

# Operation Manual

## Travelpanel 50R

### Portable Breathing Air Purification and Regulation System



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**Travel Panel 50R  
Operations Manual  
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by  
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## Introduction

The Travelpanel 50R system is designed for the purification and regulation of compressed respirable breathing air. It is designed to remove water, oil, and particulate contaminants as small as 0.3 microns in diameter. An activated carbon filter is used to remove nuisance odors and other organic contaminants. An accurate, dependable carbon monoxide monitor is used to activate loud audible and visual alarms whenever the concentration exceeds 10 PPM carbon monoxide, the OSHA limit (29 CFR 1910.134) for Grade D respirable breathing air.

The Travelpanel 50R is designed to provide up to 50 CFM (cubic feet per minute) of purified air. The Travelpanel 50R may be used to supply respirable breathing air for up to four air-line respirator users at the same time.

**Note: The combined air consumption of all respirators supplied by a single Travelpanel must not exceed a maximum of 50 CFM. Consult the respirator's owner's manual to determine specific CFM requirements.**

A single regulator is used to adjust the outlet pressure for all four quick-connect air-line fittings. The pressure may be set to anywhere between 0 and 125 PSI (pounds per square inch).

**⚠WARNING** The Travelpanel 50R may only be used together with compressors which are rated for use as a breathing air source.

Please see Appendix A for a more detailed discussion of compressor limitations and commonly encountered breathing air contaminants.

## Section 1: How the Travelpanel 50R works

The Travelpanel 50R is designed to purify breathing air in three stages. Inlet air is first passed through a pre-filter, then a coalescing filter, and finally an activated carbon "adsorber" filter prior to use. After the inlet air has been filtered it is regulated to meet the design requirements of the specific respirators being used. A carbon monoxide monitor continuously samples the purified air to insure that the CO concentration does not exceed the maximum concentration for Grade D respirable breathing air. If the carbon monoxide concentration rises above 10 PPM loud audible and visual alarms are activated, notifying respirator wearers that their compressed air source is contaminated, and no longer meets the minimum requirements for respirable Grade D breathing air.

### 1.1 Pre-filter assembly

Inlet air is first directed through a pre-filter assembly. The pre-filter element is designed to intercept most particulate contaminants. Particulate contaminants larger than 5 microns in diameter should be removed during this phase of filtration. The pre-filter assembly also includes an integral auto-draining water trap. Inlet vanes cause the air to spin as it enters the pre-filter "bell." As the air spins water and oil are centrifugally separated from the air-stream. Liquids coalesce on the inner surface of the pre-filter housing and flow to the bottom of the bell. When sufficient fluid has accumulated in the bottom of the housing a "float" causes the water trap valve to open and the accumulated fluids to drain.

**Caution: The pre-filter and coalescing filter housings should be examined regularly during use. Make sure accumulated liquids are properly drained. In some cases it may be necessary to relieve pressure in the system by disconnecting the Travelpanel from the compressed air source before the auto-drain can function properly.**

## 1.2 Coalescing filter

The inlet air is directed next through a coalescing filter. Most of the water and other liquids present should have been removed as the air passed through the pre-filter. This filter is equipped with a manual drain.

Pressing the manual drain stem at the bottom of the coalescing filter housing opens the drain, and allows accumulated fluids to be vented.

The coalescing filter is designed to remove 99.9 % of all aerosol particulates (including water and oil droplets as well as dusts and solids) greater than 0.3 microns in diameter.

## 1.3 Activated carbon "adsorber" filter

The activated carbon filter is designed to finish the purification process. The "adsorber" filter removes nuisance odors as well as any other remaining organic contaminants. Any remaining particulates are removed during this phase of filtration.

## 1.4 Pressure regulation

The Travelpanel may be used to provide air for up to four respirator wearers. A single regulator is used to adjust the outlet pressure for all four quick connect air-line fittings. The pressure may be set anywhere between 0 and (the NIOSH maximum) 125 PSI (pounds per square inch).

**Note: Since a single regulator is used to govern the outlet pressure for all four quick connect air-line fittings, it is not possible to use hose length and respirator combinations which require different pressure settings for different outlets.**

## 1.5 Carbon monoxide monitor

Travelpanel filtration is not designed to remove carbon monoxide. A carbon monoxide monitor is provided to continuously sample the purified air to insure that the concentration of CO does not exceed the permissible limit for Grade D breathing air.

A threaded brass flow restrictor is used to provide a constant flow of purified air

(0.5 liters per minute) from the outlet manifold. The (now) low pressure sample is directed down a short length of tube to a gasketed cup attached to the sensor housing. Carbon monoxide readings are continuously displayed on the instrument LCD (liquid crystal display).

## 1.6 Travelpanel 50R Component Locations

- |  |   |
|--|---|
| (1) 61-030 Pre-filter assembly with auto-drain     | (16) 61-033 Coalescing filter element         |
| (2) 61-031 Coalescing filter                       | (17) 61-009 Charcoal filter element           |
| (3) 61-006 Charcoal filter                         | (18) 17-007 Charcoal filter O-ring            |
| (4) 12-005 Pressure regulator                      | (19) Filter bowls                             |
| (5) 12-006 Air pressure gauge                      | (20) 53-035 Automatic pre-filter drain tubing |
| (6) Pressure regulator adjustment knob             | (21) 61-022 Coalescing filter manual drain    |
| (7) Regulator lock-nut                             | (22) Charcoal filter manual drain             |
| (8) 12-004 Relief valve (125 PSI)                  | (23) Hose fitting                             |
| (9) 05-414 Brass street elbow                      | (24) Filter change indicator                  |
| (10) 55-017 Four-outlet manifold                   | (25) High-Intensity alarm                     |
| (11) 12-003 Flow restrictor                        | (26) Alarm test push-button                   |
| (12) 53-011 Neoprene tubing, 5/16 o.d. x 3/16 i.d. | (27) CO monitor external Alarm relay jack     |
| (13) 55-020 Airflow adaptor                        | (28) Inlet housing coupling                   |
| (14) 3300TP CO monitor                             | (29) Outlet hose couplings                    |
| (15) 61-032 Pre-filter element                     | (30) High intensity alarm battery housing.    |

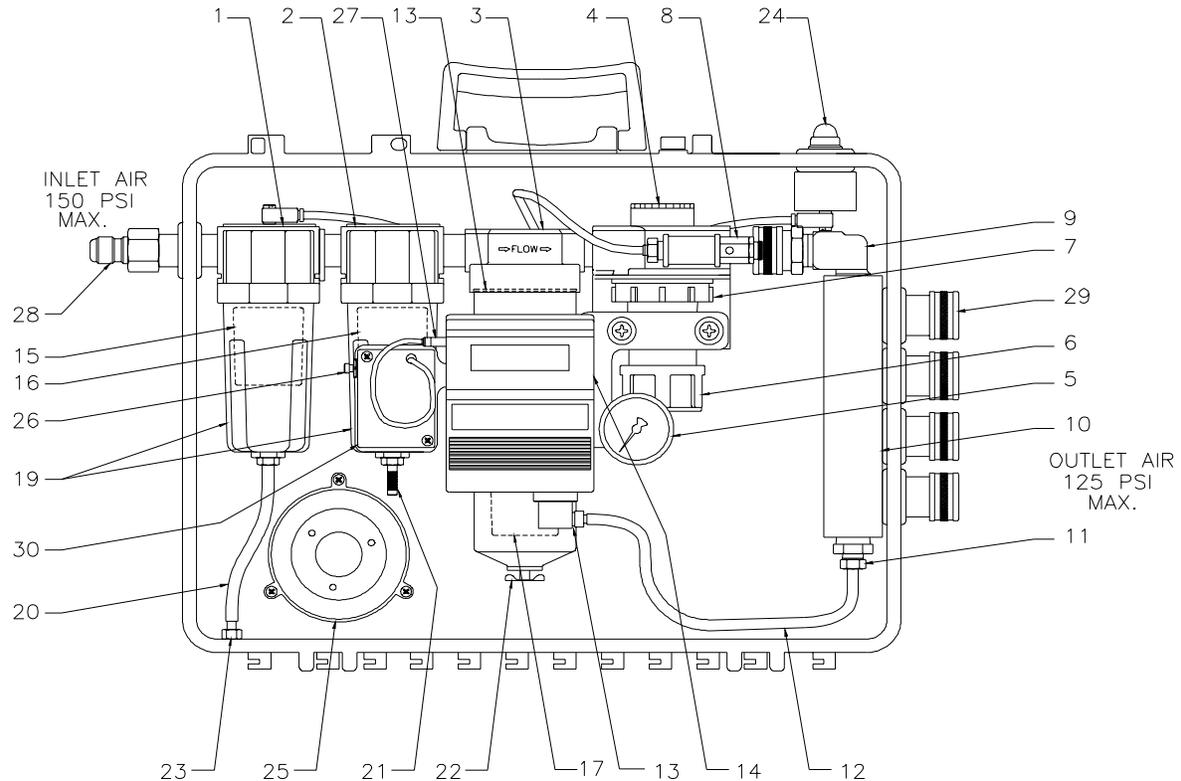


Figure 1.6.

## Section 2 Travelpanel 50R Set-Up

### 2.1 Daily safety procedures

**⚠WARNING** The Travelpanel 50R must be checked for proper function prior to each day's use.

The following sections contain a number of precautionary procedures which should be followed every day to ensure maximum worker safety.

#### 2.1.1 Carbon monoxide monitor checks

- 1) Turn the unit on and wait a few seconds for the readings to stabilize
- 2) Make sure that the "LO BATT" message is not showing on the left side of the liquid crystal display. If this message is displayed, replace the expended battery with a new 9-volt alkaline battery.
- 3) Perform the fresh-air zero procedure (**see section 4.2.1.**)
- 4) Verify accuracy by exposing the sensor to known concentration "span" gas. Adjust the sensor if necessary (**see section 4.2.2.**)

#### 2.1.2 Filter preparation checks

Be sure that the manual drains on the coalescing and charcoal filters are closed. Use the following procedures to determine that the filters are clean enough for continued operation.

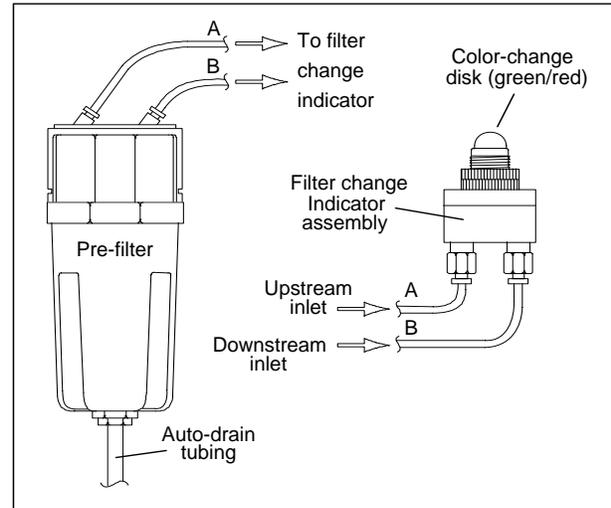
##### 2.1.2.1 Pre-filter replacement check

The best indication that the pre-filter element must be replaced is the status of the filter change indicator.

**Note:** The status of the filter change indicator may only be checked while the Travelpanel is in operation and connected to a source of compressed air.

The filter change indicator is designed to measure the pressure before and after the pre-filter element. When the pre-filter is clean, compressed air moves through the filter with little resistance. Over time the contaminants which are removed

from the air-stream build up on the surface of the filter. This build up makes it harder for air to pass through the filter. The increased resistance produces a pressure drop "downstream" from the pre-filter. When the pressure drop exceeds 15 PSI the indicator disc changes color from green to red, and the pre-filter element must be replaced.



**Figure 2.1. Filter Change Indicator**

It is also possible to determine the need for filter replacement by checking their appearance visually. In the course of normal operation, Travelpanel filters gradually become discolored. The degree of discoloration depends both on the nature and the quantity of the contaminants present in the air being filtered. The most common contaminant is oil from oil-lubricated breathing air compressors. When the pre-filter becomes seriously discolored by oil, (a dark golden color), it is another indication that the pre-filter element is not suitable for operation (regardless of input and output pressure differential). Replace the pre-filter element whenever such discoloration is noted. (**See section 4.1.1. for pre-filter replacement procedures**)

##### 2.1.2.2 Coalescing filter replacement check

As a general rule, the coalescing filter should be replaced every third time the pre-filter element is replaced. However, it is possible that the coalescing filter should be replaced at a more frequent interval. If the pre-filter is unable to catch

the bulk of oil contaminating the input air, the coalescing filter will become discolored over time. The more rapidly the coalescing filter begins to look contaminated, the more frequently the filter element needs to be replaced. (See section 4.1.2. for coalescing filter replacement procedures.)

### 2.1.2.3 Activated carbon "adsorber" filter replacement check

As a general rule, the carbon filter should be replaced every third time the pre-filter element is replaced. At times however, the charcoal filter also may require more frequent replacement. Odors present in the Travelpanel output air are an indication that the activated carbon filter is not performing adequately, and that the filter element requires replacement. (See section 4.1.3. for activated carbon filter replacement procedures.)

### 2.1.3 High intensity alarm test

The Travelpanel 50 design includes a high intensity audible alarm with a built in test button. The alarm-test push-button is located on the alarm battery housing. (The push-button is component # 26 on Figure 1.6) Push the button to verify alarm operation.

**⚠CAUTION** The Travelpanel 50R high intensity alarm is very loud (110 dBA at 6 inches). To avoid risk of hearing damage, cover the alarm bell before depressing the alarm-test push-button.

## 2.2 Inlet air attachment

**Maximum allowable inlet pressure is 125 PSI.**

Travelpanel 50R standard accessories include a quick-disconnect coupler designed to screw into the user's inlet air hose. To connect the Travelpanel to the desired air source, attach the coupler to a suitable respirable breathing air inlet hose, pull back the outer ring on the coupler and slide the coupler onto the inlet air fitting. Make sure that the coupler outer ring snaps back into place after attachment. To disconnect the coupler, pull back the outer ring on the coupler and slide the coupler off the

fitting.

**Note: Be sure that the air source has enough capacity to supply the required CFM output for the respirators that will be used at the pressure that is required.**

## 2.3 Respirator attachment

The Travelpanel 50R may be used to supply respirable breathing air for up to four air-line respirator users at the same time.

**Note: The combined air consumption of all respirators supplied by a single Travelpanel 50R must not exceed a maximum of 50 CFM. Consult the respirator owner's manual to determine specific CFM requirements.**

The Travelpanel 50R design includes four quick connect outlet fittings used for respirator air-line attachment.

Travelpanels may be ordered from the factory equipped with either Hansen or Schraeder type outlet fittings. The fittings selected should be a function of the type of connections required by the respirators and air-line hose that will be used.

## Section 3: Travelpanel 50R Operation

### 3.1 Start-up

Turn on the carbon monoxide monitor.

**⚠️WARNING** The accuracy of Biosystems Model 3300 TP Carbon Monoxide detector inside the TravelPanel 50R should be checked periodically with known concentration calibration gas. Failure to check accuracy can lead to inaccurate and potentially dangerous readings.

Connect the Travelpanel 50R to the inlet air source. Test the high intensity audible alarm. Turn the inlet air on and adjust the Travelpanel manifold pressure to the respirator manufacturer's recommended output. **It is best to attach at least one respirator to the Travelpanel and adjust the regulator while actually flowing air.**

The pressure-regulator adjustment knob is the black plastic ring on the bottom of the pressure regulator (component #6 on diagram 1.6). Turn clockwise to increase pressure, or counter-clockwise to decrease pressure.

**Note: The manifold pressure may not exceed the NIOSH specified maximum of 125 PSI. Excess air is automatically vented by means of the self-resetting pressure relief valve whenever the pressure exceeds this value. Always keep the regulator pressure set below 125 PSI.**

In the event of a pressure relief valve malfunction, (i.e., if manifold pressure exceeds 125 PSI and the pressure relief valve fails to automatically activate,) then the unit is not safe for operation. Turn manifold pressure all the way down and shut off the inlet air. Bleed off remaining pressure through the manual drain on the bottom of the coalescing filter by pressing on the manual drain stem.

When pressure is fully released, disconnect air inlet and outlet hoses. In the event of a relief valve malfunction, the unit must be sent back to the factory for servicing. Contact Biosystems'

instrument service department.

### 3.2 Carbon monoxide monitoring

**⚠️WARNING** The Travelpanel monitors, but does not remove, carbon monoxide from breathing air.

The Travelpanel design includes a built-in carbon monoxide (CO) monitor that continuously samples the outlet manifold air. The OSHA (29 CFR 1910.134) limit for carbon monoxide in respirable Grade D breathing air is 10 PPM (parts per million). Travelpanel 50R alarms are activated whenever the concentration exceeds this concentration. Possible reasons for an alarm include, but are not limited to:

- 1) Compressor malfunction (for instance carbon monoxide can be produced when lubricant oil is burned or "smoked" due to compressor overheating)
- 2) Inlet air to compressor becomes contaminated (for instance, the compressor begins to suck vehicle exhaust into the system).
- 3) Other contaminant(s) affecting the carbon monoxide sensor. The sensor used in the Travelpanel is designed to respond to a number of potential contaminants besides carbon monoxide. Possibilities include (but are not limited to): organic vapors, hydrogen, sulfur-containing gases, unsaturated hydrocarbons, nitric oxide, and nitrogen dioxide.

**If the CO monitor alarm is activated, stop breathing Travelpanel 50R-supplied air as quickly as possible, and investigate the source of CO contamination. Do not resume Travelpanel operation until CO contamination is eliminated.**

### 3.3 Shut-down procedure

When finished with the Travelpanel, shut off inlet air and bleed off excess pressure before disconnecting inlet or outlet hoses. Excess pressure is released by pressing on the manual drain stem on

the coalescing filter. Disconnect inlet air and/or respirators if necessary. Turn off the carbon monoxide monitor.

## **Section 4: Maintenance Procedures**

Maintenance on the Travelpanel 50R, original Travelpanel, and Airpanel 50 wall mounted purification panels consists of changing the filters, calibrating the CO monitor, checking the CO monitor alarm set-point, and replacing the CO monitor battery. Calibration kits and replacement filters are available from Biosystems. The filter maintenance kit (P/N 6015) contains replacement o-rings, three pre-filter elements, one coalescing filter element, and charcoal element. The CO monitor calibration kit (P/N 6020) contains one cylinder (103 liters) of 50 PPM carbon monoxide calibration gas, one 1.0 LPM (liter per minute) fixed flow rate regulator, tubing, fittings, and foam-lined carrying case.

### **4.1 Filter Change Procedures**

#### **4.1.1 Pre-filter element replacement**

- 1) Turn filter-housing bowl counter-clockwise approximately 1/4 of a rotation, until unlocked.
- 2) Remove the bowl from the filter-housing body. Replace the o-ring at the top of the bowl, making sure that the o-ring seats evenly.
- 3) Unscrew the white plastic spinner from the filter attachment and slide off the used filter element.
- 4) Replace the used filter with a new pre-filter element and screw the spinner back into place.
- 5) Put the filter-housing bowl back into the body and turn 1/4 of a rotation clockwise until the filter-housing assembly is locked.

#### **4.1.2 Coalescing filter replacement**

- 1) Turn filter bowl counter-clockwise approximately 1/4 of a rotation, until unlocked.
- 2) Remove the bowl from the filter body. Replace the o-ring at the top of the bowl, making sure that the o-ring seats evenly.

- 3) Unscrew the particle filter from the filter-housing body and discard. Screw in the replacement filter.
- 4) Put the filter-housing bowl back into the body and turn 1/4 rotation clockwise until the filter-housing assembly is locked.

#### 4.1.3 Activated carbon "adsorber" filter replacement

- 1) Unscrew and remove the filter-housing bowl by turning counter-clockwise.
- 2) Unscrew and remove the black securing ring from the bottom of the filter element and slide the used filter off of the metal filter securing rod.
- 3) Replace the O-ring around the inside of the filter-housing body, making sure that the O-ring seats evenly.
- 4) Replace the filter element and screw the black securing ring back into place.
- 5) Screw the filter-housing bowl back into place.

### 4.2 Carbon monoxide monitor maintenance

**⚠WARNING** The accuracy of Biosystems Model 3300 TP Carbon Monoxide detector inside the TravelPanel 50R should be checked periodically with known concentration calibration gas. Failure to check accuracy can lead to inaccurate and potentially dangerous readings.

#### 4.2.1 Calibration procedures

The Travelpanel 50R design includes a Biosystems Model 3300 TP carbon monoxide monitor. The carbon monoxide monitor has been designed for easy calibration. Calibration is a simple two-step procedure. In the first step the instrument is "zeroed" while the sensor in the carbon monoxide monitor is exposed to fresh air. In the second step the sensor is adjusted while actually exposed to known concentration "span" calibration gas.

Calibration adjustments are made by using the "zero" and "span" pots located

on the front of the monitor. A small flat blade type "jewelers" screwdriver is used to adjust the potentiometers. The zero pot is used for making adjustments in fresh air only. The span pot is used to adjust the sensor while exposed to known concentration test gas.

#### 4.2.1.1 Fresh air zero procedure

- 1) Remove the airflow adaptor from the Model 3300 sensor housing. **Pull out--do not twist!**

**Caution: Twisting the adaptor in the sensor housing may cause the sensor to rotate and become disconnected from its leads, rendering the monitor inoperable.**

- 2) Turn the instrument on in a fresh air environment and wait for the readings to stabilize (approximately 90 seconds.)
- 3) The display should read 000 PPM while the sensor is exposed to fresh air. If the reading needs to be adjusted, turn the zero pot clockwise to raise, or counter-clockwise to lower the value.

**Make sure the air is fresh! Do not smoke or engage in other activities which may expose the sensor to carbon monoxide while adjusting the instrument zero-setting**

- 4) When the zero-reading is correct, reattach the airflow adaptor to the sensor housing. **Press in - do not twist--the airflow adaptor.** Make sure that a proper seal is attained and that the adaptor is snug in the sensor housing socket.

#### 4.2.1.2 Span calibration procedure

- 1) Attach the regulator to the cylinder of calibration gas. Make sure all threads and seating surfaces of the regulator are clean. Attach a short length of tubing to the regulator.
- 2) The airflow adaptor should still be attached to the carbon monoxide sensor housing. Re-attach the adaptor to the sensor if necessary. Connect the adaptor nipple to the tubing connected to the regulator and cylinder.

- 3) Open the regulator valve to obtain a flow of 1.0 liters per minute.
- 4) Wait for the readings to stabilize (it may take thirty or forty seconds).
- 5) After the numbers have stopped changing adjust the span pot until the display reading matches the concentration printed on the cylinder of calibration gas. (Turn the pot clockwise to raise the value, or counter-clockwise to lower the value.)
- 6) When the span reading matches the level shown on the calibration gas bottle, turn the regulator off, and disconnect the airflow adaptor from the sensor housing, exposing the sensor to fresh air. The display reading should drop to 000 PPM within 90 seconds. If the zero-reading is not accurate, repeat the zero and span calibration procedure.
- 7) Reattach the airflow adaptor to the sensor housing. **Press in - do not twist - the airflow adaptor.** Re-attach the neoprene tubing connecting the adaptor to the outlet manifold.

#### 4.2.2 Carbon monoxide monitor alarm set-points

**Note: U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Grade D respirable breathing air specifications may be subject to change. Travelpanel 50R alarm set-points should never be adjusted to a value higher than the current Grade D breathing air limit for carbon monoxide. It is recommended that customers verify current Grade D limits before adjusting the alarm set-point.**

**The standard Biosystems Travelpanel 50R alarm set-point is 10 PPM.**

##### 4.2.2.1 Alarm set-point verification

It is possible to check the alarm set-point by slowly turning the "zero" potentiometer on the front of the monitor clockwise until the alarm activates.

As the potentiometer is turned in a clockwise direction, the numbers should

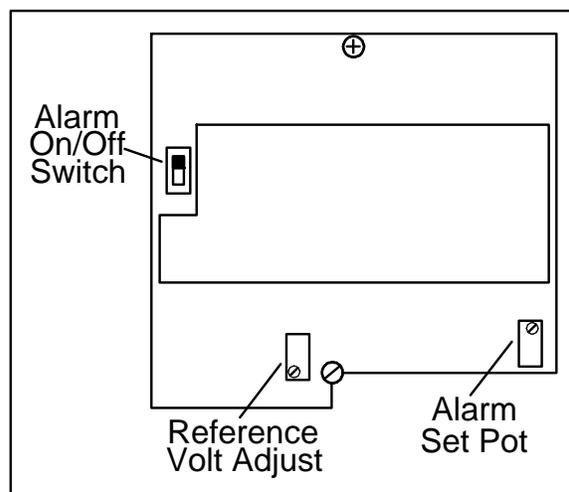
rise. The alarm should activate at the 10 PPM set-point. Adjust the alarm set-point if necessary using the following procedure. After the alarm set-point has been verified, twist the zero-pot counter-clockwise until a reading of "0" PPM has been restored.

**Note: Make sure the Travelpanel 50R the airflow adaptor has been removed from the sensor housing and that the carbon monoxide sensor is directly exposed to fresh air before adjusting the zero potentiometer.**

##### 4.2.2.2 Alarm set-point adjustment

- 1) Loosen the regulator lock-nut (component # 7 on Figure 1.6), swing out the CO monitor bracket, and remove the instrument from the bracket.
- 2) Remove the three screws from the back of the unit and separate the two halves of the instrument. Loosen the threaded sensor retention ring if necessary.

Situate the instrument so that the circuit board is oriented as in the following diagram.



**Figure 4.1. Alarm-set-point potentiometer location**

- 3) Turn the unit on and wait for the readings to stabilize (approximately 90 seconds).
- 4) Turn the zero pot on the front of the unit clockwise until the display reads 10 PPM.
- 5) If the unit is in alarm state at this

point, SLOWLY turn the alarm pot (see diagram) counter clockwise until the alarm shuts off.

- 6) Turn the alarm pot clockwise just until the alarm activates. Check the alarm set-point by turning the **zero** pot down and then back up to the desired alarm set point. If the alarm fails to activate, repeat the alarm-adjust procedure.
- 7) Rejoin the two halves of the instrument case. Re-tighten the sensor retention ring.

**Caution: Make sure that the sensor does not rotate as the sensor retention ring is re-tightened. Rotation of the sensor may cause it to become disconnected from the sensor lead, and render the instrument inoperable.**

- 8) The instrument must be recalibrated whenever the alarm point is adjusted prior to being put back into service.

#### **4.2.3 Carbon monoxide monitor battery replacement**

The Model 3300 TP uses a 9 volt alkaline battery. A fresh battery will provide over one hundred hours of continuous operation. It is very important to replace the battery once the "LO BATT" message appears on the LCD display. Even though the unit may appear to be functioning normally, low voltage can seriously affect the accuracy and response of the sensor.

- 1) Loosen the regulator lock-nut (component # 7 on Figure 1.6), swing out the CO monitor bracket so that the back of the instrument can be accessed.
- 2) Slide the battery door out from the back of the case.
- 3) Carefully disconnect the discharged battery and replace it with a fresh 9-volt alkaline battery.
- 4) Put the battery door back into place. Swing the CO monitor bracket back into place and re-tighten the regulator lock-nut.

#### **4.3 Leak test procedure**

The volume of available inlet air is usually not a limiting factor in situations requiring the use of a Travelpanel 50R system. Incidental leakage of a minor amount of air from the system is not normally a cause for concern. On the other hand significant leakage may indicate a loose fitting or damaged component. Leaking or damaged components should be replaced prior to the panel being put back into service. Travelpanel 50R pneumatics may be tested for leakage by using the following procedure.

- 1) Attach the Travelpanel to a compressed air source and turn the source air on.
- 2) Wait until the pressure has stabilized and turn the source air off.
- 3) Watch the air pressure gauge for sixty seconds. A pressure drop of 5 or more PSI during a one-minute interval indicates there is a significant leak somewhere in the system.
- 4) In the event of a significant leak make sure all filter bowls and fittings are secure and appropriately tight. Make sure that any O-rings or gaskets removed during filter replacement have been replaced with fresh ones.
- 5) Repeat the test. In the event the system continues to leak a commercially available soap solution such as "Snoop" may be used to track down the point of leakage. Contact Biosystems' instrument service department for help in replacement of damaged components.

#### **4.4 High intensity audible alarm**

The Travelpanel 50R is equipped with a high intensity audible alarm. The alarm's sound intensity exceeds 120 dBA (decibels), ensuring that it will be heard even in noisy environments. This siren uses its own 9-volt power source. The alarm battery may be tested by pressing the red battery-test button.

**Caution: The high intensity alarm is not**

**classified as intrinsically safe, and may pose a hazard in combustible atmospheric conditions.**

The high intensity alarm contains some components which may act as a source of ignition in combustible environments. Disconnect the High Intensity Alarm from the CO monitor and remove the alarm battery if the possibility exists that the Travelpanel will be used in an explosive atmosphere.

#### **4.4.1 Changing the high intensity alarm battery**

- 1) Make sure the Travelpanel 50R is not located in a hazardous area.
- 2) Disconnect the high intensity alarm lead from the relay jack located on the side of the Travelpanel 50R carbon monoxide monitor. (The high intensity alarm may briefly sound as the lead is disconnected.)
- 3) Unscrew the two flathead screws which secure the 9-volt alarm battery housing.
- 4) Replace the battery and re-secure the alarm battery housing.
- 5) Reconnect the high intensity alarm lead. (The high intensity alarm will briefly sound as the lead is re-connected.)

# Appendices

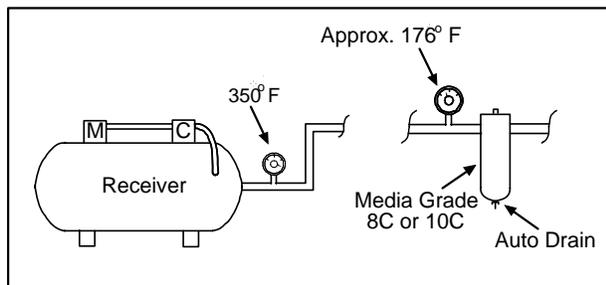
## Appendix A: Principles of Air Purification for Advanced Users

Industrial air supply is typically generated by an oil lubricated compressor. These compressors can be of either the screw or piston type. When such compressors are used to provide breathing air, you must filter the air, regulate its pressure and check for the presence of carbon monoxide. When the air to be purified and regulated comes from a portable compressor, (e.g., as used in sand blasting, asbestos removal, and painting applications) the problems are worse. Generally, portable compressors provide outlet air of a lower quality than larger, permanently installed compressors. The quality of the inlet air to the compressor may also be of concern.

This appendix discusses how to ensure that the air from your compressor is properly purified and pressure regulated to meet OSHA requirements for breathing air.

### 1. What comes out of a typical compressor

Contamination of industrial airline breathing systems is primarily in the form of compressor lubrication mists, vapors, oils, greases, rust, liquid and gaseous water, airline fabrication by-products (slag, flux, metal particles) and industrial contaminants within the atmosphere prior to compression (typically carbon monoxide).



**Figure 1**

All compressors, regardless of age and maintenance record, contaminate the airstream to some degree with lubrication mists and rust particles. Filtration is

required to make the resulting airstream breathable.

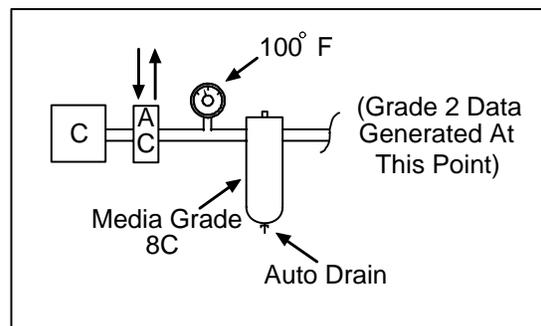
Figure 1 shows a typical small compressor with no aftercooler intended for intermittent general use. A very important thing to note is that the air coming out is very hot (350° F) and extremely humid.

### Contamination Specifications

Water Vapors	42,000 ppm
Dew Point	176° F
Solids	100,000,000/cu. meter
Oil Aerosols	0.5 ppm
Oil Vapors	1.0 ppm
Hydrocarbon Vapors	80 ppm
Specs met	none

When inlet air at room temperature and normal humidity is compressed, the dew point (temperature at which water will condense out of the gaseous state) is raised significantly. This presents problems downstream of the compressor since the water will condense out of the airstream when heat is lost to the surrounding atmosphere.

When working with lubricated air tools, air motors, cylinders, etc., the compressor is normally fitted with an aftercooler, a coarse pre-filter, and an auto draining water trap. This system, which meets Compressed Air and Gas Institute specification CAGI-G7.1 (Grades A and B) is shown in figure 2. For a permanent compressor, this represents the absolute minimum quality of air that should be used with a Travelpanel air purification system.



**Figure 2**

Contamination Specifications

Water Vapors	550 ppm
Dew Point	40° F
Solids	1,000/cu. meter
Oil Aerosols	0.001 ppm
Oil Vapors	0.02 ppm
Hydrocarbons	50 ppm

Specs met CAGI G7.1 (D&E)  
ISA S7.3

Note that the air is much cooler and drier. In addition, the lower temperature has the added advantage of lowering the Hydrocarbon vapor concentration.

When using a portable compressor, the same cooling effect can be produced by immersing the inlet hose to the Travelpanel in an ice water bath. The first stage filter of the Travelpanel is fitted with an auto bleed that will remove the condensate.

**Caution: If hot, water-saturated air is fed to a Travelpanel 50R, the air will cool as it passes through the filters. Water and oil vapors will condense, fouling the filters and possibly damaging the CO monitor. Keep the inlet air to the Travelpanel as cool as possible.**

The ideal inlet air to the Travelpanel 50R is pre-filtered, dried air of the type used for high quality spray painting, air gauging, air conveyors, instrumentation, and close tolerance valves. Figure 3 shows such a system which meets CAGI G7.1 (Grade D&E) and ISA A7.3 specifications.

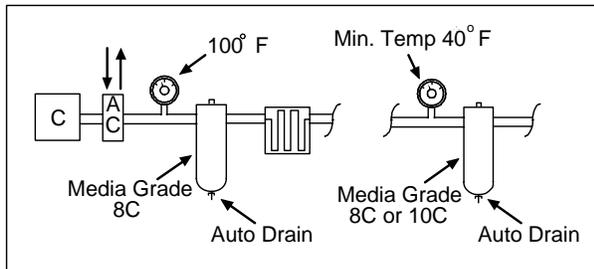


Figure 3

Contamination Specifications

Water Vapors	550 ppm
Dew Point	40° F
Solids	1,000/cu. meter
Oil Aerosols	0.001 ppm
Oil Vapors	0.02 ppm
Hydrocarbons	50 ppm

Specs met CAGI G7.1 (D&E)  
ISA S7.3

Note that other types of dryers, such as regenerative desiccant dryers, produce air too dry for respiratory use.

**2. How the Travelpanel 50R works**

**2.1. Filtration system**

The Biosystems Inc. Travelpanel 50R portable air purification panel filters worker breathing air in three stages.

**2.1.1. Particulate interceptor/Pre-coalescer filter and water trap**

The inlet air to the Travelpanel is first directed through a particulate interceptor/pre-coalescer filter with an integral auto-draining water-trap.

This low pressure drop filter is intended to precipitate and collect gross amounts of aerosol (airborne liquid particle) contaminants and solid contaminants larger than 5 microns. The filter is made up of a corrosion-resistant zinc die-cast body, a transparent polycarbonate sump bowl (capacity: 3.4 ounces) with a float-actuated auto-drain valve and a Porex (PFTE) filter element.

When pressurized air enters the filter bowl, the curved inlet and a deflector direct the incoming air into a downward, whirling pattern. Centrifugal force hurls the larger solid and liquid particles outward, where they collect on the inner surface of the filter bowl. The particles spiral down past a baffle into the sump bowl. The baffle prevents turbulent air in the upper bowl from re-entraining liquid contaminants and carrying them downstream. Then, the dry, cleaner air follows a convoluted path through the filter element, where finer solid particles

are filtered out. Finally, the air passes up the center of the element and out the discharge port.

In this way, the pre-coalescing filter removes impurities in two operations: dynamically, by centrifugal separation, which throws out heavier particles and entrained water, and statically, through the filter element itself, which filters out the smaller particles.

The pressurized air is now free of residuals, precipitates, and oil and water aerosols larger than 5 microns.

### **2.1.2. Coalescing filter**

Next, the air is directed through a coalescing filter with a manual drain. If the inlet air to the Travelpanel 50R is properly cooled, it shouldn't be necessary to use the manual drain. The coalescing filter is intended to remove 99.9% of all oil and water aerosols larger than 0.3 microns. The coalescing filter is made up of a corrosion-resistant zinc die cast body, a transparent polycarbonate sump bowl (capacity 3.4 ounces) with a manual drain valve and borosilicate sub-micronic glass fiber/epoxy bonded element.

The high-efficiency coalescing filter operates on a somewhat different principle than the particulate interceptor filter. The principles include direct interception, inertial impaction, and diffusion.

As the pre-filtered air enters the cylindrical element at the center, the contaminating particles larger than the filter element openings are stopped by direct interception. Solid particles remain in the filter element while aerosols agglomerate into larger drops. Aerosols in the turbulent airstream impact the glass fibers and accumulated droplets are removed from the flow.

Diffusion (molecular Brownian movement) causes the smaller particles to collide or coalesce with the glass fibers and accumulated liquid droplets on the fibers. Collected liquid migrates to the crossing points of the fibers, where larger drops form or coalesce. Pressure differential through the element then

forces these drops to the downstream surface of the element where they gravitate downward to the sump.

As a result, the coalescing elements can capture particles smaller than the nominal size of the flow passages through the element at a lower delta pressure than would be expected with an element of equal filtration capability that uses the direct interception process of entrapment.

### **2.1.3. Activated charcoal filter (Adsorber)**

Following the pre-coalescer and coalescer filter is the final stage of filtration, the adsorption process. The adsorber "polishes" the airstream, removing trace amounts of hydrocarbons as well as odors. The adsorber filter is comprised of a zinc die-cast body, a spun aluminum bowl, a manual drain valve, and an activated charcoal adsorber element. Air enters the center of the filter element, passes through the activated charcoal, and exits at the discharge port. The chemical action of the activated charcoal serves to cleanse the breathing air of trace hydrocarbons and organic odors.

## **2.2. Pressure regulation**

After the inlet air has been filtered, it is necessary to regulate its pressure to NIOSH requirements. An adjustable regulator with a pressure gauge ensures that the outlet manifold is within the acceptable limits for the respirator being used.

## **2.3. Carbon monoxide monitoring**

Even with such extensive filtration, it is impossible to remove existing carbon monoxide from the breathing air. Carbon monoxide can be produced by breakdown of the compressor lubricants, or it can be present in the inlet air. The Travelpanel 50R contains a built in CO monitor with an alarm set at 10 parts per million.

## **Summary**

The Travelpanel series of air purification panels are designed to meet or exceed

OSHA industrial breathing air specifications for respirable Grade D breathing air contained in 29 CFR 1910.134.

There are two additional requirements, namely:

1) Compressor inlet air must contain

between 19.5 and 23.5 % oxygen.

2) Compressor inlet air must contain less than 1000 PPM carbon dioxide.

Since fresh air contains 20.9% oxygen and only trace amounts of carbon dioxide are produced by compressors, these requirements are very easy to meet.

## Appendix B: Causes and Sources of Contamination

### (1) Contamination from intake air

Carbon monoxide	Carbon dioxide	Gaseous hydrocarbons	Condensed hydrocarbons	Water
Motor exhaust	Recirculated air from central air conditioning and/or heating in highly populated areas (shopping malls, industrial plants, etc.)	Fumes from nearby dry cleaning shops, beauty salons, chemical plants, industrial manufacturing plants, motor exhaust	Dust, pollen, motor exhaust	Humidity

### (2) Contamination from within compressor

Carbon monoxide	Carbon dioxide	Gaseous hydrocarbons	Condensed hydrocarbons	Water
<p><b>a)</b> Combustion product of hydrocarbon fuels and lubricants--can be caused by overheated oils</p> <p><b>b)</b> Oxidation of charcoal filters due to over-heating</p> <p><b>c)</b> CO which has accumulated on a filter can be released when a drop in operating pressure occurs</p>	<p><b>a)</b> Certain CO filters convert CO into CO<sub>2</sub>, causing an increase in levels (usually not enough to cause alarm)</p> <p><b>b)</b> CO<sub>2</sub> which has accumulated on a filter can be released when a drop in operating pressure occurs.</p>	Overheating compressor lubricants can cause the generation of lubricant vapors which can slip by piston rings	<p><b>a)</b> Oil mist can be generated from compressor lubricants escaping through faulty piston rings.</p> <p><b>b)</b> Inorganic particulates can be caused by carbon from an activated charcoal filter or rust from steel piping</p>	Moisture can be picked up by the output air when water separators are not properly maintained

# Biosystems Standard Warranty Gas Detection Products

## General

Biosystems LLC (hereafter Biosystems) warrants gas detectors, sensors and accessories manufactured and sold by Biosystems, to be free from defects in materials and workmanship for the periods listed in the tables below.

Damages to any Biosystems products that result from abuse, alteration, power fluctuations including surges and lightning strikes, incorrect voltage settings, incorrect batteries, or repair procedures not made in accordance with the Instrument's Reference Manual are not covered by the Biosystems standard warranty.

The obligation of Biosystems under this warranty is limited to the repair or replacement of components deemed by the Biosystems Instrument Service Department to have been defective under the scope of this standard warranty. To receive consideration for warranty repair or replacement procedures, products must be returned with transportation and shipping charges prepaid to Biosystems at its manufacturing location in Middletown, Connecticut, or to a Biosystems Authorized Warranty Service Center. It is necessary to obtain a return authorization number from Biosystems prior to shipment.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY AND ALL OTHER WARRANTIES AND REPRESENTATIONS, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. BIOSYSTEMS WILL NOT BE LIABLE FOR LOSS OR DAMAGE OF ANY KIND CONNECTED TO THE USE OF ITS PRODUCTS OR FAILURE OF ITS PRODUCTS TO FUNCTION OR OPERATE PROPERLY.

## Instrument & Accessory Warranty Periods

Product(s)	Warranty Period
PhD <sup>5</sup> , PhD Lite, PhD Plus, PhD Ultra, Cannonball3, MultiVision, Toxi, Toxi/Oxy Plus, Toxi/Oxy Ultra, ToxiVision, Ex Chek	As long as the instrument is in service
ToxiPro, MultiPro	2 years from date of purchase
ToxiLtd	2 years after activation or 2 years after the "Must Be Activated By" date, whichever comes first
Mighty-Tox	90 days after activation or 90 days after the "Must Be Activated By" date, whichever comes first
Mighty-Tox 2 Prorated credit is given towards repair or purchase of a new unit of the same type.	0 – 6 months of use 100% credit 6 – 12 months of use 75% credit 12 – 18 months of use 50% credit 18 – 24 months of use 25% credit
IQ Systems, Series 3000, Airpanel, Travelpanel, ZoneGuard, Gas✓Chek1 and Gas✓Chek4	One year from the date of purchase
Battery packs and chargers, sampling pumps and other components, which by their design are consumed or depleted during normal operation, or which may require periodic replacement	One year from the date of purchase

## Sensor Warranty Periods

Instrument(s)	Sensor Type(s)	Warranty Period
PhD Plus, PhD Ultra, PhD <sup>5</sup> , PhD Lite, Cannonball3, MultiVision, MultiPro, ToxiVision, ToxiPro, Ex Chek	O <sub>2</sub> , LEL**, CO, CO+, H <sub>2</sub> S & Duo-Tox	2 Years
	All Other Sensors	1 Year
Toxi, Toxi/Oxy Plus, Toxi/Oxy Ultra	CO, CO+, H <sub>2</sub> S	2 Years
	All Other Sensors	1 Year
All Others	All Sensors	1 Year

\*\* Damage to combustible gas sensors by acute or chronic exposure to known sensor poisons such as volatile lead (aviation gasoline additive), hydride gases such as phosphine, and volatile silicone gases emitted from silicone caulks/sealants, silicone rubber molded products, laboratory glassware greases, spray lubricants, heat transfer fluids, waxes & polishing compounds (neat or spray aerosols), mold release agents for plastics injection molding operations, waterproofing formulations, vinyl & leather preservatives, and hand lotions which may contain ingredients listed as cyclomethicone, dimethicone and polymethicone (at the discretion of Biosystems Instrument Service department) void Biosystems' Standard Warranty as it applies to the replacement of combustible gas sensors.