

# factair

F4000 & F4000ED

SAFE-AIR TESTER

OPERATING MANUAL



FAC QAM 093 Issue B 03/15



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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. The European Standard for breathing-air quality is EN12021, which should be referred to in conjunction with any overriding national standards.

The F4000, is designed primarily for use on airline systems up to 10bar but can also test high pressure charging systems when used in conjunction with the F3002 High Pressure Regulator.

The F4000 has a touch screen display and is supplied in a hard weatherproof case with storage provision for a wide range of accessories and equipment. It is primarily designed to be used from within the case; however the tester can also be removed and operated separately where space is at a premium.

The test is carried out using the Draeger Impactor for oil and chemical reagent tubes for carbon monoxide, carbon dioxide and water\*. These are supplied in packs of 10 per type and the chemical reagent tubes show the degree of contaminant present as a colour change to the crystals that they contain. The extent of this is read against the scale on the tube. For the Impactor the degree of oil contamination is displayed 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 working days providing there is no major damage that requires an extensive rebuild. *(Allow an extra 5 working days for calibration of ED versions.)*

*Note:- Please download all stored data before returning the Tester to Factair.*

### Temperature Parameters

Storage: -20/+50°C      Operating Range: -10/+45°C

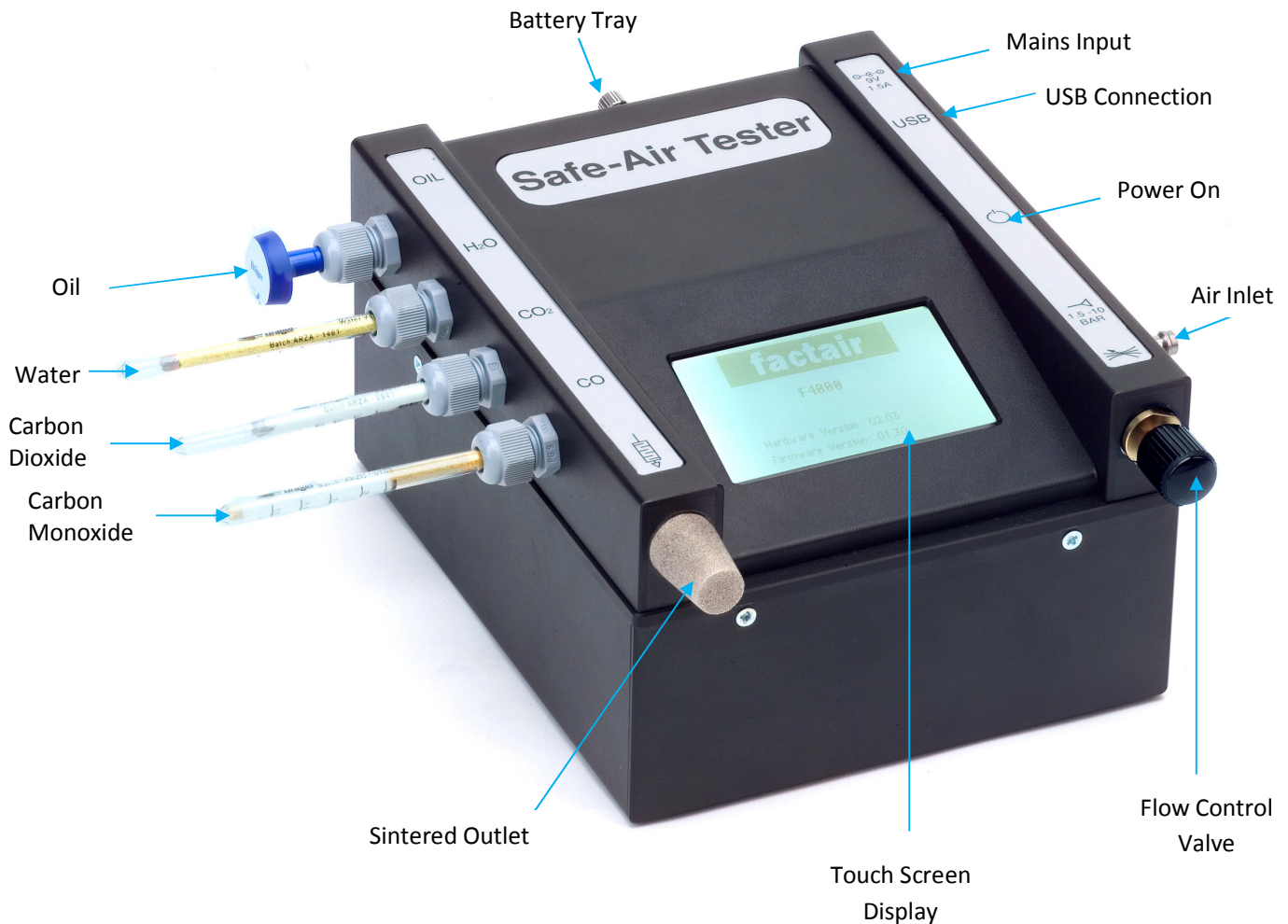
This tester is calibrated for the following approved reagent tubes/Impactor.

H <sub>2</sub> O (water-reagent tube)*	Draeger ref. 6728531
CO (carbon monoxide-reagent tube)	Draeger ref.6728511
CO <sub>2</sub> (carbon dioxide-reagent tube)	Draeger ref.6728521
Oil (Impactor) **	Draeger ref.8103560

*\*Note:- a water reagent tube is not required with the F4000ED which will automatically record the moisture and dewpoint readings*

*\*\*Note:- The tester can also be used with the old type Draeger reagent tube for oil, ref.6728371.  
(Refer to Appendix 2 at the rear of the manual for instructions.)*

**IMPORTANT – IT IS RECOMMENDED THAT YOUR SAFE-AIR TESTER IS RETURNED FOR  
RECALIBRATION AND SERVICING WITHIN 12 MONTHS FROM THE ISSUE DATE OF ITS CALIBRATION  
CERTIFICATE**



**Equipment List:**

- F4000 Safe-Air Tester
- Hard Case
- Mains Power Supply
- USB Memory Stick
- 6 x AA Alkaline Batteries
- Travel Container for used detector tubes
- Tube Tip Cutter
- F1946 Connection ¼ BSP inlet adaptor
- Stylus Pen

**Optional Extras**

F2216 Tube Kit Includes 10 of each: all Draeger Oil Impactor, H<sub>2</sub>O, CO & CO<sub>2</sub>

OR  
F1798 Tube Kit Includes 10 of each: all Draeger Oil, H<sub>2</sub>O, CO & CO<sub>2</sub>  
F3002 High-Pressure Regulator  
F2193 Connection adaptor terminating in a CEJN Plug  
F2194 Connection adaptor terminating in a Rectus Plug  
F2195 Connection adaptor terminating in an Instantair Plug

## 1. Pre-Use

Testers are supplied with 6 off size AA alkaline type batteries packed separately and stored underneath the tester within the case. Please note rechargeable batteries are not suitable for use with this instrument.

These must be installed prior to use unless it is the intention to power the unit solely from a mains supply. To install the batteries lift the tester out of its case, open the battery drawer at the rear of the unit and place the batteries inside.

*Note: - It is important to strictly observe polarity when fitting batteries and ensure that they are correctly located.*

If on start up the battery level is too low a warning will be displayed on the screen; the test cannot continue until the batteries are replaced or the unit is operated from the mains power supply. During use the battery condition is displayed on the screen.

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

## 2. Testing- Airline up to 10 bar

To carry out a test first switch on the machine by pressing and holding the green “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 model, serial number, date last calibrated and whether it is within the recommended calibration period. Press the arrow key to progress to the main menu.

To change the default settings, such as date, time, language, test standard and units of measure enter the configure tester screen. *See Appendix 1 to configure tester.*

To carry out a test press the “begin test” button, the unit will automatically calibrate the oxygen cell against the surrounding atmosphere; the unit therefore needs to be in a well ventilated area.

*Note:- If the temperature is greater than 40°C the calibration will operate for an extended period to stabilise the Oxygen cell.*

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

The unit has 4 test programmes available: Airline Systems up to 40 bar; High Pressure Systems up to and including 200bar; High Pressure Cylinders above 200bar and High Pressure Charging

Compressors. All of the high-pressure tests require the use of the F3002 regulator which has a DIN connector that can accept input pressures up to 300bar.

Select (Airline < 40 bar)

Select the appropriate water range: 50 to 2000 mg/m<sup>3</sup> is for standard airline systems with a fridge dryer or no dryer and 5 to 200 mg/m<sup>3</sup> is for systems incorporating desiccant dryers. Having selected the appropriate range press the arrow key.

Select oil determination method – Select (Impactor Test)

*Note:- For detector tube test refer to Appendix 2 at rear of manual.*

Confirm that all settings are correct by pressing the right arrow key. If settings are not correct, press the left arrow key and repeat the previous procedures.

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.

*\*Adaptors available.*

*F1946 – Safe-Air Tester to ¼”bsp male – Standard fitting supplied with Tester.*

*F2193 - Safe-Air Tester to CEJN coupling – Optional equipment*

*F2194 - Safe-Air Tester to Rectus coupling – Optional equipment*

*F2193 - Safe-Air Tester to Instantair coupling – Optional equipment*

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 (Set) button and 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 equipment. 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 RPE.

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

Carry out the odour test by smelling 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 through the tube ports could result in damage to the unit. If the odour test is satisfactory, press the 'pass' button.

The unit will now commence a 5-minute purge sequence, during which time an airflow will be passed through all 4 ports. This clears contaminants from previous tests and ensures that a representative sample is being tested.

Once the purge has finished, the Draeger tubes can be prepared for insertion. Remove both ends using the cutter provided. This ensures a clean cut is made and that glass fragments do not fall into the tube ports.

*See Appendix 3 covering the use of the Draeger tube tip cutter.*

As each tube is prepared it should be inserted into the relevant gland with the arrow pointing away from the unit and tightened firmly.

*Note:- Model F4000ED does not require a water tube as it will automatically record the water/dewpoint reading.*

The Impactor should be inserted into the oil port; ensure the Impactor has an intact protective seal. This seal must remain in place for the duration of the test.

Once the tubes and Impactor have been inserted, press the "OK" button to start the test. The duration will be displayed as a countdown, together with airline temperature, ambient temperature, oxygen content and pressure.

The status of the individual tests is indicated on the right-hand side of the display. The spinning egg timers indicate tests are active and ticks, tests are complete. The unit can be left until the test time has elapsed.

Once the test is complete close the flow control valve, the readings from the 3 tubes and Impactor can now be entered.

To enter the results press the corresponding button on the screen and key in via the numeric pad/button display, press the return arrow and repeat for all readings.

*Note:- Instructions on reading the detector tubes and Impactor, and their safe disposal, can be found in Appendix 4 at the back of the manual.*



Once all readings have been entered press the right arrow key, once you proceed beyond this point the results cannot be altered.

The “test complete” screen automatically determines whether the test was a pass or fail and displays all the measurements recorded during the test. If the test was a fail a flashing asterisk would be indicating those criteria which did not meet the standard.

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 F4000 automatically calculates the pressure dewpoint from the water content you previously entered and system pressure, it 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 10 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 use the return arrows to return to the main menu screen and press the X in the top right hand corner of the screen.

*Note: - The unit will automatically turn off after a few minutes if left unused at the main menu screen.*

### **3. Testing- High-pressure systems 200 & 300 bar**

To carry out a test first switch on the machine by pressing and holding the green “on” button, this is on the right hand side of the unit, for approximately 3 seconds. The display will show the model, serial number, date and time and whether it is within the recommended calibration period. Press the arrow key to progress to the main menu.

To change the default settings, such as date, time, language and units of measure enter the configure Tester screen.

To carry out a test press the “Begin Test” button, the unit will then automatically calibrate the oxygen cell against the surrounding atmosphere, the unit therefore needs to be in a well ventilated area.

*Note:- If the temperature is >40°C then the calibration will operate for an extended period to stabilise the oxygen cell.*

You now have the option of entering a description for the cylinder reference or test location; if you wish to use numbers press the “function” button. Push the right arrow button when you are ready to proceed.

The unit has 4 test programmes available: Airline Systems up to 40 bar; High-Pressure Systems up to and including 200bar; High-pressure Cylinders above 200bar and High-pressure Charging Compressors. All of the high-pressure tests require the use of the F3002 regulator which has a DIN connector that can accept input pressures up to 300bar.

*For cylinders, please ensure the test is carried out on a fully charged cylinder.*

Select either (High-pressure Cylinder < 200bar)  
(High-pressure Cylinder > 200bar)  
(High-pressure Charging Compressor)

Select oil determination method – Select (Impactor Test) press the arrow key.

*Note:- For detector tube test refer to Appendix 2 at rear of manual.*

Confirm that all settings are correct by pressing the right arrow key. If settings are not correct, press the left arrow key and repeat the previous procedures.

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.

*\*Note:- A Din to Din adaptor ref.F2158 is required to connect the F3002 high-pressure regulator to a charging hose.*

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.

*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 through the tube ports could result in damage to the unit. If the odour test is satisfactory press the arrow key to continue.

The unit will now commence a 5-minute purge sequence, during which time an airflow will be passed through all 4 ports. This clears contaminants from previous tests and ensures that a representative sample is being tested.

Once the purge has finished, the Draeger tubes can be prepared for insertion. Remove both ends using the cutter provided. This ensures a clean cut is made and that glass fragments do not fall into the tube ports.

*See Appendix 3 covering the use of the Draeger tube tip cutter.*

As each tube is prepared it should be inserted into the relevant gland with the arrow pointing away from the unit and tightened firmly.

*Note:- Model F4000ED does not require a water tube as it will automatically record the water/dewpoint reading.*

The Impactor should be inserted into the oil port; make sure the Impactor has an intact protective seal. This seal must remain in place for the duration of the test.

Once the tubes and Impactor have been inserted, press the “OK” button to start the test. The duration will be displayed as a countdown, together with ambient temperature, oxygen content and pressure.

The status of the individual tests is indicated on the right-hand side of the display. To indicate the tests are active the spinning egg timers are displayed, these change to ticks once each test is complete. The unit can be left until the test time has elapsed.

Once the test is complete, the readings from the 3 tubes and Impactor can now be entered.

To enter the results press the corresponding button on the screen and key in via the numeric pad/button display, press the return arrow and repeat for all readings.

*Note:- Instructions on reading detector tubes and Impactor, and their safe disposal, can be found in Appendix 4 at the back of the manual.*

Once all readings have been entered press the right arrow key, if you proceed beyond this point the results cannot be altered.

The test complete screen automatically determines whether the test was a pass or fail and displays all the measurements recorded during the test. If the test was a fail a flashing asterisk would be indicating those criteria which did not meet the standard. Additionally the F4000 automatically calculates the atmospheric dewpoint from the water content that has been entered.

This test result is automatically recorded in the instrument’s memory, which can store up to 10 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 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.

To turn off the Tester use the return arrows to return to the main menu screen and press the X in the top right-hand corner of the screen.

*Note:- The unit will automatically turn off after a few minutes if left unused at the main menu screen.*

#### 4. Exporting Test Results and PC Software.

To transfer test results from the Safe-Air Tester to the PC software, return to the main menu and press the “Export Tests” button. Insert the memory stick provided with the unit into the USB slot and press “Yes”.

*Note:- The system will not download duplicate tests, therefore ensure that any test which is already downloaded to the memory stick has been deleted from the tester.*

Once the instrument has completed exporting the results to the memory stick you can choose whether to delete the results from the Safe-Air Tester’s memory.

*Note:- Before you can import the results you must first install the software on your PC, a copy of the software is available on the memory stick and on our website.*

Making sure you have connected your memory stick to your PC, start the software and from the file down menu click on “Import F4000 test results file” and select the drive location for the memory stick. Multiple test results can be imported by left clicking on the first, holding the left shift key and clicking on the last record and then click “Open”. You will then be able to choose the location where you would like test results to be stored.

Individual test records can be opened from the file drop down menu by selecting “Open a test results file”. Once loaded further information can be added about the following:-

Test location.

Date next test due.

Test engineer and relevant address. *Note:- These details can be saved as default.*

For each “Airline” test you will need to confirm whether the recorded test volume and pressure was sufficient for the RPE 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.*

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.

*Note:- The logo stored within the Tester’s opening screen will automatically become the header logo on the test certificate.*

## **HELPFUL TIPS**

### **With detector tubes**

- Ensure that there are no fragments of glass in the tube glands 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 tubes 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.

### **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.
- If the Tester has been used on an excessively wet supply it can be purged dry by running a full test on a known dry source without any detector tubes fitted.
- When using the mains power supply, ensure that the Tester is switched off prior to connection and disconnection.

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

## Appendix 1

### Configure Tester

At this screen you have the following options available~

- |                   |   |
|-------------------|---|
| (Set Date)        | Enter the current date using the scroll keys.   |
| (Set Time)        | Enter the current time using the scroll keys. <i>Note:- It is a 24-hour clock.</i>                        |
| (Set Language)    | Select required language from the list available.   |
| (Set Units)       | Select pressure and temperature units from the list available.  |
| (Update oil list) | Updates stored oil test data for Draeger chemical reagent tubes from a new list stored on a memory stick. |
| (Select Standard) | Selects test standard from the list available.  |
| (Setup Tester)    | For manufacturer's use only.  |

## Appendix 2

### Using the F4000 and F4000ED with Draeger reagent type oil tube ref.6728371

From the “Select oil detection method” screen select (Detector Tube).

The oil setting defaults to 15 minutes, if you have no knowledge of the type of compressor lubricant being used in the breathing-air system then accept default time and continue to the next screen.

If you can determine with a high degree of certainty the specific compressor lubricant being used, then select (change oil).

The F4000 and F4000ED has within its memory the test data for in excess of 400 different oils, these can then be selected and the unit will automatically set the correct test parameters for that specific oil. The “Select Oil” screen provides 4 options for selecting specific oil settings.

- (List) - Contains test data on all oils
- (Favourite) - To create a list of regularly used oils
- (Custom) - To create a specific test currently not available in (List)
- (Last Used) - Defaults to last used oil test.

Using (List)

From “Select Oil” screen press (List)

The “Oil list” screen has 2 options

- (Filter by Supplier) - Using scroll buttons find and select all oils from a specific supplier
- (Show all Oils) - Lists all oils by supplier then type reference.

From either of the above methods select the appropriate oil then press right arrow to pass to confirmation screen, continue as per instruction in the main manual.

To create a “Favourite” oil list from “Select Oil “menu select (Favourite)

Use the (+) button to add new oils as described above and use the (–) button to remove oils from the favourite list.

To create a custom oil test from the “select oil” menu select (Custom)

You will then have the following options~

- (Enter name) - Enable name and type of oil to be entered
- (Enter Time) - Enter test time for new oil (Check with Factair Technical for advice)
- (Add to Favourites) - Enables new oil to be added to favourites list.



## Appendix 3

### Draeger Tube Tip Cutter

The F2187 is especially designed to prevent glass from falling out of the opener by accident. The reservoir for the broken-off tips is easy to empty.

#### Instructions

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



#### Following information is only for EU-member states:

The use of the symbol indicates that this product may not be treated as household waste. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. For more detailed information about recycling of this product, please contact your local city office, your household waste disposal service or the shop where you purchased the product.

## Appendix 4

### Reading the Draeger Oil Impactor and Chemical Reagent Tubes

#### 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/m<sup>3</sup> the Impactor has a limit of detection of 0.05 mg/m<sup>3</sup>. The Impactor can detect all mineral and synthetic oils, 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/m<sup>3</sup>, the screen will remain blank. For tests above that read as follows:

The bottom line represents an oil concentration of 0.1 mg/m<sup>3</sup>. When the oil deposited forms a continuous line then the concentration is in excess of 0.1 mg/m<sup>3</sup>. The middle line represents a concentration of 0.5 mg/m<sup>3</sup>, again when the oil deposited forms a continuous line the concentration is in excess of 0.5 mg/m<sup>3</sup>. The top line represents a concentration of 1.0 mg/m<sup>3</sup>, again when this forms a continuous line the concentration is in excess of 1.0 mg/m<sup>3</sup>.



Pass -  
greater  
than  
0.05mg/m<sup>3</sup>  
but less  
than  
0.1mg/m<sup>3</sup>



Pass -  
greater  
than  
0.1mg/m<sup>3</sup>  
but less  
than  
0.5mg/m<sup>3</sup>



Fail - greater  
than  
0.5mg/m<sup>3</sup>  
but less than  
1.0mg/m<sup>3</sup>



Fail -  
greater  
than  
1.0mg/m<sup>3</sup>

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 (67 28371)

**REQUIREMENT** - THE AIR SHOULD HAVE A MAXIMUM OIL CONTENT OF 0.5 MG/M<sup>3</sup> AND SHOULD BE WITHOUT SIGNIFICANT ODOUR OR TASTE.

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.



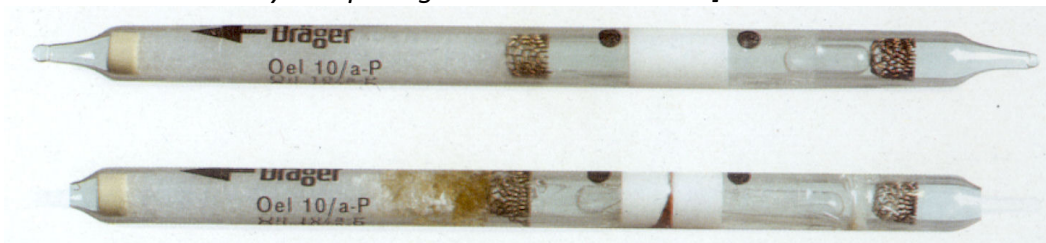
3. Place your used detector tubes in the F2154 Travel Container, until they can be disposed of properly as "sharps" or glass.



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].



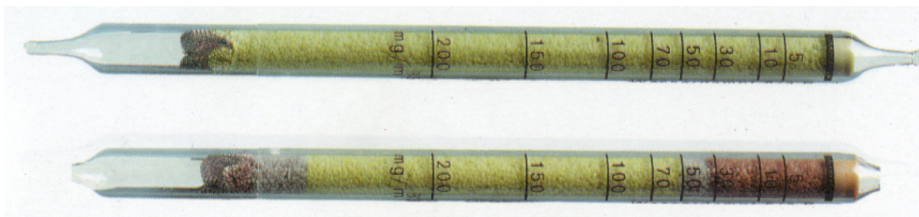


## Water (H<sub>2</sub>O) (67 28531)

<b>REQUIREMENTS</b>	<ul style="list-style-type: none"><li>- FOR AIRLINES BELOW 40 BAR THE PRESSURE DEWPOINT TO BE 5°C BELOW THE LIKELY LOWEST TEMPERATURE. WHERE THE LIKELY LOWEST TEMPERATURE IS NOT KNOWN THE PRESSURE DEWPOINT SHOULD NOT EXCEED -11°C.</li><li>- FOR HIGH-PRESSURE CYLINDERS THE FOLLOWING UPPER LIMITS APPLY: - 40 TO 200 BAR = 50MG/M<sup>3</sup>, ABOVE 200BAR = 35MG/M<sup>3</sup></li><li>- FOR HIGH-PRESSURE CYLINDER CHARGING COMPRESSORS THE UPPER LIMIT = 25MG/M<sup>3</sup></li></ul>
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A reddish brown discoloration will show the extent of the water content, which is read from the scale printed on the tube in mg/m<sup>3</sup>.

When using the 50-2000 range setting, the tube reading is multiplied by a factor of 10, i.e. a tube reading of 150mg/m<sup>3</sup> becomes 1500mg/m<sup>3</sup>. To establish the pressure dewpoint refer to the graph on the back of the Safe-Air Tester Result Sheet.



## Carbon Dioxide (CO<sub>2</sub>) (67 28521)

**REQUIREMENT** - MAXIMUM READING OF 500 PPM.

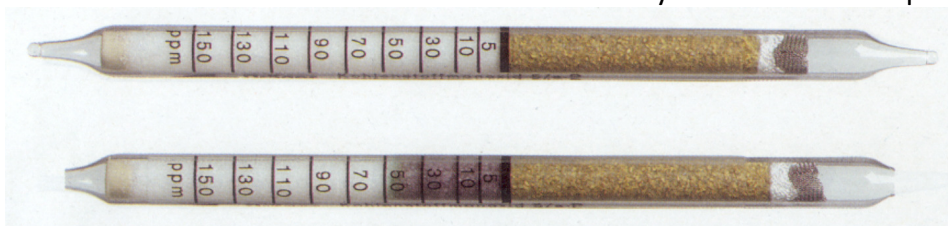
The media in the detector tube will discolour to show the presence of carbon dioxide. The total length of the discoloration read from the printed scale at that point is a measure of the concentration in parts per million.



## Carbon Monoxide (CO) (67 28511)

**REQUIREMENT** - MAXIMUM READING OF 5 PPM.

The media will discolour to show the presence of carbon monoxide in the air sample. The total length of the discoloration is the measure of concentration read directly from the scale in parts per million.



## **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.

*OR*

Place the tubes in a “sharps” or glass bin wearing protective gloves and safety spectacles. Dispose of the container via 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 5 - 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*
<b>Odour</b>	The gas shall be free from unsatisfactory odour or taste.	None (No pronounced odour)	No objectionable or nauseous odour
<b>Oxygen</b>	(21 ± 1)%	19.5% - 23.5%	19.5% - 22%
<b>Carbon Dioxide</b>	≤ 500 PPM	≤ 1000 PPM	≤ 800 PPM
<b>Carbon Monoxide</b>	≤ 5 PPM	≤ 10 PPM	≤ 10 PPM
<b>Oil</b>	≤ 0.5 mg/m <sup>3</sup>	≤ 5 mg/m <sup>3</sup>	≤ 1 mg/m <sup>3</sup>
<b>Water Airline &lt;40Bar</b>	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.	
<b>Water High Pressure</b>	40 to 200 bar ≤50 mg/m <sup>3</sup> >200 bar ≤35 mg/m <sup>3</sup> HP Charging Comp ≤25 mg/m <sup>3</sup>		Contain not more than 100 mg/m <sup>3</sup> 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'ts

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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