![sauermann logo]

SI-AQ EXPERT

MULTIFUNCTIONAL PORTABLE INDOOR AIR QUALITY MONITOR

CE

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CHAPTER 1

TECHNICAL SPECIFICATIONS & SAFETY GUIDELINES

SI-AQ EXPERT - AIR QUALITY MONITOR

1. PHYSICAL:
   Material: White ABS plastic case with internal aluminum shielding
   Dimensions (monitor): 11.42″ X 10.24″ X 4.88″ / 27.9 x 25.4 x 10.2 cm (H x L x P)
   Weight: (monitor): 15 lbs. / 7 kg
   Shipping Dimensions & Weight (monitor & all accessories): 15 lbs. / 7 kg
   19″ x 17″ x 15″ / 48.2 cm x 43.1 cm x 38.1 cm

2. POWER:
   12 Volt, 8 AH rechargeable Li-Ion battery pack
   Operating time: 6 – 8 hours continuous use
   110/240 VAC input, 12 V/2.5A fast charger
   Charging time: 3 hours maximum

3. DISPLAY:
   2.6″ x 1.4″ 128 x 64 graphic, chip on glass (white backlit) LCD display.
   Rotating display depending on monitor case orientation
   Small and large fonts, plus inverted background colour for help messages
   Battery condition & charger operation indicator

4. WIRELESS REMOTE PRINTER
   2″ high resolution, high speed, graphic thermal printer, with charger, prints:
   A. current set of data
   B. stored data
   C. periodic data printouts
   D. calibration history and external messages

5. INSTRUMENT PUMP
   Continuous Air sample pump: high quality diaphragm pump with long life motor

6. STORAGE
   2000 Internal memory storage tags, each tag stores one complete set of data

7. COMMUNICATIONS
   Bluetooth® wireless: Class 1 (100 m)
   USB Cable

8. SOFTWARE
   SI-AQ GAS Windows PC Software

SENSORS

1. AIR QUALITY SENSORS – ELECTROCHEMICAL

SENSOR		RANGE	RESOLUTION	ACCURACY*
CARBON MONOXIDE (CO)	**Std Range**	0 - 200 ppm	0.1 ppm	±4% rdg ±0.5 ppm
OXYGEN (O2)	**Std Range**	0 - 25%	0.1%	0.1% Vol. rdg
NITRIC OXIDE (NO)	**Std. Range**	0 - 250 ppm	0.1 ppm	±4% rdg ±0.5 ppm
NITROGEN DIOXIDE (NO_2)	**Std. Range**	0 - 20 ppm	0.1 ppm	±4% rdg ±0.5 ppm
SULFUR DIOXIDE (SO_2)	**Std. Range**	0 - 20 ppm	0.1 ppm	±4% rdg ±0.5 ppm
HYDROGEN SULPHIDE (H_2S)	**Std. Range**	0 - 100 ppm	1 ppm	±4% rdg ±0.5 ppm
OZONE (O_3)	**Std. Range**	0 - 5 ppm	1 ppb	
FORMALDEHYDE (CH_2O)**	**Std. Range**	0 – 10,000 ppb	1 ppb	5% rdg ±50 ppb

2. AIR QUALITY SENSORS – NON-DISPERSIVE INFRARED (NDIR) SENSORS

SENSOR		RANGE	RESOLUTION	ACCURACY*
CARBON DIOXIDE (CO_2)	**Std Range**	0 – 5,000 ppm	1 ppm	2% rdg ±10 ppm
CARBON DIOXIDE (CO_2)	High Range	0.0% - 20.0%	0.1%	±3% rdg

3. AIR QUALITY SENSORS – PHOTO IONIZATION DETECTOR (PID) SENSORS

SENSOR		RANGE	RESOLUTION	Min Detection	ACCURACY*
VOCs	**Std Range**	0 - 20,000 ppb 0 - 46,000 µg/m³	1 ppb 1 µg/m³	5 ppb	10% rdg ±20 ppb
VOCs	High Range	0 - 200 ppm 0 – 460 mg/m³	1 ppm 1 mg/m³	25 ppm	10% rdg ±2 ppm

*Note: All Accuracies indicated above are under Laboratory Conditions
** This sensor may have interference from H_2S, H_2, CO, and other reducing gases such as alcohols

4. OTHER SENSORS

SENSOR	RANGE	RESOLUTION	ACCURACY*
Temperature Type K (T1)	0 - 2000 ºF 0 - 1100 ºC	1 ºF 1 ºC	5 ºF / 3 ºC or 2% rdg
Ambient Temperature	-40 – 257 ºF -40 – 125 ºC	0.1 ºF 0.1 ºC	±0.4 ºF (32 - 140 ºF) ±0.4 ºC (0 - 60 ºC)
Barometric Pressure	260 – 1260 mbar	1 mbar	±2 mbar
Relative Humidity	5 - 95%	0.1%	±2% RH
Pressure	0 - 32.0 inH$_2$O 0 - 80 mbar	0.1 inH$_2$O 0.1 mbar	±1% rdg
Air Velocity	0 - 300 ft/s 0 - 91 m/s	1 ft/s 1 m/s	

*Note: All Accuracies indicated above are under Laboratory Conditions

MODEL SI-AQ EXPERT – SAFETY GUIDELINES

This section provides general rules which must be followed for product safety, avoiding personal injury, damage to equipment and preserving the manufacturer's warranty. Please take care to carefully observe the following instructions.

    A.   PRODUCT SAFETY INSTRUCTIONS:

> **NOTE: Please take special care when performing Span Calibration of the monitor. You cannot revert back to the factory setting after any adjustments!**

> **NOTE: CO_2 should <u>ALWAYS</u> be Calibrated or Zeroed with a Cylinder of ZERO AIR. Do Not Use Si-AQ VOC Zero Filter for CO_2 sensor calibration.**

➢ Follow the instructions in the Si-AQ Expert Manual
➢ Do not operate the instrument outside of the parameters specified in the technical specifications
➢ Never use the instrument without the disposable fiber soot line filter or the condensation disk filter, which are located inside the monitor connected to the "Sample In" input. Operating the instrument without the filters will put the monitor at high risk to damage the pump and sensors. These filters should be replaced as needed. See maintenance chapter for filter changing.
➢ It is recommended to keep the Si-AQ Expert horizontal using the included swivel handle as its stand with the LCD display facing the user
➢ Do not use or store the instrument together with any solvents
➢ Do not block the exhaust port in the back of the instrument
➢ Do not expose the monitor to extreme hot or cold temperatures outside of the stated range in this manual
➢ Do not abuse the charger cord. Do not use power cord for carrying, pulling. Keep cord away from heat, oil, sharp edges, or moving parts. Damaged or entangled cords can increase risk of electric shock
➢ Only use the supplied, appropriate AC Charger
➢ If the monitor enclosure is ever unscrewed and taken apart, avoid over-tightening the screws that hold the two main enclosure pieces together.
➢ Do not store or operate in dusty, dirty areas
➢ Always use the monitor with care and use the instrument properly
➢ Do not use force when disconnecting and reconnecting the Black external Temp, RH and Pressure Sensor (see photo below)
➢ Do not use instrument in the rain or high moisture areas to prevent water droplets on the black external Temp, RH, and Pressure Sensor.
➢ Remember to have the monitor checked and calibrated at least once a year to ensure sensor accuracy and compliance with existing standards

➢ **DO NOT LIFT OR HANDLE THE INSTRUMENT BY THE BLACK EXTERNAL TEMP, RH, PRESSURE SENSOR HOUSING! See photo below**

B.   ELECTROMAGNETIC COMPATIBLITY

Complies with EN61326-1, Portable Equipment

The Sauermann SI-AQ EXPERT Indoor Air Quality Monitor is a battery-operated Portable device designed to be used by a qualified engineer/technician to make measurements in buildings and residential facilities. For long-term testing, you may operate the unit connected to the supplied charger by carefully following the product safety instructions in Section A above.
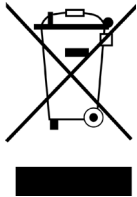
C.   ESD Protection

In extreme cases or abnormal applications, Electrostatic Discharge can potentially cause serious and immediate damage to the electronic circuits of the instrument.

D.   BATTERY DISPOSAL & RECYCLING

Recycle all applicable material properly. Take faulty/depleted batteries to proper collection/recycling centres

Dispose of batteries and the monitor according to statutory regulations. Do not dispose of with regular household items. After the monitor's useful life, please return to your local authorized Sauermann' distributor or send back to Sauermann directly. We will ensure that it is disposed of in an environmentally friendly manner

CHAPTER 2

INTRODUCTION
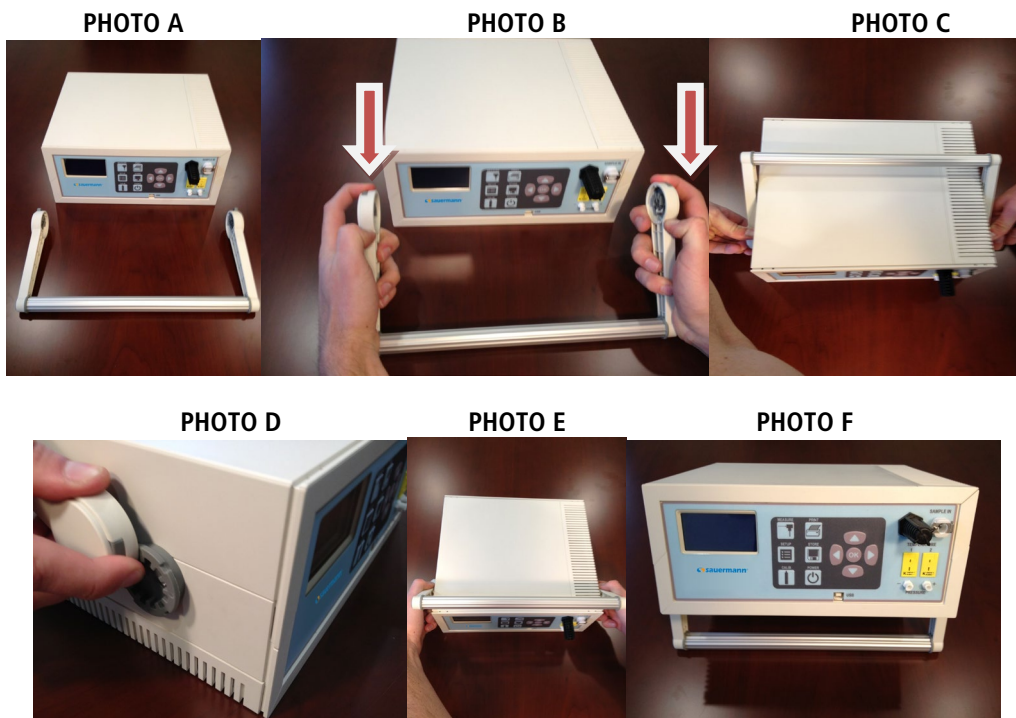
A. UNPACKING THE INSTRUMENT

Every SAUERMANN SI-AQ EXPERT includes as standard equipment:

- IAQ Monitor Model Si-AQ Expert with Temp, %RH, DPt, WBT, BP, Velocity, Differential Pressure and Differential Temperature
- Internal Continuous Sampling Pump
- Swivel Handle
- Battery charger / AC adaptor for the monitor
- USB Thumb Drive includes:
    - SI-AQ PCSOFT Software for Windows
    - Instruction Manual
- USB Cable for Software Kit
- Internal Wireless Bluetooth®
- Calibration Certificate

The instrument can have up to six (6) electrochemical gas sensors, one (1) infrared gas sensors and one (1) PID sensor installed. The Si-AQ Expert has three temperature sensors in total. All sensor readings are single range readings with ranges listed in Chapter 1.

B. INSTALLING/REMOVAL OF SWIVEL HANDLE INSTRUCTIONS

1. Depress BOTH of the Grey Push-Release buttons on the Left & Right circular ends of the handle (Photo B)
2. With the handle angled AWAY from the front face of the instrument and with the buttons depressed, position the circular ends OVER the Gray circular holders ON the side of the instrument until it falls into place (Photos C & D)
3. Depress the Grey Push-Release buttons and rotate the Handle down below the Front Face (Photo E) of the instrument until it locks into place under the instrument holding it upright in place. (Photo F)
4. To Remove the handle, repeat steps 1-3 in reverse

PHOTO A	PHOTO B	PHOTO C

PHOTO D	PHOTO E	PHOTO F

C. REPACKING UNIT IN OPTIONAL VINYL CARRYING CASE

1. With the Si-AQ Expert powered OFF, turn the instrument on its side with the FRONT FACE of the unit to the LEFT. See photo A below.
2. Place the carrying case on a supported surface (desk, floor, etc) with the Front Logo facing the user.
3. With the Si-AQ Expert powered OFF, turn the instrument on its side with the FRONT FACE of the unit to the LEFT. See photo A below.
4. Carefully place the Si-AQ Expert in the Case, taking SPECIAL PRECAUTION to NOT damage the External Temp, RH, Pressure sensor. See Photo B below

PHOTO A	PHOTO B

Place AQ Expert on its side and use caution as to NOT damage the External RH, Temp, Pressure Sensor

INSTRUCTIONS: DO NOT LIFT OR HANDLE THE INSTRUMENT BY THE BLACK EXTERNAL TEMP, RH, PRESSURE SENSOR HOUSING!

D. SI-AQ EXPERT STARTING INSTRUCTIONS

1. Make sure the instrument is in a clean-air, room-temperature environment and turn it on by pressing the **POWER** key on the keypad. The instrument will begin to draw in air from the SAMPLE IN inlet at a rate of about 500 cc/minute.

2. If needed or in doubt of the contaminants in the Ambient Air, you can initiate the ZERO CAL on ALL the GAS sensors on the Si-AQ Expert. Please refer to CHAPTER 8 of this manual for ZERO & SPAN calibration on the Si-AQ Expert.

3. Press the **MEASURE** key to view the ambient temperature, barometric pressure, relative humidity and dew point. The toxic gas readings are also displayed: CO, CO_2, NO, NO_2, SO_2, H_2S, O_3, & VOCs.

4. If, at the end of the ZERO countdown, if the display shows an error message for a particular sensor, see the troubleshooting table in section D of this chapter. The instrument will measure correctly all sensors that do not show an error message.

LIST OF ABBREVIATIONS

PARAMETERS

CO_2	Carbon Dioxide
CO	Carbon Monoxide
Ta	Ambient (room) Air Temperature
RH	Percentage of Relative Humidity
DPt	Dew Point Temperature
WBT	Wet Bulb Temperature
BP	Barometric Pressure
O_2	Oxygen
O_3	Ozone
VOCs	Volatile Organic Compounds
FMH	Formaldehyde
H_2S	Hydrogen Sulfide
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
SO_2	Sulfur Dioxide
VEL	Air / Gas Velocity (measurement with pitot tube)
ΔP	Differential Pressure (with Velocity Probe turned OFF)
T1	Thermocouple Type K Temperature (T1 Input)
T2	Thermocouple Type K Temperature (T2 Input)
BAT	Battery Life / Voltage
NA	Parameter Not Available

UNITS

PPM	Parts (of pollutant) per million
PPB	Parts (of pollutant) per billion
mg/m3	Milligrams per Cubic meter
µg/m³	Micrograms per Cubic meter
°F	Temperature Measurement in Fahrenheit
°C	Temperature Measurement in Celsius
"WC	Inches of water (pressure measurement)
mmHg	Millimeters of Mercury (pressure measurement)
"Hg	Inches of Mercury (pressure measurement)
PSI	Pounds per Square Inch (pressure measurement)
mmWC	Millimeters of water (pressure measurement)
kPa	KiloPascals (pressure measurement)
mbar	Millibars (pressure measurement)
FPS	Feet per second (gas / air velocity measurement)
MPS	Meters per second (gas / air velocity measurement)
CFM	Cubic feet per minute (gas / air velocity measurement)
V	Voltage (battery)

NOTE: MGM (milligrams per cubic meter) units are calculated and displayed for 20C and 1 atm conditions per US EPA standards.

CHAPTER 3

BASIC INSTRUMENT OPERATION

The SI-AQ EXPERT is operated by the 11 (eleven) buttons on the keyboard located on the front of the monitor.

- The **POWER** key turns the instrument on and off.

- The **MEASURE** key shows the currently measured parameters.

  Displays the monitor's currently measured data in either of two (2) fonts:
  A. Small fonts (all data displayed simultaneously plus range indicated, battery condition and time)
  B. Large fonts (four data parameters displayed simultaneously)

Note: The Si-AQ Expert allows the user to ZOOM in and out of the screen by changing   from Small to Large Fonts using the **MEASURE** key.

- Four keys will bring up a menu: **SETUP**, **CALIB**, **STORE**, & **PRINT**.

SETUP	Controls all customization parameters, such as measurement units, for the monitor
CALIB	Controls calibration settings and zeroing of the monitor's sensors.
STORE	Controls operation of the monitor's internal data storage
PRINT	Executes print commands for the monitor's optional remote Bluetooth® printer

- The menus are navigated with the **UP**, **DOWN**, **LEFT**, **RIGHT**, & **OK** keys.

INSTRUMENT OPERATION OVERVIEW

1. Turn the Si-AQ Expert on by pressing the **POWER** key. The instrument's internal pump will immediately turn on and the SAUERMANN logo will appear.

2. If applicable, attach the optional probe and sampling line to the monitor.

3. Press the **MEASURE** key and check the unit's battery condition.

```
CO2:  520PPM  O2:  20.9%
CO:     0PPM  NO2:    0PPM
Ta:  79.1°F  SO2:    0PPM
RH:  46.9%   H2S:    0PPM
DPt:57.0°F  O3:     0PPB
BP:  1012mb  VOC:    0PPB
_____
Sampling     ▭12:45:00
```

NOTE: Depending on the options enabled for your SI-AQ EXPERT some of the entries in one or more of the displays shown above will be blank if that option is not available.

The **MEASURE** key allows the user to toggle between a small font and a large font screen. Select the small font screen.

The battery icon is displayed in the middle of the bottom line of the display. Its condition is marked by the shaded fraction of the icon. If the unit is powered by the battery charger a small "plug" icon will replace the battery icon.

NOTE: When connecting the battery charger to the monitor make sure that the "plug" icon appears on the **MEASURE** screen. This ensures a proper power connection and charging of the batteries.

Battery Full

Battery Empty

Battery Charger Connected

Fast-Charge Mode

```
APR  1 '14  12:45:00
Temperature Units: F
Measure Units:  PPM
Pressure Units: inWC
Pumps: AUTO 1000cc/m
Velocity Probe: OFF
Velocity Units: FPS
Duct Size:    0 in2
Display Contrast: 24
Baudrate: 115 kbps
Version:  1.00Li
```

4. If you are using the monitor for the first time, press the **SETUP** key to set the appropriate parameters (i.e.: measurement units) for your application. See Chapter 5 for an explanation of each parameter.

5. All sensor readings shown on the screen indicate Ambient measurements. To ZERO the gas sensors, please see Maintenance Chapter 11 of this manual.

6. To obtain a printout of the data displayed, press the **PRINT** key. The cursor (reverse colour) will point to:

   <div align="center">Print Test Record</div>

   Press the **OK** key to execute a printout on the Si-AQ Expert's optional remote printer.

7. Measured data can be stored in the monitor's internal memory. Please refer to Chapter 7 for more details about data storage.

8. When you are finished with your measurements allow the monitor to draw clean ambient air for several minutes before turning the monitor off. If you are using the optional probe, please disconnect and let the instrument run in clean ambient air before turning the instrument off.

CHAPTER 4

POWER REQUIREMENTS

The Si-AQ Expert can run off of AC power or the internal Li-Ion rechargeable battery pack. It is recommended to run the Si-AQ Expert off AC power as often as possible for maximum operating time.

Power is supplied by a Li-Ion rechargeable battery pack. The battery pack will supply power to the monitor for approximately 6-8 hours of continuous operation.

A 110 – 240 Volt AC charger having a 12 Volt DC / 2.5A output is supplied with the instrument. The battery charger will fully charge the battery pack in three hours.

You can check the condition of the batteries at any time:

1. By pressing the **MEASURE** key (small font screen), and observing the battery icon, located at the bottom of the display.

          Battery Full

          Battery Empty

          Battery Charger Connected

          Fast-Charge Mode

2. By pressing the **MEASURE** key, (large font screen), the user can scroll all the way to the end using the **DOWN** arrow key to observe the battery life shown in voltage. When the unit is operating on its internal batteries, the voltage displayed will vary from an initial 8.0 to 8.4 volts (fully charged) dropping slowly to approximately 7 volts (batteries nearly empty). When the battery voltage drops to 7.1 volts a "low battery" warning will appear on the display. Within a few minutes later the instrument will automatically turn off, to preserve the remaining battery power for the sensor bias voltages.

SENSORS - TECHNICAL

The great versatility of the Si-AQ Expert Air Quality monitor is partly due to the large number of sensors available within a single monitor.

These sensors are primarily gas sensors and can be grouped into four categories based on their principle of operation:
1. Six (6) electrochemical gas sensors*
2. One (1) NDIR (infrared gas sensors) – CO_2
3. One (1) Photo ionization detector (PID gas sensor) - VOC
4. Non-gas sensors (Temperature, Velocity, Humidity, Pressure, and Barometric pressure) sensors

*__NOTE:__ When O_3 (Ozone) sensor is installed, the Si-AQ Expert can include O_3 + NO_2 __OR__ O_3 + SO_2. The unit can __NOT__ have all three (3) sensors (O_3 + NO_2 + SO_2) together simultaneously.

The main section of the monitor that houses all the electrochemical, NDIR, and PID gas sensors, battery pack, and PC board. On the face of the unit, the external sampling system or Ambient Temperature, Relative Humidity, and Barometric Pressure.

The figure below shows the location of the gas sensors on their housing:

SENSOR LIST:

CO_2
CO
VOCs
NO
NO_2
SO_2
H_2S
CH_2O
O_2
O_3
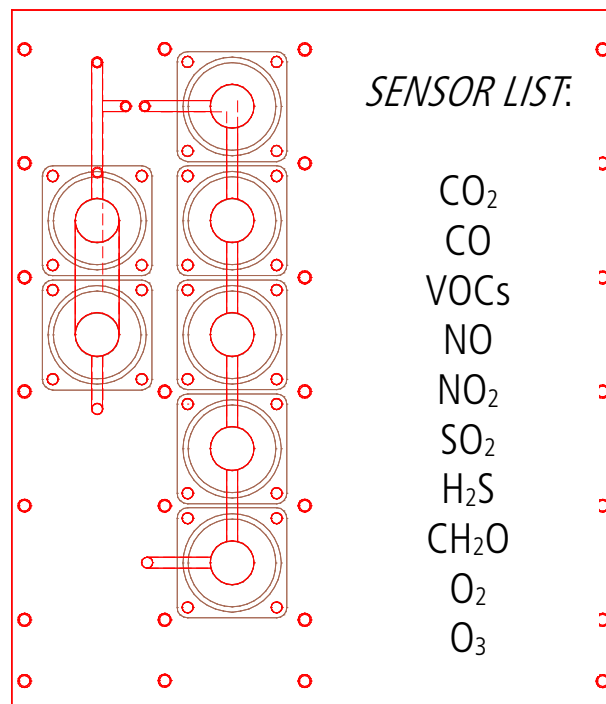
1. ELECTROCHEMICAL SENSORS

All electrochemical sensors are mounted on bayonet style fittings for easy removal.
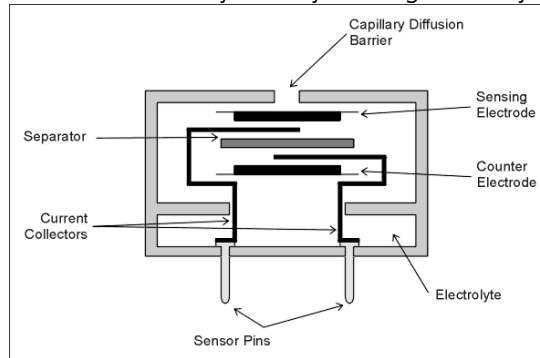
The electrochemical sensors are described below:

A. Nitrogen Dioxide sensor (NO₂)

This is a three-electrode sensor that responds to nitrogen dioxide gas. Nitrogen dioxide is a "sticky" gas and this sensor's response is usually the slowest of all sensors.

B. Sulfur Dioxide sensor (SO₂)

It is a three-electrode sensor that responds to sulfur dioxide gas. It is equipped with an inboard filter to remove interference from H_2S gas and other acidic gases.

C. Nitric Oxide sensor (NO sensor)

This is also a three-electrode sensor that responds to nitric oxide. It is equipped with an inboard filter to remove any interference from other acidic gases.

The nitric oxide sensor requires a constant bias-voltage for proper operation. This is supplied by the monitor's battery. If the battery voltage drops below a certain value, the monitor will turn off automatically to maintain the sensor bias. If, however, the battery voltage further drops to near zero, one must wait 24 hours after connecting the battery charger, for the sensor bias to recover.

D. Oxygen sensor (O₂ sensor)

This sensor measures the oxygen concentration in the sample. It is a two-electrode electrochemical cell. It has a silver cathode and a lead anode. Oxygen diffuses through a tiny hole and reacts with the lead anode. The reaction produces an electric current. The unit software linearizes the current vs. oxygen response. The cell becomes exhausted when all the lead is consumed.

E. Hydrogen Sulfide sensor (H₂S)

This is a 4-series three-electrode micro sensor with low methanol interference. It measures the concentration of hydrogen sulfide, which is a highly toxic gas. Special precautions must be taken during calibration.

F. Carbon Monoxide sensor (CO)

This is also a three-electrode sensor that responds to carbon monoxide. It is equipped with an inboard filter to remove any interference from other acidic gases.

G. Ozone sensor (O₃)

This is also a three-electrode sensor that responds to ozone.

H. Formaldehyde Sensor (CH₂O)

This is also a three-electrode sensor that responds to formaldehyde. It is equipped with an inboard filter to remove any interference from other acidic gases.

This sensor may have interference from H_2S, H_2, CO, and other reducing gases such as alcohols. In applications where the user is measuring both H2S and Formaldehyde, the Formaldehyde readings could be inaccurate as the levels of H2S increase. Relative measurements could be appropriate in these situations.

2. NDIR (INFRARED) SENSOR (CO₂)

A non-dispersive infrared (or NDIR) sensor is a simple spectroscopic device most commonly used to measure CO_2 in indoor air quality applications. The main components are an infrared source (lamp), a sample chamber or light tube, a wavelength sample chamber, and the CO_2 gas concentration is measured electro-optically by its absorption of a specific wavelength in the infrared (IR).
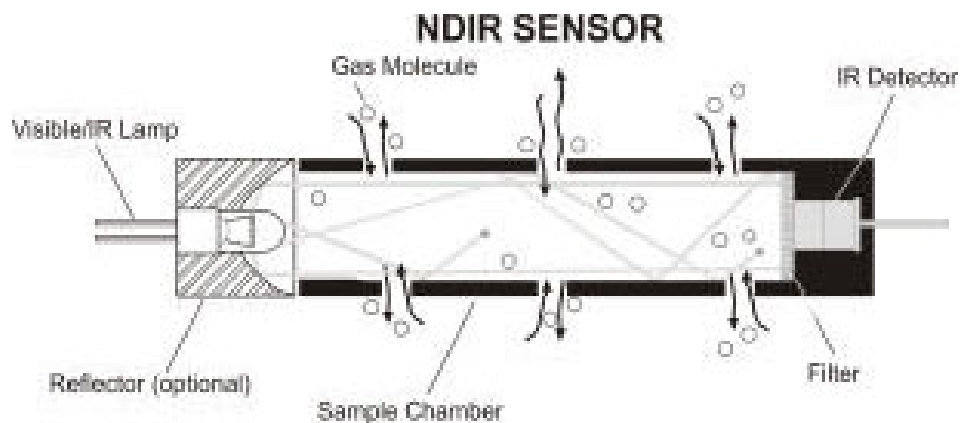

The Si-AQ Expert Air Quality Monitor is equipped with one standard NDIR infrared sensor capable of CO_2 measurement (standard range: 0 – 5000 ppm). This infrared sensor can be substituted for higher CO_2 ranges upon special request.

The NDIR options have the following specifications:

GAS	RANGE	ACCURACY
CARBON DIOXIDE (CO_2)	0 - 5000 ppm	2% of reading $\pm$10 ppm
CARBON DIOXIDE (CO_2)	0.0% - 20.0%	3% of reading

3. PHOTO IONIZATION DETECTOR (PID) - VOCs

Photo ionization detectors are the most common method to measure volatile organic compounds (VOCs) and other gases in indoor air quality in concentrations in parts per billion (PPB) and parts per million (PPM).
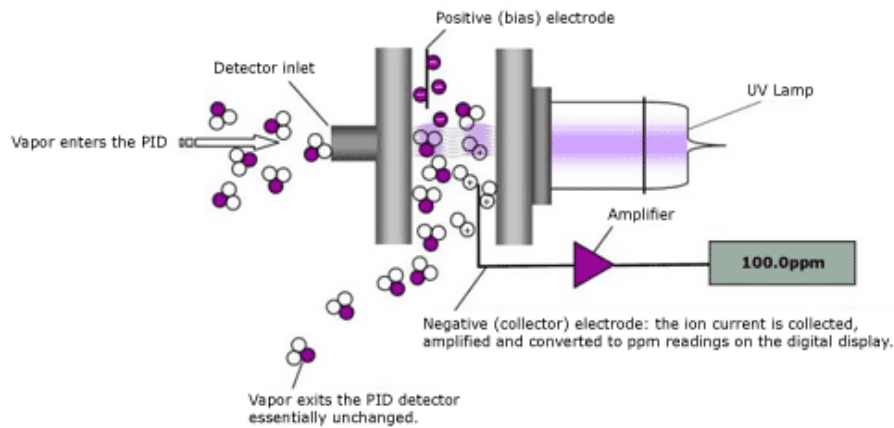
The PID options have the following specifications:

GAS	RANGE	ACCURACY
VOCs*	0 - 20,000 ppb 0 - 46,000 µg/m³	$\pm$10% rdg $\pm$20 ppb
VOCs*	0 - 200 ppm 0 - 460 mg/m³	$\pm$10% rdg $\pm$2 ppm

*VOC sensor will not measure Formaldehyde. The ionization potential of the sensor is outside of the VOC sensor range. If you need Formaldehyde, you need to use the direct CH_2O sensor.

4. NON-GAS SENSORS

A. Ambient Temperature sensor

This is a solid state sensor located on the front panel of the monitor. The ambient temperature is displayed on the **MEASURE** screen in either °F or °C. The dew point is calculated from the ambient temperature and relative humidity. The dew point is displayed on the Small and Large Font **MEASURE** screens as DPt.

B. Humidity sensor

This is a solid state sensor located on the front panel of the monitor. The relative humidity is displayed on the **MEASURE** screen in %RH (% Relative Humidity). The Wet Bulb is calculated from the ambient temperature, relative humidity, and barometric pressure. The wet bulb is displayed on the Large Font **MEASURE** screen only as WBT.

C. Barometric Pressure sensor

This is a solid state sensor located at the front panel of the monitor. The barometric pressure is displayed on the Small and Large Font **MEASURE** screens as BP.

D. External Temperature Sensor (T1 & T2)

The thermocouple is located at the tip of any optional or separate Type K thermocouple probe and/or wire. The T1 & T2 temperature measurements are displayed on the Large Font **MEASURE** screen only as T1, T2.

E. Differential Pressure / Air Velocity sensor.

If the monitor comes with the Differential Pressure option and/or the air velocity option (optional separate S-type pitot tube and pressure tubing), the internal pressure sensor is a very low range pressure sensor. The Velocity measurements are displayed on the **MEASURE** screen only as VEL. Differential Pressure are displayed on the **MEASURE** screen only as ΔP.

Connecting Differential Pressure Hoses:

1. Connect White Connector to either P+ or P- Connection as shown in photo below.

2. Once connected, turn White Connector CLOCKWISE to lock. Do NOT Over tighten.
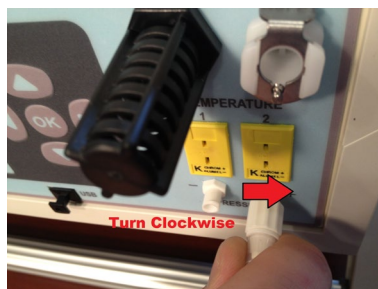
3. To Disconnect, turn White Connector COUNTER-CLOCKWISE to unlock and pull hose off to remove.

CHAPTER 6

SI-AQ EXPERT SETUP

The **SETUP** MENU allows the operator to change the instrument's parameters.

```
APR  1 '14  12:45:00
Temperature Units: F
Measure Units:  PPM
Pressure Units: mbar
Pumps: AUTO 1000cc/m
Velocity Probe: OFF
Velocity Units: FPS
Duct Size:    0 in²
Display Contrast: 24
Baudrate:  115 kbps
Version:  1.00Li
```

Every parameter listed on the **SETUP** MENU screen can be changed as follows:

    a. Use the **UP / DOWN** keys to move the highlighted line to the parameter you wish to change.

    b. Press **OK** to edit the value. The arrow will disappear as the current line shifts to the left by one character and a cursor appears over the value. This indicates that you are in edit mode.

    c. Use the **UP / DOWN** keys (keys displaying the triangles) until the desired value of the selected parameter appears on the display.

    d. Press the **OK** key to execute the change.

A more detailed explanation of each parameter follows:

1) DATE & TIME: The monitor's internal clock is displayed in the format month-day-year, hour-minute-second. Hours are always displayed using a 24-hour clock format.

2) TEMPERATURE UNITS: The **UP / DOWN** keys toggle between °F (Fahrenheit) and °C (Celsius). Stack temperature and ambient temperature will be displayed, printed, and saved in the selected units.

3) GAS MEASURING UNITS: When the cursor is blinking on this line, you can select any of the following units of measurement for the toxic gas sensors:
   - PPM: Parts per million (volumetric)
   - PPB: Parts per billion (volumetric)
   - MGM: Milligrams per cubic meter (weight)
   - µGM: Micrograms per cubic meter (weight)

   Note: Formaldehyde, Ozone and VOCs will always read in PPB (parts per billion)

4) PRESSURE UNITS: Pressure measurements can be shown in millibar (mbar), inches of water (inWC), millimeters of water (mmWC), millimeters of mercury (mmHG), inches of mercury (inHG), pounds per square inch (psi) or kilopascal (kPa).

   1 mbar = 0.10 kPa = 0.40 inWC = 10.2 mmWC = 12.95 inHg = 0.75 mmHg = 1.45 PSI

5) VELOCITY UNITS: (Velocity Option) Select between feet per second (FPS), meters per second (MPS), cubic feet per minute (CFM), or cubic meter per minute (CMM).

AIR VELOCITY AND DIFFERENTIAL PRESSURE <u>CAN NOT</u> BE MEASURED SIMULTANEOUSLY. USER MUST CHOOSE <u>ONE</u> OR THE OTHER.

To change the selection, hit the **SETUP** key. Using the **DOWN** arrow key, scroll Down to **VELOCITY PROBE** and hit **OK**. The **OFF/ON** selection will be highlighted. Use the Up & Down arrow keys to change the selection from OFF to ON or vice versa. With the Velocity Probe Selection **OFF**, the Si-AQ Expert will measure **Differential Pressure (ΔP)** automatically. With the Velocity Probe Selection **ON**, the Si-AQ Expert will measure **Air Velocity (VEL)** automatically. When you have your selection chosen, hit the **OK** button and the entire Velocity Probe will be highlighted again. Hit the **MEASURE** Button to get back to the Main Measurement screen once you are complete.

6) DUCT SIZE: (Velocity Option). Estimate the cross-section area of your Ducts in square inches (in^2) and set this value to obtain automatic & accurate Air Flow measurements in m/s or m^3/min.

NOTE: When using the Velocity Feature on the Si-AQ Expert it is recommended to ZERO the readings BEFORE using the Pitot tube to ensure proper Velocity measurements. See Chapter 9 for instructions on Zeroing the Si-AQ Expert. (Zero Gas Sensors)

Connecting Pitot Tube: In air conditioning, heating and ventilating work, it is helpful to understand the techniques used to determine air velocity. In this field, *air velocity* (distance travelled per unit of time) is usually expressed in meters per second (m/s). By multiplying air velocity by the cross section area of a duct, you can determine the air volume flowing past a point in the duct per unit of time. *Volume flow* is usually measured in cubic meters per minute (m^3/min). To make Air Velocity measurements using the Si-AQ Expert, you will need to use the *Optional* 12″ Pitot tube. Follow Steps #5 & #6 above to (1) turn the Velocity Probe option ON (VEL will appear on the unit's main screen) and (2) set up your Duct Size. Connect the supplied hoses from the Pitot tube to the WHITE (-) and/or (+) PRESSURE connections on the Front of the Si-AQ Expert.

7) PUMP: Pump status is displayed:
   a) AUTO - Automatic sample mode is selected
   b) OFF – The internal Pump is turned off.

8) DISPLAY CONTRAST: Select the best value for viewing the LCD screen.

9) BAUDRATE: The communication speed for both the USB port and the Bluetooth® connection is set here. The default setting is 115 kbps.

CHAPTER 7

INTERNAL DATA STORAGE

The STORE MENU allows the operator to store data and manage the internal storage tags.

```
Store Current Buffer
Select Buffer
Start Average Test
Start Periodic Store
Select Interval: 1m
Review Buffer
Name Buffers
Erase Buffers
00: TAG#00
```

The Si-AQ Expert has 2000 internal storage tags. Each tag stores one complete set of air quality data. There are two ways to store air quality data to the monitor's buffer. You can either store data by selecting the option STORE CURRENT DATA after pressing the **STORE** key, or alternatively you can make use of the monitor's capability of storing data automatically on a periodic basis. You can set the time period between data storage. The STORAGE MENU shows the relevant display lines for the storage options.

1. STORE CURRENT BUFFER: The monitor will store one set of data into the tag currently selected. The index number and the name of this tag appear at the bottom of the screen.

2. SELECT BUFFER: Selecting this item will display an index of the monitor's 2000 internal storage tags. Tags that are used have an icon next to their index number. The selected storage tag is indicated by the reverse colour line. When data is stored, this pointer will automatically advance to the next available tag. If you want to store data in a different location, use the UP, DOWN, & OK keys to select a new tag. As you scroll up and down, tags containing data show their date and time at the bottom of the display. Empty tags show the word empty.

3. START AVERAGE TEST: This will begin a period of data averaging, with the average values stored periodically in successive memory tags. The interval between each storage cycle is displayed below and can be set by the user. Once enabled, this line will read: STOP AVERAGE TEST.

4. START PERIODIC: This will turn on the periodic store function. In this mode, the unit will continuously store data at an interval displayed on the next line. Once enabled, this line will read: STOP PERIODIC.

5. SELECT INTERVAL: The time between each store is set here. This can range from 10 seconds to 60 minutes.

6. REVIEW BUFFER: This choice allows you to view previously saved data. Press **OK**. The display will switch to the data screen, with the data in the first tag displayed. The time and date when the data was saved will appear at the bottom of the display. Use the **UP / DOWN** keys to scroll through the tags.

7. NAME BUFFERS: This choice will take you to another screen where you can rename one or more tags. This is useful if you use several tags together to form a test series. Select the starting test index with the **UP / DOWN / LEFT / RIGHT** keys and press **OK**. Next, select the ending test index. The cursor will move to the first character of the first tag's name, and the alphanumeric keyboard will appear. Use the **UP / DOWN / LEFT / RIGHT** keys to navigate around the keyboard and press **OK** to select the letter or number. For lower-case letters, highlight `shift` and press **OK**, for symbols, highlight `sym` and press **OK**. The arrows in the corner will move the cursor forward or backward through the tag's name.

```
*** NAME  BUFFERS ***
Starting Tag: 00
Ending Tag:  00
Name:xxxxxxxxxxxxxxxx
1 2 3 4 5 6 7 8 9 0 ◄
A B C D E F G H sym ►
I J K L M N O P shift
Q R S T U V W X Y Z
```

8. ERASE BUFFER: This option is used to erase stored data. Data that has been stored in the monitor's memory will be retained even after the instrument has been shut off and its batteries removed. To erase the contents of a specific tag, use the **UP / DOWN** keys to move the arrow to the desired tag. As you scroll up and down, tags containing data show their date and time at the bottom of the display. Empty tags show the word empty. If you wish to erase all 1000 of the monitor's stored data, move the arrow to the entry ALL TAGS and press **OK**.

WIRELESS REMOTE PRINTER

The Si-AQ Expert uses a wireless Bluetooth® remote printer. The printer is powered by a rechargeable battery. An AC charger is supplied with the printer. The printer is optional with the Si-AQ Expert.

First you must turn the printer on. Then press **PRINT** to scan and connect with your wireless printer to establish communications between the monitor and the printer.

```
* WIRELESS PRINTERS *        * WIRELESS PRINTERS *        * WIRELESS PRINTERS *
 Scan for printers            Device Found                 Device Connected
 Press OK to search           Press OK to Connect          Press OK to Continue
                             Device 1:001122334455        Device 1:001122334455
```

When you have connected successfully the printer's green status light will turn on. Pressing the **PRINT** key will now display the PRINT MENU.

The PRINT MENU allows the user to print test records.

```
Print Test Record
Start Test Log
   Log Interval: 60s
Print Buffer
Configure Record
Edit Customer Name
Calibration Record
Paper Feed On/Off
Mobile Printer...
```

```
Ⓢsauermann®

Serial #: 000000
Company Name

  TEST RECORD

AUG  1 '14  12:45:00

      CO2:   XX.X %
       CO: XXXX PPM
T ambient:  XXX °F
       RH: XX.X %
      DPt:  XXX °F
      WBT: XXXX °F
       BP: XXXX psi
   Oxygen: XX.X %
       NO: XXXX PPM
      NO2: XXXX PPM
      NOx: XXXX PPM
      SO2: XXXX PPM
      H2S: XXXX PPM
       O3:  XXX PPM
      VOC:  XXX PPM
```

PRINT TEST RECORD: This option will print a test record of the current air quality parameters.

PRINT TEST LOG: This option begins a log of the following air quality parameters: CO_2, Temperature, %RH, Wet Bulb, Dew Point, Barometric Pressure, Oxygen, Carbon Monoxide, VOCs, etc.

LOG INTERVAL: This selects the interval between each log entry. The interval can be set between 1 and 60 seconds.

PRINT BUFFER: This option is used to print data stored in the monitor's memory. Each line corresponds to one storage tag. Tags containing data show an icon next to the index number. When you scroll up and down, the date (mm/dd) and time (hh/mm) when the data was stored appear at the bottom; empty tags show the word "empty". To print the contents of a specific tag, use the **UP / DOWN** keys to move the arrow to the desired tag and press **OK**. If you wish to print the entire monitor's stored data in sequence, move the arrow to the entry ALL TAGS and press **OK**.
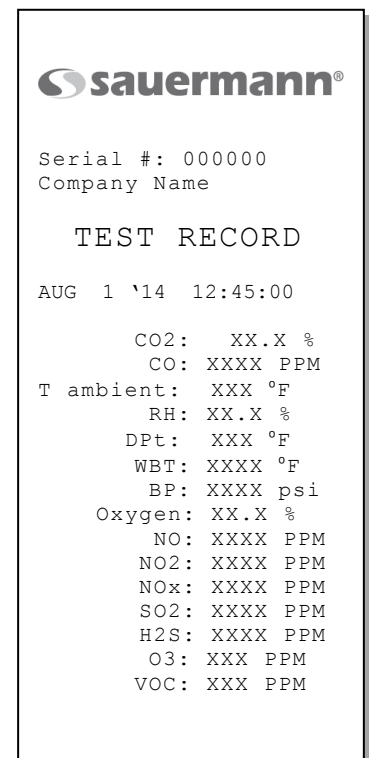
CONFIGURE RECORD: This option allows the user to add, delete, or change the order of the parameters that appear on the paper print out.

EDIT CUSTOMER NAME: This will display a screen where you can change the information printed at the top of each printout. Usually the customer's name or the operator's name appears here. To edit this information, use the **UP / DOWN / LEFT / RIGHT** keys to navigate around the keyboard, and press **OK** to select the letter or number. For lower-case letters, highlight `shift` and press **OK**, for symbols, highlight `sym` and press **OK**. The arrows in the corner will move the cursor forward or backward through the name.

```
** EDIT HEADER INFO **
 SAUERMANN SI-AQ EXPERT


1 2 3 4 5 6 7 8 9 0 ◄
A B C D E F G H sym ►
I J K L M N O P shift
Q R S T U V W X Y Z
```

CALIBRATION RECORD: This option will print a record of each sensor's last calibration, including the date of calibration and span gas value used.

PAPER FEED: This toggles the printer's motor on and off, advancing the paper out the top of the printer as needed. The motor will not turn on if there is no paper present.

MOBILE PRINTER: The WIRELESS PRINTERS screen will appear. You can disconnect your current Bluetooth® connection and connect to another printer in range.

ZERO & SPAN CALIBRATION

> **NOTE: CO₂ should <u>ALWAYS</u> be Span Calibrated or Zeroed with a Cylinder of ZERO AIR ONLY.**

Every instrument must occasionally be tested against some known value or standard in order to make sure that its accuracy has not deteriorated. If the instrument is reading outside of the stated accuracies in this manual, the unit should be calibrated by following the procedures described in this chapter.

This chapter will contain all the information on calibrating and adjusting the Si-AQ Expert IAQ Monitor. The term Span Calibration means comparing the Si-AQ Expert's readings to a standard concentration (i.e.: calibrated gas bottles) and adjusting/changing the Si-AQ Expert's individual sensor's readings to match the standard concentration for the most accurate measurements. The term ZERO calibration refers to the user's ability to calibrate each sensor with zero concentration of the targeted gas. See Chapter 11, Maintenance, for recommended frequencies of each procedure.

If the unit is returned to Sauermann for Span Calibration, the unit will be shipped back after Calibration with a new Calibration Certificate valid for one (1) year. If the unit is Span Calibrated in the field, the original calibration certificate is no longer valid.

> **NOTE: Please take special care when performing Calibration of the monitor. You cannot revert back to the factory setting after any adjustments!**

```
**** CALIBRATION ****
 Zero Gas Sensors
 Zero CO2 Sensor
 Zero Thermocouples
 Zero Errors
 Zero Time:  60sec
 Span Time: 120sec
 ** Span Lockout **
 Sensor History
 Span CO:   xxxx PPM
 Span H2:   xxxx PPM
 Span CO2: xxxx PPM
 Span NO:   xxxx PPM
 Span NO2: xxxx PPM
 Span SO2: xxxx PPM
 Span H2S: xxxx PPM
 Span FMH: xxxx PPB
 Span Ozone:xxxx PPB
 Span VOC: xxxx PPB
 Span Velocity: xx "
 Span ΔP:   xx "
 Span AmbT: xx.x C
 Span BP:   xxxx mbar
 Span RH:   xx.x %
 Cal Thermcple1:xxxF
 Cal Thermcple2:xxxF
```

The CALIBRATION MENU lets you set span calibration values for each sensor and performs all sensor calibrations. The CALIBRATION MENU is shown below

A brief explanation of the parameters shown follows below:

ZERO GAS SENSORS: This will set the zero point of CO, NO, NO₂, SO₂, H₂S, CH₂O, O₂, VOCs, Pressure & Velocity values.

ZERO CO₂ SENSOR: This will set the zero point of CO₂.

ZERO THERMOCOUPLE: This calibrates the external thermocouple input (T1) to ambient temperature.

ZERO ERRORS: This will display a list of sensors that were out of the monitor's acceptable range during the last zero countdown.

ZERO TIME: This is the countdown time for the zero procedure. The zero cycle time should set at 20-60 seconds.

SPAN TIME: When carrying out a span calibration, you must introduce the span gas for an appropriate amount of time before the monitor executes the span calibration. This setting, which is the same for all sensors, controls this time interval. The span time is indicated in seconds.

SPAN LOCKOUT: This controls access to the remaining span calibration menu options. Span lockout prevents accidental or mistaken calibrations. Span lockout is enabled and disabled by entering a 4-digit code.

SENSOR HISTORY: The date that each sensor was installed is displayed, along with the date the sensor was last calibrated and the span gas concentration used.

SPAN XXXX: The remaining lines of the CALIBRATION MENU are used for carrying out span calibrations of the CO, CO_2, NO, NO_2, SO_2, H_2S, Ozone, Formaldehyde, VOCs, and Velocity sensors. For detailed use of these settings, please refer below.

A. ZEROING THE SI-AQ EXPERT

Select **CALIB** key to go into Calibration Mode

There are two (2) methods to Field-Calibrate the GAS & CO_2 Sensors on the Si-AQ Expert.

      (i)   ZERO Gas Sensors using the **ZERO AIR CYLINDER** and Moisture Exchange Tube (Si-AQ Moisture Exchange) (to zero ALL gas sensors)
      (ii) Using the Si-AQ VOC Zero Filter to ZERO the VOC gas sensor in **AMBIENT AIR** (except the CO_2 sensor)

    1. ZEROing ALL GAS Sensors using a certified CYLINDER of ZERO AIR

If you have a gas cylinder/bottle of ZERO AIR, you can use this for Zeroing ALL the gas sensors in the Si-AQ Expert. If you do not have this cylinder, please contact Sauermann to purchase our optional Calibration Kit consisting of ZERO AIR & regulator for proper calibration of the Si-AQ Expert (part #: Si-AQ Calibration Kit).

ZERO GAS SENSORS: This will set the zero point of CO, NO, CH_2O, NO_2, SO_2, H_2S, O_2, and VOCs values. Connect Cylinder to the "A" inlet connection on the bottom of the Si-AQ Expert using the optional accessories included in the CALIBATION KIT (Part #: Si-AQ Calibration Kit). See CALIBRATION APPARATUS section below for how to connect. For Best Results, use the Si-AQ Moisture Exchange – Moisture Exchange Tube accessory for ZERO Air Calibration. See Section C below under Calibration Apparatus for more information on the Moisture Exchange Tube.

ZERO CO_2: This will set the zero point of CO_2. **You must use cylinder of ZERO AIR for CO_2 ZERO CALIBRATION**.

    –   Connect Cylinder to the "Sample In" pump inlet connection on the front of the Si-AQ Expert using the optional accessories included in the CALIBATION KIT (Part #: Si-AQ Calibration Kit). See CALIBRATION APPARATUS section below for how to connect.
    –   Open ZERO AIR Flow and let ZERO AIR flow to the Si-AQ Expert for about 30 seconds. Verify that the CO_2 is decreasing on the instrument. If the CO_2 is NOT decreasing, check the flow from the bottle to make sure it is open.
    –   After 30 seconds, Select the CALIBRATION button on the Si-AQ Expert

- Scroll down using down arrow key and have the cursor (reverse colour) point to the line

```
Zero CO2 Sensors
```

- Press the **OK** key to execute a zero cycle of the CO_2 Sensor. The monitor will count down from the Zero Time setting as explained above. This process should take 30 seconds.

If no error messages appear at the end of the countdown, disconnect calibration apparatus from the Si-AQ Expert

2. **ZEROing VOC & Gas Sensors using Si-AQ VOC Zero Filter (with the exception of CO_2) in AMBIENT AIR CONDITIONS**

Turn the unit and let the instrument WARM UP for a minimum of 5 minutes.

If the sensor has been stored for a significant amount of time, it may have been exposed to ambient conditions that may cause the sensor to exhibit a drifting characteristic of the baseline signal. After prolonged storage, it is recommended to power on the sensor for a period of time before operating it. The detector will clean itself and the baseline signal will drop and stabilize. If the sensor is used on a daily basis, the user should let it stabilize before use.

In order to zero the gas sensors (except CO_2) in Ambient Air, insert the **Si-AQ VOC Zero Filter** into the "Sample In" inlet on the front of the Si-AQ Expert and ensure that the opening on the bottom end of the filter is not blocked. Allow the unit to run with the filter connected for at least 30 seconds before continuing, this ensures that any potential contaminants inside the unit are purged.

Press the **CALIB** key and have the cursor (reverse colour) point to `Zero Gas Sensors:`
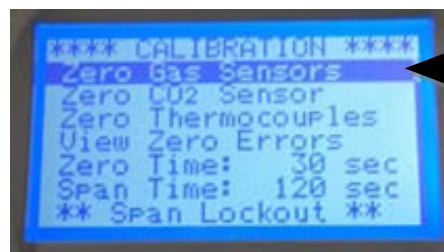
Press the **OK** key to execute a Zero cycle of all the gas sensors while the instrument is running in ambient air. This procedure should last 60 seconds.

At the end of the zero period the Si-AQ Expert reads the output of all gas sensors (except the CO_2 sensor) and sets them all to zero, with the exception of the Oxygen (O_2) that it sets to 20.9%.

If no error messages appear at the end of the countdown, place the Si-AQ VOC Zero Filter into a sealable bag to prevent moisture from entering it and proceed with your measurements.

ZERO THERMOCOUPLE: This calibrates the one external thermocouple input (T1) to ambient temperature.

Be sure the Thermocouples being testing are at room temperature before Calibrating

To start the zero procedure, press the **CALIB** key and select ZERO Thermocouples.

B. SPAN CALIBRATION
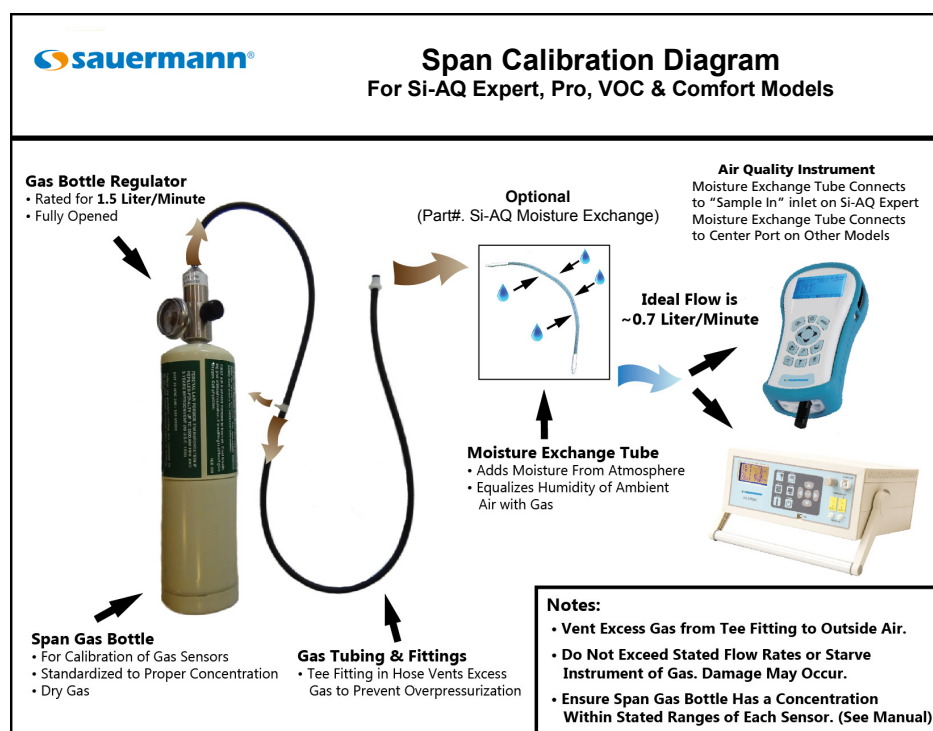
Sauermann recommends performing a span calibration of the instrument once every 6 months for maximum accuracy, or at a minimum of once per year. The parameters that require a span calibration are: carbon monoxide, carbon dioxide, nitric oxide, nitrogen dioxide, sulfur dioxide, hydrogen sulfide, oxygen, formaldehyde, and VOCs. You can carry out all span calibrations in sequence.

NOTE: You must always span calibrate the instrument when a sensor is replaced.

Span calibration using your own gas

If you wish to use your own span gas to perform span calibrations, you must take certain precautions and follow the instructions below carefully in order to calibrate the sensors properly.

Notice that you will need a number of certified gas cylinders. Make sure that you use a bypass flow meter as shown below in the CALIBRATION APPARATUS section, in order to supply an adequate flow of span gas without developing excessive or insufficient pressure on the sensors.

Make sure the concentration of the calibration gas is within the range of each sensor. <u>Do not use gas that will over-range the sensor</u>.

The CO span gas can be in the range of 30 - 200 PPM, 2% accuracy with balanced nitrogen, preferably.

The NO span gas can be in the range of 10 - 200 PPM, 2% accuracy with balanced nitrogen, required.

The NO_2 span gas can be in the range of 10 - 20 PPM, 2% accuracy with balanced nitrogen or air.

The SO_2 span gas can be in the range of 10 - 20 PPM, 2% accuracy, with balanced nitrogen, preferably.

The VOC (Isobutylene) span gas can be in the range of 0 - 10 PPM, 2% accuracy with balanced air.

The CH_2O (Formaldehyde) span gas can be in the range of 0 - 2 PPM, with balance nitrogen, preferably.

The H_2S span gas can be in the range of 10 - 20 PPM, 2% accuracy, with balance nitrogen, preferably.

The CO_2 span gas can be in the range of 2500 PPM, 2% accuracy, with balance air

Make sure the concentration of the calibration gas is within the range of each sensor. <u>Do not use gas that could over-range the sensor</u>.

For greatest accuracy, it is recommended that you use a span gas value close to the gas concentration you <u>expect to measure</u>.
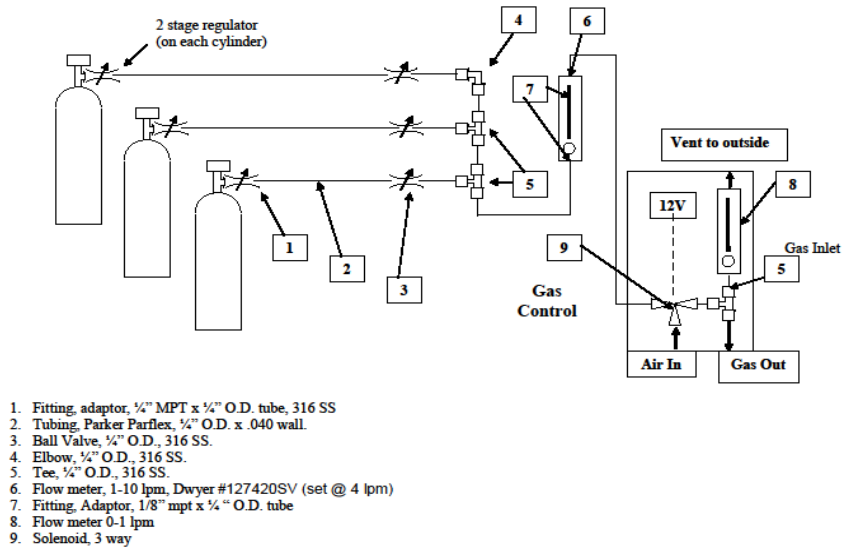

C. CALIBRATION APPARATUS

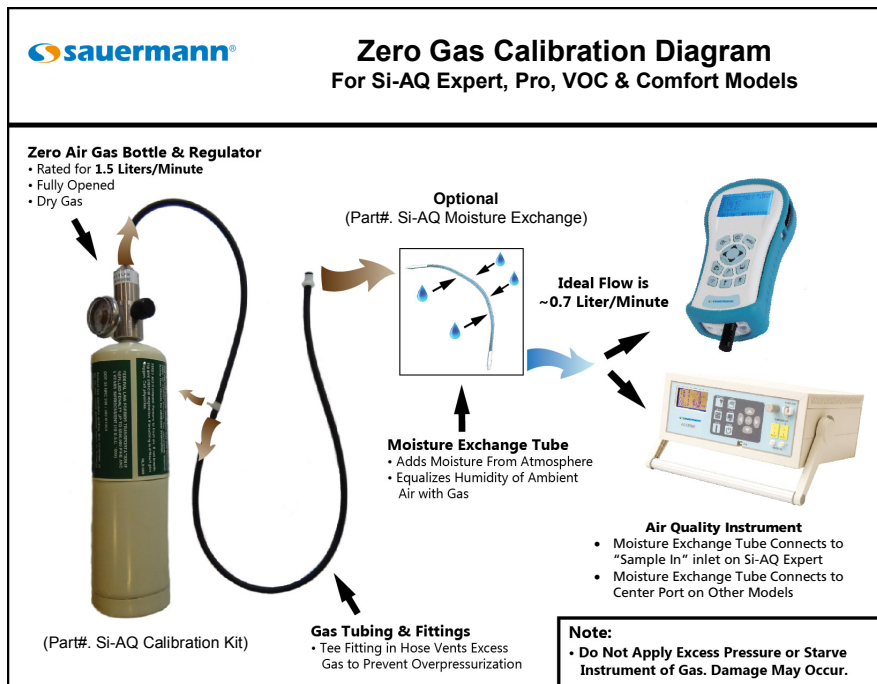| **TO SPAN CALIBRATE THE MONITOR, IT IS BEST TO USE ONLY SINGLE GAS MIXTURES WITH EITHER NITROGEN OR AIR BALANCE.** |
| --- |

During calibration an adequate flow of span gas must be supplied without developing excessive pressure on the sensors. A compressed cylinder of span gas must be equipped with a primary pressure regulator. Connect the regulator of the bottled gas to the Si-AQ Expert "Sample In". A simple way to feed the span gas to your monitor is by <u>an open T-connection</u> that will ensure that gas is fed at ambient pressure. The regulator valve is used to control the flow of gas to the monitor. To ensure that the span gas is fed properly and as efficiently as possible, connect a bypass flow-meter at the outlet. Adjust the regulator to maintain approximately 750 cc/min of flow at the outlet.

You must not feed gas to the SI-AQ EXPERT under pressure and you must not starve the SI-AQ EXPERT's pump for gas. When feeding the gas, you must maintain a reasonably constant pressure, near ambient pressure.

Gas Calibration Fixture

1. Fitting, adaptor, ¼" MPT x ¼" O.D. tube, 316 SS
2. Tubing, Parker Parflex, ¼" O.D. x .040 wall.
3. Ball Valve, ¼" O.D., 316 SS.
4. Elbow, ¼" O.D., 316 SS.
5. Tee, ¼" O.D., 316 SS.
6. Flow meter, 1-10 lpm, Dwyer #127420SV (set @ 4 lpm)
7. Fitting, Adaptor, 1/8" mpt x ¼" O.D. tube
8. Flow meter 0-1 lpm
9. Solenoid, 3 way

ZERO AIR Gas Bottle Calibration

Zero Gas Calibration Diagram
For Si-AQ Expert, Pro, VOC & Comfort Models

Zero Air Gas Bottle & Regulator
• Rated for **1.5 Liters/Minute**
• Fully Opened
• Dry Gas

Optional
(Part#. Si-AQ Moisture Exchange)

Ideal Flow is ~0.7 Liter/Minute

Moisture Exchange Tube
• Adds Moisture From Atmosphere
• Equalizes Humidity of Ambient Air with Gas

Air Quality Instrument
• Moisture Exchange Tube Connects to "Sample In" inlet on Si-AQ Expert
• Moisture Exchange Tube Connects to Center Port on Other Models

(Part#. Si-AQ Calibration Kit)

Gas Tubing & Fittings
• Tee Fitting in Hose Vents Excess Gas to Prevent Overpressurization

Note:
• Do Not Apply Excess Pressure or Starve Instrument of Gas. Damage May Occur.

D. CALIBRATION PROCEDURE

The following page illustrates the sequence of keystrokes to carry out a span calibration of the Si-AQ Expert. It is assumed that the instrument has been zeroed and there have been no error messages.

Electrochemical Gas & PID VOC Sensors
1. Turn the Si-AQ Expert on and press OK to perform a zero. Allow the instrument to warm up for 15 minutes and repeat the zero.

2. Connect the outlet from the tee fitting of the gas calibration fixture to the connector on the front of the monitor labelled "SAMPLE IN" using the set up shown on the following figure:

> **NOTE: Please take special care when performing Calibration of the monitor. You cannot revert back to the factory setting after making any adjustments!**

3. Turn on the gas flow and observe the gas readings on the instrument. If the gas reading for the sensor being calibrated does not increase after a few seconds, turn off the gas flow until the problem is found. Otherwise, press OK.
4. Press the key labelled "**CALIB**" to enter the calibration menu.
5. Scroll down to the **SPAN TIME** and set the value to *20 seconds*.
6. Scroll down to the sensor to be calibrated. If the calibration lock is on, enter the password **1315**.
7. Use the arrow keys to enter the span value printed on the calibration cylinder. Press OK.
8. Turn on the gas flow and observe gas readings. If the gas reading for the sensor being calibrated does not increase after a few seconds, turn off the gas flow until the problem is found. Otherwise, press OK.
9. When the countdown reaches 3 seconds, there will be a series of beeps. Verify that the reading for the sensor being calibrated matches the value entered in the calibration menu, and that the reading for all the other sensors is zero. Turn off the gas flow.
10. Repeat this procedure for each electrochemical sensor to be calibrated.
11. After all the sensors are calibrated, turn the unit off and back on again, and perform a zero.

Temperature, Humidity and Barometric Pressure

Please contact Sauermann for proper Calibration Procedure

Pressure and Air Velocity Calibration Procedure

1. Connect a pressure calibration standard to the pressure (+) connector on the front of the instrument.
2. In the SETUP menu, make sure the velocity sensor is off.
3. Press the "CALIB" key to enter the calibration menu.
4. Scroll down to SPAN ΔP and press OK.
5. Using the calibration standard, generate a pressure value near the maximum stated value for the scale being used, for instance 80 mbar if using the mbar range.
6. Enter the value generated as the span value using the arrow keys and press the enter key.
7. Verify that the reading on the instrument matches the reading on the calibration standard.

E. VOC SENSOR CLEANING PROCEDURE

Depending on the applications and usage, the VOC sensor should be cleaned every 6 months – 1 year.

Warning: All maintenance procedures must be performed on a clean surface using clean tools. Avoid touching the lamp's window as well as the metalized portion of the Cell Assembly with your bare fingers.

Fingerprints left on these parts may adversely affect the sensors operation. Latex gloves are preferred, but if they are not used, your hands must be clean and free of oils, lotions, etc. It is acceptable to hold the lamp by its glass body or by the edges of the window.

Tools Required
- Fine-Tipped Tweezers
- Latex Gloves (Optional)

Disassembly

1. Power down the instrument according to the User's Manual and remove the sensor from the instrument.

2. Remove the Filter Cap by applying slight upward pressure with the tip of the tweezers just below the hole in the cap and between the cap and housing, it will pop off.
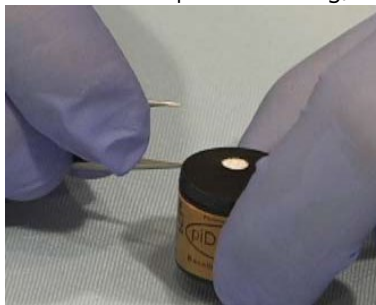
3. With tweezers, remove both the Filter Media and set aside.

4. Using the tweezers, remove the spacer and set aside.

5. With tweezers, carefully remove the Cell Assembly by prying under the Cell's edge where connector pins are located.

6. With tweezers, grasp the lamp by placing the tips in the housing notch and gently pull it out. Be careful not to scratch the lamp lens or chip edges.

Cleaning the Lamp

Grab the lamp by the cylindrical glass body and clean the window by rubbing it against the Polishing Pad. Use a circular motion and try to keep the window surface flat relative to the pad. Five seconds of rubbing will be enough in most cases. Another indication of cleaning completeness is that you have used about 1/6th of the pad's surface during the procedure.

Reassembly

1. Install the lamp into the sensor, making sure that the lamps metalized pads are aligned with the corresponding excitation springs inside the lamp cavity.
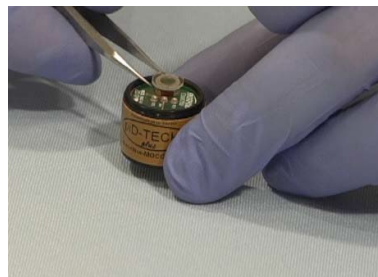
2. Using a padded swab, press the lamp down firmly. Be careful not to scratch the surface of the lamp.

3. Using fine-tipped tweezers, install the cell assembly. Align the pins with the corresponding sockets on the sensor and push down on the end with the pins. Make sure the cell assembly is flush with the lamp window.

4. Place the spacer around the cell assembly.

5. Place the Filter Media over the Cell Assembly centred on top of the sensor. Make sure the filters are installed in the correct order. The Cotton Filter first, then ½ of the Teflon Filter on top, with the shiny side up, placed over the Cell Assembly.
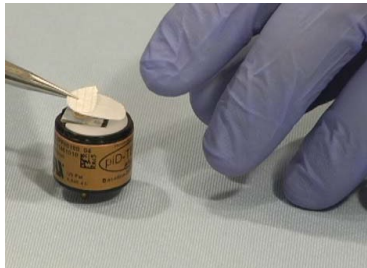
6. Alight the Cap Key with the notch on the housing. Starting at the side opposite the notch, press down until the Filter Cap snaps on to the housing. If the Cap Key is incorrectly aligned, there will be a noticeable bulge on the side of the cap.

CHAPTER 10

SI-AQ PCSOFT SOFTWARE

1. COMMUNICATIONS

The Si-AQ Expert Monitor communicates with a PC either using the USB cable or wirelessly using its internal Bluetooth® (BT) module. If your computer does not have internal BT capabilities, use the external BT module that is supplied with the Si-AQ Expert.

The communication protocol is as follows:
>BAUD RATE: 115000 baud
>FORMAT: 8 bits, 1 stop bit, no parity
>HANDSHAKE: None

USB CONNECTION

For USB connections, use the A-to-B type USB cable supplied with the instrument. To establish a USB connection, the FTDI USB driver must first be installed on your computer. The USB drivers for Windows computers are located on the SAUERMANN USB Thumb Drive:

- When you plug the USB cable from the computer to the monitor, you should hear a small "da-ding" sound indicating that the USB connection has been made.
- If you have the FTDI USB driver already installed in your computer, the computer will know and will NOT initialize the "New Hardware Wizard".
- If the New Hardware Wizard appears you need to install the FTDI USB driver. To install this driver:
  1. Locate the FTDI USB driver on the CD and save it to your desktop.
  2. Follow the instructions in the New Hardware Wizard
  3. You will have to go through the wizard **twice**, once to install the ftdiport.inf file and once for the ftdibus.inf file.

BLUETOOTH® CONNECTION

For Bluetooth® connections, the connection process varies with different Bluetooth® devices. Follow your manufacturer's instructions for adding a device. The SAUERMANN' Bluetooth® modem is a Class 1 device, with a maximum range of 100 m. Obstacles such as walls and equipment will reduce the effective range.
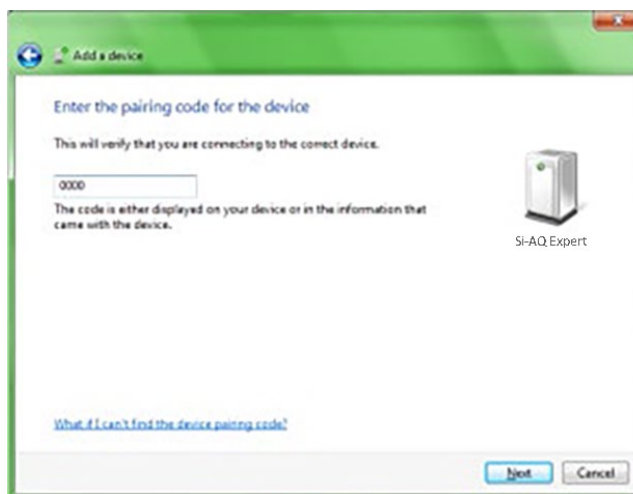
1. Turn your instrument on, and it will appear on the screen after a few moments. Select it from the list and click Next.
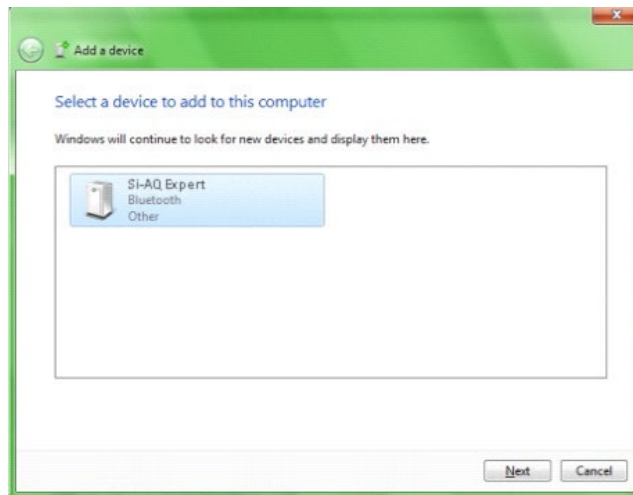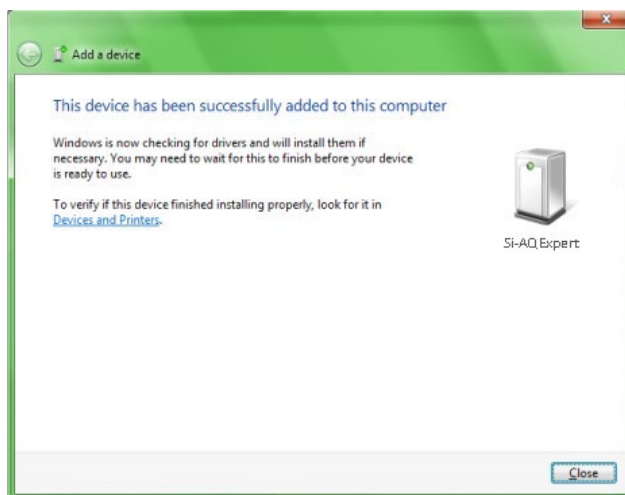

2. On the next screen, select "Enter the device's pairing code" and click Next.
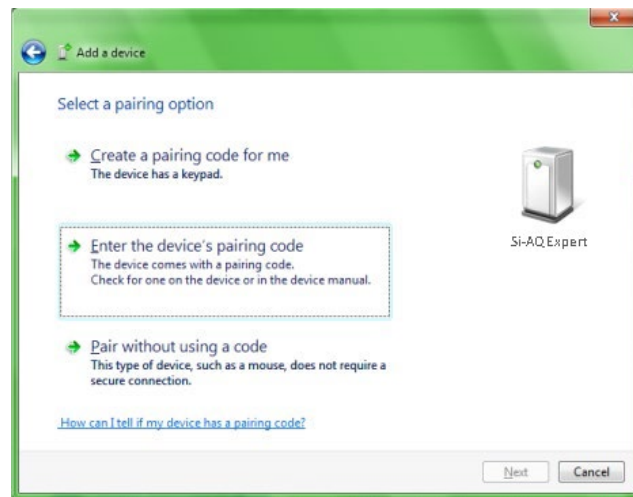
3. Enter the pairing code "**1234**" or "**0000**" (four zeros) into the empty field & click Next.

4. Paring will complete and the PC to instrument communication drivers will be automatically installed.

ALL CONNECTIONS

When you connect your monitor to your computer for the first time, the connection will be assigned a unique comport number. Remember the c*omport* number as it will be needed to open an SI-AQ PCSOFT session.

You can find the *comport* associated with your SAUERMANN in the Windows Device Manager.

To open the Device Manager:
- Go to the Windows "START" menu, click "RUN" and type **devmgmt.msc** (Or go to the Control Panel, choose the System icon, then the Hardware tab, and click the Device Manager Key).
- A window will open that will list "PORTS" among other items. Click on "PORTS".
- The comport will be listed as:
  o USB Serial Port **(USB)**
  o Standard Serial over Bluetooth® link **(Bluetooth®)**
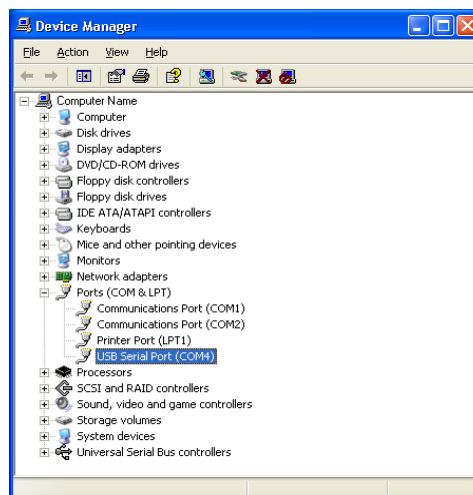
2. SI-AQ PCSOFT SOFTWARE

You can enhance the performance and versatility of the SAUERMANN SI-AQ EXPERT by using the SI-AQ PCSOFT software program. SI-AQ PCSOFT is available for most Windows operating systems.

The SI-AQ PCSOFT software is a robust package that allows you to:
1. Monitor all Air Quality parameters.
2. Record maximum, minimum, average for all Air Quality parameters.

3. Select a variety of saving and printing options.
4. Retrieve stored data.
5. Set alarms for every air quality parameter including recording the time duration that alarms have been exceeded.
6. Plot bar graphs and time plots of all air quality parameters.

**The SI-AQ PCSOFT software can be downloaded from the included USB Thumb Drive.**

Windows 8 users may have to load drivers from the following link:
http://www.makeuseof.com/tag/how-can-i-install-hardware-with-unsigned-drivers-in-windows-8/

Consult the SI-AQ PCSOFT manual for details on installing and operating the program. The manual can be accessed by clicking on "Help" and then "How Do I…" in the SI-AQ PCSOFT software program.

STARTING SI-AQ PCSOFT

1   Before starting Si-AQ PCSoft, have your monitor turned on and connected via USB or Bluetooth®.

2   Start SI-AQ PCSOFT. If you have connected before, the monitor icon will appear. If this is the first time you are connecting you will need to add a new port.

3   On the SI-AQ PCSOFT window click on "Connections", then click on "Add Port".
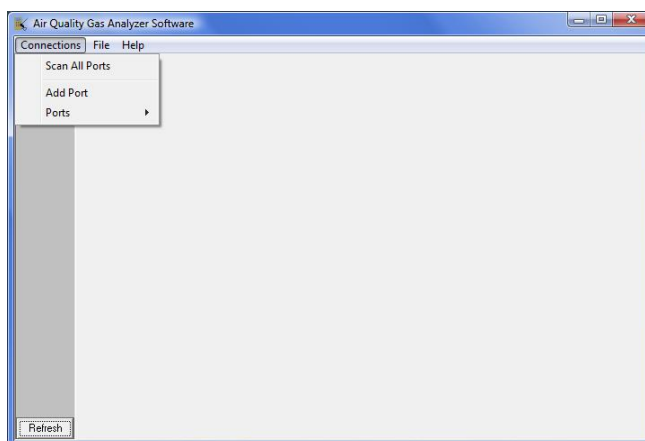
4   Enter the COM port number which appeared in the Device Manager and click "OK".

5   The COM port with its number should appear on the left side of the SI-AQ PCSOFT window. SI-AQ PCSOFT will look for a monitor on this port. After a moment the SAUERMANN monitor icon should appear. You are now connected to your monitor.

6   Click on the SAUERMANN icon. A menu will appear. Choose "Monitor" from the menu. *(Follow the SI-AQ PCSOFT manual for further instructions).*
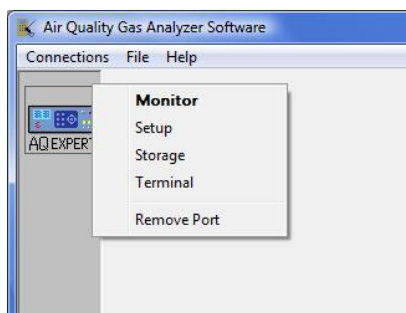
CHAPTER 11

MAINTENANCE

The Si-AQ Expert Indoor Air Quality Monitor is a sophisticated analytical instrument designed to perform accurate air quality measurements. However, because the monitor is a portable, field/lab used instrument that can be used in many environments, care must be taken to prevent physical and environmental abuse to help maintain trouble-free operation.

There are some of the components that will require periodic inspection or replacement. These are:

1. The disposable fiber line filter for particulates, located inside the of the monitor
2. The disposable round disk condensation filter for moisture, also located inside the of the monitor
3. Gas sensor periodic replacement / Calibration
4. Printer paper replacement (separate optional wireless printer)

INTERVAL	ITEM	PROCEDURE
Weekly	ZERO Check of ALL Gas Sensors	Perform using ZERO AIR
Weekly	ZERO Check of the CO_2 Sensor	Perform using ZERO AIR
6 Months	Inlet & Moisture Filters	Check and/or Replace
Annually	SPAN Calibration of ALL Gas Sensors	Perform or send to Factory

Note: These stated intervals are dependent on the unit's usage and applications

A. Fiber Line Filter and Condensation Disk Filter Replacement

The disposable fiber line filter is located inside the monitor located right in line with the sampling pump. Its function is to prevent dirt & dust particles from reaching the monitor's pump and sensors. The disk condensation filter is also located in the same area directly behind the fiber line filter. Its function is to prevent any residual water/moisture from penetrating into the sensor area.

You must replace the filters when they become discoloured or show any signs of cracks. **Never operate the Si-AQ Expert without these filters**.

Frequency of filter replacement depends on the application this instrument is being used in and the hours of active use.

To replace the filters, remove the top section of the instrument case (see section B below for more details on how to remove top section of the instrument) and disconnect the two pieces of flexible tubing that hold the respective filters in place. If you are replacing the disk filter, make sure that the filter's lettering is facing the front face of the instrument.

B. Sensor Replacement

This should be an infrequent operation, since the sensors have a typical life of a few years.
If you receive an error message for one of the sensors during instrument operation you may have to replace the sensor. Please contact Sauermann for replacement sensors. The user can send the unit back to the factory for sensor installation and re-calibration of the instrument or the sensors can be replaced in the field. The replacement sensors will be supplied with installation instructions.

> **NOTE: You must always span calibrate the instrument every time
> you replace a sensor.**

> **NOTE: CO$_2$ should <u>ALWAYS</u> be Calibrated or Zeroed with a Cylinder of ZERO AIR.
> Do Not Use Si-AQ VOC Zero Filter for CO$_2$ sensor calibration.**

To access the sensor compartment you must remove the top section of the instrument case. The top section of the monitor case is held to the bottom section by a total of four retaining screws. With both hands, slide off the vent covers on each side. Use a Philips screwdriver to remove both pairs of retaining screws (one pair on each side of the case). It is best to remove the bottom pair of screws first. Carefully lift the top of the instrument case together with the attached aluminum mounting shielding plate especially since the top & bottom cases pieces are connected with cables/wires. When the plastic case is open, be careful when near the main board because some of the resistors on the board can get significantly hot. The location of the gas sensors on the manifold is shown in the figure in Chapter 5.

To replace a sensor, locate its correct position on the manifold. Carefully lift the small PC board that is mounted on top of the sensor. Grab the sensor with your fingers and lift it twisting it out of its bayonet fitting.

Take a new sensor. Remove any springs that may be shorting the sensor pins. Install it on its mount and connect the small PC board on top of it.

Replace the top section of the case and secure it with the four screws.

Wait 30 minutes before zeroing the monitor:

Span calibrate the sensor as explained in Chapter 8. If you are installing a pre-calibrated sensor, use the following procedure:

1) While holding the **SETUP** key, press the **MEASURE** key three times. The display will show the sensor factors.
2) Press the **DOWN** key until you reach the appropriate sensor then press OK.
3) Use the **UP / DOWN** keys to enter the correct factor, digit by digit starting with the hundreds digit, press **OK** to move through the tens, ones, and tenths digits.

C. Printer Paper Replacement

The external printer uses a high quality 2" thermal paper. Keep any spare paper rolls in a cool dark place to prevent paper discoloration.

1) Press the open key on the printer to open the paper cover
2) Insert the paper as shown in the image. Remove any remaining core of a used paper roll.
3) Make sure to align the paper roll properly.
4) Pull the paper out as shown in the image and close the cover.
5) Tear off any excess paper in the direction of the side of the printer.
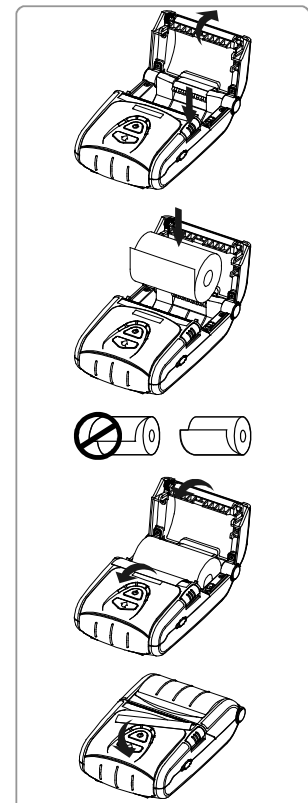
SI-AQ EXPERT OPTIONS

The SAUERMANN' SI-AQ EXPERT is an extremely versatile Indoor Air Quality (IAQ) measurement system that meets practically all Air Quality measurement requirements. It has been designed as a modular system, permitting the installation, in the field, of most of the various available options. This manual describes the complete instrument equipped with all the options.

The Si-AQ Expert's standard capabilities include Ambient Temperature, Relative Humidity, Wet Bulb, Dew Point, Barometric Pressure, two (2) separate Type K (TcK) thermocouple temperature measurement inputs, Air Velocity measurements, differential pressure measurements, 2000 internal storage tags, Bluetooth® wireless PC communications, REAL-TIME Data Logging capabilities using the included SI-AQ PCSOFT Windows software, USB Cable, and extensive user-friendly help screens. The available additional gas sensor options and accessories are:

1. AIR QUALITY MONITOR SENSORS*

- Carbon Dioxide (CO_2) – non-dispersive infrared (NDIR) sensor (0-20%)
- Carbon Dioxide (CO_2) – non-dispersive infrared (NDIR) sensor (0-5000 ppm)
- Carbon Monoxide (CO) – electrochemical sensor (0-200 ppm)
- Oxygen (O_2) - electrochemical sensor (0-25%)
- Nitrogen Dioxide (NO_2) - electrochemical sensor (0-20 ppm)
- Nitrogen Oxide (NO) - electrochemical sensor (0-250 ppm)
- Sulfur Dioxide (SO_2) – electrochemical sensor (0-20 ppm)
- Hydrogen Sulfide (H_2S) – electrochemical sensor (0-100 ppm)
- Formaldehyde (FMH-CH_2O) – electrochemical sensor (0-10 ppm)
- Ozone (O_3) – electrochemical sensor (0-5 ppm)
- Isobutylene (VOC) sensor – Photo ionization detector (PID Sensor) (0-20 ppm)
- Isobutylene (VOC) sensor – Photo ionization detector (PID Sensor) (0-200 ppm)

  *Note: When O_3 (Ozone) sensor is installed the Si-AQ Expert can include O_3 + NO_2 **OR** O_3 + SO_2.
  The unit can *NOT* have all three (3) sensors (O_3 + NO_2 + SO_2) together simultaneously.

2. OPTIONAL EXTERNAL MEASURING PROBE (Part #: Si-AQ Probe with Hose)

Certain applications might have the need for the optional probe (12″ long stainless steel probe with 10′ ft long hose) for hard to reach places, separate areas, etc. The probe consists of the stainless steel extraction probe, the sampling line and a Type K thermocouple for external temperature measurements with the probe.

This standard probe (Part # Si-AQ Probe with Hose) is suitable for temperatures up to 800ºC/1470ºF.

The end of the probe's sampling line connects to the SAMPLE IN quick disconnect connector of the Si-AQ Expert and the thermocouple connector connects to either of the yellow TEMPERATURE 1 or 2 inputs on the Si-AQ Expert.

3. OPTIONAL VINYL CARRYING CASE (Part #: Si-AQ Expert Vinyl Case)

4. OPTIONAL PITOT TUBES (Part #: Si-AQ Pitot Tube)

Pitot tube – This optional L-shaped pitot tube consists of stainless steel tubing with the tips open and bent at a certain angle to properly measure air and/or gas velocities. The Pitot tube must always be oriented with the open tips parallel to the direction of the air flow. The end of the Pitot tube assembly is connected by means of two flexible hoses to a very accurate pressure transducer located inside the monitor.

5. OPTIONAL DIFFERENTRIAL PRESSURE HOSES (Part #: Si-AQ Diff. Press. Kit)

This optional PRESSURE HOSES consist of two (2) clear hoses for either (1) single positive pressure connection, one (1) single negative pressure connection, or (2) hoses for differential pressure using both connections simultaneously. The hoses connect to the (-) and/or (+) PRESSURE connections on the Front face of the Si-AQ Expert.

6. OPTIONAL WIRELESS REMOTE PRINTER (Part #: Si-AQ Bluetooth® Printer)

The Si-AQ Expert uses a wireless Bluetooth® remote printer. The printer is powered by a rechargeable battery. An AC charger is supplied with the printer. The printer is optional with the Si-AQ Expert. See Chapter 8 for more information

7. OPTIONAL CALIBRATION KIT (ZERO AIR) (Part #: Si-AQ Calibration Kit)

The Si-AQ Expert uses a bottled Cylinder of ZERO AIR for ZERO Calibration.
Part #: **Si-AQ Calibration Kit** comes with (1) 17L ZERO AIR Cylinder & (1) Regulator
Part #: **Si-AQ Air** is replacement (1) 17L ZERO AIR Cylinder only

CHAPTER 13

BASIC TROUBLESHOOTING

ZERO ERRORS		
Channel	**Possible Causes**	**Resolution**
(Electrochemical sensors) CO NO NO_2 SO_2 H_2S CH_2O O_2 O_3	Sensor has been recently exposed to gas and has not yet returned to zero.	Purge for 10 minutes with fresh air, monitor sensor voltage, and re-zero.
	Insufficient Warm Up	Allow the sensors to warm up after 10 minutes
	Incorrect ZERO calibration	Repeat ZERO calibration in fresh air or with ZERO AIR cylinder
	Pump Failed	Check pump flow, if pump failed replace
	Battery was dead, sensor has destabilized.	Charge battery, wait up to 24 hours for sensors to stabilize, and re-zero.
	Sensor cell life has expired.	Call SAUERMANN for replacement.
(PID sensors) VOC	Sensor has been recently exposed to gas and has not yet returned to zero.	Purge for 10 minutes with fresh air, monitor sensor voltage, and re-zero.
	Battery was discharged, sensor has destabilized.	Charge battery, wait up to 24 hours for sensors to stabilize, and re-zero.
	Sensor cell life has expired.	Call SAUERMANN for replacement.
Temperature Thermocouple	Thermocouple is not connected	Check electrical connections running to the probe
Infrared CO_2	No response from infrared system	Zero period must be at least 45 seconds. **Zero the instrument again with a cylinder ZERO AIR**.
	Infrared system is reporting error code	Infrared system may need maintenance.
Velocity	Velocity probe/Pitot Tube is not connected	Check probe and connections.
Bluetooth® connection failure	Connection Failed	Redo connection process
Monitor will not turn on. (Screen is off)	Battery is discharged.	Plug in the charger. Monitor should turn on.
	Battery is not charging.	Check the charger and jack. Check the case for excessive heat.
	Internal initialization problem.	Reset the monitor.
Monitor turns on but screen is blue or faded.	Internal initialization problem.	Reset the monitor.
	Monitor is overheating.	Unplug charger. Check internal fan. Turn on & off to reinitialize.
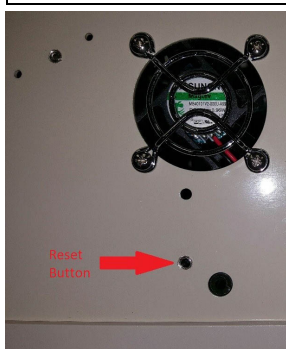
NOTE: The reset button is located on the bottom of the analyzer approximately 1.5" (4 cm) from one of the four black feet as shown in the photo below. You will need a pen tip or other small object to press the reset button. Make sure the charger is <u>disconnected</u> from the analyzer when pushing the reset button.

REPLACEMENT PARTS

PART NUMBER	DESCRIPTION
Si-AQ O2 Cell (0-25%)	O_2 Sensor (0-25%)
Si-AQ CO Cell (0-200 ppm	CO Sensor (0-200 ppm)
Si-AQ NO Cell (0-250 ppm)	NO Sensor (0-250 ppm)
Si-AQ NO2 Cell (0-20 ppm)	NO_2 Sensor (0-20 ppm)
Si-AQ SO2 Cell (0-20 ppm)	SO_2 Sensor (0-20 ppm)
Si-AQ H2S Cell (0-100 ppm)	H_2S Sensor (0-100 ppm)
Si-AQ O3 Cell (0-5 ppm)	O_3 Sensor (0-5 ppm)
Si-AQ CO2 Sensor (0-5000 ppm)	NDIR CO_2 Sensor (0-5000 ppm)
Si-AQ CO2 Cell (0-20%)	NDIR CO_2 Sensor (0-20%)
Si-AQ VOC Cell (0-20k ppb)	PID VOC Sensor (0-20 ppm)
Si-AQ VOC Cell (0-200 ppm)	PID VOC Sensor (0-200 ppm)
Si-AQ CH2O Cell (0-10 ppm)	Formaldehyde Sensor (0-10 ppm)
Si-AQ Calibration Kit	Calibration KIT – ZERO AIR Cylinder w/ Regulator
Si-AQ Air	Replacement ZERO AIR Cylinder ONLY
Si-AQ Expert Vinyl Case	Vinyl Carrying Case with Shoulder Strap
Si-AQ Bluetooth® Printer	Remote Bluetooth® Wireless Printer
Si-AQ Probe with Hose	12″ Probe and 10′ hose
Si-AQ Diff. Press. Kit	Differential Pressure Hoses
Si-AQ VOC Zero Filter	Disposable ZERO Filter (VOCs)

CHAPTER 14

VOCs Ionization Potentials and Response Factors

Appendix I: Ionization Potentials

Chemical Name IP (eV) Chemical Name IP (eV)

A
2-Amino pyridine 8
Acetaldehyde 10.21
Acetamide 9.77
Acetic acid 10.69
Acetic anhydride 10
Acetone 9.69
Acetonitrile 12.2
Acetophenone 9.27
Acetyl bromide 10.55
Acetyl chloride 11.02
Acetylene 11.41
Acrolein 10.1
Acrylamide 9.5
Acrylonitrile 10.91
Allyl alcohol 9.67
Allyl chloride 9.9
*Ammonia 10.2
Aniline 7.7
Anisidine 7.44
Anisole 8.22
Arsine 9.89

B
1,3-Butadiene (butadiene) 9.07
1-Bromo-2-chloroethane 10.63
1-Bromo-2-methylpropane 10.09
1-Bromo-4-fluorobenzene 8.99
1-Bromobutane 10.13
1-Bromopentane 10.1
1-Bromopropane 10.18
1-Bromopropene 9.3
1-Butanethiol 9.14
1-Butene 9.58
1-Butyne 10.18
2,3-Butadione 9.23
2-Bromo-2-methylpropane 9.89
2-Bromobutane 9.98
2-Bromopropane 10.08
2-Bromothiophene 8.63
2-Butanone (MEK) 9.54
3-Bromopropene 9.7
3-Butene nitrile 10.39
Benzaldehyde 9.53
Benzene 9.25
Benzenethiol 8.33
Benzonitrile 9.71
Benzotrifluoride 9.68
Biphenyl 8.27
Boron oxide 13.5

Boron trifluoride 15.56
Bromine 10.54
Bromobenzene 8.98
Bromochloromethane 10.77
Bromoform 10.48
Butane 10.63
Butyl mercaptan 9.15
cis-2-Butene 9.13
m-Bromotoluene 8.81
n-Butyl acetate 10.01
n-Butyl alcohol 10.04
n-Butyl amine 8.71
n-Butyl benzene 8.69
n-Butyl formate 10.5
n-Butyraldehyde 9.86
n-Butyric acid 10.16
n-Butyronitrile 11.67
o-Bromotoluene 8.79
p-Bromotoluene 8.67
p-tert-Butyltoluene 8.28
s-Butyl amine 8.7
s-Butyl benzene 8.68
sec-Butyl acetate 9.91
t-Butyl amine 8.64
t-Butyl benzene 8.68
trans-2-Butene 9.13

C
1-Chloro-2-methylpropane 10.66
1-Chloro-3-fluorobenzene 9.21
1-Chlorobutane 10.67
1-Chloropropane 10.82
2-Chloro-2-methylpropane 10.61
2-Chlorobutane 10.65
2-Chloropropane 10.78
2-Chlorothiophene 8.68
3-Chloropropene 10.04
Camphor 8.76
Carbon dioxide 13.79
Carbon disulfide 10.07
Carbon monoxide 14.01
Carbon tetrachloride 11.47
Chlorine 11.48
Chlorine dioxide 10.36
Chlorine trifluoride 12.65
Chloroacetaldehyde 10.61
a -Chloroacetophenone 9.44
Chlorobenzene 9.07
Chlorobromomethane 10.77
Chlorofluoromethane (Freon 22) 12.45
Chloroform 11.37
Chlorotrifluoromethane (Freon 13) 12.91

Chrysene 7.59
Cresol 8.14
Crotonaldehyde 9.73
Cumene (isopropyl benzene) 8.75
Cyanogen 13.8
Cyclohexane 9.8
Cyclohexanol 9.75
Cyclohexanone 9.14
Cyclohexene 8.95
Cyclo-octatetraene 7.99
Cyclopentadiene 8.56
Cyclopentane 10.53
Cyclopentanone 9.26
Cyclopentene 9.01
Cyclopropane 10.06
m-Chlorotoluene 8.83
o-Chlorotoluene 8.83
p-Chlorotoluene 8.7

D
1,1-Dibromoethane 10.19
1,1-Dichloroethane 11.12
1,1-Dimethoxyethane 9.65
1,1-Dimethylhydrazine 7.28
1,2-Dibromoethene 9.45
1,2-Dichloro-1,1,2,2-tetrafluoroethane
(Freon 114) 12.2
1,2-Dichloroethane 11.12
1,2-Dichloropropane 10.87
1,3-Dibromopropane 10.07
1,3-Dichloropropane 10.85
2,2-Dimethyl butane 10.06
2,2-Dimethyl propane 10.35
2,3-Dichloropropene 9.82
2,3-Dimethyl butane 10.02
3,3-Dimethyl butanone 9.17
cis-Dichloroethene 9.65
Decaborane 9.88
Diazomethane 9
Diborane 12
Dibromochloromethane 10.59
Dibromodifluoromethane 11.07
Dibromomethane 10.49
Dibutylamine 7.69
Dichlorodifluoromethane (Freon 12) 12.31
Dichlorofluoromethane 12.39
Dichloromethane 11.35
Diethoxymethane 9.7
Diethyl amine 8.01
Diethyl ether 9.53
Diethyl ketone 9.32
Diethyl sulfide 8.43
Diethyl sulfite 9.68
Difluorodibromomethane 11.07
Dihydropyran 8.34
Diiodomethane 9.34
Diisopropylamine 7.73
Dimethoxymethane (methylal) 10
Dimethyl amine 8.24
Dimethyl ether 10
Dimethyl sulfide 8.69

Dimethylaniline 7.13
Dimethylformamide 9.18
Dimethylphthalate 9.64
Dinitrobenzene 10.71
Dioxane 9.19
Diphenyl 7.95
Dipropyl amine 7.84
Dipropyl sulfide 8.3
Durene 8.03
m-Dichlorobenzene 9.12
N,N-Diethyl acetamide 8.6
N,N-Diethyl formamide 8.89
N,N-Dimethyl acetamide 8.81
N,N-Dimethyl formamide 9.12
o-Dichlorobenzene 9.06
p-Dichlorobenzene 8.95
p-Dioxane 9.13
trans-Dichloroethene 9.66

E
Epichlorohydrin 10.2
Ethane 11.65
Ethanethiol (ethyl mercaptan) 9.29
Ethanolamine 8.96
Ethene 10.52
Ethyl acetate 10.11
Ethyl alcohol 10.48
Ethyl amine 8.86
Ethyl benzene 8.76
Ethyl bromide 10.29
Ethyl chloride (chloroethane) 10.98
Ethyl disulfide 8.27
Ethylene 10.5
Ethyl ether 9.51
Ethyl formate 10.61
Ethyl iodide 9.33
Ethyl isothiocyanate 9.14
Ethyl mercaptan 9.29
Ethyl methyl sulfide 8.55
Ethyl nitrate 11.22
Ethyl propionate 10
Ethyl thiocyanate 9.89
Ethylene chlorohydrin 10.52
Ethylene diamine 8.6
Ethylene dibromide 10.37
Ethylene dichloride 11.05
Ethylene oxide 10.57
Ethylenelmine 9.2
Ethynylbenzene 8.82

F
2-Furaldehyde 9.21
Fluorine 15.7
Fluorobenzene 9.2
Formaldehyde 10.87
Formamide 10.25
Formic acid 11.05
Freon 11 (trichlorofluoromethane) 11.77
Freon 112 (1,1,2,2-tetrachloro-1,2-difluoroethane) 11.3
Freon 113 (1,1,2-trichloro-1,2,2-trifluororethane) 11.78

Freon 114 (1,2-dichloro-1,1,2,2-tetrafluoroethane) 12.2
Freon 12 (dichlorodifluoromethane) 12.31
Freon 13 (chlorotrifluoromethane) 12.91
Freon 22 (chlorofluoromethane) 12.45
Furan 8.89
Furfural 9.21
m-Fluorotoluene 8.92
o-Fluorophenol 8.66
o-Fluorotoluene 8.92
p-Fluorotoluene 8.79

H
1-Hexene 9.46
2-Heptanone 9.33
2-Hexanone 9.35
Heptane 10.08
Hexachloroethane 11.1
Hexane 10.18
Hydrazine 8.1
Hydrogen 15.43
Hydrogen bromide 11.62
Hydrogen chloride 12.74
Hydrogen cyanide 13.91
Hydrogen fluoride 15.77
Hydrogen iodide 10.38
Hydrogen selenide 9.88
Hydrogen sulfide 10.46
Hydrogen telluride 9.14
Hydroquinone 7.95

I
1-Iodo-2-methylpropane 9.18
1-Iodobutane 9.21
1-Iodopentane 9.19
1-Iodopropane 9.26
2-Iodobutane 9.09
2-Iodopropane 9.17
Iodine 9.28
Iodobenzene 8.73
Isobutane (Isobutylene) 9.4
Isobutyl acetate 9.97
Isobutyl alcohol 10.12
Isobutyl amine 8.7
Isobutyl formate 10.46
Isobutyraldehyde 9.74
Isobutyric acid 10.02
Isopentane 10.32
Isophorone 9.07
Isoprene 8.85
Isopropyl acetate 9.99
Isopropyl alcohol 10.16
Isopropyl amine 8.72
Isopropyl benzene 8.69
Isopropyl ether 9.2
Isovaleraldehyde 9.71
m-Iodotoluene 8.61
o-Iodotoluene 8.62
p-Iodotoluene 8.5

K
Ketene 9.61

L
2,3-Lutidine 8.85
2,4-Lutidine 8.85
2,6-Lutidine 8.85

M
2-Methyl furan 8.39
2-Methyl napthalene 7.96
1-Methyl napthalene 7.96
2-Methyl propene 9.23
2-Methyl-1-butene 9.12
2-Methylpentane 10.12
3-Methyl-1-butene 9.51
3-Methyl-2-butene 8.67
3-Methylpentane 10.08
4-Methylcyclohexene 8.91
Maleic anhydride 10.8
Mesityl oxide 9.08
Mesitylene 8.4
Methane 12.98
Methanethiol (methyl mercaptan) 9.44
Methyl acetate 10.27
Methyl acetylene 10.37
Methyl acrylate 9.9
Methyl alcohol 10.85
Methyl amine 8.97
Methyl bromide 10.54
Methyl butyl ketone 9.34
Methyl butyrate 10.07
Methyl cellosolve 9.6
Methyl chloride 11.28
Methyl chloroform (1,1,1-trichloroethane) 11
Methyl disulfide 8.46
Methyl ethyl ketone 9.53
Methyl formate 10.82
Methyl iodide 9.54
Methyl isobutyl ketone 9.3
Methyl isobutyrate 9.98
Methyl isocyanate 10.67
Methyl isopropyl ketone 9.32
Methyl isothiocyanate 9.25
Methyl mercaptan 9.44
Methyl methacrylate 9.7
Methyl propionate 10.15
Methyl propyl ketone 9.39
a -Methyl styrene 8.35
Methyl thiocyanate 10.07
Methylal (dimethoxymethane) 10
Methylcyclohexane 9.85
Methylene chloride 11.32
Methyl-n-amyl ketone 9.3
Monomethyl aniline 7.32
Monomethyl hydrazine 7.67
Morpholine 8.2
n-Methyl acetamide 8.9

N

1-Nitropropane 10.88
2-Nitropropane 10.71
Naphthalene 8.12
Nickel carbonyl 8.27
Nitric oxide, (NO) 9.25
Nitrobenzene 9.92
Nitroethane 10.88
Nitrogen 15.58
Nitrogen dioxide 9.78
Nitrogen trifluoride 12.97
Nitromethane 11.08
Nitrotoluene 9.45
p-Nitrochloro benzene 9.96

O

Octane 9.82
Oxygen 12.08
Ozone 12.08

P

1-Pentene 9.5
1-Propanethiol 9.2
2,4-Pentanedione 8.87
2-Pentanone 9.38
2-Picoline 9.02
3-Picoline 9.02
4-Picoline 9.04
n-Propyl nitrate 11.07
Pentaborane 10.4
Pentane 10.35
Perchloroethylene 9.32
Pheneloic 8.18
Phenol 8.5
Phenyl ether (diphenyl oxide) 8.82
Phenyl hydrazine 7.64
Phenyl isocyanate 8.77
Phenyl isothiocyanate 8.52
Phenylene diamine 6.89
Phosgene 11.77
Phosphine 9.87
Phosphorus trichloride 9.91
Phthalic anhydride 10
Propane 11.07
Propargyl alcohol 10.51
Propiolactone 9.7
Propionaldehyde 9.98
Propionic acid 10.24
Propionitrile 11.84
Propyl acetate 10.04
Propyl alcohol 10.2
Propyl amine 8.78
Propyl benzene 8.72
Propyl ether 9.27
Propyl formate 10.54
Propylene 9.73
Propylene dichloride 10.87
Propylene imine 9
Propylene oxide 10.22
Propyne 10.36

Pyridine 9.32
Pyrrole 8.2

Q

Quinone 10.04

S

Stibine 9.51
Styrene 8.47
Sulfur dioxide 12.3
Sulfur hexafluoride 15.33
Sulfur monochloride 9.66
Sulfuryl fluoride 13

T

o-Terphenyls 7.78
1,1,2,2-Tetrachloro-1,2-difluoroethane (Freon 112) 11.3
1,1,1-Trichloroethane 11
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113) 11.78
2,2,4-Trimethyl pentane 9.86
o-Toluidine 7.44
Tetrachloroethane 11.62
Tetrachloroethene 9.32
Tetrachloromethane 11.47
Tetrahydrofuran 9.54
Tetrahydropyran 9.25
Thiolacetic acid 10
Thiophene 8.86
Toluene 8.82
Tribromoethene 9.27
Tribromofluoromethane 10.67
Tribromomethane 10.51
Trichloroethene 9.45
Trichloroethylene 9.47
Trichlorofluoromethane (Freon 11) 11.77
Trichloromethane 11.42
Triethylamine 7.5
Trifluoromonobromo-methane 11.4
Trimethyl amine 7.82
Tripropyl amine 7.23

V

o-Vinyl toluene 8.2
Valeraldehyde 9.82
Valeric acid 10.12
Vinyl acetate 9.19
Vinyl bromide 9.8
Vinyl chloride 10
Vinyl methyl ether 8.93

W

Water 12.59

X

2,4-Xylidine 7.65
m-Xylene 8.56
o-Xylene 8.56
p-Xylene 8.45

Appendix II: Response Factors

1,2,3-trimethylbenzene 0.49
1,2,4-trimethylbenzene 0.43
1,2-dibromoethane 11.7
1,2-dichlorobenzene 0.5
1,2-dichloroethane (11.7 lamp) 0.5
1,3,5-trimethylbenzene 0.34
1,4-dioxane 1.4
1-butanol 3.4
1-methoxy-2-propanol 1.4
1-propanol 5.7
2-butoxyethanol 1.3
2-methoxyethanol 2.5
2-pentanone 0.78
2-picoline 0.57
3-picoline 0.9
4-hydroxy-4-methyl-2-pentanone 0.55
4-methylbenzyl alcohol 0.8
acetaldehyde 10.8
acetic acid 11
acetone 1.2
acetophenone 0.59
acrolein 3.9
allyl alcohol 2.5
ammonia 9.4
amylacetate 3.5
arsine 2.6
benzene 0.53
bromoform 2.3
bromomethane 1.8
butadiene 0.69
butyl acetate 2.4
carbon disulfide 1.2
chlorobenzene 0.4
cumene (isopropylbenzene) 0.54
cyclohexane 1.5
cyclohexanone 0.82
decane 1.6
diethylamine 1
dimethoxymethane 11.3
dimethyl disulfide 0.3
diesel fuel #1 0.9
diesel fuel #2 0.75
epichlorhydrin 7.6
ethanol 10
ethyl acetate 4.2
ethyl acetoacetate 0.9
ethyl acrylate 2.3
ethyl ether (diethyl ether) 1.2
ethyl mercaptan 0.6
ethylbenzene 0.51
ethylene 10.1
ethylene glycol 15.7
ethylene oxide 19.5
gasoline 1.1
heptane 2.5
hydrazine 2.6
hydrogen sulfide 3.2

isoamyl acetate 1.8
isobutanol 4.7
isobutyl acetate 2.6
isobutylene 1
isooctane 1.3
isopentane 8
isophorone 0.74
isoprene (2-methyl-1,3-butadiene) 0.6
isopropanol 5.6
isopropyl acetate 2.6
isopropyl ether 0.8
isopropylamine 0.9
Jet A fuel 0.4
JP-5 fuel 0.48
JP-8 fuel 0.48
mesityl oxide 0.47
methanol (11.7 lamp) 2.5
methyl acetate 7
methyl acetoacetate 1.1
methyl acrylate 3.4
methyl benzoate 0.93
methyl ethyl ketone 0.9
methyl isobutyl ketone 1.1
methyl mercaptan 0.6
methyl methacrylate 1.5
methyl tert-butyl ether 0.86
methylamine 1.2
methylene chloride (11.7 lamp) 0.85
m-xylene 0.53
naphtalene 0.37
n,n-dimethylacetamide 0.73
n,n-dimethylformamide 0.8
n-hexane 4.5
nitric oxide 7.2
n-nonane 1.6
nitrogen dioxide (11.7 lamp) 10
n-pentane 9.7
n-propyl acetate 3.1
octane 2.2
o-xylene 0.54
phenol 1
phosphine 2.8
pinene, alpha 0.4
pinene, beta 0.4
propionaldehyde (propanal) 14.8
propylene 1.3
propylene oxide 6.5
p-xylene 0.5
pyridine 0.79
quinoline 0.72
styrene 0.4
tert-butyl alcohol 3.4
tert-butyl mercaptan 0.55
tert-butylamine 0.71
tetrachloroethylene 0.56
tetrahydrofuran 1.6
thiophene 0.47
toluene 0.53
trans-1,2-Dichloroethene 0.45

trichloroethylene 0.5
trimethylamine 0.83
turpentine - crude sulfite 1
turpentine - pure gum 0.45
vinyl acetate 1.3

vinyl bromide 0.4
vinyl chloride 1.8
vinylcyclohexane (VCH) 0.54
vinylidene chloride (1,1-DC