

STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use		Document Number: 962C-SOP-049
Original Approval Date: Oct 19, 2021	Revision Number: 2	Page 1 of 20
Latest Revision Date: Mar 15, 2024	Next Revision Date: Mar 15, 2027	Document Approval Level: 4

This document is not controlled if printed.

PERSONAL GAS MONITORS – FIELD USE

						<i>Tammy Siver</i>
2	APP	Mar 15, 2024	Approved	Gerald Kuipers	Tammy Siver	Tammy Siver
1	APP	Oct 19, 2021	Approved	Gerald Kuipers	Lisa Norris	Tammy Siver
Rev	Status	Rev. Date	Status Description	Prepared by	Reviewed by	Approved by

STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use		Document Number: 962C-SOP-049
Original Approval Date: Oct 19, 2021	Revision Number: 2	Page 2 of 20
Latest Revision Date: Mar 15, 2024	Next Revision Date: Mar 15, 2027	Document Approval Level: 4

This document is not controlled if printed.

The following is a step-by-step procedure on how to complete a specific task or meet a facility specific requirement. Standard Operating Procedures (SOPs) are written for all identified critical tasks. By virtue of the hazard or complexity associated with critical tasks it is paramount that the SOP be followed as written. SOPs contain a listing of high-level hazards associated with the task, for detailed hazard analysis reference the applicable Task Hazard Assessments. SOPs do not replace the requirements contained in the company Standards, Codes, and Processes nor does it replace the need to comply with required legislation. Section 8.0 references documentation that the worker shall understand before work commences.

1.0 PURPOSE

- To establish a Company standard to ensure that workers are familiar with the field use of multi-gas and single gas personal gas monitors. This Standard Operating Procedure is applicable to the basic field operation of the industrial Scientific Ventis MX-4 Multi-Gas Monitor and Tango TX-1 Single Gas Monitor when used in diffusion mode only.

2.0 SCOPE AND APPLICATION

- This document applies to all company Heavy Construction & Mining and/or Maintenance operations when a requirement for atmospheric monitoring exists for the use of multi-gas or single gas personal monitor. Ensure all site-specific requirements are being met or exceeded before performing the task.

3.0 HAZARDS AND CONTROLS

- Not trained in the use of multi-gas or single gas personal gas monitors.
 - Workers to be trained in the field use requirements of personal gas monitors prior to using.
- Presence of toxic or combustible gas in work area or oxygen deficient atmosphere.
 - Use personal gas monitor in areas where atmospheric hazards may exist.
- Instrument goes into alarm or warning mode.
 - Leave work area.
- Accuracy of Instrument readings or instrument is showing abnormal readings in fresh air environment
 - Ensure gas monitor is bump tested prior to each days use (or at other frequencies where instrument performance or response is not reduced, or it is not practical to bump test each day. (To be determined by a competent person.)
 - Ensure gas monitor is calibrated monthly as per manufacturers recommendation.

4.0 CHECKLIST

- Attend all preparatory meetings (IE: daily PSI; job scope; review of JSA's and SOP's for the job)
- Complete FLRA cards before starting the work.
- Ensure all personnel involved in the task are aware of the hazards and the controls to be used, as identified in the SOP's; JSA's; and FLRA's.
- Conduct a pre-job inspection of all equipment to be worked on and tools to be used.
- Standard of Training required for working on this job: Users to review applicable manufacturer. Instrument Videos, demonstrate ability to use instrument and On-the job training.**

STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use		Document Number: 962C-SOP-049
Original Approval Date: Oct 19, 2021	Revision Number: 2	Page 3 of 20
Latest Revision Date: Mar 15, 2024	Next Revision Date: Mar 15, 2027	Document Approval Level: 4

This document is not controlled if printed.

5.0 DEFINITIONS

5.1 Bump Test

A brief exposure of each gas monitor sensor to an expected concentration of gas greater than the sensors low alarm set point. It is a functional test to verify sensor and alarm operation only. It is not a measure of monitor accuracy; no adjustments are made to the monitor during a bump test. If a monitor fails a bump test, a full calibration is recommended.

5.2 Calibration

A process where gas monitor sensors are exposed to a known concentration of gas and the monitor self-adjusts so that the sensors retain their ability to correctly measure and accurately display gas concentration values. If a sensor had degraded beyond an acceptable level, it has reached its end of life and will no longer pass a calibration. Calibration consists of two steps:

- (i) Zero Calibration – monitor is exposed to the ambient / or zero grade air and each toxic or LEL sensor registers to zero and the O₂ sensor is calibrated to a value of 20.9%.
- (ii) Span Calibration – Each sensor expects to be exposed to a known concentration of gas and as each sensor calibrates, the monitor adjusts to the calibration gas and known values if needed to ensure that the gas concentration values are accurately registered and displayed.

5.3 Carbon Monoxide

A colorless, odorless and tasteless gas that is slightly less dense than air and is toxic to humans when encountered in concentrations above occupational exposure limits.

5.4 Explosive Limits (LEL/UEL)

Explosive Limits (LEL / UEL) are the lower and upper limits within a range in which an explosion can occur and are defined as per the following:

- The LEL is the minimum amount of fuel (i.e. gas, vapour, dust) that must be present in air to ignite. If the air/fuel mixture is below the LEL, it is considered too “lean” and will not ignite. Expressed as a % by volume in air of a defined Lower Explosive Limit (LEL) of a specific chemical.
- The UEL is the maximum amount of fuel (i.e. gas vapour, dust) that can be present in air for ignition to occur. If air/fuel mixture is above the UEL, it is considered too “rich” and will not ignite. In this situation, there is insufficient oxygen to support combustion. Expressed as a % by volume in air of a defined Upper Explosive limit (UEL) of a specific chemical.

5.5 Explosive Range

This includes all concentrations measured as a percent of volume in air of a flammable gas or vapour that will propagate flame when exposed to a source of ignition. The range are the values between the LEL and UEL. The explosive range will vary with temperature and pressure.

5.6 Hydrogen Sulphide

Hydrogen sulphide, commonly known as H₂S, is a colorless flammable gas that has the characteristic foul odor of rotten eggs. It is heavier than air, very poisonous, corrosive, flammable and explosive. Hydrogen sulphide is produced by the bacterial breakdown of organic matter in the absence of oxygen.



STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use		Document Number: 962C-SOP-049
Original Approval Date: Oct 19, 2021	Revision Number: 2	Page 4 of 20
Latest Revision Date: Mar 15, 2024	Next Revision Date: Mar 15, 2027	Document Approval Level: 4

This document is not controlled if printed.

5.7 IDS

Instrument Docking Station.

5.8 IDLH

Immediately Dangerous to Life and Health. An oxygen deficient atmosphere or an atmospheric concentration of any harmful substance that poses an immediate threat to life or may cause irreversible or delayed adverse health effects or may interfere with an individual's ability to escape from a dangerous atmosphere.

5.9 TLV – Ceiling

A concentration that should not be exceeded during any part of the working exposure

5.10 TLV – STEL (Threshold Limit Value - Short Term Exposure Limit)

A 15-minute TWA exposure that should not be exceeded at any time during the workday and is a concentration to which workers can be exposed to continuously for a short period of time without suffering from irritation, chronic or irreversible tissue damage, dose rate dependent toxic effects or narcosis of sufficient degree to increase the likelihood of accidental injury, impaired self-rescue or significantly reduced work efficiency.

5.11 TLV – TWA (Threshold Limit Value – Time Weighted Average)

Is the TWA exposure for a conventional 8-hour workday and 40-hour work week to which it is believed that workers may be repeatedly exposed to day after day, for a working lifetime without adverse effect can continuously be exposed to.

5.12 TWA

Time Weighted Average.

6.0 PROCEDURE

The following information outlines field level user requirements as it applies to the Industrial Scientific Ventis MX-4 Multi-Gas Personal Monitor and Tango TX1 Single Gas Personal Monitor. These steps must be followed when using these monitors in diffusion mode.

6.1 General Rules of Gas Detection

(a) Bump Test Prior to Each Days Use

Before you use your instrument, it is important that you know that the sensor and alarms will function properly. The only way that you can be sure of this is to expose your instrument to a known concentration of gas and verify that it responds correctly. A bump test prior to each day's use assures you that your gas detector will save your life if you are in danger. **(Note: Bump test frequencies may be reduced if instrument response remains stable or it is not practical or allowable to bump test instruments daily).**

(b) Calibrate

Conditions such as temperature, humidity, sensor age and gas exposure will all affect the output of your sensor. Calibrating your instrument compensates for these factors and guarantees that your readings are accurate. You can attain the highest accuracy by calibrating your gas detector on a regular schedule. Do this at least monthly.



STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use		Document Number: 962C-SOP-049
Original Approval Date: Oct 19, 2021	Revision Number: 2	Page 5 of 20
Latest Revision Date: Mar 15, 2024	Next Revision Date: Mar 15, 2027	Document Approval Level: 4

This document is not controlled if printed.

(c) Review Data

Almost all gas detectors in use today provide some form of datalogging. Information stored in your gas detector can provide keen insight into potential problems that may be hiding in your work environment. You may find cases of alarms with no reports or find conditions where gas concentrations exist just below the alarm thresholds of the instruments. Most data reviews take place only after an accident occurs. A weekly review of data gives you the opportunity to find potential danger points and correct them before tragedy strikes.

6.2 Basic Operation Industrial Scientific Ventis MX-4 Multi Gas Monitor and Tango TX1 Single Gas Monitor

The following steps shall be followed prior to each daily use of the Industrial Scientific Ventis MX-4 Multi-Gas Monitor or Tango TX1 Single Gas Monitor. **(Note: Bump test frequencies may be reduced if instrument response remains stable or it is not practical or allowable to bump test instruments daily).**

6.2.1 Bump test the instrument using the IDS

Prior to each daily use (or other determined bump test frequency) a functional bump test of the instrument against a known concentration of gas will be completed. The Industrial Scientific Ventis MX-4 and Tango TX1 can be bump tested using the Instrument Docking Station (IDS) which will automatically perform a bump test and or calibration based on the frequency that the IDS has been configured to, or the instruments can be manually bump tested by following the steps in Section 6.2.1.1 (Ventis MX-4) and Section 6.2.1.2 (Tango TX-1) Please note that the IDS's are instrument specific based on instrument selection at the time or ordering and have an instrument specific cradle.

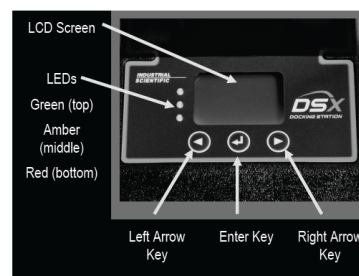
To perform a bump test using the IDS, follow the steps listed below:

Step 1: Confirm that IDS is turned on

The IDS does not have a separate power switch on the unit. The unit is powered on and off at the power source (Power cord). Power to the IDS is confirmed by a solid green LED (Green – Top Position)

Prior to inserting the instrument into the IDS cradle, confirm that the green LED is illuminated, and the LCD display shows an IP address (connection to the network) and the s/n at the bottom of the screen.

If the Green Light is not illuminated, notify your supervisor and HS&E and proceed to **Section 6.2.1.1** or **6.2.1.2** to perform a manual bump test prior to use.



STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use

Document Number: 962C-SOP-049

Original Approval Date: Oct 19, 2021

Revision Number: 2

Page 6 of 20

Latest Revision Date: Mar 15, 2024

Next Revision Date: Mar 15, 2027

Document Approval Level: 4

This document is not controlled if printed.

Step 2: Check calibration gas cylinder

Confirm that the dial on the gauge indicates that there is pressure in the cylinder.



Step 3: Place instrument in IDS cradle

Not all instruments are docked the same way. Some instruments are docked face up while some are docked facedown. Note that instruments with sampling pumps require the use of the aspirator insert and instruments without a pump will use the diffusion insert (Applicable to Ventis MX-4 Multi-gas Instruments).



Step 4: IDS Performs Bump test

After the instrument has been placed in the IDS Cradle, the IDS will perform the following functions:

- 1) Zero fresh air calibration
- 2) Bump test (LCD displays "Testing Instrument")
- 3) LCD Returns to the main menu and the Green LED is illuminated

If the instrument fails a bump test a calibration is required. DO NOT USE THE INSTRUMENT UNLESS THE APPLICABLE TEST SHOWS AS A PASS. Contact your supervisor or HS&E if the RED LED is illuminated.



STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use

Document Number: 962C-SOP-049

Original Approval Date: Oct 19, 2021

Revision Number: 2

Page 7 of 20

Latest Revision Date: Mar 15, 2024


Next Revision Date: Mar 15, 2027

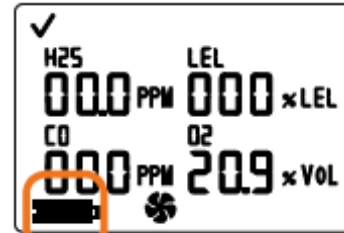
Document Approval Level: 4

This document is not controlled if printed.


6.2.1.1 Manual Bump Test – Ventis MX4

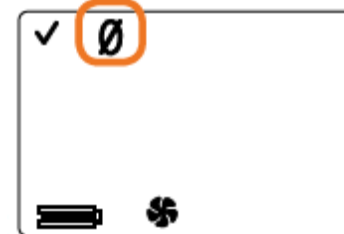
Step 1: Turn on the instrument


Turn on the instrument by pressing the on/off mode button  (#5) for 3 seconds (See Figure 6-1), then release for start-up. The instrument will run through a series of screen until it reaches the Gas Readings screen. Check, the battery icon on the bottom L/H corner of the LCD display



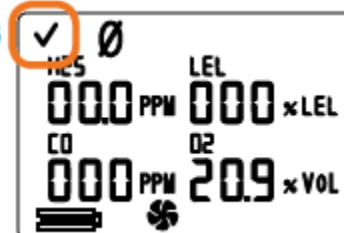
Step 2: Zero the instrument in fresh air

Press the on/off mode button  (#5) multiple times to get to the zero Initiate screen.




Press the enter button  (#6) to start the zero process

The Zero Results screen will indicate **PASS** displayed with a **CHECK MARK**.



Or **FAIL** displayed with an “F” or “P” for each failed or passed sensor


If the results indicate **PASS** move on to step 3


If the Results indicate **FAIL** press the on/off mode button  (#5) to return to the zero Initiate Screen.

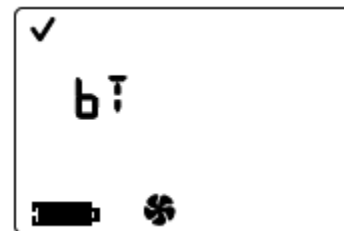


Repeat the Zero process.

Step 3 Bump test the instrument

Press  (#5) until the bump test Initiate screen is shown

Press  (#6) to initiate the bump test and apply gas.



STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use		Document Number: 962C-SOP-049
Original Approval Date: Oct 19, 2021	Revision Number: 2	Page 8 of 20
Latest Revision Date: Mar 15, 2024	Next Revision Date: Mar 15, 2027	Document Approval Level: 4


This document is not controlled if printed.


After a **PASSED** bump test, the instrument goes into gas monitoring mode.


After a **FAILED** bump test, the **Bump Test Fail** Screen displays, and a low-level audio alarm turns on.

NOTE: If the instrument FAILS the Bump test, the unit requires a full calibration.

STEP 4 Clear the peak readings.

Press  (#5) until the **Peak Readings** screen is shown.

Press  (#6) once to clear the peak values.

Press  (#5) until the instrument returns to the Gas Readings screen

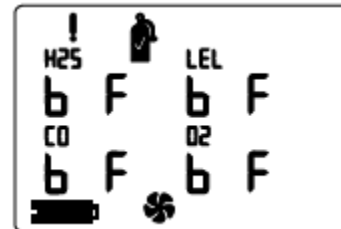
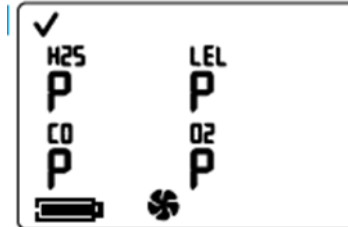


Figure 6-1 Ventis MX-4 Multi-Gas Monitor Overview



Number	Feature	Functions
1	Visual alarm indicator	Signals an alarm or warning; frequency varies by alarm level. Also used as a confidence indicator.
2	Pump inlet (aspirated) Sensor ports (diffusion)	Air intake; calibration and bump test gas intake.
3	LCD display	User interface; backlight flashes when monitor is in system, high, or low alarm states.
4	Audible alarm ports	On when monitor is in system, high, or low alarm states; frequency and tone vary by alarm level. Also used for warnings and as confidence indicator.
5	On/Off/Mode button	Used to power-on and power-off. Also used to bypass a process/step or advance to a next screen in both gas monitoring and configuration modes. Sets values in configuration mode.
6	Enter button	Used to begin a process/step in a process. Edits values in configuration mode.
7	IrDA interface	Indicates infrared light data exchange in-progress.
8	Charging contacts	Battery charging.

STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use

Document Number: 962C-SOP-049

Original Approval Date: Oct 19, 2021

Revision Number: 2

Page 9 of 20

Latest Revision Date: Mar 15, 2024


Next Revision Date: Mar 15, 2027

Document Approval Level: 4

This document is not controlled if printed.

6.2.1.2 Manual Bump Test – Tango TX1

Step 1: Turn on the instrument



Press and hold the on/off mode button  for three seconds (See Figure 6-2), then release to initiate the start-up sequence and power on the unit.

The instrument will perform a series of self-tests during start up and display a number of screens.

If all start-up diagnostics pass, the audio, visual and vibration indicators turn on then off. Several start-up screens will display followed by the home screen.






Step 2: Zero the Instrument in fresh air

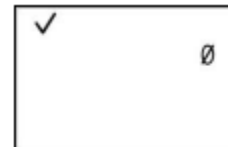
Press the on/off mode button  until the initiate zero screen is activated. At the initiate zero screen, press  to start the zero process.

While the sensors are zeroed, the zero-in-progress screen is activated.

After the sensors are zeroed, the zero-results screen is activated and an audible alert is emitted.

If the result for either sensor is an “F” for fail, press  to reactivate the initiate-zero screen. Repeat the zero process.

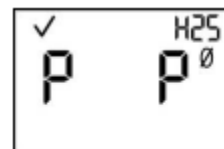
If the result for both sensors (if equipped) is a “P” for pass, press  then  to display the initiate-calibration screen. If calibration is not desired, wait approximately 30 seconds for the zero-results screen to deactivate, the home screen will be automatically activated.



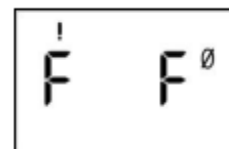
Initiate zero



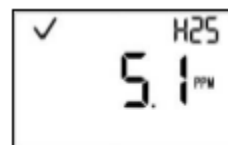
Zero in-progress



Zero results (pass)



Zero results (fail)



Home screen
(numeric display)

STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use

Document Number: 962C-SOP-049

Original Approval Date: Oct 19, 2021

Revision Number: 2

Page 10 of 20

Latest Revision Date: Mar 15, 2024

Next Revision Date: Mar 15, 2027

Document Approval Level: 4


This document is not controlled if printed.


Step 3: Bump test the Instrument

Place the calibration cup over the case top; align its top groove with the small ridge at the top of the instrument

Press down to secure the cup in place; a click will sound.

Visually Inspect the calibration cup to ensure its edges along the top and sided align with the case top edges.

From anywhere in the operation-mode loop, press  until the initiate bump test screen is activated.

Press  to start the bump test process

Press  to cancel the bump test

Once the bump test is started, the apply gas screen is activated; the expected type and concentration of calibration gas are displayed.

The screen remains activated for up to 5 minutes as the unit awaits the application of calibration gas.

To start the flow of gas, turn the regulator knob in a counterclockwise direction. The screen will show "Bump test in Progress"

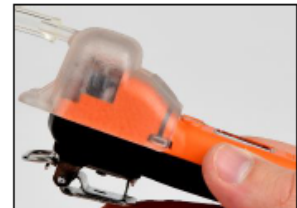
If either or both sensors fail the bump test, the calibration due warning screen will be automatically activated. Calibrate the instrument.

If both sensors pass the bump test, the home screen will be automatically activated

To stop the flow of gas, turn the regulator knob in a clockwise direction and tighten.

To remove the calibration cup, lift up from the cups tabs. Set aside or store for futures use.

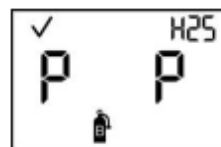
Bump testing



Initiate bump test



Bump test in progress



Bump test results (pass)



Bump test results (fail)



STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use

Document Number: 962C-SOP-049

Original Approval Date: Oct 19, 2021

Revision Number: 2

Page 11 of 20

Latest Revision Date: Mar 15, 2024

Next Revision Date: Mar 15, 2027

Document Approval Level: 4

This document is not controlled if printed.

Figure 6-2 Tango TX1 Single Gas Monitor Overview



6.2.2 Calibrate the instrument using the IDS

Prior to each days use (or other determined bump test frequency) a functional bump test of the instrument against a known concentration of gas will be completed. (See Section 6.2.1 Bump test the instrument using the IDS).

The Industrial Scientific Ventis MX-4 and Tango TX1 is also calibrated using the using the Instrument Docking Station (IDS). **When an instrument is placed in the appropriate IDS cradle, the IDS will automatically perform a calibration based at a predetermined monthly frequency (30 days or at the beginning of the month) as per steps 1-3 in section 6.2.1 (Bump test the instrument using the IDS). A calibration is substituted for a bump test as identified in Section 6.2.1 Step 4**

If the instrument fails a calibration. DO NOT USE THE INSTRUMENT. Contact your supervisor or HS&E if this occurs. (This is identified by an illuminated red LED and a “Calibration Failed” reading on the LDC screen).

In the event that an automatic calibration cannot be performed and the instrument is due for calibration, a manual calibration of the instrument must be completed by following the steps in Section 6.2.2.1 (Manual Calibration – Ventis MX4) and Section 6.2.3.2 (Manual Calibration Tango TX-1) Please note that the IDS’s are instrument specific based on instrument selection at the time or ordering and have an instrument specific cradle.

STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use

Document Number: 962C-SOP-049

Original Approval Date: Oct 19, 2021

Revision Number: 2

Page 12 of 20

Latest Revision Date: Mar 15, 2024


Next Revision Date: Mar 15, 2027

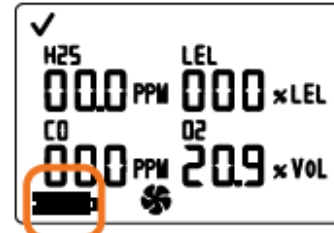
Document Approval Level: 4

This document is not controlled if printed.

6.2.2.1 Manual Calibration – Ventis MX4

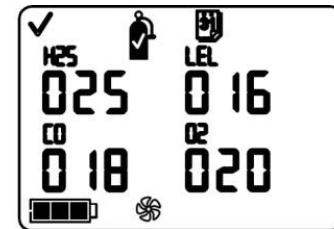
Step 1: Turn on the instrument

Turn on the instrument by pressing the on/off mode button  (#5) for 3 seconds (See Figure 6-1), then release for start-up. The instrument will run through a series of screen until it reaches the Gas Readings screen. Check, the battery icon on the bottom L/H corner of the LCD display.




Step 2: Press on/off/mode to advance to Days Since Calibration Screen


Displays the number of days since the last Successful calibration for each installed sensor. Each value may be different.



Step 3: Zero the instrument in fresh air

Press the on/off mode button  (#5) multiple times to get to the zero Initiate screen.




Press the enter button  (#6) to start the zero process

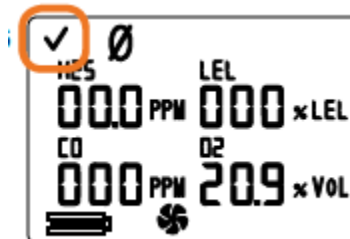
The Zero Results screen will indicate **PASS** displayed with a **CHECK MARK**.

Or **FAIL** displayed with an “F” or “P” for each failed or passed sensor

If the results indicate **PASS** move on to step 4

If the Results indicate **FAIL** press the on/off mode button  (#5) to return to the zero Initiate Screen.

Repeat the Zero process.



STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use		Document Number: 962C-SOP-049
Original Approval Date: Oct 19, 2021	Revision Number: 2	Page 13 of 20
Latest Revision Date: Mar 15, 2024	Next Revision Date: Mar 15, 2027	Document Approval Level: 4

This document is not controlled if printed.

Step 4: Calibrate the Instrument

Calibration Apply Gas Screen will appear

The gas cylinder icon flashes. Each sensor's display shows the calibration gas concentration to be applied. (The O₂ display is blank as the sensor was calibrated during zeroing.) The monitor waits up to five minutes to successfully sense the gas.

Calibration in-progress Screen

If gas is sensed, the gas values for the LEL and toxic sensors increase and the O₂ value decreases.

If gas is NOT sensed, a failed calibration registers and the Calibration Failed Screen displays.

To Terminate Calibration

Press ON/OFF/MODE while the gas cylinder icon flashes to terminate the quick calibration process (or to skip a sensor's calibration in standard calibration) and return to the gas monitoring mode.

To Calibrate

From the already prepared gas cylinder, start the flow of gas as noted below for the monitor/regulator combination in use.

For an **aspirated** monitor with a **demand** flow regulator, complete the tubing connection from the regulator to the pump inlet.

For an **aspirated** monitor with a **positive** flow regulator, turn (counterclockwise) the regulator's knob.



Aspirated monitor with demand flow regulator

STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use

Document Number: 962C-SOP-049

Original Approval Date: Oct 19, 2021

Revision Number: 2

Page 14 of 20

Latest Revision Date: Mar 15, 2024

Next Revision Date: Mar 15, 2027

Document Approval Level: 4

This document is not controlled if printed.

For a **diffusion** monitor with a **positive** flow regulator:

- Place the calibration cup over the upper portion of the monitor's case top (front of monitor). To attach properly, complete or observe the following:
 - The cup fully covers the sensor ports.
 - The monitor's display and buttons are NOT covered.
 - The cup's side arms fit securely in the grooves on the sides of the monitor.
 - The Ventis name on the calibration cup is upright and readable.
 - The cup's nipple points up and away from the monitor.
 - Turn (counterclockwise) the regulator's knob.



Diffusion monitor with positive flow regulator

Sensor Results Screen*

Pass (top) or Fail (bottom) Screen

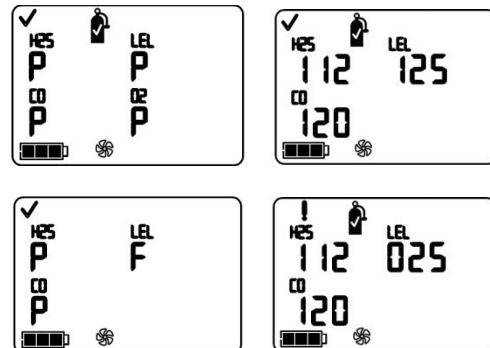
The display alternately shows a "P" for pass (or "F" for fail) and the final span value reading for each sensor. A check mark displays, and a single beep will sound.

STOP THE FLOW OF GAS.

After calibration, or if calibration is terminated at any time during the process, **stop the flow of gas** as follows.

For an **aspirated** monitor with a **demand** flow regulator, disconnect the tubing from the pump inlet.

For an **aspirated or diffusion** monitor with a positive flow regulator, turn (clockwise) the regulator's knob.



All Sensors Pass

The user returns to the mode from which the calibration process was entered (configuration or gas monitoring).

Sensor Fail

If one or more sensors fail calibration, the Calibration Fail Screen displays and a **system level alarm turns on**.

STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use

Document Number: 962C-SOP-049

Original Approval Date: Oct 19, 2021

Revision Number: 2

Page 15 of 20

Latest Revision Date: Mar 15, 2024

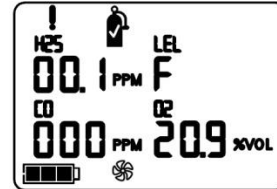
Next Revision Date: Mar 15, 2027

Document Approval Level: 4

This document is not controlled if printed.

Calibration Failed Screen*

Gas readings display for all successfully calibrated sensors and an "F" displays for any failed sensors. A system level alarm turns on. The warning icon and gas cylinder display to indicate a sensor calibration failure.




Any failed sensor **stays in alarm** until it passes a calibration or is replaced.

Press **ON/OFF/MODE** to repeat calibration.

6.2.2.2 Manual Calibration – Tango TX1

Step 1: Turn on the instrument



Press and hold the on/off mode button  for three seconds (See Figure 6-2), then release to initiate the start-up sequence and power on the unit.

The instrument will perform a series of self-tests during start up and display a number of screens.

If all start-up diagnostics pass, the audio, visual and vibration indicators turn on then off. Several start-up screens will display followed by the home screen.




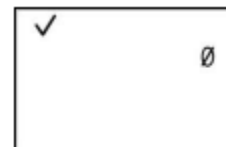
Step 2: Zero the Instrument in fresh air

Press the on/off mode button  until the initiate zero screen is activated. At the initiate zero screen, press  to start the zero process.

While the sensors are zeroed, the zero-in-progress screen is activated.

After the sensors are zeroed, the zero-results screen is activated and an audible alert is emitted.

If the result for either sensor is an "F" for fail, press  to reactivate the initiate-zero screen. Repeat the zero process.



Initiate zero



Zero in-progress

STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use

Document Number: 962C-SOP-049

Original Approval Date: Oct 19, 2021

Revision Number: 2



Page 16 of 20

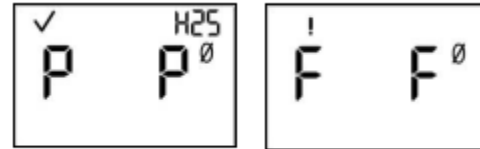
Latest Revision Date: Mar 15, 2024

Next Revision Date: Mar 15, 2027

Document Approval Level: 4

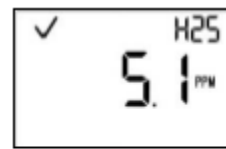
This document is not controlled if printed.

If the result for both sensors (if equipped) is a "P" for pass, press  then  to display the initiate-calibration screen. If calibration is not desired, wait approximately 30 seconds for the zero-results screen to deactivate, the home screen will be automatically activated.



Zero results (pass)

Zero results (fail)




Home screen
(numeric display)

Step 3: Calibrate the Instrument

Place the calibration cup over the case top; align its top groove with the small ridge at the top of the instrument


Press down to secure the cup in place; a click will sound.

Visually inspect the calibration cup to ensure its edges along the top and sides align with the case top edges.

To start the calibration process, press . Both sensors (if equipped) will be calibrated simultaneously.

To cancel the calibration press .

Once the calibration is started, the apply-gas screen is activated; the expected type and concentration of calibration gas are displayed.

The screen remains activated for up to 5 minutes as the unit awaits the application of calibration gas. To cancel the calibration press .

Calibration



Initiate calibration



Calibration apply gas

STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use

Document Number: 962C-SOP-049

Original Approval Date: Oct 19, 2021

Revision Number: 2

Page 17 of 20

Latest Revision Date: Mar 15, 2024


Next Revision Date: Mar 15, 2027

Document Approval Level: 4

This document is not controlled if printed.

To start the flow of gas, turn the regulator knob in a counterclockwise direction.

When the sensors are calibrated, the calibration in progress screen displays the span reserve value.

If desired, press  to cancel the calibration.

If at least one sensor passes the calibration, the home screen will be automatically activated.

Note: The span reserve value divided by the calibration gas concentration yields the span reserve percentage. A span reserved percentage of greater than 70% indicates a “good” sensor, 50%-70% indicates “marginal” sensitivity. When the span reserve percentage is less than 50%, the sensor will not pass calibration.

If at least one sensor passes calibration, two results screens are alternatively activated; one indicates the pass or fail result for each sensor and the other displays the span reserve value.

If neither sensor passes calibration, the audible, visual and vibrating alarms turn on. Two results screens are alternatively activated; one indicates the fail results and the other displays the span reserve value.

Note: With two installed, working sensors, the span reserve value is the algorithm calculation of the “DualSense Technology”

To stop the flow of gas, turn the regulator knob in a clockwise direction and tighten.

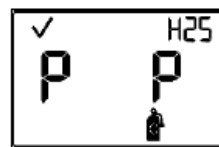
To remove the calibration cup, lift up from the cup's tabs. Set aside or store for future use



Calibration in progress



Span reserve value



Calibration results (pass)



Calibration results (fail)



STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use

Document Number: 962C-SOP-049

Original Approval Date: Oct 19, 2021

Revision Number: 2

Page 18 of 20

Latest Revision Date: Mar 15, 2024

Next Revision Date: Mar 15, 2027

Document Approval Level: 4

This document is not controlled if printed.

6.2.3 Wearing the Instrument

Industrial Scientific recommends that the unit be worn within a 25.4 cm (10 ") radius of the nose and mouth based on the U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) definition of the breathing zone. Refer to OSHA, other agencies or groups, and company safety policy as needed for additional information.

Industrial Scientific also recommends that the unit be worn within the instrument operator's sight line.

The instrument operator may wear the unit with its factory-installed garment clip or with the optional belt clip. The garment clip is solely intended for attachment to a garment. The belt clip may be attached to a belt or garment. The clips should be securely fastened and attached in a manner that ensures the unit's sensor portals are fully exposed to the air. No part of the unit should be covered by any garment, part of a garment, or other item that would restrict the flow of air to the sensors or impair the operator's access to the audible, visual, or vibration alarms. Attach the desired clip as described below.

Figure 3 Ventis MX-4



Figure 4 Tango TX-1



Figure 5 Garment Clipt (Tango TX-1 Shown)



STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use		Document Number: 962C-SOP-049
Original Approval Date: Oct 19, 2021	Revision Number: 2	Page 19 of 20
Latest Revision Date: Mar 15, 2024	Next Revision Date: Mar 15, 2027	Document Approval Level: 4

This document is not controlled if printed.

6.2.4 Alarms Warnings and Notifications

6.2.4.1 Alarms – Ventis MX-4

All monitor alarms and warnings should be taken seriously and responded to as stated in company safety standards. Once initiated, an alarm will remain on while the alarm condition is present. For gas-related alarms, once the detected gas concentration changes, the alarm indicators will change to reflect any new condition such as low-alarm gas, high-alarm gas, over-range gas, or no gas alarm. When the latch alarm feature is enabled and the monitor goes into alarm, it will remain in alarm until the alarm condition no longer exists and the monitor user presses the ENTER button for one second. This applies only to gas-related alarms.

It is practical for the monitor user to be aware of the possible alarms prior to monitor set-up and use. The Ventis MX4 has four alarm and warning levels. A “system level” alarm generates the highest frequency tone and highest level visual and vibration signals. It is used to indicate such events as a pump, critical battery failure, or sensor failure. The “high” or “low” level audio alarms, in combination with visual and vibration indicators, turn on when gas concentration readings are over-range, high, or low. The lowest level indicator is a warning with beep patterns to indicate service needs (e.g., low battery or calibration due). The beep is also used as a confidence indicator when enabled.

6.2.4.2 Alarms, Warnings and Failures – Tango TX-1

Alarms

The Tango® TX1 instruments have alarms of two different intensities, high and low. Alarms are persistent: they turn off when the alarm-causing event is no longer detected; however, if the instrument’s alarm latch is enabled, an alarm will remain on until the user presses to turn it off.

When all alarm signals are on:

- The high alarm features the red lights, with steady sound. It is fast paced.
- The low alarm is similar to the high alarm, but includes blue, as well as red light. It is medium paced.

Note: Signals (visual, audible, and vibration) vary based on instrument settings.

Once the detected gas concentration changes, the alarm indicators will change to reflect any new condition such as low-alarm gas, high-alarm gas, over-range gas, or no gas alarm. Different events can produce the same alarm. Events are distinguished from one another through the use of symbols that appear on the instrument display screen

Warnings and Failures

Warnings turn on and off repeatedly. The more urgent the warning, the shorter the time between on-off occurrences: a warning that repeats every two seconds is more urgent than a warning that repeats every 30 seconds.

Warnings persist until the event is resolved. In some cases, an unresolved warning will become more urgent in frequency. For example, a low-battery warning that is not resolved will change to alarm status indicating a critical low-battery condition.

As with alarm events, warning events are distinguished from one another on the instrument display screen using different symbols.



STANDARD OPERATING PROCEDURE

Personal Gas Monitors - Field Use		Document Number: 962C-SOP-049
Original Approval Date: Oct 19, 2021	Revision Number: 2	Page 20 of 20
Latest Revision Date: Mar 15, 2024	Next Revision Date: Mar 15, 2027	Document Approval Level: 4

This document is not controlled if printed.

In the event of an alarm, warning or failure, leave the work area and report the event to your supervisor or HS&E.

7.0 NOTES

If this task is to be done by a method different than described in this SOP, the work must **STOP** and the alternate method must be **DOCUMENTED** with an adequate hazard assessment tool such as a JSA. The document must be **APPROVED** by a supervisor before such procedures are implemented.

If using a different model or manufacturer of personal gas monitoring equipment, the manufacturer instructions for use must be followed and additional training may be required as outlined in the hazard assessment.

8.0 REFERENCES

- Alberta Occupational Health and Safety Act, Regulation and Code – Part 4 Chemical Hazards, Biological Hazards and Harmful Substances, Section 20 to 23
- 950C-C-021 Gas Monitoring Code
- 950C-C-032 Hydrogen Sulphide (H₂S) Code
- Industrial Scientific Tango TX-1 Product Manual – The Essential Guide for Safety Teams and Operators
- Industrial Scientific Ventis MX-4 Product Manual – Set-up Operation Service
- Industrial Scientific DSX-L Product Manual

9.0 APPENDICES

- No appendices.