete you can save the test result file and if required print off a certificate. In the UK, Health and Safety Executive guideline HSG53 recommends test results should be retained for a minimum of 5 years.

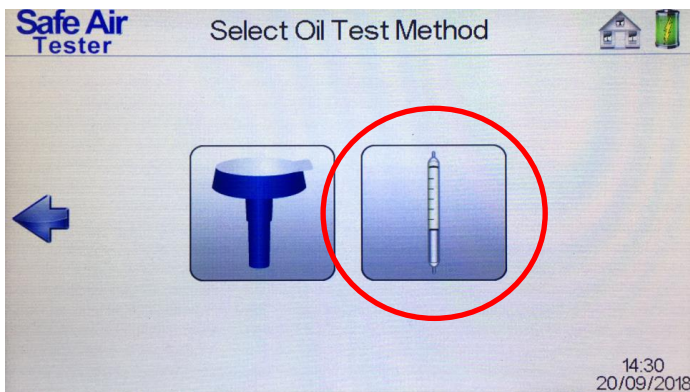
Appendix 1 - Using the test port for the Draeger oil tube

As well as the Draeger oil Impactor the F8000 test port can also be used with the Draeger oil tube.

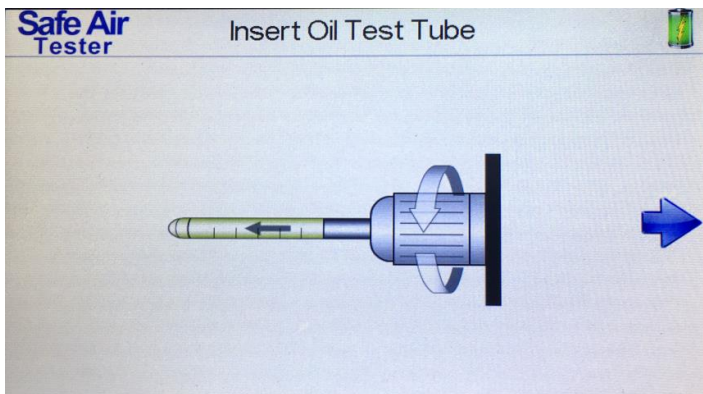
Test		Draeger ref.	Factair Part No:	Sensitivity
Oil (chemical reagent tube)		6728371	TUB0003	0.1 mg/m ³

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

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



To complete a tube test commence a new test and after you have input the test location details you will have the option to select a tube test as shown, press the button to proceed.

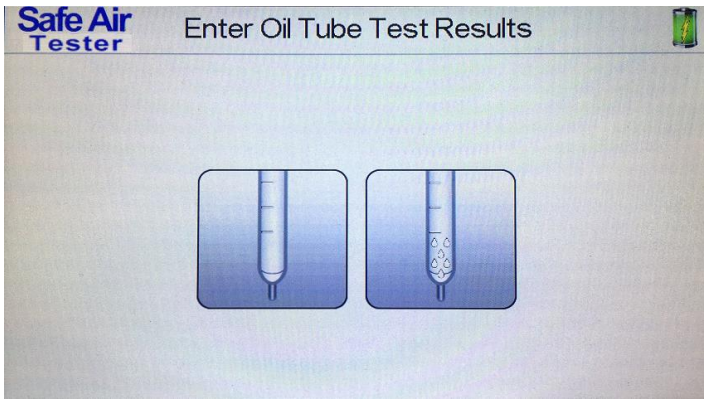


If you can determine with a high degree of certainty the specific compressor lubricant being used, then refer to the “test times” chart provided on Factair’s website marked for the F8000. If you have no knowledge of the type of compressor lubricant being used in the breathing-air system then Factair 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 memory.

Appendix 2 - Reading the Draeger 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 Draeger tube tip cutter

The F2187 Draeger Tube Tip Cutter is an optional extra not provided with the F8000 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.



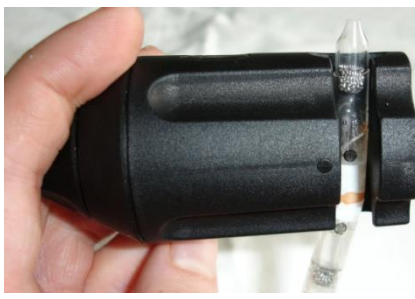
3. Repeat steps 1 and 2 with the other end of the tube

Using the tube tip cutter with the Draeger 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 Draeger-Tubes

When Draeger 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 Draeger 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 F8000 incorporates as standard a 0-40PPM 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 F8000 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

- Make sure the system flow control valve is closed after each test. Connecting an air supply to the Tester with the system flow regulator in the open position can damage the unit.
- Never connect to a non-regulated supply from an HP cylinder or compressor.
- Maximum inlet pressure to the Tester is 10 bar. If exposed to an overpressure the Tester will display an overpressure warning necessitating its return to the manufacturer for checking and resetting.
- When using the mains power supply, ensure that the Tester is switched off prior to connection and disconnection.
- 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.

Frequency of Breathing-Air Tests

Low Pressure Systems

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.

In the UK national standard EN12021 advises that samples should be taken and analysed at least every three months or more frequently if there has been a change in, or concerns relating to, the production process.

In the HSE guideline document Respiratory Equipment at Work (HSG53) it states you should base the frequency of such tests on a risk assessment, but again they should take place at least every three months, and more often when the quality of air cannot be assured to these levels.

For mobile breathing-air compressors, in the UK, COSHH stipulates that, the employer should ensure that wherever a compressor is located, the quality of air it supplies is not compromised by nearby contaminants. We strongly therefore recommend that for mobile compressors the air quality is tested whenever it is first moved into a new position or prevailing wind conditions change.

The final decision on frequency of test is the responsibility of the Employer and needs to not only reflect local legislation but also the task and frequency of use. It should be incorporated into their risk assessment and updated regularly to reflect results from ongoing breathing-air tests to maintain a robust control system.

High Pressure Systems

Whilst up to a 3 month periodicity for testing may be suitable for low pressure breathing-air systems, further consideration should be given to high pressure compressors where the life of filter elements are normally much shorter, typically 50 hours for a HP filter cartridge and this is reduced further in high ambient temperatures.

Accordingly for these systems we recommend that your risk assessment for testing HP systems should be based on the expected filter life and an air quality test should first be completed when new filter elements are fitted and then again when they reach 50% of their life based on the hours run usage. Subsequent tests would then be dependent on usage with a maximum interval between tests of 3 months.

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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