

GAS DETECTION MADE EASY

**INDUSTRIAL
SCIENTIFIC**

**TRAINING
DEPARTMENT**



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Download the Gas Detection Made Easy App

Learn about hazardous gas types, detection methods, sensor technologies, regulations, and more.



The Microscope That Created a Company



It all began one afternoon in 1984 in Glasgow, Scotland at the Anderson Strathclyde Board of Directors meeting. Kenton E. McElhattan, National Mine Service Company President & CEO and Anderson Strathclyde board member, was challenged by Anderson Strathclyde's Chief Financial Officer for having requested \$600 to purchase a used microscope. The microscope was sorely needed by the Industrial Safety Division of National Mine Service to conduct research on better ways of sensing methane gas. Concluding a rather spirited discussion that afternoon, McElhattan pulled his personal checkbook from his briefcase and asked, "To whom should I make the \$600 check payable?"

At the time, 51% of National Mine Service was owned by Anderson Strathclyde. As a producer of heavy mining machinery and mining systems, Anderson Strathclyde struggled to understand the research and development needs of National Mine Service in order to develop gas monitoring products for use by workers in underground mines.

With a vision of a company in which employees had a voice and were encouraged to use it, McElhattan ultimately proposed a resolution whereby he would return to the U.S. and, along with his son Kent, purchase the Industrial Safety Division of National Mine Service. On January 25, 1985, the purchased division became known as Industrial Scientific. Since then, Industrial Scientific has grown to become the world's leading provider of gas detection products and services. The company helps to keep hundreds of thousands of workers safe in hazardous environments around the world – all thanks to a little microscope.

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Training Department Mission Statement

The Training Team is committed to educating workers on the proper use of gas detection equipment and services while empowering them to enhance their culture of safety.

EDUCATE

MOTIVATE

INSPIRE

Our trainings are available in English, French, or German.
Please contact us for more information

www.indsci.com/services/training



Mike J. Platek, Field Services Professional, Training Specialist



Mike has been with Industrial Scientific Corporation since 1985, starting in the Engineering and Sales Departments. During this time, he had the good fortune of assisting in the design of ISC instruments and systems equipment. Later he moved into Training and started his venture of training both end users and distributors alike. He has worked with all of the industries Industrial Scientific services, offering training in instrumentation, confined spaces, and fixed system setup.

He holds a degree in Mechanical Engineering and came to Industrial Scientific Corporation with experience in designing longwall mining equipment and railroad switching equipment. Mike is certified nationally for Firefighter I and in the State of Pennsylvania as an EMT. He holds certification in Hazardous Materials and Confined Space Supervision, and participates in classes for training and safety. He is a volunteer firefighter and serves on his county's hazardous material team.

As a Training Specialist his duties include, but are not limited to, hosting Gas Detection Made Easy classes, both in house and regionally throughout North America as well as at customer locations. He is also tasked with evaluating computer-based training materials produced in the department and other training materials used in our GDME classes.

Jamie Greene, Field Services Professional, Training Specialist



Jamie Greene has been with Industrial Scientific Corporation since 2017 where he started in the Surface Mount Manufacturing department. After a short year in manufacturing he transitioned into the New Product Development and Hardware Quality Assurance test labs. During this time Jamie gained product knowledge and learned the inner workings of all Industrial Scientific instruments old and new. This position allowed him to work closely with other departments and project teams to test the specifications of our products to ensure they are the durable, life saving instruments that they are.

He holds a Bachelor of Science in Multimedia Communications and a Minor in Graphic Design from Slippery Rock University.

Jamie joined the team as a Training Specialist in March 2020. His duties include hosting onsite and online training classes as well as GDME classes regionally and in Pittsburgh. He is also tasked with creating and delivering computer and video-based training materials for the training team and used as part of Industrial Scientific's suite of classes worldwide.

Nick Vieira, Field Services Team Lead, Training Specialist



Nick Vieira joined the Training Team in April 2021. He spent the previous 9 years in the Oil and Gas Industry as an expert in Measurements & Logging while Drilling. His background in that industry included service and operation of precision equipment, coordination of personnel, and promoting customer satisfaction; in addition, it supplied him with invaluable experience on the front lines of Gas Monitoring, as well as site and safety supervision.

Nick is a trained trainer, with over 6 years' experience providing on the job and technical trainings. During his time in Oil & Gas he was responsible for the production and delivery of various training programs and content. He is also certified in Root Cause Analysis and a certified Scrum Master.

As a Training Specialist his duties include, but are not limited to, hosting Gas Detection Made Easy classes, both in house and regionally throughout North America. He is also tasked with the delivery of computer-based trainings and content.



Discover All That iNet® Has to Offer

You're plenty busy focusing on the things that matter to your safety program. Amid your daily tasks is the hefty responsibility of ensuring that your people are protected from workplace hazards so that they go home safely at the end of each day. Buying your fleet of gas detectors was easy, but then the challenges came. How do you get real-time visibility into what's happening in the field? How do you ensure that your instruments are always ready for use? For all of these challenges and more, iNet® is a proven solution that works for thousands of customers worldwide.

How Does iNet Work?

Gas detection technology is evolving every day. We've come a long way in terms of making gas detectors safer, more intelligent, and more sustainable. Today's gas detectors must be extremely rugged, but also smarter than ever before. Much like purchasing a cell phone that you enhance with apps and services, the way you customize your gas detection experience is no different. iNet provides an integrated solution for gas detection that allows you to choose the equipment, software applications, and services that help to keep your workers safe and your workload manageable.

Join the 10,000+ Customer Sites on iNet

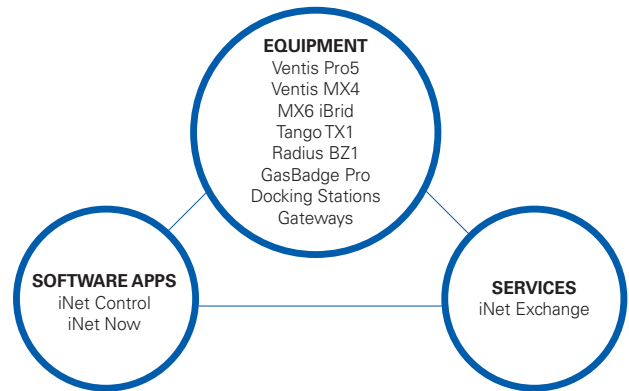
Over 74,100,000 Alarm Events | Over 378,000 Gas Detectors
85 Countries | 17 Years of Cloud Experience

Integrated Solution for Gas Detection

iNet is an integrated solution for gas detection that can be easily configured to meet the needs and goals of your gas detection program.

Customers pick equipment, software, and services.

See all that iNet has to offer at www.indsci.com/inet



What Combination of iNet Offerings Best Meets Your Needs?

INET SOFTWARE AND SERVICES	REQUIRED EQUIPMENT	DESCRIPTION
iNet Control Software	DSXi*	Gas detection management software including equipment and compliance management, data records and reporting, and worker trends
iNet Exchange Service	DSXi or DSX-L	Gas detection as a service including automatic repair and replacement, and calibration gas replenishment
iNet Now Software	Smart Device, Ventis Pro	Live monitoring software including map of workers and real-time text and email alerts

*DSX Docking Stations in Standalone mode can be upgraded in the field to DSXi.

Streamline Gas Detector Maintenance and Repair with iNet® Exchange

If you are responsible for managing a gas detection program, you may struggle to ensure that instruments are always ready and working properly. Even simple maintenance can become a costly headache when you have to keep extra gas monitors and spare parts around.

iNet® Exchange is a subscription-based service for gas detectors covering repair and replacement. iNet Exchange simplifies operations across all aspects of your gas detection program—gas detector availability, cost, and ownership—by delivering equipment on demand. There is no need to worry about instrument warranties, paperwork of processing the claim, or time to wait for new equipment. Parts, equipment, and shipping are covered, and even damaged instruments can be traded in. As an iNet Exchange customer, you will always have the equipment you need, when you need it.

Get your iNet Exchange account today,
contact us to learn how
www.indsci.com/inet-exchange

Ensure gas detectors are there when and where you need them

- Avoid downtime with proactive gas detector replacement, typically within 48 hours
- Eliminate the costs of extra parts, monitors, and calibration gas
- Eliminate the time spent managing warranty claims

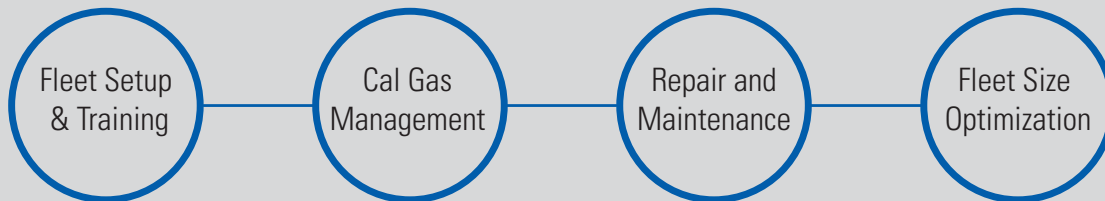
Pay for only what you need, when you need it

- Increase or decrease the number of instruments in your fleet to meet demand
- Get everything you need for your gas detection program including setup, training, calibration gas, and maintenance and repair through one service
- Add rental equipment at discounted rates for temporary projects

Eliminate unexpected gas detector expenses

- Set up your iNet Exchange program with no capital up-front investment
- Lock in a fixed cost that covers all necessary items including gas detectors, shipping, calibration gas, docking stations, and more
- Receive replacement units automatically without making additional purchases

With iNet Exchange, you can focus on your people’s safety rather than managing gas detector logistics. We handle everything from setup to maintenance and repair.



Benefits of iNet Exchange vs. Warranties

✓ iNET EXCHANGE	✗ WARRANTY
Replacement gas detectors automatically ship	RMA/warranty claim forms must be processed
Equipment typically shipped within 48 hours	Weeks or months to receive repaired instrument
Right-sized fleet always available for use	Extra gas detectors needed while waiting for warranty repair

Bring Visibility to Your Gas Detection Program with iNet® Control

If you're responsible for worker safety, you probably spend too much time sorting through piles of paperwork for your gas detection program. What if there was an automated solution that went beyond collecting raw data to help you quickly identify hazards, track worker safety, and manage equipment?

iNet® Control is gas detection management software that provides unparalleled visibility into your gas detection program. Now you can easily manage your hazards, people, and equipment from anywhere with one simple dashboard. For DSXi Docking Station customers, access to iNet Control is included at no additional charge.

Track and mitigate the everyday hazards your people face

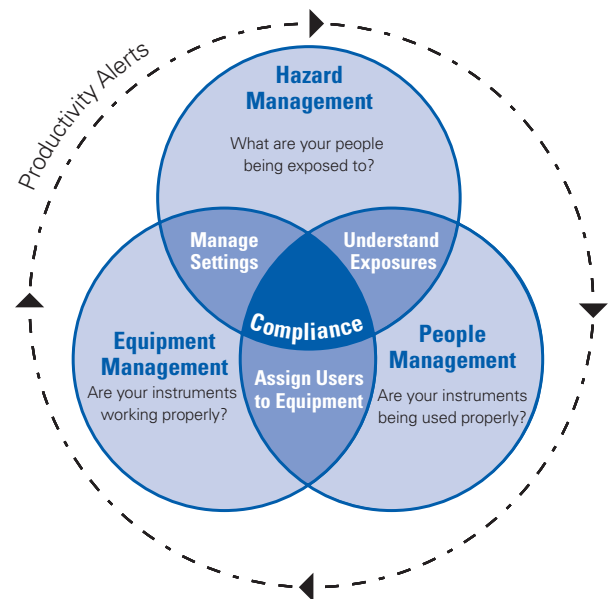
- Receive easy-to-read summary reports that identify when, where, and for which users alarms occurred
- Track alarm trends over time with customizable graphs
- Review and sort historical data by instrument, user, or alarm type
- Receive tailored email summary reports based on the data that matters to you most

Know how gas detectors are being used and take corrective action

- Create user groups with different settings and permissions and receive alerts when any settings are changed
- Assign settings for users in an easy-to-use menu
- Monitor who is using each instrument and when that instrument is being used improperly
- Assess how users responded during alarms and see if notifications were shut off or ignored
- View full data log records to see which hazards workers were exposed to

Easily maintain your gas detection equipment and manage compliance

- Set schedules for equipment groups, bump tests, calibrations, data downloads, and diagnostic reports to ensure instruments are maintained according to company policy
- Report on bump tests, alarm summaries, instrument status, and instrument warnings
- Receive alerts and apply firmware updates when they become available to take advantage of new enhancements
- Print and email bump test and calibration certificates on demand for easy auditing
- Change or verify instrument settings across your fleet to meet the needs of users and applications
- Track the history of components and users to uncover trends and anomalies



Get your iNet Control account today, contact us to learn how www.indsci.com/inet-control

Receive the Following Email Alerts to Help You Understand Gas Alarm Events, Usage, and Gas Detector Maintenance

What are your people exposed to?

- Gas type
- Alarm duration
- Peak gas concentration
- Average gas concentration
- Instrument, user, and location

Are instruments used properly?

- Who used which instruments without being bump tested or calibrated
- Who turned a monitor off during alarm
- Who changed a critical setting
- Who manually calibrated and bumped instruments

Are instruments working properly?

- Bump/calibration overdue
- Equipment not seen/no data
- Marginal/failed sensor
- Firmware updates

Get Real-Time Safety Alerts Any Time, Anywhere with iNet® Now

iNet® Now is Live Monitoring software that provides real-time text and email alerts for gas hazards, panic, and man-down situations, allowing you to see and respond to incidents as they happen. A map helps you to pinpoint the location of workers and instruments. With iNet Now, you can have confidence that workers are visible even when you're miles away.

- Receive notifications and respond immediately when a worker encounters a high alarm, low alarm, TWA, STEL, panic, or man-down situation; alerts are fully customizable by gas level
- Eliminate the human error, cost, and time it takes for lone workers to complete manual check-in processes
- Improve your gas detection program visibility
- Get your live monitoring application up and running immediately



Get started with iNet Now at
www.indsci.com/inet-now

Is iNet Now Right for Your Application?

Mobile Workers

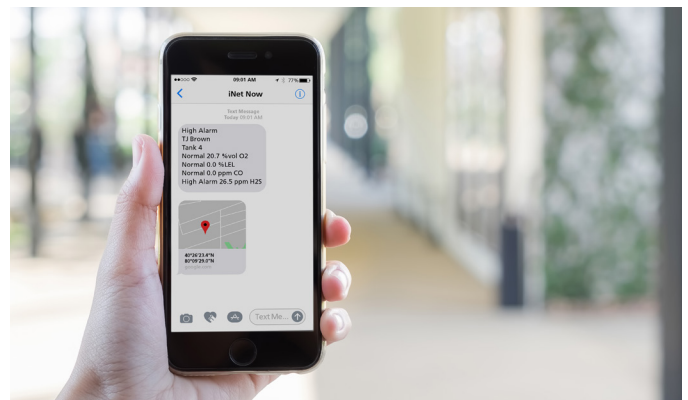
iNet Now gives mobile workers the peace of mind that someone has their back in an emergency. Whether workers are isolated from their nearby team members or are unaccompanied in the field, they are never truly alone with iNet Now.

Emergency Response Teams

Emergency response teams use the Radius BZ1 and Ventis Pro5 with LENS Wireless to monitor emergency response sites. iNet Now further enhances safety at emergency response sites by providing real-time alerts and an updated map showing worker and instrument status, allowing safety personnel to see what's happening before entering a potentially hazardous location.

Confined Space Entry Teams

Confined space entry teams consist of a small group of mobile workers with LENS-connected Radius BZ1 and Ventis Pro5 gas detectors. iNet Now provides real-time alerts and an updated map showing worker and instrument status so that safety personnel can monitor real-time conditions in and around the confined space.



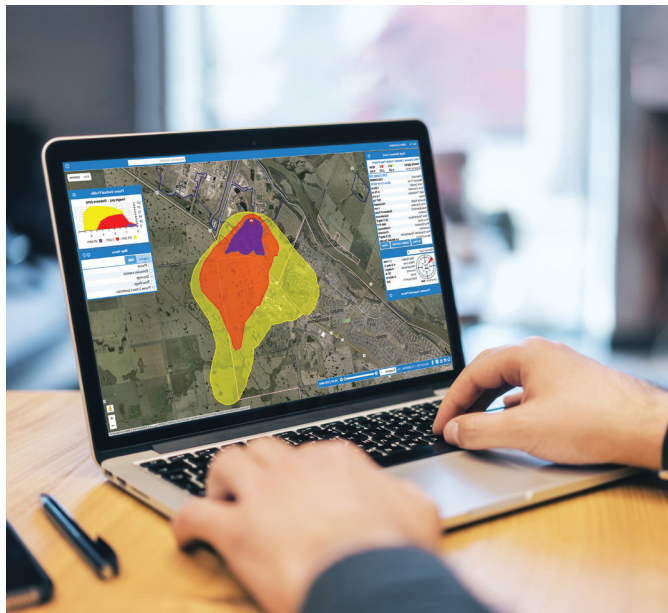


SAFER One

SAFER One, software for advanced hazard modeling, gives you the real-time information you need to proactively respond to a chemical release and reduce the risk to your people, plant, and community.

Easily identify the source, severity, and community impact of a chemical event by integrating real-time data from on-site gas and weather sensors with Google Maps™. Whether it's for emergency response or everyday use, SAFER One ensures you're prepared for any chemical situation.

- See impacted areas – now and in the future – on a clear map. Aggregate real-time data from gas sensors, weather stations, and local maps to see all vital information in one place.
- Quickly identify the source of the chemical leak so you can stop it faster.
- Generate detailed reports to share with first responders and community stakeholders. Have confidence that your information is up-to-date and accurate, from start to finish.
- Improve efficiency and accuracy by eliminating tedious manual event analysis processes. Allow our proven, patented algorithms to calculate it for you using real-time data.



SAFER One gives you full visibility into your site by integrating with other solutions. See below for some common integrations.

WEATHER STATIONS

PART NO.	DESCRIPTION
18109636-1010	Weather Station, All-Weather Sensor, Communication Box, Ethernet
18109636-2010	Weather Station, All-Weather Sensor, Communication Box, Fiber
18109636-3010	Weather Station, All-Weather Sensor, Communication Box, RF
18109636-3110*	Weather Station, All-Weather Sensor, Communication Box, RF, Includes Yagi Directional Antenna w/ N-Type Connector
18109636-3210*	Weather Station, All-Weather Sensor, Communication Box, RF, Includes Omni Directional Antenna with Mounting Bracket
17159981	Lufft Weather Sensor, WS700, US & CA only, Configured (has the rain gauge and solar radiation)
17160154	Lufft, Weather Station, WS501-UMB
17160157	Lufft, Raing Gauge, Tipping Bucket, WTB100 (this is needed with 17160154)

See how you can take your existing safety processes to the next level with SAFER One at: www.indsci.com/safer



**DSX™
DOCKING STATION**



INSTRUMENT CONFIGURATIONS

PART NUMBER	DESCRIPTION														
18109327-ABC	Ventis® MX4, Ventis® Pro5														
18109329-ABC	MX6 iBrid®														
18109330-ABC	Tango®														
18109331-ABC	GasBadge® Pro														
18109396-ABC	SafeCore® Module														
-ABC	<table border="0"> <tr> <td>A – DSX Mode:</td> <td>C – Power Cord Type:</td> </tr> <tr> <td>0 = DSX Standalone</td> <td>1 = North America</td> </tr> <tr> <td>1 = DSXi Cloud-connected</td> <td>2 = Europe</td> </tr> <tr> <td>2 = DSX-L Local Server</td> <td>3 = Australia</td> </tr> <tr> <td>B – Number of Gas Inlet Ports:</td> <td>4 = UK</td> </tr> <tr> <td>3 = 3 Ports</td> <td></td> </tr> <tr> <td>6 = 6 Ports (for Ventis, MX6 iBrid, and SafeCore only)</td> <td></td> </tr> </table>	A – DSX Mode:	C – Power Cord Type:	0 = DSX Standalone	1 = North America	1 = DSXi Cloud-connected	2 = Europe	2 = DSX-L Local Server	3 = Australia	B – Number of Gas Inlet Ports:	4 = UK	3 = 3 Ports		6 = 6 Ports (for Ventis, MX6 iBrid, and SafeCore only)	
A – DSX Mode:	C – Power Cord Type:														
0 = DSX Standalone	1 = North America														
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2 = DSX-L Local Server	3 = Australia														
B – Number of Gas Inlet Ports:	4 = UK														
3 = 3 Ports															
6 = 6 Ports (for Ventis, MX6 iBrid, and SafeCore only)															

KITS*

18109400	DSX Standalone Kit: Tango TX1 (H ₂ S)
18109401	DSX Standalone Kit: Ventis MX4, Ventis Pro5 (LEL, CO, H ₂ S, O ₂)
18109404	DSXi Cloud-connected Kit: Tango TX1 (H ₂ S)
18109405	DSXi Cloud-connected Kit: Ventis MX4, Ventis Pro5 (LEL, CO, H ₂ S, O ₂)

ACCESSORIES

18105684	iGas® Reader
18105924	5-Port Gas Regulator Manifold Clamp
18105932	6-Port Gas Regulator Manifold
17113887	Ethernet Cable, 5' (Cat5E network cable)
17113895	Ethernet Cable, 10' (Cat5E network cable)
17113903	Ethernet Cable, 25' (Cat5E network cable)
17154813	3G/4G Router
17113945	5-Port Ethernet Hub
18109406	DSX to DSXi Activation Certificate

The DSX™ Docking Station easily maintains the gas detectors that keep your people safe in hazardous environments

Your Gas Detectors...

Ready When You Need Them

Know that your instruments are ready for use every day, every shift, without the burden of manual maintenance routines.

Your Calibration Gas...

There Before You Run Out

Stop worrying about calibration gas and let DSX monitor and order replacement gas cylinders when you need them.

Your Software...

Updated Upon Release

Effortlessly manage your fleet, data, and software updates from any web-enabled device.

Your People...

Back Home at the End of Every Shift



One Docking Station, Three Modes

DSX Standalone

- The DSX in standalone mode is a simple out-of-the-box gas detector maintenance station that requires no PC or network configuration.

DSXi Cloud-connected

- The DSX in cloud-connected mode is an automated maintenance, record storage, and fleet management solution.

DSX-L Local Server

- The DSX in local server mode provides the option to automatically store data from all docking stations behind a corporate network firewall, addressing network and data storage restrictions or preferences.



Notes:

PRODUCT SPECIFICATIONS

WARRANTY

Two-year warranty – DSX (Standalone) and DSX-L (Local Server)
Guaranteed for Life™ Program** – DSXi (Cloud-connected)

INSTRUMENTS SUPPORTED

GasBadge Pro, MX6 iBrid, Tango TX1, Ventis MX4, Ventis Pro5, SafeCore

DIMENSIONS

GasBadge Pro, Tango TX1: 22.7 x 16.9 x 27.3 cm (8.92 x 6.65 x 10.75 in)
Ventis MX4, Ventis Pro5: 24.9 x 16.9 x 27.3 cm (9.83 x 6.65 x 10.75 in)
MX6 iBrid: 25.3 x 16.9 x 27.3 cm (9.96 x 6.65 x 10.75 in)
SafeCore: 27.3 x 16.9 x 29.2 cm (10.75 x 6.65 x 11.5 in)

GAS INLETS

3-Port Version: One "fresh" air port, two calibration gas ports

6-Port Version: One "fresh" air port, five calibration gas ports (for Ventis, MX6 iBrid and SafeCore only)

PUMP FLOW RATE

1.2 SCFH (550 mL/min)

COMMUNICATION

10/100 Ethernet support, RJ-45 Category 5 Connection

DISPLAY

128 x 64 Dot Matrix LCD – Multilingual modes
English, Spanish, French, German and Portuguese***

PERFORMANCE SPECIFICATIONS

OPERATING TEMPERATURE RANGE

0 °C to 50 °C/32 °F to 122 °F

OPERATING HUMIDITY RANGE

0% to 80% relative humidity (RH) up to 30 °C (86 °F), decreasing linearly to 50% RH at 50 °C (122 °F)

EXTERNAL POWER SUPPLY RATINGS

Supply voltage: 100-240 VAC/12 VDC
Frequency range: 50-60 Hz
Current rating: 5A

***DSX Docking Station Kits Include:** Choice of Standalone or Cloud-connected 3-port DSX Docking Station, 116L calibration gas (appropriate mix) with demand flow regulator with iGas® pressure switch, USB storage device (Standalone only).

**Specific terms of the Guaranteed for Life™ Program are included with all products and are available upon request.

***DSX-L (Local Server) does not support Portuguese.



MX6 iBRID® MULTI-GAS MONITOR



The MX6 iBrid® is the first 6 gas monitor to feature a full-color LCD screen

The display improves safety with clear readings in low light, bright light or anywhere in between. Whether the work is outside, inside or underground, it's easy to see what gas hazards lurk in the immediate work environment.

Step through the instrument settings and functions with an intuitive menu and the instrument's five-way navigation button. It even supports the option of on-board graphing for easily interpreted direct readings and recorded data.

SPECIFICATIONS*

INSTRUMENT WARRANTY

Warranted for as long as the instrument is supported by Industrial Scientific

CASE MATERIAL

Lexan/ABS/Stainless Steel with protective rubber overmold

DIMENSIONS

135 x 77 x 48 mm (5.3 x 3.05 x 1.9 in) without Pump
193 x 77 x 56 mm (7.6 x 3.1 x 2.2 in) with Pump

WEIGHT

409 g (14.4 oz) typical, without Pump; 511 g (18.0 oz) typical, with Pump

DISPLAY/READOUT

Color Graphic Liquid Crystal Display

POWER SOURCE/RUN TIMES

Rechargeable, Extended-Range Lithium-ion Battery (36 hours) without Pump
Rechargeable, Extended-Range Lithium-ion Battery (20 hours) with Pump
Replaceable AA Alkaline Battery (10.5 hours) without Pump

OPERATING TEMPERATURE RANGE

-20 °C to 55 °C (-4 °F to 131 °F)

OPERATING HUMIDITY RANGE

15% to 95% non-condensing (continuous)

SUPPLIED WITH MONITOR

Universal charger, nylon carrying case, belt clip, calibration cup, wrist strap, quick start guide, dust filter/water stop (with pump), sample tubing (with pump).

CERTIFICATIONS

INGRESS PROTECTION IP64

- ANZEx: Ex ia s Zone 0 I; Ex ia s Zone 0 IIC T4
- ATEX: Ex ia IIC T4 Ga; II 1G (or Ex d ia IIC T4 Gb IR sensor);
Ex ia I; Equipment Group and Category: I M1/II 1G
- China CPC: Metrology Approval
- China Ex: Ex ia d I/IIC T4
- China MA: Approval for Mining Products; CH₄, O₂, CO, CO₂
- CSA: CI I, Gr A-D T4; Ex d ia IIC T4
- EAC: PBExiadl X; 1ExiadlICT4 X
- IECEX: Ex ia I (Ex ia d I IR sensor); Ex ia IIC T4 Ga; Ex d ia IIC T4 Gb
- INMETRO: Ex ia IIC T4 Ga
- KC: Ex d ia IIC T4
- KIMM: Ex d ia IIC T4
- MDR: Registration of Plant Design; CH₄, O₂, CO, H₂S, NO₂
- MSHA: 30 CRF, Part 22, Intrinsically safe for methane/air mixtures
- PA-DEP: BFE 114-08 Permissible for PA Bituminous Underground Mines
- UL: CI I, Div 1, Gr A-D, T4; CI II, Groups F G;
CI I, Zone LEL 0, AEx ia d IIC T4 (or AEx ia d IIC T4 IR sensor)

SPECIFICATIONS*

MEASURING RANGES

SENSOR	RANGE	RESOLUTION
CATALYTIC BEAD		
Combustible Gas	0%-100% LEL	1%
Methane	0%-5% vol	0.01%
ELECTROCHEMICAL		
Ammonia	0-500 ppm	1
Carbon Monoxide	0-1,500 ppm	1
Carbon Monoxide (High Range)	0-9,999 ppm	1
Carbon Monoxide (CO/H ₂ low)	0-1,500 ppm	1
Chlorine	0-50 ppm	0.1
Chlorine Dioxide	0-1 ppm	0.01
Carbon Monoxide/ Hydrogen Sulfide (COSH)	CO: 0-1,500 ppm H ₂ S: 0-500 ppm	1 0.1
Hydrogen	0-2,000 ppm	1
Hydrogen Chloride	0-30 ppm	0.1
Hydrogen Cyanide	0-30 ppm	0.1
Hydrogen Sulfide	0-500 ppm	0.1
Nitric Oxide	0-1,000 ppm	1
Nitrogen Dioxide	0-150 ppm	0.1
Oxygen	0-30% vol	0.1%
Phosphine	0-5 ppm	0.01
Phosphine (High Range)	0-1,000 ppm	1
Sulfur Dioxide	0-150 ppm	0.1
INFRARED		
Hydrocarbons	0-100% LEL	1%
Methane (% vol)	0-100% vol	1%
Methane (% LEL)	0-100% LEL	1%
Carbon Dioxide	0-5% vol	0.01%
PHOTOIONIZATION		
VOC	0-2,000 ppm	0.1

LANGUAGE

English, Portuguese, French, Indonesian, Spanish, Russian, German, Polish, Italian, Czech, and Dutch

* These specifications are based on performance averages and may vary by instrument

Additional MX6 iBrid Features

- Diffusion mode or internal sampling pump versions.
- Simple, user-friendly, menu-driven navigation.
- Five way navigation button.
- Durable, concussion proof over-mold case.
- Up to 6 gases monitored simultaneously.
- Full color graphic LCD is highly visible in a variety of lighting conditions.
- Powerful 95 dB audible alarm.
- Instrument display can be customized to provide numeric readout of gas concentrations, continuous graphical representation of hazard trends, and Go/No Go indication.
- On board memory provides storage of readings at 1-minute intervals for 6 gases for a minimum of 1 year.
- Allows user to adjust instrument to specific requirements for display, alarms, calibration, and data logging.
- Bump Test and Self Test on Start-up functionality.
- Electronically enhanced RFI protection.
- The MX6 iBrid can now provide at least a full eight hours of runtime after being stored for six weeks. This allows for MX6 iBrid monitors to be stored and available for use in between the recommended 30-day calibration period.
- Bump Test Overdue feature allows the user to set the bump interval between 0.5 and 7 days in 0.5 day increments. When enabled, the audio and visual indications alert the user every 15 seconds.
- Users can select Next or Last Calibration Date to be displayed at start-up and a single date will appear.
- Bump failure is distinguished from a calibration failure on the instrument display and the sensor that failed the bump test shows, "B F".
- New LCD provides crisper, easier-to-read text even in bright sunlight.
- The MX6 iBrid requires users to block the pump during startup prior to advancing to the Normal Reading Screen.
- The ability to reset the Over Range alarm without restarting the instrument.
- Option to disable the ability to turn off an instrument while in gas alarm.

Notes:

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VENTIS® MX4
MULTI-GAS MONITOR

The Ventis® MX4 is a compact, multi-gas monitor available in both aspirated and diffusion versions

- Configure for diffusion applications or with an integral sampling pump for sample draw applications
- Detect from one to four gases with a wide range of sensor options
- Use the diffusion monitor for 20 hours with a rechargeable lithium-ion extended-range battery

Highly configurable, the Ventis MX4 meets your gas detection needs with ease. It is the ideal instrument for monitoring one to four gases in confined spaces and nearly any other potentially hazardous environment.

This lightweight instrument is available with a bright safety orange overmold, providing visibility in darker environments. An extended-range lithium-ion battery provides up to 20 hours of continuous monitoring when using the diffusion version.

SPECIFICATIONS*

INSTRUMENT WARRANTY

Monitor, pump (if applicable), CO, H₂S, O₂, and LEL sensors have a four-year warranty. All other sensors and batteries are warranted for four years.

CASE MATERIAL

Polycarbonate with protective rubber overmold

DIMENSIONS

103 x 58 x 30 mm (4.1 x 2.3 x 1.2 in) without Pump lithium-ion battery version
172 x 67 x 66 mm (6.8 x 2.6 x 2.6 in) with Pump lithium-ion battery version

WEIGHT

182 g (6.4 oz) – Ventis without Pump, lithium-ion battery version
380 g (13.4 oz) – Ventis with Pump, lithium-ion battery version

TEMPERATURE RANGE

-20 °C to 50 °C (-4 °F to 122 °F) **

OPERATING HUMIDITY RANGE

15% to 95% non-condensing (continuous)

DISPLAY/READOUT

Backlit Liquid Crystal Display (LCD)

POWER SOURCE/RUN TIME

Rechargeable slim extended lithium-ion battery
(18 hours typical @ 20 °C) without Pump

Rechargeable lithium-ion battery
(12 hours typical @ 20 °C) without Pump

Rechargeable extended-range lithium-ion battery
(20 hours typical @ 20 °C) without Pump
(12 hours typical @ 20 °C) with Pump

Replaceable AAA alkaline battery
(8 hours typical @ 20 °C) without Pump
(4 hours typical @ 20 °C) with Pump

ALARMS

Ultra-bright LEDs, loud audible alarm (95 dB at 30 cm), and vibrating alarm

SENSORS

Combustible gases/methane – Catalytic Bead

O₂, CO, H₂S, NO₂, SO₂ – Electrochemical

MEASURING RANGES

Combustible Gases:	0%-100% LEL in 1% increments
Methane (CH ₄):	0%-5% of vol in 0.01% increments
Oxygen (O ₂):	0%-30% of vol in 0.1% increments
Carbon Monoxide (CO):	0-1,000 ppm in 1 ppm increments
Carbon Monoxide (CO/H ₂ low):	0-1,000 ppm in 1 ppm increments
Hydrogen Sulfide (H ₂ S):	0-500 ppm in 0.1 ppm increments
Nitrogen Dioxide (NO ₂):	0-150 ppm in 0.1 ppm increments
Sulfur Dioxide (SO ₂):	0-150 ppm in 0.1 ppm increments

CERTIFICATIONS

INGRESS PROTECTION IP66/67

ANZEx:	Ex ia s Zone 0 I/IIC T4
ATEX:	Ex ia IIC T4 Ga and Ex ia I Ma; Equipment Group & Category II 1G/I M1
China CMC:	Metrology approval
China CPC:	CPA 2017-C103
China Ex:	Ex ia IIC T4 Ga; Ex ia d I Mb
China KA:	Approved for Underground Mines with CO, H ₂ S, O ₂ and CH ₄
China MA:	Approved for Underground Mines with CO, H ₂ S, O ₂ and CH ₄ (Note: Diffusion 17144453 pack only)
CSA:	CI I, Div 1, G A-D, T4; Ex d ia IIC T4
EAC:	PBExdial X/1ExdialIIC T4 X
IECEX:	Ex ia IIC T4 Ga
INMETRO:	Ex ia IIC T4 Ga
KC:	Ex d ia IIC T4
KIMM:	Ex d ia IIC T4
MED:	Portable Multi-Gas Detector; Category 2 (MED 96/98/EC; MED 2012/32/EU Marine Directive) Li-ion
MSHA:	30 CFR Part 22; Permissible for underground mines; Li-ion
PA-DEP:	BFE 46-12 Permissible for PA Bituminous Underground Mines; Charger/docking station accessories; Category 1
SANS:	SANS 1515-1; Type A; Ex ia I/IIC T4; Li-ion
TIIS:	Ex ia IIC T4 X
UL:	CI I, Div 1, Groups A-D, T4; Zone 0, AEx ia IIC T4; CI II, Gr F-G (Carbonaceous and Grain dust)

** Operating temperatures above 50 °C (122 °F) may cause reduced instrument accuracy. Operating temperatures below -20 °C (-4 °F) may cause reduced instrument accuracy and affect display and alarm performance. See Product Manual for details.

SPECIFICATIONS***SUPPLIED WITH MONITOR**

Calibration Cup (Ventis)

LANGUAGE

English (1), French (2), Spanish (3), German (4), Italian (5), Dutch (6), Portuguese (7), Russian (9), Polish (A), Czech (B), Chinese (C), Danish (D), Norwegian (E), Finnish (F), Swedish (G), Japanese (J)

* These specifications are based on performance averages and may vary by instrument

Additional Ventis MX4 Features

Integral Pump Option

- The Ventis MX4 can be configured with or without an integral motorized sampling pump capable of drawing samples from up to 100 feet.

Slide-on Pump Option

- The Ventis MX4 is designed for use with the self-powered motorized Ventis® Slide-on Pump (VSP) capable of drawing samples from up to 50 feet.
- The Ventis MX4 can be attached and removed from the Ventis Slide-on Pump without the use of tools.

Alarms

- Ultra-bright LEDs, loud audible alarm (95 dB at 30 cm) and vibrating alarm.
- Dual-level, user-selectable alarm levels.

STEL and TWA Readings and Alarms

- Short-Term and Time-Weighted Average exposure measurements and alarms allow users to potentially set instantaneous alarms at higher levels, allowing work to continue safely while still providing alarms in conditions of prolonged exposure at lower gas concentrations.

Data Logging

- On-board continuous data logging memory is capable of storing a minimum of three months of data for the four-sensor configuration at the fixed 10 second interval.

Alarm Event Log

- On-board event-logger will record the last sixty alarm events in its memory. Information stored for each event will be: sensor type and serial number, peak exposure level, alarm duration, alarm date and time, alarm thresholds, and sensor measurement units.

Peak/Hold Function

- Provides quick access to an on-screen review of the highest gas readings the sensors have been exposed to since the last time the peak readings were cleared (lowest for O₂) without the need to download data logged information.

**Quick-Cal Function**

- When enabled, this mode saves time and money by allowing all sensors to be calibrated simultaneously using one cylinder of blended calibration gas.

Confidence Indicator

- When enabled, the confidence indicator will emit a signal every 90 seconds in gas monitoring mode, to inform the user that the unit is operational.

Programmable Bump Test Mode

- Prompts user to bump test the instrument on a regular basis and provides an alarm that prevents normal use if bump test has not been performed at the desired interval. When enabled, the monitor will sound two beeps every 30 seconds and its display icons will indicate a bump test is due.

Calibration Overdue Alarm

- Prompts user and prevents normal use if instrument has not been calibrated within the user prescribed timeframe.

Communications

- IrDA data interface for communication to Datalink accessory, and to Docking Stations™.

Accommodates New CO/H₂ Low Sensor

- A new Carbon Monoxide with low Hydrogen cross-interference (CO/H₂ low) sensor for the Ventis MX4 was released in conjunction with the version 4.0 firmware. The CO/H₂ low sensor will be differentiated on the instrument display as a COL in all Ventis units that have v4.0 or later firmware versions.



VENTIS® PRO5 MULTI-GAS MONITOR



Detect up to five gases simultaneously with the rugged, wireless, Ventis® Pro5 Multi-Gas Monitor. With Ventis Pro5, safety goes beyond the gas detector whether you need team-based alarm sharing, remote monitoring with location details, or both. The monitor is also backed by a Guaranteed for Life™ warranty.

- Eliminate the need for two pieces of equipment by using Ventis Pro5 for personal monitoring and confined space entry.
- Train workers on one, multi-purpose gas monitor and reduce the risk and investment of having different devices in the field.
- Improve team and site safety by locally sharing alarms and gas readings between wirelessly-connected Ventis Pro5 Multi-Gas Monitors.
- Get real time location and alarm data directly from Ventis Pro5 Multi-Gas Monitors to a designated safety contact with the optional cellular or wi-fi battery pack.
- Custom start up messages, alarm action messages, and acknowledgeable gas alerts
- Reinforce safe behavior with programmable alarm action messages like “EVACUATE” or “VENTILATE” based on alarm level.
- Simplify the user experience with the ability to hide unnecessary screens based on user needs, role, industry, or site.
- User and Site tracking with iAssign® Technology.
- Compatible with most Ventis® MX4 accessories.

SPECIFICATIONS*

WARRANTY

Monitor is Guaranteed for Life™ as long as the instrument is supported by Industrial Scientific Corporation (excludes sensors, batteries, and filters). O₂, LEL, CO, and H₂S sensors and pumps are warranted for four years. All other sensors and batteries are warranted for two years.

KEYPAD

Two buttons for operation. Dedicated panic button.

DATA LOG

At least 3 months at 10-second intervals

EVENT LOGGING

60 alarm events

INGRESS PROTECTION

IP68 (submersion at 1.5 meters for 1 hour)

CASE MATERIAL

Polycarbonate with protective rubber overmold

DIMENSIONS

104 x 58 x 36 mm (4.1 x 2.3 x 1.4 in) without Pump
 172 x 67 x 65 mm (6.8 x 2.6 x 2.6 in) with Pump
 104 x 58 x 61 mm (4.1 x 2.3 x 2.4 in) with wi-fi or Cellular Battery

WEIGHT

200 g (7.05 oz) typical, without Pump
 390 g (13.76 oz) typical, with Pump
 243 g (8.5 oz) typical, with wi-fi Battery
 244 g (8.6 oz) typical, with Cellular Battery

HUMIDITY RANGE

15% to 95% non-condensing (continuous)

TEMPERATURE RANGE

-40 °C to 50 °C (-40 °F to 122 °F) **

DISPLAY/READOUT

Backlit liquid crystal display (LCD)

COMMUNICATION

LENS WIRELESS MESH NETWORK
 Frequency: ISM license-free band (2.405 - 2.480 GHz)
 Max Peers: 25 devices per network group
 Range: 100 m (300 ft) line of sight, face-to-face
 Encryption: AES-128
 Approvals: FCC Part 15, IC, CE/RED, others†

CELLULAR

LTE CAT M1
 US: AT&T, Verizon
 Canada: TBD

WI-FI

802.11 b/g/n 2.4GHz wi-fi with WPA2 security

ALARMS

Four visual alarm LEDs (two red, two blue);
 95 decibel (dB) audible alarm at a distance of 10 cm (3.94 in);
 Vibration alarm

SENSORS

Combustible Gases/Methane – Catalytic Bead
 O₂, CO, CO/H₂ Low, H₂S, HCN, NH₃, NO₂, PH₃, SO₂, Cl₂ – Electrochemical
 CO₂, CH₄, CO₂/LEL, CO₂/CH₄, HC – Infrared

Test Drive the Ventis Pro5 with the Instrument Simulator
www.indsci.com/VentisProSimulator

SPECIFICATIONS*

MEASURING RANGES

CATALYTIC BEAD
 Combustible Gases: 0-100% LEL in 1% increments
 Methane (CH₄): 0-5% of vol in 0.01% increments

ELECTROCHEMICAL
 Ammonia (NH₃): 0-500 ppm in 1 ppm increments
 Carbon Monoxide (CO): 0-2,000 ppm in 1 ppm increments
 Carbon Monoxide (CO/H₂ low): 0-1,000 ppm in 1 ppm increments
 Carbon Monoxide/Hydrogen Sulfide: CO: 0-1,500 ppm in 1 ppm increments
 H₂S: 0-500 ppm in 0.1 ppm increments
 Chlorine (Cl₂): 0-50ppm in 0.1 ppm increments
 Hydrogen Sulfide (H₂S): 0-500 ppm in 0.1 ppm increments
 Hydrogen Cyanide (HCN): 0-30 ppm in 0.1 ppm increments
 Nitrogen Dioxide (NO₂): 0-150 ppm in 0.1 ppm increments
 Oxygen (O₂) (Standard/Long-Life): 0-30% of vol in 0.1% increments
 Phosphine (PH₃): 0-10 ppm in 0.01 ppm increments
 Sulfur Dioxide (SO₂): 0-150 ppm in 0.1 ppm increments

INFRARED
 Carbon Dioxide (CO₂): 0-5% vol in 0.01% increments
 Methane (CH₄): 0-5% vol in 0.01% increments
 5-100% vol in 0.1% increments
 Carbon Dioxide/Combustible: CO₂: 0-5% vol in 0.01% increments
 LEL: 0-100% LEL in 1% increments
 Carbon Dioxide/Methane: CO₂: 0-5% vol in 0.01% increments
 CH₄: 0-5% vol in 0.01% increments
 CH₄: 5-100% vol in 0.1% increments
 Hydrocarbons: 0-100% LEL in 1% increments

CERTIFICATIONS

INGRESS PROTECTION IP68
 ANZEx: Ex ia I Ma/Ex ia IIC T4 Ga, -40 °C ≤ Ta ≤ 50 °C
 Ex d ia I Mb/Ex d ia IIC T4 Gb IR sensor, -20 °C ≤ Ta ≤ 50 °C IR sensor
 ATEX: Equipment Group and Category II 1G, Ex ia IIC, Ga, T4
 Equipment Group and Category II 2G, Ex d ia IIC, Gb, T4, IR sensor
 China CPC: CPA 2017-C103
 China Ex: Ex ia IIC T4 Ga, -40 °C ≤ Ta ≤ 50 °C; Ex d ia IIC T4 Gb IR sensor, -20 °C ≤ Ta ≤ 50 °C IR sensor
 CSA: CI I, Div 1, Gr A-D, T4; CI I, Zone 1, Ex d ia IIC, T4 | C22.2 No. 152 for % LEL reading only | 70046111
 IECEx: CI I, Zone 0, Ex ia IIC, Ga, T4; CI I, Zone 1, Ex d ia IIC, Gb, T4, IR sensor
 INMETRO: Ex ia IIC T4 Ga, -40 °C ≤ Ta ≤ 50 °C
 Ex d ia IIC T4 Gb IR sensor, -20 °C ≤ Ta ≤ 50 °C IR sensor
 KC: Ex d ia IIC T4
 MSHA: 30 CFR Part 22; Permissible for underground mines
 PA-DEP: BFE 46-12 Permissible for PA Bituminous underground mines
 UL: CI I, Div 1, Gr A-D, T4; CI II, Div 1, Gr E-G, T4
 CI I, Zone 0, AEx ia IIC, T4; CI I, Zone 1, AEx d ia IIC, T4, IR sensor
 Ventis Pro5 with wi-fi and Cell: certified to ATEX, IECEx, UL and CSA
 See www.indsci.com/ventispro for all certifications.

WIRELESS CERTIFICATIONS

Ventis Pro5 Instruments: FCC, ISED – Canada, EU Radio Equipment Directive (R.E.D.) and many other countries
 Ventis Pro5 with wi-fi: FCC, ISED – Canada, EU Radio Equipment Directive (R.E.D.)
 Ventis Pro5 with LTE Cat M1 Cellular: FCC, ISED-Canada, PTCRB, AT&T and Verizon

POWER SOURCE/RUN TIME

Rechargeable Slim Extended Lithium-ion battery (no Pump option)
 (18 hours typical @ 20 °C) with LEL
 (54 hours typical @ 20 °C) with IR
 Rechargeable Lithium-ion battery (no Pump option)
 (12 hours typical @ 20 °C) with LEL
 (36 hours typical @ 20 °C) with IR
 Rechargeable Extended-Range Lithium-ion battery with LEL
 (23 hours typical @ 20 °C) without Pump
 (18 hours typical @ 20 °C) with Pump
 Rechargeable Extended-Range Lithium-ion battery with IR
 (72 hours typical @ 20 °C) without Pump
 (32 hours typical @ 20 °C) with Pump
 Rechargeable wi-fi Lithium-ion battery (no Pump option)
 (16 hours typical @ 20 °C) with LEL
 Rechargeable Cellular Lithium-ion battery (no Pump option)
 (16 hours typical @ 20 °C) with LEL

LANGUAGE

English, French, Spanish, German, Italian, Dutch, Portuguese, Polish

SUPPLIED WITH MONITOR

Calibration Cup (without Pump), Sample Tubing (with Pump), Reference Guide

* These specifications are based on performance averages and may vary by instrument.
 ** Operating temperatures above 50 °C (122 °F) may cause reduced instrument accuracy. Operating temperatures below -20 °C (-4 °F) may cause reduced instrument accuracy and affect display and alarm performance. See Product Manual for details.
 † See www.indsci.com/wireless-certifications for country-specific wireless approvals and certifications.





RADIUS® BZ1
AREA MONITOR



When it comes to choosing equipment to protect your worksite from gas hazards, rely on the Radius® BZ1 Area Monitor. Protect workers with easy visibility and loud, clear alerts. Enjoy less setup, user training, and time in the shop.

- Detect up to seven gases using 15 sensor options including PID
- Typical run time of 7 days (168 hours)
- Extended Run Time Power Supply can extend battery run time to over 1 month
- Intrinsically Safe Extended Run Time Power Supply can provide indefinite run time in hazardous locations
- Ultra-bright blue and red lights and attention-grabbing alarms with distinctive tones
- Audible alarms sound at 108 dB at 1 m to cut through high-noise environments
- Largest display of any area monitor on the market
- Intuitive text-based navigation and configuration
- Customizable alarm action messages such as "EVACUATE" or "VENTILATE"
- LENS® Wireless enables communication between area monitors and Ventis Pro5 Multi-Gas Monitors
- All-weather sensor deployment and 360-degree gas path for more accurate detection
- DualSense® Technology increases worker safety by using two sensors to detect the same gas
- See real-time alerts with iNet® Now Live Monitoring

SPECIFICATIONS*

WARRANTY

Two-year warranty, including sensors and battery

KEYPAD

Three buttons

DATA LOG

At least 3 months at 10-second intervals

EVENT LOGGING

60 alarm events

INGRESS PROTECTION

IP66

CASE MATERIAL

Impact-resistant polycarbonate alloys

DIMENSIONS

29 x 29 x 55 cm (11.5 x 11.5 x 21.5 in)

WEIGHT

7.5 kg (16.5 lb)

TEMPERATURE RANGE

-20 °C to 55 °C (-4 °F to 131 °F)

HUMIDITY RANGE

15% to 95% non-condensing (continuous)

DISPLAY/READOUT

11.2 cm (4.4 in) monochrome backlit graphical liquid crystal display (LCD)

POWER SOURCE/RUN TIME

Rechargeable nickel-metal hydride (NiMH) battery
 7 days (168 hours) typical @ 20 °C, without Pump, with wireless
 3.5 days (84 hours) typical @ 20 °C, with Pump, with wireless
 30 days (720 hours) typical @ 20 °C, electrochemical sensors only, without Pump, with wireless
 ≤8 hour recharge time

ALARMS

108 decibel (dB) at 1 m (3.3 ft) redundant audible alarms
 Redundant, visual alarm LEDs (red and blue)

SENSORS

Up to 6 sensors (catalytic bead, photoionization detector, electrochemical, IR, and PID)

Up to 7 simultaneous readings



SPECIFICATIONS*

MEASURING RANGES

CATALYTIC BEAD	
Combustible Gases:	0-100% LEL in 1% increments
ELECTROCHEMICAL	
Ammonia (NH ₃):	0-500 ppm in 1 ppm increments
Carbon Monoxide (CO):	0-1,500 ppm in 1 ppm increments
Carbon Monoxide (CO High Range):	0-9,999 ppm in 1 ppm increments
Carbon Monoxide (CO/H ₂ Low):	0-1,000 ppm in 1 ppm increments
Carbon Monoxide/Hydrogen Sulfide:	CO: 0-1,500 ppm in 1 ppm increments H ₂ S: 0-500 ppm in 0.1 ppm increments
Chlorine (Cl ₂):	0-50 ppm in 0.1 ppm increments
Hydrogen (H ₂):	0-2,000 ppm in 1 ppm increments
Hydrogen Sulfide (H ₂ S):	0-500 ppm in 0.1 ppm increments
Hydrogen Cyanide (HCN):	0-30 ppm in 0.1 ppm increments
Nitrogen Dioxide (NO ₂):	0-150 ppm in 0.1 ppm increments
Oxygen (O ₂):	0-30% vol in 0.1% increments
Sulfur Dioxide (SO ₂):	0-150 ppm in 0.1 ppm increments
Phosphine (PH ₃):	0-5 ppm in 0.01 ppm increments
Nitric Oxide (NO):	0-1,000 ppm in 1 ppm increments
INFRARED	
Carbon Dioxide (CO ₂):	0-5% vol in 0.01% increments
PHOTOIONIZATION	
Volatile Organic Compounds (10.6 eV):	0-2,000 ppm in 0.1 ppm increments

PUMP
Optional integral pump, up to 30.48 m (100 ft) sample draw

WIRELESS
Optional LENS Wireless, mesh network
Frequency: ISM license-free band (2.405 - 2.480 GHz)
Max Peers: 25 devices per network group
10 independent, configurable network groups
Range: 300 m (~1,000 ft) line of sight
Encryption: AES-128
Approvals: FCC Part 15, IC, CE/RED, others**

CERTIFICATIONS
INGRESS PROTECTION IP66
ATEX: Ex da ia IIC T4 Ga, Equipment Group and Category II 1G
China CPC: China CPC
China EX: Ex d ia IIC T1 Ga; Ex d ia IIC T4 Gb IR sensor
CSA: CI I, Div 1, G A-D, T4
C22.2 No. 152 applies only to %LEL thermo-catalytic reading
IECEx: Ex da ia IIC T4 Ga
INMETRO: Ex da ia IIC T4 Ga; Ex db ia IIC T4 Gb IR sensor
UL: CI I, Div 1, Gr A-D, T4; CI 1 Zone 0 AEx da ia IIC T4 Ga1

SUPPLIED WITH MONITOR
Calibration cup (without pump), sample tubing and pump inlet water barrier (with pump), hand tool, charging power supply and region-specific cord

LANGUAGE
English, French, Spanish, German

* These specifications are based on performance averages and may vary by instrument.
** See www.indsci.com/wireless-certifications for country-specific wireless approvals and certifications.

Test drive the Radius BZ1 with the Instrument Simulator
www.indsci.com/radius-simulator



With the Radius BZ1, all critical technology pieces such as sensors, software, pumps, and wireless, live inside the patent-pending SafeCore® Module. Smart sensors are positioned face down to prevent the elements from interfering with gas readings, resulting in fewer false alarms.

The module slides out from the Radius Base for easy docking and automated maintenance, ensuring that your sensors are always ready to provide accurate gas detection.



• Diffusion



• Aspirated



The Radius Base is made of a durable, weather-resistant plastic. The base has built-in audio and visual alarms that grab workers' attention, even in high-noise environments. A large battery keeps the unit working as long as you do, and side-grip handles help make the base easy to move from location to location.

It has never been easier to keep your area monitors up and running in the field. The SafeCore Module and Radius Base work together to provide maximum gas detection ability, while simplifying the job of maintaining your area monitors.



SOLAR POWER SUPPLY



Continuously power Radius® BZ1 Area Monitors and RGX® Gateways in hazardous or remote locations with the Solar Power Supply (SPS). The Solar Power Supply helps you minimize the cost and risk of charging and rotating equipment in dangerous, remote locations thanks to its continuous power supply, portability, and durability.

- Eliminate the need for charging or rotating equipment by continuously powering devices with the SPS
- Decrease the amount of time and labor needed to deploy and relocate solar-powered devices with SPS's easy-to-move pieces
- Rugged, durable, and UL/CSA Class 1 Div 2 certified to ensure operational readiness in the harshest environments

CONFIGURATION OPTIONS

The SPS will power one Radius BZ1 Area Monitor or one RGX Gateway, or any one of the following combinations:

- One Radius BZ1 and one RGX Gateway simultaneously
- Two Radius BZ1 area monitors simultaneously
- Two RGX Gateway units simultaneously

The SPS insert assembly supports the mounting of one compatible device of each type. When two compatible devices of the same type are being powered, one can be mounted on the SPS and one can be placed elsewhere, allowing the area monitor to be in the best place for gas detection and Solar Power Supply to be placed in the most optimal location for sunlight.

SPECIFICATIONS*

WARRANTY

The Solar Power Supply is warranted to be free from defects in material and workmanship for a period of two years after purchase. Radius BZ1 and RGX Gateway paired with the SPS fall under their designated warranties.

KEYPAD

One (power on and off)

INGRESS PROTECTION

NEMA 4X (enclosure) for outdoor usage

MATERIALS

Aluminum stand and bracket assembly with stainless steel enclosure

POWER CABLES

Input - Cable from solar panel to enclosure

Outputs - Intrinsically safe (IS) cables supplying DC power from enclosure to compatible devices

DIMENSIONS

Approximately 0.84 x 1.83 x 1.22 m (33 x 72 x 48 in) when packaged, prior to assembly

WEIGHT

63.27 kg (139.48 lb)

Subassemblies (solar panel assembly, stand, battery, insert assembly, etc.) weigh less than 27.21 kg (60 lb) for ease of handling

TEMPERATURE RANGE

Ambient: -20 °C to +45 °C (-4 °F to +113 °F)

Storage: -40 °C to +75 °C (-40 °F to +167 °F)

HUMIDITY RANGE

20-90% relative humidity non-condensing

OPERATING CONDITIONS

Meets requirements for Electromagnetic Compatibility (EMC) for Class A equipment and meets EMC requirements while connected as a system to a Radius BZ1 area monitor.

DISPLAY/READOUT

None – A compatible product will indicate that it is receiving power from the SPS.

OUTPUT PARAMETERS

Uo 14.7 VDC

Io 300 mA

Cob 0.58 pF

LOb 0.32 mH

DURABILITY

Can withstand exposure to fungus and salt fog (Up to 96 hours of salt fog)

Unanchored, the SPS can withstand up to 60 mph side or headwinds

CERTIFICATIONS

CSA Class 1 Div 2 certification

POWER SOURCE/ RUN TIME

Indefinitely if its battery remains charged

Recommend daily minimum of 4 hours of direct sunlight to maintain the battery's level of charge



TANGO® TX2 TWO GAS MONITOR



Protect workers, reduce false alarms, and spend less time managing your gas detector fleet with the Tango® TX2. The Tango TX2 is the most accurate two-gas monitor featuring individual sensors that increase alarm accuracy. A two-year runtime and replaceable battery simplify gas detection management by eliminating the need for charging infrastructure.

INSTRUMENT CONFIGURATIONS

PART NUMBER	DESCRIPTION
TX2-12011	Tango TX2, CO, H2S, English
TX2-14011	Tango TX2, CO, NO2, English
TX2-15011	Tango TX2, CO, SO2, English
TX2-1G011	Tango TX2, CO, CO Low, English
TX2-24011	Tango TX2, H2S, NO2, English
TX2-25011	Tango TX2, H2S, SO2, English
TX2-2G011	Tango TX2, H2S, CO Low, English
TX2-45011	Tango TX2, NO2, SO2, English
TX2-4G011	Tango TX2, NO2, CO Low, English
TX2-5G011	Tango TX2, SO2, CO Low, English

ACCESSORIES

18109330-ABC	DSX™ Docking Station for Tango TX2 A – DSX Mode: 0 = DSX Standalone, 1 = DSXi Cloud-connected, 2 = DSX-L Local Server B – Number of Gas Inlet Ports: 3 = 3 Ports, 6 = 6 Ports C – Power Cord Type: 1 = North America, 2 = Europe, 3 = Australia, 4 = UK
17154367	Replacement battery
18109171	Soft nylon case, Black
18109239	Soft nylon case, Safety Orange
18109218	Dust barrier kit, 5 pack
18109230	Water barrier kit, 5 pack
18109238	CalCup and tubing kit
17154484	Suspender clip
17154915-0	AlarmAmp, Black
17154915-1	AlarmAmp, Safety Orange

* These specifications are based on performance averages and may vary by instrument.

** Operating temperatures above 50 °C (122 °F) may cause reduced instrument accuracy. Operating temperatures below -20 °C (-4 °F) may cause reduced instrument accuracy and affect display and alarm performance.

Patent No. 9,064,386 – AlarmAmp™

SPECIFICATIONS*

INSTRUMENT WARRANTY

Guaranteed for Life™. Warranted for as long as the instrument is supported by Industrial Scientific Corporation (excludes sensors, batteries, and filters). CO and H₂S sensors warranted for three years. All other sensors are warranted for two years.

DISPLAY

Segment liquid crystal display (LCD)

KEYPAD

Two buttons

CASE MATERIALS

Case top: Polycarbonate with a protective rubber overmold
Case bottom: Conductive polycarbonate

ALARMS

Three strobe-emitting visual alarm LEDs (two red; one blue)
100 decibel (dB) audible alarm at a distance of 10 cm (3.94 in); Vibration alarm

DIMENSIONS

99 x 51 x 35 mm (3.9 x 2.0 x 1.4 in)

WEIGHT

126.0 g (4.4 oz)

TEMPERATURE RANGE

-40 °C to 50 °C (-40 °F to 122 °F) **

HUMIDITY RANGE

15% to 95% Non-condensing (continuous)

SENSORS

CO, CO/H₂, H₂S, NO₂, SO₂ – Electrochemical sensor technology

SENSOR MEASURING RANGES

Carbon Monoxide (CO): 0 to 1,000 ppm in 1 ppm increments
Carbon Monoxide (CO/H₂ low): 0 to 1,000 ppm in 1 ppm increments
Hydrogen Sulfide (H₂S): 0.0 to 500.0 ppm in 0.1 ppm increments
Nitrogen Dioxide (NO₂): 0.0 to 150.0 ppm in 0.1 ppm increments
Sulfur Dioxide (SO₂): 0.0 to 150.0 ppm in 0.1 ppm increments

BATTERY

3.6 V Primary lithium-thionyl chloride (Li-SOCl₂); 1.5AH, 2/3AA; replaceable; non rechargeable; always on; up to 2-year run time depending on operating conditions

DATA LOGGING

3 months at 10-second intervals

EVENT LOGGING

60 alarm events

CERTIFICATIONS

DIRECTIVE OR CB AREA CLASSIFICATION STANDARDS

ATEX¹: Ex ia I Ma;
Ex ia IIC T4 Ga; Equipment Group and Category: I M1 and II 1G,
EN 60079-0: 2012
EN 60079-11: 2012
EN 50303: 2000

IECEx³ Ex ia I Ma, Ex ia IIC T4 Ga

IEC 60079-0: 2011
IEC 60079-11: 2011

UL (C-US)⁴: Class I, Groups A, B, C, and D; Class II, Groups E, F, and G; T4; Exia Class I, Zone 0, AEx ia IIC T4

UL 913 8th Ed.
UL 60079-0 6th Ed.
UL 60079-11 6th Ed.
CSA C22.2 No. 157



TANGO® TX1 SINGLE GAS MONITOR



By wearing the Tango® TX1, workers will be the safest single gas monitor users in the world

A patented DualSense® Technology increases worker safety, regardless of bump test frequency, while reducing overall costs. Let the Tango TX1 show you why two is safer than one.

- Low-cost CO, H₂S, NO₂, and SO₂ monitoring
- Powerful 100 dB audible alarm complemented with vibrating alarm
- Three strobe-emitting LED visual alarms (two red and one blue)
- Guaranteed for Life™ with replaceable sensors and batteries that extend the life of the instrument
- Acknowledgeable gas alerts

AlarmAmp™

For higher-noise environments, the Tango TX1 alarm volume, typically 100 dB at 10 cm, can be increased nearly 10 dB with the addition of the optional patented AlarmAmp™. The Tango TX1 alarm is louder than that of any other single gas instrument on the market.



SPECIFICATIONS*

INSTRUMENT WARRANTY

Guaranteed for Life™. Warranted for as long as the instrument is supported by Industrial Scientific Corporation (excludes sensors, batteries, and filters). CO and H₂S sensors are warranted for three years. All other sensors are warranted for two years.

DISPLAY

Segment liquid crystal display (LCD)

KEYPAD

Two buttons

CASE MATERIALS

Case top: Polycarbonate with a protective rubber overmold
Case bottom: Conductive polycarbonate

ALARMS

Three strobe-emitting visual alarm LEDs (two red; one blue); 100 decibel (dB) audible alarm at a distance of 10 cm (3.94 in); Vibration alarm

DIMENSIONS

99 x 51 x 35 mm (3.9 x 2.0 x 1.4 in)

WEIGHT

126.0 g (4.4 oz.)

TEMPERATURE RANGE

-40 °C to 50 °C (-40 °F to 122 °F) **

HUMIDITY RANGE

15%-95% Non-condensing (continuous)

SENSORS

CO, H₂S, NO₂, SO₂ – Electrochemical sensor technology

SENSOR MEASURING RANGES

Carbon Monoxide (CO):	0-1,000 ppm in 1 ppm increments
Carbon Monoxide (CO/H ₂ low):	0-1,000 ppm in 1 ppm increments
Hydrogen Sulfide (H ₂ S):	0.0-500.0 ppm in 0.1 ppm increments
Nitrogen Dioxide (NO ₂):	0.0-150.0 ppm in 0.1 ppm increments
Sulfur Dioxide (SO ₂):	0.0-150.0 ppm in 0.1 ppm increments

BATTERY

3.6 V Primary lithium-thionyl chloride (Li-SOCl₂); 1.5AH, 2/3AA; replaceable; nonrechargeable; always on; 2 year run time depending on operating conditions

DATA LOGGING

3 months at 10-second intervals

EVENT LOGGING

60 alarm events

CERTIFICATIONS

INGRESS PROTECTION IP66/67

-40 °C to 50 °C (-40 °F to 122 °F)

ATEX: Ex ia I Ma; Ex ia IIC T4 Ga;
Equipment Group/Category: I M1/II 1G

CSA : CI I, Gr A-D, T4; Ex ia IIC T4

IECEX: Ex ia I Ma; Ex ia IIC T4 Ga

INMETRO: Ex ia I Ma; Ex ia IIC T4 Ga

UL (C-US): CI I, Gr A-D, T4; CI II, Gr E-G; CI I, Zone 0, AEx ia IIC T4

-20 °C to 50 °C (-4 °F to 122 °F)

China Ex: Ex ia IIC T4 Ga

China MA: Ex ia I Ma; H₂S, CO

EAC: PO Ex ia I X; 0 Ex iX IIC T4 X

KC: Ex ia IIC T4

* These specifications are based on performance averages and may vary by instrument.

** Operating temperatures above 50 °C (122 °F) may cause reduced instrument accuracy. Operating temperatures below -20 °C (-4 °F) may cause reduced instrument accuracy and affect display and alarm performance. See Product Manual for details.

Patent No. 9,000,910 – DualSense® Technology

Patent No. 9,064,386 – AlarmAmp®



GASBADGE® PRO SINGLE GAS MONITOR



GasBadge® Pro provides a lifetime of gas hazard protection with more features than any other single gas monitor available

- Interchangeable “smart” sensors monitor oxygen or any one of many toxic gases
- One-year datalogging capacity (minimum)
- Standard STEL and TWA
- Guaranteed for Life™ warranty
- HbCO detection option available

Interchangeable “smart” sensors enable the GasBadge Pro to be quickly adapted to monitor unsafe levels of oxygen or any one of the following toxic gases: carbon monoxide, hydrogen sulfide, nitrogen dioxide, sulfur dioxide, chlorine, chlorine dioxide, phosphine, ammonia, hydrogen cyanide, and hydrogen.

Housed in a rugged enclosure, the monitor is immune to RF, water resistant, and extremely durable. A protective concussion-proof overmold protects the unit from extreme abuse in a variety of harsh industrial environments. Its simple and intuitive four-button navigation allows easy access to setup, operation and calibration functions.

SPECIFICATIONS

INSTRUMENT WARRANTY

Guaranteed for Life: Instrument is warranted for as long as supported by Industrial Scientific Corporation (excluding sensors, batteries, and filters). CO, H₂S, and O₂ sensors are warranted for 2 years. All other sensors warranted for 1 year.

CASE

Rugged, water-resistant polycarbonate shell with protective concussion proof overmold. RFI resistant.

DIMENSIONS

9.4 x 5.08 x 2.79 mm (3.7 x 2 x 1.1 in)

WEIGHT

85 g (3 oz)

SENSORS

CO, H₂S, O₂, NO₂, SO₂, NH₃, Cl₂, ClO₂, PH₃, HCN, H₂, CO/H₂ low

MEASURING RANGES

CO:	0-1,500 ppm in 1 ppm increments
CO/H ₂ low:	0-1,500 ppm in 1 ppm increments
H ₂ S:	0-500 ppm in 0.1 ppm increments
O ₂ :	0-30% by vol in 0.1% increments
NO ₂ :	0-150 ppm in 0.1 ppm increments
SO ₂ :	0-150 ppm in 0.1 ppm increments
NH ₃ :	0-500 ppm in 1 ppm increments
Cl ₂ :	0-100 ppm in 0.1 ppm increments
ClO ₂ :	0-1 ppm in 0.01 ppm increments
PH ₃ :	0-10 ppm in 0.01 ppm increments
HCN:	0-30 ppm in 0.1 ppm increments
H ₂ :	0-2,000 ppm in 1 ppm increments

DISPLAY

Custom LCD with graphical icons for easy use
Segmented display for direct gas readings
Backlight for low light conditions
“Go/No Go” display mode
Peak reading indication

ALARMS

User selectable low and high alarms
Ultra-bright LEDs, loud audible alarm (95 dB) and vibrating alarm

BATTERY RUN TIME

User replaceable 3V, CR2 Lithium battery, 2,600 hour run time, typical

DATA LOGGING

1 year continuous storage of data.

EVENT LOGGER

Continually on. Logs last 15 alarm events, stamping how long ago the event occurred, the duration of the event, and the peak reading seen during the event. Event-logger can be viewed on PC or printed directly from the instrument to an infrared printer.

TEMPERATURE RANGE

-40 °C to 60 °C (-40 °F to 140 °F), typical

HUMIDITY RANGE

0% to 99% RH (non-condensing), typical

IP RATING

Third-party certified IP64

CERTIFICATIONS

ANZEx:	Ex ia I/IIC T4
ATEX:	Ex ia I/Ex ia IIC T4; Equipment Group/Category I M1/II 1G
China Ex:	Ex ia I/IIC T4
China MA:	Ex ia I
CSA:	Cl I, Gr A-D, T4; Ex ia IIC T4
IECEx:	Ex ia I/IIC T4
INMETRO:	Ex ia IIC T4
KC:	Ex ia I/IIC T4
UL:	Cl I, Div 1, Gr A-D, T4; Cl II, Gr E-G

SUPPLIED WITH MONITOR

Attached suspender clip, calibration adapter and tubing, and operating instructions



LENS[®]
WIRELESS



How many times in a workday do you find yourself trying to do your job without all of the necessary information? How often does that lack of information put your safety at risk? When it comes to working with traditional gas detectors, you are often left to guess about what to do when an instrument starts beeping and flashing. Should you run toward an unidentified alarm to help a peer, or should you evacuate the area and call for help?

With LENS[®] Wireless, you will have the information you need to take action in the moment. No more second guessing. No more putting your life in danger.

Experience the Power of the Connected Worker

LENS Wireless is the first gas detection solution that allows personal monitors and area monitors to share gas readings and alarms with one another. Now when a gas hazard, man-down, or panic situation causes an instrument to alarm, all peers in the connected group will instantly be notified of the hazard and the person in danger. When seconds matter, you can rely on help from workers nearby, rather than a control room or call center hundreds of miles away.

Notes:

Safety Made Simple

Many wireless gas detection products on the market require site surveys, IT setup, extra equipment and license purchases, and extensive training. It's no wonder why many organizations have not even considered wireless as an option.

With LENS Wireless, forming a connected group of monitors is as simple as tapping two Ventis Pro5 instruments together, or a Ventis Pro5 Multi-Gas Monitors to a Radius BZ1 Area Monitor. Connect up to 25 devices to create a dynamic safety web across your worksite. LENS Wireless adapts for organizations large and small within minutes. No IT setup. No infrastructure. No configuration.



Average time to deploy 25 LENS Wireless instruments
(Joining 25 instruments into a group)

2 minutes

Average time to implement other wireless solutions
(Instrument, IT, and central controller setup)

2 hours – 2 days

Work Smarter and Safer

Smarter, Faster Decisions – By viewing peer readings and alarms on your own monitor, you will be able to make an informed decision about the hazard, allowing you to avoid needless evacuations or safely move to a designated muster point. There's no need for a laptop or central controller to view peer readings in real time.

Safer Emergency Response – Make “would be” rescuer fatalities a thing of the past. First responders will know what workers in hazardous areas are exposed to—in real time, allowing them to properly equip themselves the first time, before attempting a rescue. Panic and man-down alarms will be relayed to the first responders if workers become injured or unresponsive.

Better Site-Wide Communication – Gas hazards are not just a local issue for the worker who is exposed. Explosive and toxic gases also pose a threat to those in the vicinity. With LENS Wireless, you have visibility into hazards happening up to a mile away, allowing you to take appropriate safety precautions when gas levels in the area approach dangerous levels.

Get Started with LENS Wireless Today

Any Ventis Pro5 instrument purchased without wireless simply needs an upgrade card and firmware version 2.0 or greater to activate wireless.

The LENS Wireless Difference

- Share gas readings and alarms between Ventis Pro5 Multi-Gas Monitors and Radius BZ1 Area Monitors.
- Enjoy out-of-the-box operation with no site surveys, IT setup, licenses, or additional infrastructure needed.
- Identify peer alarm types in real time, enabling a faster, more appropriate response.
- View gas readings from other peers in your group on any monitor without needing a central controller to relay the information.
- Receive readings from up to 1.5 km (~1 mi) away with wireless hopping between instruments.
- Activate the panic alarm on your personal monitor to notify all peers in your group of an emergency.
- Depend on self-healing mesh networks to always stay connected, even if a single unit drops off.

SPECIFICATIONS*

Optional LENS Wireless, mesh network
 Frequency: ISM license-free band (2.405 - 2.480 GHz)
 Max Peers: 25 devices per network group
 Range: Ventis Pro5: 100 m (300 ft) line of sight, face-to-face
 Radius BZ1: 300 m (~1,000 ft) line of sight
 Encryption: AES-128
 Approvals: FCC Part 15, IC, CE/RED, others

*See www.indsci.com/wireless-certifications for country-specific wireless approvals and certifications.





iASSIGN®
BEACON, TAGS AND
STANDBY CLIP



Gas detectors record basic information about gas hazards, but they don't help you understand who was exposed and where. iAssign® Beacons continuously broadcast a programmable site identifier and permission level, which enables Ventis Pro5 Multi-Gas Monitors to automatically record locations in real time.

iAssign Beacons allow you to send out real-time, site-specific reminders to your team, set access permission reminders, and automatically track data logged events, making it easier to analyze your data and prevent hazards in the future.

Spend less time investigating problems by knowing who and where

- Locate problem sites across your facility
- Add worker and location names to your data logs
- Stay compliant with clear and accurate record keeping
- Collect consistent site recordings when technology like GPS is not available

Keep workers out of restricted areas

- Alert workers when entering restricted areas with simple-to-program proximity alarms
- Reduce the need for separate devices, extra signage, or physical barriers to manage worker clearances

Install and maintain iAssign Beacons with ease

- Configure the coverage areas of your beacons from 1 to 30 meters
- Install intrinsically safe beacons in indoor or outdoor locations

LOGGED INFORMATION WITHOUT iASSIGN

DATE	TIME	S/N	GAS TYPE	AVG. READING	DURATION
3/23	2:09 pm	100458	H ₂ S High Alarm	28 PPM	3 min, 27 sec

LOGGED INFORMATION WITH iASSIGN

DATE	TIME	S/N	GAS TYPE	AVG. READING	DURATION	LOCATION	USER
3/23	2:09 pm	100458	H ₂ S High Alarm	28 PPM	3 min, 27 sec	Storage Tank A	Tony P



iAssign Tags – Allow workers to assign their names to their gas monitors with a simple tap.

iAssign Tag Specifications



Tag Type	Standard Tag	Waterproof Tag	All Weather Tag	Keychain Tag
Part Number	18109417	18109418	18109419	18109420
Thickness	0.7 mm	1.5 mm	3 mm	4 mm
Adhesive Back	Yes	Yes	No	No



iAssign Beacons – Automatically assign location names to Ventis Pro5 Multi-Gas Monitors based on proximity, helping safety managers see where hazards occurred and who was involved.

Using tags and beacons, anyone reviewing the data can easily see who had the instrument and where the measurements were taken, making the information more actionable.

Get Up and Running Quickly and Easily with iAssign

1. Download the iAssign App from the Google Play store
2. Program iAssign Tags with names and optional access levels
3. Program iAssign Beacons with location names, ranges, and access levels
4. Distribute the tags to your team members
5. Install the beacons across your facility
6. Begin seeing gas detector user and location information

With iAssign Tags and Beacons, you will know where and when specific workers encountered dangerous conditions so that you can identify patterns and take action to eliminate the risk of future exposures.



Standby Clip – places the Man-Down Alarm in a standby state, preventing activation.

While the Standby Clip accessory will always place man-down alarms in a standby state, the user has the option to place other alarms in standby as well. User selectable alarms for standby state include:

- Man Down Only
- Man Down + LENS peer alarms
- Man-Down + Gas alarms
- Man-Down + LENS peer alarms + Gas Alarms

When the standby clip is installed, symbols on the monitor screen alert the operator which feature is in standby. In addition, Ventis Pro monitors that communicate with iNet Now Live Monitoring software will report a "Standby" status to the remote terminal when the Standby Clip is installed on the monitor.

STANDBY CLIP SPECIFICATIONS

PART NUMBER

17159316

MONITOR SUPPORTED

Ventis Pro5 Diffusion

REQUIRED FIRMWARE

v4.0 or greater

iASSIGN BEACON SPECIFICATIONS*

PART NUMBER

18109491

RUN TIME

Four years

WARRANTY

One year

INGRESS PROTECTION

IP65

TEMPERATURE RANGE

-40 °C to 50 °C

HUMIDITY RANGE

0% to 100% RH

DIMENSIONS

125 x 85 x 43mm (5 x 3.3 x 1.68 in)

WEIGHT

9 oz (250 g)

RANGE

Configurable from 1 to 30 m (3 to 100 ft)

TECHNOLOGY

Bluetooth, Near Field Communication (NFC)

PROGRAMMING METHOD

iAssign app available in Google Play store

ACCESSORIES

Instruction card, drywall anchors, screws

APPLICATION

iAssign Beacons may be used to track locations only

CERTIFICATIONS

ATEX: II 1 G, Ex ia IIC T4 Ga
 c UL us: CI I, Div 1 Gr A, B, C, D, T4; CI II, Div 1, Gr E, F, G;
 CI I Zone 0, AEx ia IIC T4; Ex ia IIC T4
 IECEx: Ex ia IIC T4 Ga
 Wireless: FCC Part 15, IC

BLUETOOTH LOW ENERGY

Frequency: 2402 to 2480 MHz
 Transmit power: +4 dBm
 Based upon standard: Bluetooth v4.1
 Contains FCC ID#: RYYEYSGJN (Taiyo Yuden)

* These specifications are based on performance averages and may vary by instrument.

iASSIGN TAG SPECIFICATIONS

TECHNOLOGY

Near Field Communication (NFC)

PROGRAMMING METHOD

iAssign app available in Google Play store

APPLICATION

iAssign tags may be used to track workers and locations





**RGX®
GATEWAY**



Remove Live Monitoring Barriers

- Receive real-time alerts from personal gas monitors and area monitors when alarms occur
- Locate workers faster when an incident happens using a live map
- Monitor hazardous locations and get data out of confined spaces in real time
- Set up in minutes without the need for costly IT infrastructure

SPECIFICATIONS

WARRANTY: 2 years

DIMENSIONS: 11 x 9 x 6 in (28 x 23 x 15 cm)

WEIGHT: 5.6 lb (2.5 kg)

CASE MATERIAL: Polycarbonate | Leather external case

RUN TIME / POWER SOURCE

Rechargeable Battery Pack: 168 hours at 25 °C (77 °F), 5 minute non-critical data interval

Charge Time: Up to 8 hours

Power Voltage Inputs: 9-30 VDC (for operation in industrial facility, vehicle, and office)

TEMPERATURE RANGE: -20 °C to 55 °C (-4 °F to 134 °F)

HUMIDITY RANGE: 5% to 95% non-condensing (continuous)

INGRESS PROTECTION: IP65

DATA LOGGING (IF SIGNAL LOST): 12 hours

LOCATION: GPS Radio; Antenna: Internal; Accuracy: ~10 m (32 ft) outdoors

SUPPLIED WITH GATEWAY: Charging Power Cord

OPTIONAL ACCESSORIES

Extended Run Time Power Supply (intrinsically safe or standard)
Mounting Kits (wall or magnet)

USER INTERACTION

Power Button with Status Indicator

Configuration: Locally over Ethernet or wi-fi, or remotely over-the-air (iNet® Control)

Firmware Upgrades: Over-the-air

COMMUNICATION*

LENS WIRELESS, MESH NETWORK

Frequency: ISM license-free band (2.4 GHz)

Max Instruments: 25 devices (including RGX)

RANGE

World Mode, RGX Gateway to RGX Gateway 300 m (~1,000 ft) line of sight
CE/RED Compliant Mode, RGX Gateway to RGX Gateway 185 m (~600 ft) line of sight

World Mode, RGX Gateway to Radius BZ1 300 m (~1,000 ft) line of sight
CE/RED Compliant Mode, RGX Gateway to Radius BZ1 185 m (~600 ft) line of sight

World Mode, RGX Gateway to Ventis Pro5 100 m (~300 ft) line of sight
CE/RED Compliant Mode, RGX Gateway to Ventis Pro5 100 m (~300 ft) line of sight

ENCRYPTION: AES-128

APPROVALS: FCC Part 15, IC, CE/RED, Others*

CELLULAR

LTE with 3G fallback

US: Verizon, AT&T, T-Mobile

Canada: Telus, Bell, Rodgers

EMEA: Tele2

Asia Pacific: Telefonica

Antenna: Internal Multi-Band

WI-FI

802.11 b/g/n 2.4 GHz wi-fi with WPA2 Enterprise security

ETHERNET (INTERNAL ONLY)

Ethernet 10/100 Mb

HAZARDOUS CERTIFICATIONS

ATEX**:

China Ex:

cULus:

IECEx**:

Zone 2: Ex ec ic IIC T6 Gc; RoHS Compliant

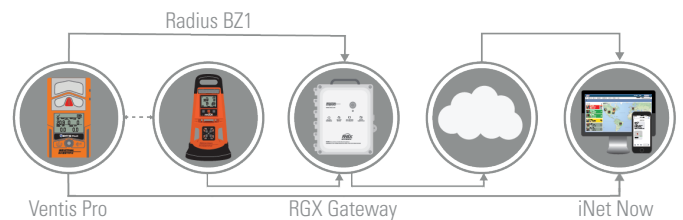
Zone 2: Ex ec ic IIC T6 Gc (CN)

Class I, Division 2, Groups A, B, C, D, T6; Zone 2:

Ex ec ic IIC T6 Gc (CA) AEx ec ic IIC T6 Gc (US)

Zone 2: Ex ec ic IIC T6 Gc

* See www.indsci.com/wireless-certifications for country-specific wireless approvals and certifications
** Requires leather case





Monitor Lone Workers in Real Time

The TGX™ Gateway links safety managers with remote teams through dual cellular and satellite connectivity, so you can monitor, escalate, and respond the moment a worker needs help. The vehicle-installed gateway sends location, gas readings, and real-time alerts from Industrial Scientific wireless gas detectors to cloud-based iNet® Now software so you can see who's in danger, know what happened, pinpoint their location, and dispatch help.

- Real-time visibility into the location and wellbeing of mobile workers in remote areas without cellular coverage
- Email, text, and on-screen alerts when alarms occur, ensuring the right messages get to the right people at the right time
- Dual cellular and satellite connectivity ensures communication coverage at all times
- Monitor up to 24 instruments at once
- Vehicle-installed device eliminates charging and ensures a reliable power source

Learn more about the TGX Gateway at www.indsci.com/tgx

SPECIFICATIONS*

WARRANTY

2 year

DIMENSIONS

102 x 102 x 76 mm

WEIGHT

280 g

ENVIRONMENTAL

Operating temperature: -40 °C to 80 °C (-40 °F to 176 °F)

COMMUNICATION

CELLULAR

Cellular (2G): Quad band 850/900/1800/1900MHz

Cellular (3G/HSPA): Pentaband 800/850/900/1900/2100MHz

Antenna: external

SATELLITE

Iridium

Antenna: external

LOCATION

GPS (NMEA protocol)

Antenna: external

Accuracy: ~5 m (16 ft) outdoors

POWER REQUIREMENT

Input: 9-30VDC, 12VDC @ 300mA

REGULATORY

FCC, IC & PTCRB compliant

RoHS compliant

COMPATIBILITY

Works with Ventis® Pro5 Multi-Gas Monitors and Radius® BZ1 Area Monitors

LENS

Frequency: ISM license-free band (2.4 GHz)

Max Instruments: 25 devices (including TGX)

RANGE

TGX Gateway to RGX® Gateway 300 m (~1,000 ft) line of sight

TGX Gateway to Radius BZ1 300 m (~1,000 ft) line of sight

TGX Gateway to Ventis Pro5 100 m (~300 ft) line of sight



Live Monitoring Applications

By using Ventis® Pro5 Multi-Gas Monitors, Radius® BZ1 Area Monitors, and a compatible gateway, you can easily monitor any of the following in real time.



Confined Spaces



In-Plant Locations



Perimeters



Tank Farms



Emergency Situations



Mobile Workers



Geofences



TOTAL VISIBILITY

Verify worker status and location in real time by viewing a map, and respond faster and with more information when an incident occurs.

INCREASED EFFICIENCY

Receive notifications and respond immediately when a worker encounters danger, such as a high gas alarm, or activates panic or man-down alerts.

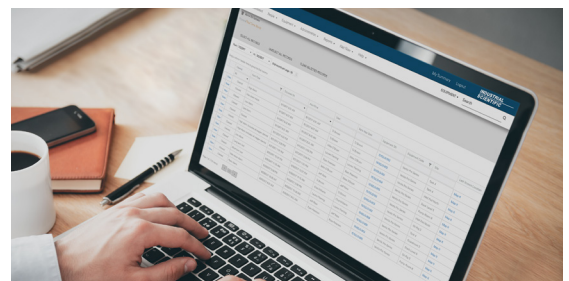


RISK MITIGATION

Ensure the safety and security of every worker, regardless of location, in real time.

VALUABLE INSIGHTS

Use data to improve reporting, analyze worker and instrument trends, and make informed decisions about your safety program.





**VENTIS®
SLIDE-ON-PUMP**



The Ventis® Slide-on Pump is ideally suited for operators who wear their gas monitors for personal protection but occasionally require a pump for confined space entries. Available in black or safety orange and powered by its own battery, the slide-on pump is compatible with the Ventis MX4 and Ventis Pro5 Multi-Gas Monitors.

- **Convenient sampling** – Sample draw distance of up to 50 feet provides convenient sampling in a wide range of applications
- **Easy to attach** – No tools are required to attach or remove the Ventis Slide-on Pump to or from the monitor
- **Uses same batteries and chargers as Ventis** – Monitor and pump both use the same batteries, and can easily be exchanged between instruments
- **Flexible battery options** – Three available battery options make this pump extremely flexible in the field

Integral Sampling Pump Specifications

- MX6 iBrid, Ventis MX4 and Ventis Pro5 integral pumps have a sample draw range of 100 feet through 1/8 inch ID tubing
- Ventis Slide-on Pump has a sample draw range of 50 feet through 1/8 inch ID tubing
- MX6 iBrid, Ventis MX4, and Ventis Pro5 integral pumps and Slide-on Pump have a flow rate of 0.25 LPM (0.5 SCFH)
- Audible and visual indication of fault conditions
- Replaceable, external dust filter is incorporated into each pump
- Classified as intrinsically safe for use in Class I, Division I, Groups A, B, C, & D
- Two-year warranty on MX6 iBrid integral pumps and Ventis MX4 integral and Slide-on Pumps
- Ventis MX4 Slide-on Pump powered by internal rechargeable lithium-ion battery



Ventis Pro and Ventis MX4 Series Integral Pumps



SP6 for the MX6 iBrid

Electronic Sampling Pumps

Maximum sampling distance 100 feet for the SP6 and Ventis pump with 1/8 inch urethane tubing or 3/16 inch urethane tubing

Maximum sampling distance 50 feet VSP with 1/8 inch urethane tubing or 3/16 inch urethane tubing

"2 & 2" Sampling rule

- 2 Seconds per foot of tubing used
- 2 Minutes sample time per location

Confined Space Sampling

- Top, middle, and bottom at a minimum, OSHA recommends 4-foot intervals

Benzene Tube

The Pre-Filter Tube Holder, Pre-Filter Tubes, and Pre-Filter Tube Tip Breaker accessories for the MX6 iBrid gas monitor. When used together, these accessories enable properly configured MX6 gas monitors to display benzene-specific readings.



Benzene Pre-Filter Tubes



Benzene Pre-Filter Tube Tip Breaker



Benzene Tube Holder, Quick Connect



Dilution Tube

Dilution Sampling

In locations of oxygen atmospheres below 10% by vol., it is recommended that a dilution tube be attached to obtain a more accurate reading of combustible gases. This tube would draw a 1:1 ratio of ambient oxygen with the gas sample being drawn. The action of the dilution tube will elevate the oxygen readings to a level suitable for combustible gas monitoring. The criteria to keep in mind when using the dilution tube:

- Use to sample in atmospheres of less than 10% by volume oxygen.
- Ambient oxygen reading must be between 20% to 23.5% by vol.
- Instrument readings will approximately be equal to one half of all gas concentrations being sampled.
- Maximum sampling tube length of 10 feet.
- Avoid drawing oil, dust, or steam into the dilution tube.
- Do not clean the air intake hole or sample hole with wire or drill bits that may enlarge the diameter of the holes.
- Installation of the dilution tube in the reverse direction will cause erroneous low readings.
- The area being sampled must be at atmospheric pressure.
- Do not use for sampling of positive pressure lines.
- Store dilution tube in a sealed container.

PRODUCT WARRANTY SUMMARY

INSTRUMENT

GASBADGE PRO		
Hardware		Guaranteed for Life™
Sensors		
	Carbon Monoxide (CO)	2-year
	Hydrogen Sulfide (H2S)	2-year
	Oxygen (O2)	2-year
	Nitrogen Dioxide (NO2)	1-year
	Sulfur Dioxide (SO2)	1-year
	Chlorine (Cl2)	1-year
	Chlorine Dioxide (ClO2)	1-year
	Phospine (PH3)	1-year
	Hydrogen Cyanide (HCN)	1-year
	Hydrogen (H2)	1-year
	Carbon Monoxide (CO) H2 Low Interference	1-year
	Replacement Sensors ¹	1-year
Battery		No Warranty
Consumable & Miscellaneous Items²	(Including case top)	1-year
Accessories³	(carrying cases, chargers, and calibration equipment	1-year
TANGO		
Hardware		Guaranteed for Life™
Sensors		
	Carbon Monoxide (CO)	2-year
	Hydrogen Sulfide (H2S)	2-year
	Oxygen (O2)	2-year
	Nitrogen Dioxide (NO2)	2-year
	Sulfur Dioxide (SO2)	2-year
	Carbon Monoxide (CO) H2 Low Interference	2-year
	Replacement Sensors ¹	1-year
Battery		No Warranty
Consumable & Miscellaneous Items²		1-year
Accessories³	(carrying cases, chargers, and calibration equipment	1-year

¹ Replacement sensors are defined as sensors purchased as a spare part and used to replace an existing sensor in the monitor.

² Examples of consumable items include remote sampling equipment, water barriers, and filters.

³ Example of accessories include carry cases, chargers, and calibration equipment.

PRODUCT WARRANTY SUMMARY

INSTRUMENT

VENTIS MX4		
Hardware		4-year⁴
Sensors		
	Combustible (LEL)	4-year⁴
	Carbon Monoxide (CO)	4-year⁴
	Hydrogen Sulfide (H2S)	4-year⁴
	Oxygen (O2)	4-year⁴
	Nitrogen Dioxide (NO2)	2-year
	Sulfur Dioxide (SO2)	2-year
	Carbon Monoxide (CO) H2 Low Interference	2-year
	Replacement Sensors ¹	1-year
Battery		2-year
Ventis Pump		4-year
Ventis Slide-on-Pump		4-year
Consumable & Miscellaneous Items²	(Including case top)	1-year
Accessories³	(carrying cases, chargers, and calibration equipment)	1-year
DOCKING STATIONS		
DSX Standalone		2-year
DSX-L Localled Connected		2-year
DSXi Cloud Connected		Guaranteed for Life™
Gateways & Beacons		
RGX Gateway		2-year
TGX Vehicle Gateway		2-year
iAssign Beacon		1-year

¹ Replacement sensors are defined as sensors purchased as a spare part and used to replace an existing sensor in the monitor.

² Examples of consumable items include remote sampling equipment, water barriers, and filters.

³ Example of accessories include carry cases, chargers, and calibration equipment.

⁴ Listed warranty term only applies to product manufactured on or after January 1st, 2020. Product manufactured before January 1st, 2020 are covered for 2-years from the date of manufacture.

PRODUCT WARRANTY SUMMARY

INSTRUMENT

VENTIS PRO5		
Hardware		Guaranteed for Life™
Sensors		
	Combustibles (LEL)	4-year⁴
	Carbon Monoxide (CO)	4-year⁴
	Hydrogen Sulfide (H2S)	4-year⁴
	Oxygen (O2)	4-year⁴
	Carbon Monoxide (CO) / Hydrogen Sulfide (H2S) Dual	2-year
	Nitrogen Dioxide (NO2)	2-year
	Sulfur Dioxide (SO2)	2-year
	Carbon Monoxide (CO) H2 Low Interference	2-year
	Hydrogen Cyanide (HCN)	2-year
	Phosphine (PH3)	2-year
	Ammonia (NH3)	2-year
	Chlorine (Cl2)	2-year
	Carbon Dioxide (CO2) IR	2-year
	Methane (CH4) IR	2-year
	Hydrocarbon (HC) IR	2-year
	Carbon Dioxide (CO2) / Combustible (LEL) IR	2-year
	Carbon Dioxide (CO2) / Methane (CH4) IR	2-year
	Replacement Sensors ¹	1-year
Battery		No Warranty
Ventis Pump		4-year
Ventis Slide-on-Pump		4-year
Consumable & Miscellaneous Items²	(Including case top)	1-year
Accessories³	(carrying cases, chargers, and calibration equipment	1-year

¹ Replacement sensors are defined as sensors purchased as a spare part and used to replace an existing sensor in the monitor.

² Examples of consumable items include remote sampling equipment, water barriers, and filters.

³ Example of accessories include carry cases, chargers, and calibration equipment.

⁴ Listed warranty term only applies to LEL, CO, H2S, and O2 sensors in monitors manufactured on or after January 1st, 2020. LEL, CO, H2S, and O2 sensors in monitors manufactured before January 1st, 2020 are covered for 3-years from the date of manufacture.

PRODUCT WARRANTY SUMMARY

INSTRUMENT

MX6 IBRID		
Hardware		Guaranteed for Life™
Sensors		
	Combustibles (LEL)	2-year
	Carbon Monoxide (CO)	2-year
	Carbon Monoxide (CO) High Sensor	2-year
	Hydrogen Sulfide (H2S)	2-year
	Oxygen (O2)	2-year
	Carbon Monoxide (CO) / Hydrogen Sulfide (H2S) Dual	2-year
	Nitric Oxide (NO)	2-year
	Nitrogen Dioxide (NO2)	2-year
	Sulfur Dioxide (SO2)	2-year
	Carbon Monoxide (CO) / Hydrogen (H2) Low Interference	2-year
	Hydrogen Cyanide (HCN)	2-year
	Phosphine (PH3)	2-year
	Phosphine (PH3) High Sensor	2-year
	Ammonia (NH3)	2-year
	Chlorine (Cl2)	2-year
	Hydrogen (H2)	2-year
	Chlorine Dioxide (ClO2)	2-year
	Hydrogen Chloride (HCL)	2-year
	Methane (CH4) IR	2-year
	Carbon Dioxide (CO2) IR	2-year
	Hydrocarbon (HC) IR	2-year
	Carbon Dioxide (CO2) / Combustible (LEL) IR	2-year
	Carbon Dioxide (CO2) / Methane (CH4) IR	2-year
	PID	2-year
	Replacement Sensors ¹	1-year
Battery		2-year
Consumable & Miscellaneous Items²		1-year
Accessories³	(carrying cases, chargers, and calibration equipment)	1-year

¹ Replacement sensors are defined as sensors purchased as a spare part and used to replace an existing sensor in the monitor.

² Examples of consumable items include remote sampling equipment, water barriers, and filters.

³ Example of accessories include carry cases, chargers, and calibration equipment.

PRODUCT WARRANTY SUMMARY

INSTRUMENT

RADIUS BZ1		
Hardware		2-year
Sensors		
	Combustibles (LEL)	2-year
	Carbon Monoxide (CO)	2-year
	Carbon Monoxide (CO) High Sensor	2-year
	Hydrogen Sulfide (H2S)	2-year
	Oxygen (O2)	2-year
	Carbon Monoxide (CO) / Hydrogen Sulfide (H2S) Dual	2-year
	Nitric Oxide (NO)	2-year
	Nitrogen Dioxide (NO2)	2-year
	Sulfur Dioxide (SO2)	2-year
	Carbon Monoxide (CO) / Hydrogen (H2) Low Interference	2-year
	Hydrogen Cyanide (HCN)	2-year
	Phosphine (PH3)	2-year
	Ammonia (NH3)	2-year
	Chlorine (Cl2)	2-year
	Hydrogen (H2)	2-year
	Carbon Dioxide (CO2) IR	2-year
	PID	2-year
	Replacement Sensors ¹	2-year
Battery		2-year
Integrated Pump (SafeCore)		2-year
Consumable & Miscellaneous Items²		1-year
Accessories³	(carrying cases, chargers, and calibration equipment)	1-year

¹ Replacement sensors are defined as sensors purchased as a spare part and used to replace an existing sensor in the monitor.

² Examples of consumable items include remote sampling equipment, water barriers, and filters.

³ Example of accessories include carry cases, chargers, and calibration equipment.

Industrial Scientific Default Instrument Alarm Settings

GAS	INSTANT		HYGIENE	
	LOW	HIGH	TWA	STEL
O ₂	19.5% vol	23.5% vol	N/A	N/A
CO	35 ppm ^{1,2}	70 ppm ²	35 ppm ¹	200 ppm
H ₂ S	10 ppm	20 ppm	10 ppm	15 ppm
SO ₂	2.0 ppm	4.0 ppm	2.0 ppm	5.0 ppm
NO ₂	3.0 ppm	6.0 ppm ³	3.0 ppm	5.0 ppm
Cl ₂	0.5 ppm	1.0 ppm	0.5 ppm	1.0 ppm
ClO ₂	0.1 ppm	0.2 ppm	0.1 ppm	0.3 ppm
CO ₂	0.5% vol	1.0% vol	0.5% vol	3.0% vol
PH ₃	0.3 ppm	0.6 ppm	0.3 ppm	1.0 ppm
NH ₃	25 ppm	50 ppm	25 ppm	35 ppm
HCN	5.0 ppm	10 ppm	4.0 ppm	4.0 ppm
NO	25 ppm	50 ppm	25 ppm	25 ppm
HCl	2.5 ppm	5.0 ppm	2.5 ppm	2.5 ppm
H ₂	50 ppm	100 ppm	N/A	N/A
CH ₄	1.0% vol	1.5% vol	N/A	N/A
LEL	10% LEL	20% LEL	N/A	N/A
PID	100 ppm	200 ppm	N/A	N/A

NOTE: 1. For CO, OSHA PEL is 50 ppm, Industrial Scientific uses the standard set in 1989 (35 ppm). All alarm set points are field-adjustable over the full range of the sensor, exceptions: LEL/CH₄ – 0 to 60% and 0 to 3.0% by vol CH₄. Provided standards exist, all alarm settings are based on the following: Low alarms are based on OSHA PEL and/or NIOSH values. High alarms are based on 2 times OSHA PEL values.

2. MSHA CO limits are 50 ppm for a low alarm and 100 ppm for a high alarm.

3. MSHA NO₂ limits are 5 ppm for a high alarm.

Notes:

Recommended Exposure Limits

GAS	OSHA CURRENT	NIOSH CURRENT	NIOSH IDLH	OSHA IDLH
CO	50 ppm TWA	35 ppm TWA 200 ppm C	1200 ppm	1200 ppm
H ₂ S	20 ppm C 50 ppm max*	10 ppm C	100 ppm	100 ppm
SO ₂	5 ppm TWA	2 ppm TWA 5 ppm STEL	100 ppm	100 ppm
NH ₃	50 ppm TWA	25 ppm TWA 35 ppm STEL	300 ppm	300 ppm
Cl ₂	1 ppm C	0.5 ppm C	10 ppm	10 ppm
ClO ₂	0.1 ppm TWA	0.1 ppm TWA 0.3 ppm STEL	5 ppm	5 ppm
HCl	5 ppm C	5 ppm C	50 ppm	50 ppm
HCN	10 ppm TWA	4.7 ppm STEL	50 ppm	50 ppm
PH ₃	0.3 ppm TWA	0.3 ppm TWA 1 ppm STEL	50 ppm	50 ppm
NO	25 ppm TWA	25 ppm TWA	100 ppm	100 ppm
CO ₂	5,000 ppm TWA (0.5% vol)	5,000 ppm TWA (0.5% vol) 30,000 ppm STEL (3% vol)	40,000 ppm (4% vol)	40,000 ppm (4% vol)
NO ₂	5 ppm C	1 ppm STEL	20 ppm	20 ppm

C Denotes Ceiling Limit

* 10 minute maximum duration once, only if no other measurable exposure occurs

NOTE: For reference only, consult with the latest publication of each organization for updates.

Notes:

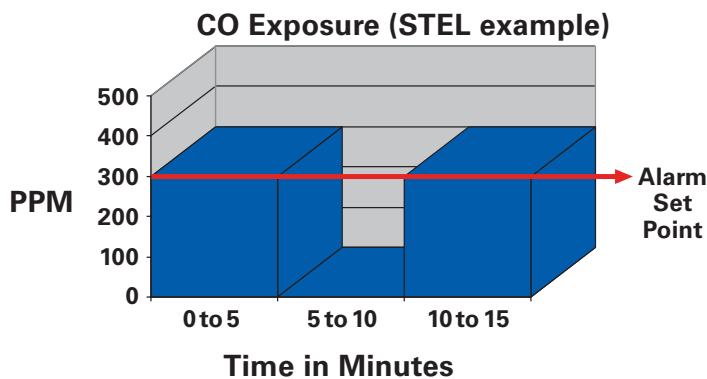
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STEL and TWA

In the world of Industrial Hygiene, personal exposure to toxic gases is measured and expressed in several different formats. Instantaneous exposures are straight forward and easy to understand. When the ambient concentration of toxic gas rises above a predetermined value, an instantaneous exposure limit is exceeded. This method is very effective for protecting workers from acutely toxic concentrations of gas.

In situations where atmospheres may contain lower concentrations of gases, exposures are averaged as concentrations over time. There are two common terms established by the American Conference of Governmental Industrial Hygienists (ACGIH) to classify these exposures, Short-Term Exposure Limit (**STEL**) and Time-Weighted Average (**TWA**).

STEL represents the average of the gas concentration a worker has been exposed to over the last 15 minute period. If this amount exceeds predetermined limits, the worker must remove him/herself from the hazard for a period of at least 1 hour before re-entry. STEL values may only be exceeded 4 times during a normal work shift.

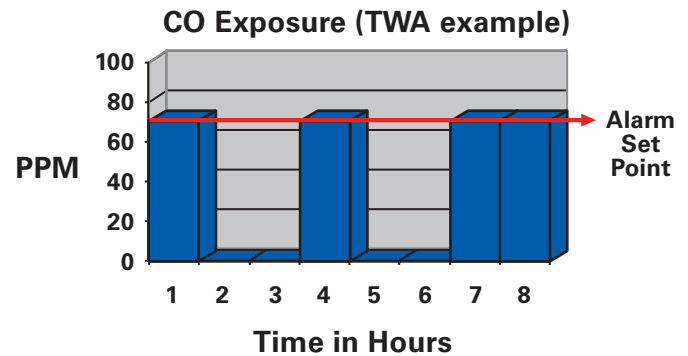


The instrument samples the gas concentration minute by minute and stores that information in the on-board datalogger. As the datalogger evaluates the concentrations stored, it sees 300 ppm of CO for 10 minutes out of 15 possible minutes. The final STEL calculation is:

$$300 \text{ ppm} \times 10 = 3000$$

$$3000 / 15 \text{ minutes} = 200 \text{ ppm for the STEL value}$$

TWA is the average amount of gas a worker has been exposed to over a given time period. This time is usually defined as 8 hours to represent a normal work day. If a predetermined TWA value is exceeded the worker may not re-enter the space for the balance of the workday.



As the datalogger records the accumulated data it sees a total of 70 ppm for 240 minutes (4 hours) of a possible 480 minutes. The final TWA calculation is as follows:

$$70 \text{ ppm} \times 240 \text{ min} = 16,800 \text{ ppm}$$

$$16,800 / 480 \text{ min} = 35 \text{ ppm for the final TWA value}$$

(note: unit exceeded TWA alarm value at hour 4)

Gas averages are virtually impossible to compute on paper. It is for this reason instruments have been designed with a microprocessor and optional datalogger with hygiene functions to do the calculations for us. To better understand how toxic gases are averaged over time please refer to the simplified graphic examples of **STEL** and **TWA**.

PEL's Permissible Exposure Limits are regulatory limits on the amount or concentration of a substance in the air. **PEL's** are based on an 8 hour time weighted average (TWA) exposure.

REL Recommended exposure limits – NIOSH "TWA" indicates a time-weighted average concentration for up to a 10 hour workday during a 40 hour workweek. A short term exposure limit (STEL) designated by "ST" preceding the value; unless noted the STEL is a 15 minute TWA exposure that should not be exceeded at any time. A ceiling REL is designated "C" preceding the value; unless noted otherwise, the ceiling value should not be exceeded at any time.

Composition of Air & Weights of Gases

AIR = Oxygen @ _____ % by Vol. x _____ 2 = _____ mw

Nitrogen@ _____ % by Vol. x _____ 2 = _____ mw

100% Total of above gases is _____ mw

Rounded up to (_____) mw (Trace Gases are heavy)

$\text{CH}_4 = \underline{12} + \underline{1}_4 = (12 + 4) = \underline{16} \text{ mw}$

$\text{NO}_2 = \underline{\quad} + \underline{\quad}_2 = (\underline{\quad} + \underline{\quad}) = \underline{\quad} \text{ mw}$

$\text{C}_5\text{H}_{12} = \underline{\quad}_5 + \underline{\quad}_{12} = (\underline{\quad} + \underline{\quad}) = \underline{\quad} \text{ mw}$

$\text{H}_2\text{S} = \underline{\quad}_2 + \underline{\quad} = (\underline{\quad} + \underline{\quad}) = \underline{\quad} \text{ mw}$

$\text{CO} = \underline{\quad} + \underline{\quad} = (\underline{\quad} + \underline{\quad}) = \underline{\quad} \text{ mw}$

Weights of Various Gases Compared to Air

Where will these gases stratify in a vessel, room, or confined space based on their molecular weight?

The following gases are lighter than air:

Acetylene
Ammonia
Carbon Monoxide
Ethylene
Hydrogen
Hydrogen Cyanide
Methane
Nitric Oxide

The following gases are heavier than air:

Argon
Butane
Carbon Dioxide
Chlorine
Ethane
Hexane
Hydrogen Chloride
Hydrogen Sulfide
Methyl Ethyl Ketone
Methyl Mercaptan
Nitrogen Dioxide
Oxygen
Propane
Sulfur Dioxide

Lower Explosive Limits of Combustible Gases

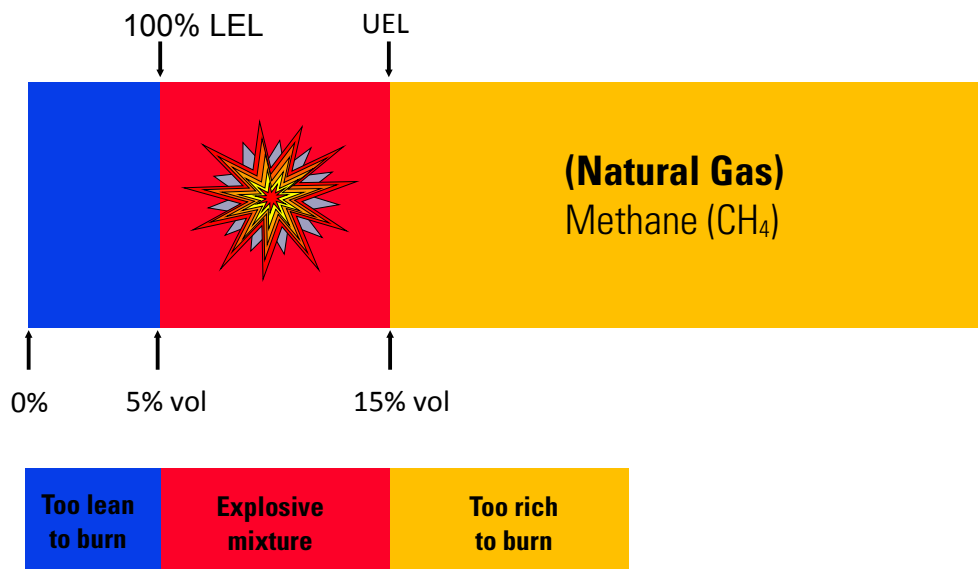
The following are the lower explosive limits (LEL) of selected gases:

Acetone	2.5% vol	Hexane	1.1% vol
Acetylene	2.5% vol	Hydrogen	4.0% vol
Ammonia	15.0% vol	Isopropyl Alcohol (Isopropanol)	2.0% vol
Benzene	1.2% vol	Methane	5.0% vol
Butane	1.9% vol	Methyl Alcohol (Methanol)	6.0% vol
Butyl Alcohol (Butanol)	1.4% vol	Methyl Ethyl Ketone	1.4% vol
Carbon Monoxide	12.5% vol	n-Pentane	1.4% vol
Diethyl Ether	1.9% vol	Propane	2.1% vol
Ethane	3.0% vol	Propylene	2.0% vol
Ethyl Alcohol (Ethanol)	3.3% vol	Styrene	0.9% vol
Ethylene	2.7% vol	Toluene	1.1% vol
Ethylene Oxide	2.7% vol	Xylene	1.1% vol

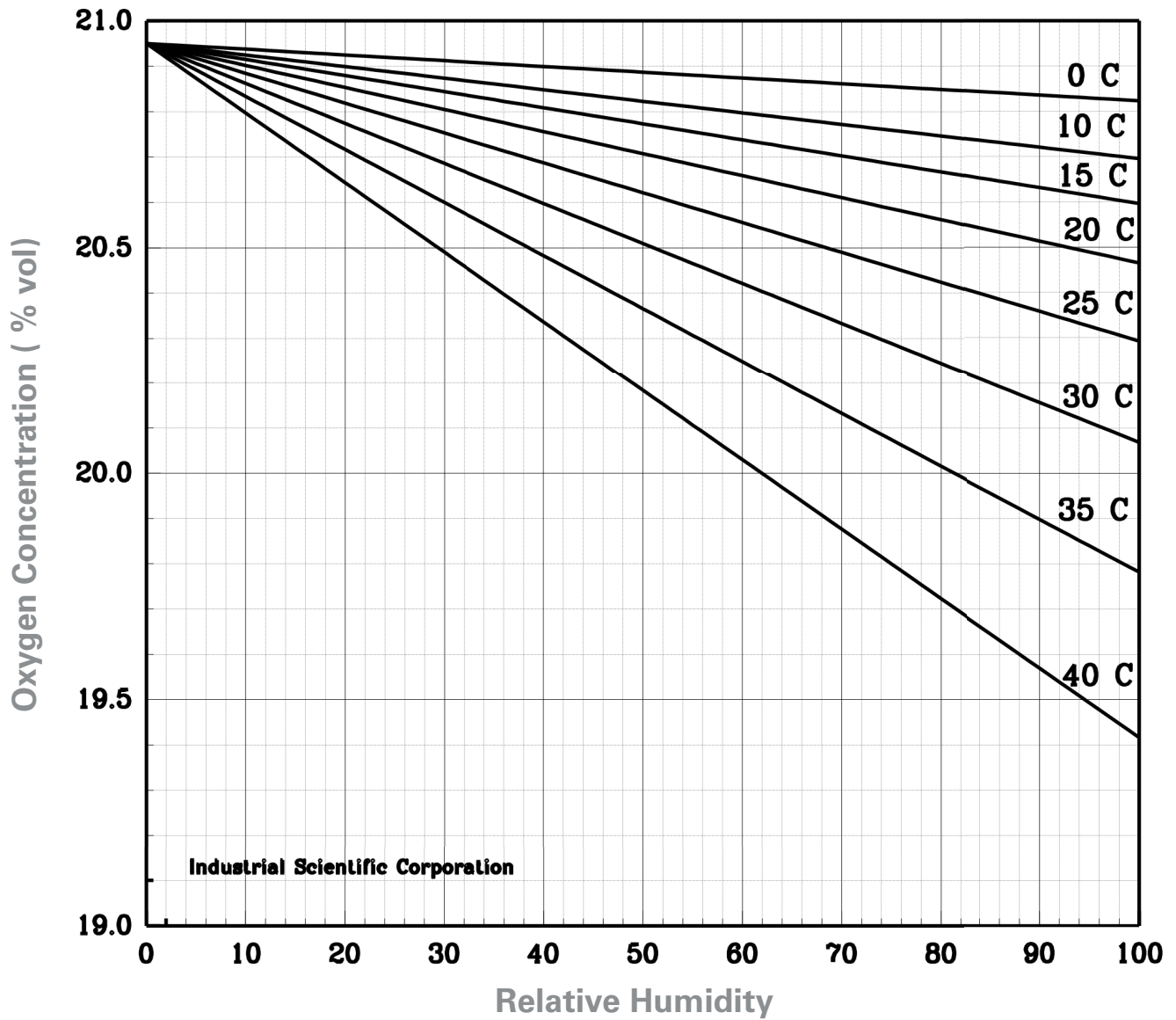
$$\% \text{ LEL} = \frac{\text{Gas Concentration (in \% vol)}}{\text{Lower Explosive Limit (in \% vol)}} \times 100$$

$$25\% \text{ LEL Pentane} = \frac{.35\% \text{ vol}}{1.4\% \text{ vol}} \times 100$$

Example of Combustion



Atmospheric Oxygen Concentration vs. Relative Humidity (at constant temperature)




Degrees Fahrenheit = 1.8 x degrees C + 32


Centigrade	0°	10°	15°	20°	25°	30°	35°	40°
Fahrenheit	32°	50°	59°	68°	77°	86°	95°	104°

Carbon Monoxide Data Sheet

Hazard:	Flammability: Will explode; 12.5% LEL
Classification:	Health: Extremely toxic
Synonyms:	Carbon oxide, flue gas, monoxide
Exposure Limits:	(NIOSH) REL: TWA 35 ppm, C 200 ppm (NIOSH) IDLH: 1200 ppm (OSHA) PEL: TWA: 50 ppm
Industries:	Steel mills, fire departments, garages, loading docks, electrical utilities, and general industries

 Carbon monoxide is an odorless, colorless gas. CO is the by-product of incomplete combustion and will appear naturally in any situation where burning takes place.

At risk groups: People with heart or respiratory problems and pregnant women.


 Carbon monoxide is a highly toxic gas and asphyxiant. CO reduces the oxygen transport properties of the blood. It reacts with the hemoglobin in the blood forming carboxyhemoglobin which prevents the hemoglobin from transferring oxygen. Low ppm exposures of carbon monoxide can cause headaches and dizziness. If the victim is removed to fresh air no permanent damages may result. High doses can be fatal.


Effects of Various CO Levels

CARBON MONOXIDE	RESULTING CONDITIONS/EFFECTS ON HUMANS
50 ppm	PEL for 8 hours (OSHA)
200 ppm	Possible mild frontal headache in 2 to 3 hours
400 ppm	Frontal headache and nausea after 1 to 2 hours
800 ppm	Headache, dizziness, and nausea in 45 minutes, and possible death in 2 hours
1600 ppm	Headache, dizziness, and nausea in 20 minutes, collapse and death in 1 hour
3200 ppm	Headache and dizziness in 5 to 10 minutes, unconsciousness and danger of death in 30 minutes
6400 ppm	Headache and dizziness in 1 to 2 minutes; unconsciousness and danger of death in 10 to 15 minutes
12,800 ppm	Immediate effects are unconsciousness, death in 1 to 3 minutes

Hydrogen Sulfide Data Sheet

Hazard:	Flammability: Will explode; 4.0% LEL
Classification:	Health: Extremely toxic
Synonyms:	Hydrosulfuric acid, sewer gas, sour gas, rotten egg gas
Exposure Limits:	(NIOSH) REL: C 10 ppm (NIOSH) IDLH: 100 ppm (OSHA) PEL: C 20 ppm
Industries:	Oil and gas industries, pulp and paper, and waste water treatment plants

 Hydrogen sulfide is a colorless gas that is known by its characteristic rotten egg like odor. It appears naturally as a by-product of decomposition. You will lose your sense of smell from H₂S exposure. Do not trust your sense of smell.


 Hydrogen sulfide is a highly toxic gas. It reacts with the enzymes in the blood stream which inhibit cell respiration. In high concentrations of hydrogen sulfide, nerve cells shut down and death is immediate. Low concentration exposure to the gas can burn the respiratory tract and cause swelling around the eyes.


Effects of Various H₂S Levels

HYDROGEN SULFIDE	RESULTING CONDITIONS/EFFECTS ON HUMANS
5 ppb-0.15 ppm	Minimal perceptible odor
4.60 ppm	Easily detected, moderate odor
10 ppm	Beginning eye irritation
100 ppm	Coughing, eye irritation, loss of sense of smell after 2 to 5 minutes
200 ppm	Eye inflammation and respiratory tract irritation after one hour of exposure
500-700 ppm	Loss of consciousness, and possibly death in 30 minutes to one hour
700-1000 ppm	Rapid unconsciousness, cessation or pausing of respirations and death
1000-2000 ppm	Unconsciousness at once, with early cessation of respiration and death in a few minutes; Death may occur even if individual is removed immediately to fresh air

Chlorine Data Sheet

Hazard:	Flammability: Will not explode
Classification:	Health: Extremely toxic oxidizing agent
Synonyms:	Chlorine gas, molecular chlorine
Exposure Limits:	(NIOSH) REL: C 0.5 ppm (NIOSH) IDLH: 10 ppm (OSHA) PEL: C 1.0 ppm
Industries:	Swimming pools, pulp and paper, waste water treatment plants, hazmat teams, railroad yards

 Chlorine is greenish yellow gas with a characteristic pungent odor. Although not classified as an explosive gas, chlorine will react explosively or form an explosive compound when combined with substances like acetylene, ethylene, ether, turpentine, ammonia, hydrogen, and fuel gas.

 Chlorine derivatives are commonly used for their disinfectant properties. Chlorine is highly toxic. The toxins take their route through the lungs irritating the respiratory tract. High exposures of chlorine gas can cause death quite rapidly.

Effects of Various Cl₂ Levels


CHLORINE	RESULTING CONDITIONS/EFFECTS ON HUMANS
0.5 ppm	REL (NIOSH)
1.0 ppm	PEL (OSHA)
3.0 ppm	Irritations of the mucous membranes, eyes and respiratory tract
3.5 ppm	Produces an easily detectable odor
15 ppm	Causes immediate irritations of the throat
100-150 ppm	Pain, tightness in the chest, and death results from prolonged exposure
1000 ppm	Fatal even when exposure is brief


NOTE: Cl₂ detection instruments per State Department orders may not be shipped out of the US with detection accuracy below 0.2 ppm because of chemical warfare.

SOURCE: Dangerous Properties of Industrial Materials (Sixth Edition) by N. Irving Sax

Nitrogen Dioxide Data Sheet

Hazard:	Flammability: Will not explode
Classification:	Health: Extremely toxic
Synonyms:	Dinitrogen tetroxide, nitrogen peroxide, nitrogen tetroxide, and NTO
Exposure Limits:	(NIOSH) REL: ST 1 ppm (NIOSH) IDLH: 20 ppm (OSHA) PEL: C 5 ppm
Industries:	Mining using diesel powered machinery, garages, chemical plants

 Nitrogen dioxide is a yellowish-brown gas with a characteristic pungent, irritating odor. Nitrogen dioxide is soluble in water at which time it reacts to form nitric acid. NO₂ can be found in industries where the burning of diesel fuel takes place. The most toxic component in diesel emissions is nitrogen dioxide.

 Nitrogen dioxide exposure in low doses can cause irritation of the eyes and throat, headache, nausea, and gradual loss of strength. High doses of NO₂ can cause pulmonary edema (fluid in the lungs) and death.


Effects of Various NO₂ Levels


NITROGEN DIOXIDE	RESULTING CONDITIONS/EFFECTS ON HUMANS
0.2-1 ppm	Detectable by pungent, irritating odor
5-10 ppm	Irritation of the nose and throat
20 ppm	Irritation of the eyes
50 ppm	Maximum exposure for a 30 minute period
100-200 ppm	Tightness in the chest, acute bronchitis, and death from prolonged exposure

SOURCE: Dangerous Properties of Industrial Materials (Sixth Edition) by N. Irving Sax

Sulfur Dioxide Data Sheet

Hazard:	Flammability: Will not explode
Classification:	Health: Extremely toxic Oxidizing Agent
Synonyms:	Sulfurous acid anhydride, sulfurous oxide, and sulfur oxide
Exposure Limits:	(NIOSH) REL: TWA 2 ppm, ST 5 ppm (NIOSH) IDLH: 100 ppm (OSHA) PEL: TWA 5 ppm
Industries:	Pulp and paper mills, coal fired generating stations, and aluminum smelting

 Sulfur dioxide is a colorless non-flammable gas with a characteristic irritating, pungent odor. Sulfur dioxide is released when compounds containing sulfur, such as fossil fuels like coal are burned.

 Sulfur dioxide is a highly toxic gas which poisons its victims via inhalation, and causes respiratory paralysis. SO₂ combines with water to form sulfuric acid (H₂SO₄). Sulfur dioxide can burn the respiratory tract upon inhalation. High doses of sulfur dioxide can cause death quite rapidly.

Effects of Various SO₂ Levels


SULFUR DIOXIDE	RESULTING CONDITIONS/EFFECTS ON HUMANS
0.3-1 ppm	Sulfur Dioxide initially detected by taste
2 ppm	PEL (NIOSH)
3 ppm	Odor becomes easily detectable
6-12 ppm	Irritation of the nose and throat
20 ppm	Irritation of the eyes
100 ppm	Maximum exposure for a 30 minute period
400-500 ppm	Dangerous concentration can cause edema of the lungs and glottis and death from prolonged exposure

NOTE: SO₂ detection instruments per State Department orders may not be shipped out of the US with detection accuracy below 0.2 ppm because of chemical warfare.

SOURCE: Dangerous Properties of Industrial Materials (Sixth Edition) by N. Irving Sax

Ammonia Data Sheet

Hazard:	Flammability: Difficult to burn, 15% LEL
Classification:	Health: Extremely toxic
Synonyms:	Anhydrous ammonia, aqua ammonia, aqueous ammonia
Exposure Limits:	(NIOSH) REL: TWA 25 ppm ST 35 ppm (NIOSH) IDLH: 300 ppm (OSHA) PEL: TWA 50 ppm
Industries:	Fertilizer plants, poultry farms, food processing, refrigeration, chemical plants

 Ammonia is a colorless gas with an extremely pungent odor. It is a widely used chemical that can be found in a variety of common industrial environments. Ammonia is characterized as a flammable although it is very difficult to ignite. When exposed to heat, an ammonia solution will decompose to form ammonia gas and oxides of nitrogen (NO_x). Ammonia is an irritant and will become extremely irritating as concentrations increase. Explosion hazard when exposed to flame or in a fire.


Effects of Various NH₃ Levels

AMMONIA	RESULTING CONDITIONS/EFFECTS ON HUMANS
0-25 ppm	Minor irritation of the eyes and respiratory tract
25 ppm	PEL (NIOSH)
50-100 ppm	Swelling of the eyelids, vomiting, irritation of the throat
100-500 ppm	Concentrations are dangerously high, irritation becomes more intense; death can result from highly concentrated, prolonged exposure

SOURCE: Dangerous Properties of Industrial Materials (Sixth Edition) by N. Irving Sax

Hydrogen Cyanide Data Sheet

Hazard:	Flammability: Will explode, 5.6% LEL
Classification:	Health: Extremely toxic
Synonyms:	Formonitrile, Hydrocyanic acid, prussic acid
Exposure Limits:	(NIOSH) REL: ST 4.7 ppm (NIOSH) IDLH: 50 ppm (OSHA) PEL: TWA 10 ppm
Industries:	Used in the leaching of precious metals, i.e. gold, chemical plants, insecticides

 Hydrogen Cyanide is a colorless to a pale blue liquid or gas. It has a distinct odor resembling bitter almonds. Hydrogen Cyanide is particularly dangerous because of its toxic/asphyxiating effects. HCN combines with the enzymes in tissue associated with cellular oxidation.

This means oxygen is unavailable to the tissues causing death by asphyxia. This suspension only lasts while the cyanide is present. Upon its removal, normal function is restored provided death has not occurred.


Effects of Various HCN Levels


HYDROGEN CYANIDE	RESULTING CONDITIONS/EFFECTS ON HUMANS
10 ppm	PEL (OSHA)
10-50 ppm	Headache, dizziness, unsteadiness
100 ppm	Feeling of suffocation, nausea
100-200 ppm	Death from exposure in 30 to 60 minutes
280 ppm	Immediately fatal

SOURCE: Dangerous Properties of Industrial Materials (Sixth Edition) by N. Irving Sax

Nitric Oxide Data Sheet

Hazard:	Flammability: Not explosive, but will accelerate burning
Classification:	Health: Extremely toxic
Synonyms:	Mononitrogen monoxide, nitrogen
Exposure Limits:	(NIOSH) REL: TWA: 25 ppm (NIOSH) IDLH: 100 ppm (OSHA) PEL TWA: 25 ppm
Industries:	Metal etching, blasting, welding, diesel combustion

 Nitric Oxide is a colorless, poisonous gas. Nitric oxide is commonly generated by the following four industrial practices: Nitric oxide fumes may be encountered whenever nitric acid comes in contact with organic material such as wood, sawdust, or refuse. It can also result from heating nitric acid and when organic nitro compounds are burned, for example dynamite. The action of nitric acid upon metals, as in metal etching and pickling, also liberates this dangerous compound. In high temperature welding (oxyacetylene or electric torch), the nitrogen and oxygen in the air combine to form oxides of nitrogen.

 Nitric Oxide is somewhat soluble in water and when inhaled will react to form nitric acid. This causes a slight irritation to mucous membranes of the upper respiratory tract. Continued exposure to high concentrations of nitric oxide can cause pulmonary edema and death.

Effects of Various NO Levels


NITRIC OXIDE	RESULTING CONDITIONS/EFFECTS ON HUMANS
25 ppm	PEL (OSHA)
0-50 ppm	Low water solubility, therefore, only slight irritation of the mucous membranes is noted even though the TWA has been exceeded
60-150 ppm	Irritation is more intense, coughing and burning of the throat is evident; symptoms will clear if victim is removed relatively quickly to a clean air environment
200-700 ppm	May be fatal even after short exposures

NOTE: Continued exposure to low concentrations of fumes, insufficient to cause pulmonary edema, are said to result in chronic irritation of the respiratory tract, headache, cough, loss of appetite, dyspepsia, corrosion of the teeth and gradual loss of strength

SOURCE: Dangerous Properties of Industrial Materials (Sixth Edition) by N. Irving Sax

Chlorine Dioxide Data Sheet

Hazard:	Flammability: Will not explode
Classification:	Health: Extremely toxic oxidizing agent
Synonyms:	Chlorine oxide, chlorine peroxide, alcide
Exposure Limits:	(NIOSH) REL: TWA: 0.1 ppm ST: 0.3 ppm (NIOSH) IDLH: 5 ppm (OSHA) PEL: TWA 0.1 ppm
Industries:	Pulp and paper mills, waste water treatment plants

 Chlorine Dioxide is a red-yellow or orange-green gas with an unpleasant irritating odor similar to chlorine and nitric acid. It is best known for its biocide and disinfectant properties. It can remain rather stable in the dark but can become very unstable in the light. Chlorine Dioxide will react or form an explosive compound if exposed to a spark, impact, sunlight, or


rapid heating of up to 100 °C. Chlorine Dioxide may also react with carbon monoxide, hydrocarbons, mercury, and some non-metals as well. Chlorine Dioxide combined with water will form hydrochloric acid, and it has a very strong irritating effect on the upper respiratory tract.

Effects of Various ClO₂ Levels

CHLORINE DIOXIDE	RESULTING CONDITIONS/EFFECTS ON HUMANS
0.1 ppm	Odor threshold and Permissible Exposure Limit (PEL)
0.25 ppm	Mild respiratory ailments
0.3 ppm	Short Term Exposure Limit (STEL)
5 ppm	Marked irritation of the respiratory tract; Immediately Dangerous to Life and Health (IDLH)
>5 ppm	Irritation of the eyes, nose and throat; cough; wheezing; shortness of breath; bronchitis; pulmonary edema; headache; vomiting

Hydrogen Chloride Data Sheet

Hazard:	Flammability: Will not explode
Classification:	Health: Extremely toxic oxidizing agent
Synonyms:	Anhydrous hydrochloric acid, chlorohydric acid, hydrochloride, spirits of salt, muriatic acid
Exposure Limits:	(NIOSH) REL: C 5 ppm (NIOSH) IDLH: 50 ppm (OSHA) PEL: C 5 ppm
Industries:	Vinyl and cotton production, semi-conductor crystals etching, petroleum and gas wells, steel manufacturing

 Hydrogen Chloride is a colorless to slight yellow corrosive gas with a pungent irritating odor. Although not considered a combustible gas, it may react or form combustible compounds when contact is made with alcohol, hydrogen cyanide, or with aluminum-titanium alloys. Dissolving Hydrogen

Chloride in water will yield a strong highly corrosive acid. HCl is a strong irritant to the eyes, nose, and upper respiratory tract. Levels of 35 ppm can cause irritation to the throat even after a very short period of time.


Effects of Various HCl Levels

HYDROGEN CHLORIDE	RESULTING CONDITIONS/EFFECTS ON HUMANS
0.25 ppm	Odor threshold
5 ppm	Permissible Exposure Limit (PEL)
35 ppm	Irritation to eyes, nose, throat even after a short period of time
50 ppm	Immediately Dangerous to Life and Health (IDLH)
1,300-2,000 ppm	Death in 2-3 minutes

SOURCE: American Industrial Hygiene Association

Phosphine Data Sheet

Hazard:	Flammability: Will explode, 1.8% LEL
Classification:	Health: Extremely toxic
Synonyms:	Hydrogen phosphide, phosphorated hydrogen, phosphorous hydride, phosphorous trihydride
Exposure Limits:	(NIOSH) REL: TWA 0.3 ppm, ST 1 ppm (NIOSH) IDLH: 50 ppm (OSHA) PEL: TWA: 0.3 ppm
Industries:	Chemical, Pesticide, Fumigant, Clandestine Drug Labs

 Phosphine is a colorless, flammable, highly toxic gas with a fishy or garlic-like odor. Phosphine acts on the central nervous system and lungs leading to pulmonary edema. Symptoms like faintness, vomiting, headache, tightness in the chest may appear rapidly after exposure. Even a short exposure to an acute amount of phosphine can lead to chronic neurological problems. It should also be recognized


that phosphine is highly flammable and may spontaneously ignite in air or even explode when mixed with oxygen. Phosphine coming in contact with oxidizers, halogenated hydrocarbons, or even aluminum and copper may cause the same. It is for this reason that extreme care must be adhered to whenever working with or around phosphine.

Effects of Various PH₃ Levels

PHOSPHINE	RESULTING CONDITIONS/EFFECTS ON HUMANS
0.3 ppm	OSHA Permissible Exposure Limit (PEL)
1 ppm	NIOSH Short Term Exposure Limit (STEL)
35 ppm	Diarrhea, nausea, respiratory distress
500 ppm	Lethal after 45 minutes
2000 ppm	Lethal after 1-3 minutes

Carbon Dioxide Data Sheet

Hazard:	Flammability: Non-flammable gas
Classification:	Health: Simple asphyxiant
Synonyms:	Dry Ice, Carbonic acid, black damp
Exposure Limits:	(NIOSH) REL: TWA 5000 ppm (0.5% vol), STEL 30,000 ppm (3.0% vol) (NIOSH) IDLH: 40,000 ppm (4.0% vol) (OSHA) PEL: TWA: 5,000 ppm (0.5% vol)
Industries:	Landfill, mines, breweries

 It is odorless and colorless and difficult to measure in ppm levels, infrared absorption is the usual technique. Carbon dioxide is present in the atmosphere (about 400 ppm), its maximum safe level is 5,000 ppm or 0.5% vol. It is a product of complete combustion and is found in brewing and other fermentation processes. CO₂ along with methane are the primary components in landfill and sewage treatment digester gas. CO₂ is used

to carbonate beverages and is a hazard in the brewing industry particularly because CO₂ is heavier than air and collects at low levels. There is some degree of risk in crowded, poorly ventilated places, and an oxygen deficient atmosphere often accompanies this situation. Another typical practice is to increase plant growth by elevating normal CO₂ levels in greenhouses.


Effects of Various CO₂ Levels


CARBON DIOXIDE	VOLUME	RESULTING CONDITIONS/EFFECTS ON HUMANS
300 ppm	0.03%	Normal concentration in air
3,000-5,000 ppm	0.03-0.5%	Low concentrations cause increased respiration and headache
5000 ppm	0.5%	Respiration increases PEL
10,000 ppm	1.0%	Symptoms may begin to occur, such as feeling hot and clammy, lack of attention to detail, fatigue, anxiety, loss of energy, weaknesses in the knees commonly known as "jelly legs"
20,000 ppm	2.0%	Respiration increases by 50%, headache after several hours of exposure
50,000-100,000 ppm	5-10%	Violent panting and fatigue to the point of exhaustion merely from respiration; severe headache; prolonged exposure at 5% vol could result in irreversible health effects

SOURCE: Dangerous Properties of Industrial Materials (Sixth Edition) by N. Irving Sax

Benzene Data Sheet

Hazard:	Flammability: Will explode; 1.2% LEL
Classification:	Health: Extremely toxic, Carcinogen
Synonyms:	Benzol, Phenyl hydride
Exposure Limits:	(NIOSH) REL: Ca, TWA: 0.1 ppm, STEL: 1 ppm (NIOSH) IDLH: Ca (500 ppm) (OSHA) PEL: (1910.1028), TWA 1 ppm, STEL 5 ppm
IP Value:	9.24 eV, MW: 78.1
Industries:	Coke production, Oil and Gas (drilling, production, distribution, sales), natural gas processing, chemical production

 A colorless, sweet smelling, flammable, toxic, liquid, aromatic hydrocarbon, C₆H₆, derived from petroleum and used in or to manufacture a wide variety of chemical products, including DDT, detergents, insecticides, and motor fuels. It is a solid below 42 °F.


 Benzene is a confirmed human carcinogen producing myeloid leukemia, Hodgkin's disease, and lymphomas by inhalation. It is moderately toxic by ingestion and subcutaneous (under the skin) routes. A severe eye and moderate skin irritant. In industry, inhalation is the primary route of chronic benzene poisoning.

Poisoning by skin contact has been reported. Research indicates that effects are seen at less than 1 ppm. Exposures needed to be reduced to 0.1 ppm before no toxic effects were observed. Elimination is chiefly through the lungs. In chronic poisoning the onset is slow, with the symptoms vague; fatigue, headache, dizziness, nausea and loss of appetite, loss of weight, and weakness are common complaints in early cases. In acute poisoning, the worker becomes confused and dizzy, complains of tightening of the leg muscles. If allowed to remain exposed, he quickly becomes stupefied and lapses into coma.

SOURCE: Sax's Dangerous Properties of Industrial Materials (9th edition) by Richard J. Lewis

Toluene Data Sheet

Hazard:	Flammability: Will explode; 1.1% LEL
Classification:	Health: Extremely toxic
Synonyms:	Methyl Benzene, Methyl benzol
Exposure Limits:	(NIOSH) TWA: 100 ppm, STEL: 150 ppm (NIOSH) IDLH: 500 ppm (OSHA) PEL: TWA 200 ppm, C 300 ppm, (OSHA) 500 ppm (10-minute maximum peak)
IP Value:	8.82 eV, MW: 92.1
Industries:	Coke production, crude oil, refining, gasoline, paint & solvents, jet fuel

 A colorless liquid with sweet, pungent, benzene like odor, flammable, toxic, aromatic hydrocarbon, C₆H₅(CH₃), derived from petroleum and coal tar and coke. It is used in solvents, paint and fuel products. Commercial grade usually contains small amounts of benzene as an impurity.

Toluene is a skin and severe eye irritant. It produces human systemic effects from inhalation and affects the CNS, causes hallucination or distorted perception, motor activity changes, antipsychotic, psychophysiological changes, and affects the bone marrow.

Inhalation of 200 ppm of toluene for 8 hours may cause impairment of coordination and reaction time; with higher concentrations (u to 800 ppm) these effects are increased and are observed in a shorter time. Occasional chronic poisoning is often described as anemia, leukoplakia (reduced white blood cells) and bone marrow hypoplasia.

At 200-500 ppm, headache, nausea, eye irritation, loss of appetite, a bad taste, impaired coordination and reaction time are reported.

SOURCE: Sax's Dangerous Properties of Industrial Materials (9th edition) by Richard J. Lewis

Styrene Data Sheet

Hazard:	Flammability: Will explode; 0.9% LEL
Classification:	Health: Extremely toxic, carcinogen
Synonyms:	Styrene monomer, vinyl benzene
Exposure Limits:	(NIOSH) TWA: 50 ppm, STEL: 100 ppm (NIOSH) IDLH: 700 ppm (OSHA) PEL: TWA 100 ppm, C 200 ppm, (OSHA) 600 ppm (5-minute max. peak in any 3 hours)
IP Value:	8.40 eV, MW: 104.2
Industries:	Petrochemical, coffee & tea decaffeination



Styrene is a colorless to yellow, oily liquid with a sweet floral smell, flammable, toxic, aromatic hydrocarbon, $C_6H_5CH=CH_2$. Styrene is a chemical used to make latex, synthetic rubber, and polystyrene resins. These resins are used to make plastic packaging, disposable cups and containers, insulation, and other products. Styrene is also produced naturally in some plants.

Mildly toxic by inhalation it has systemic effects and olfactory changes. It causes irritation and violent itching of the eyes at 200 ppm, lacrimation (flowing of tears). Its toxic effects are usually transient and result in irritation and possible narcosis.

The monomer has been involved in several industrial explosions. It is a storage hazard above 90 °F (32 °C). A very dangerous fire hazard when exposed to flame, heat, or oxidants.

SOURCE: Sax's Dangerous Properties of Industrial Materials (9th edition) by Richard J. Lewis

Battery Information

Typical Life Expectancy For Lithium-Ion Batteries

MX6 iBrid, Ventis MX4, Ventis Pro5 and Ventis batteries last approximately up to 300 charging cycles or 3 years.

Proper charging of lithium-ion batteries must be done in a charger that is specifically designed to recharge the instrument or battery.

These devices are designed so the lithium-ion battery will not be over-charged or experience a trickle charge. Over-charging or a constant trickle charge can cause a lithium-ion battery to catch fire or explode.

Charge time for a completely discharged instrument battery is approximately 5 hours.

INSTRUMENT	SLIM EXTENDED	LI-ION*	LI-ION EXTENDED	ALKALINE PACK	3V CR2 LITHIUM	2/3 AA LITHIUM	NI-MH	1/2 AA LITHIUM
MX6 iBrid			36 hours	10.5 hours AA				
MX6 iBrid with Pump			18 hours					
Ventis MX4	18 hours	12 hours	20 hours	8 hours AAA				
Ventis MX4 with Pump			12 hours	4 hours AAA				
Ventis Pro5	18 hours	12 hours	24 hours					
Ventis Pro5 with Pump			18 hours					
Ventis Pro5 with Wi-Fi Battery			16 Hours					
Ventis Pro5 with Cellular Battery			14 Hours					
VSP Slide-on Pump		18 hours	36 hours	10 hours AAA				
GasBadge Pro					2,600 hours			
Tango TX1						2 years		
Radius BZ1							160 hours	
SafeCore Module								2+ years*

* The use of bias sensors may decrease battery life.

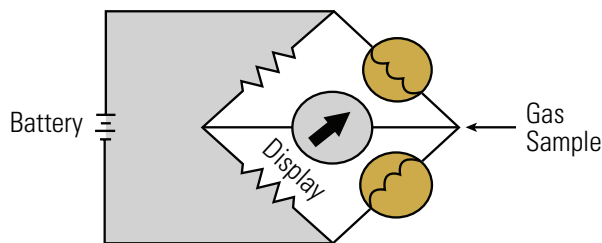
Catalytic Diffusion Sensor in a Wheatstone Bridge Circuit

Catalytic diffusion sensors are the most widely used devices for the detection of combustible gases and vapors. These sensors start with wire being wound into coils. These coils are then doped with two types of catalysts: one to make the element active and one to make it blind. These different coils are then matched into pairs of reference and sensing elements. This forms a combustible gas sensor.

This sensor is then placed into a circuit (see figure 1), where a fixed voltage is applied across both elements, causing them to heat up to very high temperatures. The sensor is also connected to a balanced resistance, a Wheatstone Bridge, which detects changes in the resistance of the sensor's elements. When a combustible gas comes in contact with the sensor, the active element begins to burn the gas causing it to increase the temperature. The temperature of the

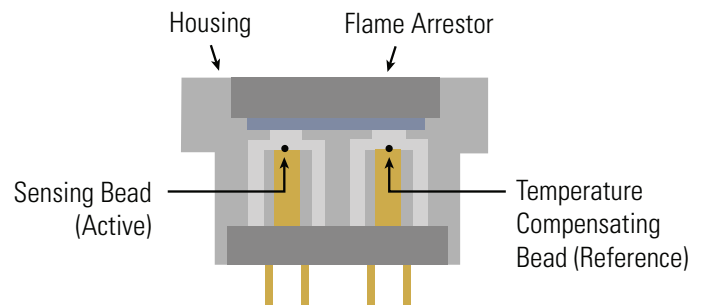
reference element remains unchanged because it is incapable of burning gas. The increased heating of the active element causes an unbalance in the circuit and this is interpreted as a positive combustible signal.

Because combustion is taking place within the sensor chamber the sensor must be designed and built in such a way that it is intrinsically safe and will not act as an ignition source in the event it is exposed to a combustible atmosphere. This is accomplished through the use of a flame arrestor (see figure 2). This device, usually made of a sintered material, acts as a cooling path for gases escaping the sensor. Only units that have been tested and approved by third party approval agencies (UL, CSA, MSHA, FM or CENELEC) can be trusted to be intrinsically safe.



Wheatstone Bridge Circuit

Figure 1



Combustible Gas Sensor

Figure 2

Minimum oxygen requirements for proper combustible gas detection is 10% vol.

NOTE: Do not attempt to disassemble a sensor; if the sensor is cracked, dented, or otherwise visibly damaged, the sensor must be packaged and returned to Industrial Scientific or disposed of according to official regulations. For additional information, please contact your local Industrial Scientific representative. Global contact information can be found at www.indsci.com/offices.

Poisons

A poison is a substance that will adhere itself to a Catalytic Bead and cause permanent damage to a portion or the entire sensing bead. A sensor that has been exposed to a poison becomes desensitized and cannot recover. A poison will shorten the life of a combustible sensor. If you think the combustible sensor has been exposed to a poison, calibrate the instrument as soon as possible; crosscheck against methane.

Inhibitors

An inhibitor is a substance that will adhere itself to the catalytic bead and cause the sensor to be desensitized. A combustible sensor has the potential for partial recovery from exposure to these inhibitors. Exposure to inhibitors may effect the long-term life of the sensor. You can help recovery by having the instrument calibrated to pentane gas.

Silicone Based Compounds

In a curing state silicone will poison a combustible sensor.

Sulfur Compounds – H₂S, SO₂, etc.

The rule is – If it is safe for you, it is safe for the instrument.

Halogenated Compounds

Contains one or more of the following: Astatine, Fluorine, Chlorine, Bromine, Iodine

Calibration is the only way to identify if any loss of sensitivity has occurred to the combustible sensor, and identify if the sensor should be replaced.

Notes:

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LEL Correlation Factors

The following chart outlines LEL correlation factors for combustible gas sensors.

	CALIBRATION GAS						
	LEL (% vol)	Butane	Hexane	* Hydrogen	* Methane	* Pentane	* Propane
Acetone	2.5%	1.06	0.70	1.70	1.70	0.90	1.10
Acetylene	2.5%	0.74	0.60	1.30	1.30	0.70	0.80
Benzene	1.2%	1.16	0.80	1.90	1.90	1.00	1.20
Butane	1.8%	1.00	0.55	1.69	1.58	0.79	0.98
Ethane	3.0%	0.84	0.60	1.30	1.30	0.70	0.80
Ethanol	3.3%	0.94	0.52	1.59	1.49	0.74	0.92
Ethylene	2.7%	0.84	0.60	1.40	1.30	0.70	0.90
Hexane	1.1%	1.81	1.00	3.04	2.86	1.42	1.77
Hydrogen	4.0%	0.59	0.33	1.00	0.94	0.47	0.58
Isopropanol	2.0%	1.16	0.90	2.00	1.90	1.00	1.20
Methane	5.0%	0.63	0.35	1.06	1.00	0.50	0.62
Methanol	6.0%	0.63	0.50	1.10	1.10	0.60	0.70
Nonane	0.8%	2.34	1.30	3.95	3.71	1.84	2.29
Pentane	1.4%	1.28	0.71	2.15	2.02	1.00	1.25
Propane	2.1%	1.02	0.57	1.72	1.62	0.80	1.00
Styrene	0.9%	1.30	1.00	2.20	2.20	1.10	1.40
Toluene	1.1%	1.62	0.89	2.71	2.55	1.26	1.57
Xylene	1.1%	1.58	1.10	2.60	2.50	1.30	1.60
Ammonia	—	—	—	—	1.00	—	—
JP-4	—	—	—	—	—	1.20	—
JP-5	—	—	—	—	—	0.90	—
JP-8	—	—	—	—	—	1.50	—

Accuracy +/- 25% error

NOTE: Calibration gases available from Industrial Scientific Corporation

1. The correlation factors in the table are averaged results for estimation use only. It's not recommended for analytical application with high accuracy expectation.
2. The correlation factors may vary from sensor to sensor with tolerance of +/- 25% for new sensors. The number could further shift for old sensors.
3. To get a more accurate result, it's recommended to calibrate the instrument with a gas that has CF close to 1. The closer, the better.
4. It's not recommended to use correlation factors if the target gas is methane and the sensor is old.
5. Expect more deviation when an old sensor is calibrated with methane gas.

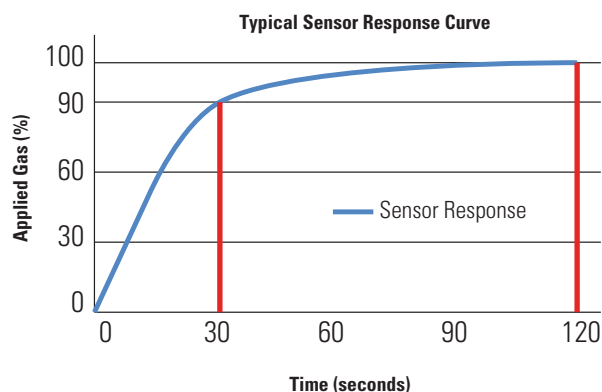
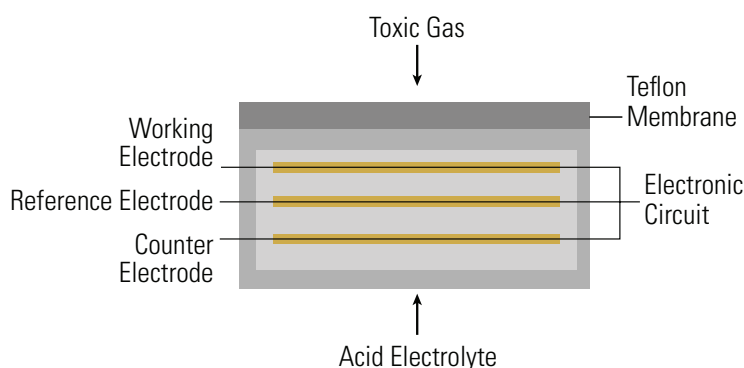
* Preferred gases

Electrochemical Sensors

The basic components of an electrochemical sensor are a working (or sensing) electrode, a counter electrode, and some may contain a reference electrode. These electrodes are enclosed in the sensor housing in contact with a liquid electrolyte. The working electrode is on the inner face of a Teflon membrane that is porous to gas, but impermeable to the electrolyte.

The gas diffuses into the sensor and through the membrane to the working electrode. When the gas reaches the working electrode, an electrochemical reaction occurs: either an oxidation or reduction depending on the type of gas. For example, carbon monoxide may be oxidized to carbon dioxide, or oxygen

may be reduced to water. An oxidation reaction results in the flow of electrons from the working electrode to the counter electrode through the external circuit; and conversely a reduction reaction results in a flow of electrons from the counter electrode to the working electrode. This flow of electrons constitutes an electric current, which is proportional to the gas concentration. The electronics in the instrument detect and amplify the current and scale the output according to the calibration. The instrument then displays the gas concentration in parts per million (ppm) for toxic gas sensors and percent by volume for oxygen sensors.



Reactive Gas Sensor Guidelines Cl_2 , NO_2 , HCl , NH_3 , SO_2 , ClO_2 , HCN , PH_3

Calibration Requires

Flow gas @ 0.5 LPM

For gas sampling and instrument calibration of reactive gases (gases for which there is a dedicated ISC sensor), use urethane tubing.

For the following exotic gases: Cl_2 , ClO_2 , HCl , and VOCs, use Teflon-lined Sample Tubing.

Manual Calibration

1. Use a constant flow regulator rated at 0.5 lpm
2. Use a demand flow regulator for instruments with a pump
3. When using a multi-gas instrument with both Cl_2 and H_2S sensors, calibrate the Cl_2 sensor first to eliminate the negative cross interference of H_2S

Docking Station Calibration

The Docking Station is programmed to select the proper sequence for calibration of reactive gases.

NOTE: Do not attempt to disassemble a sensor; if the sensor is cracked, dented, or otherwise visibly damaged, the sensor must be packaged and returned to Industrial Scientific or disposed of according to official regulations. For additional information, please contact your local Industrial Scientific representative. Global contact information can be found at www.indsci.com/offices.

Electrochemical Sensor Cross Interference Table

SENSOR

GAS

	Carbon Monoxide	Carbon Monoxide/Hydrogen Low	Hydrogen Sulfide (Ventis)	Hydrogen Sulfide (Tango, MX6)	Sulfur Dioxide	Nitrogen Dioxide	Chlorine	Chlorine Dioxide	Hydrogen Cyanide	Hydrogen Chloride	Phosphine	Nitric Oxide	Hydrogen	Ammonia
Carbon Monoxide	100	100	1	1	1	0	0	0	0	0	0	0	20	0
Hydrogen Sulfide	5	5	100	100	1	-40	-3	-25	10	300	25	10	20	25
Sulfur Dioxide	0	5	5	5	100	0	0	-5	10	40	-1	0	0	-40
Nitrogen Dioxide	-5	5	-25	-25	-165	100	45	50	-70	—	-11	30	0	-10
Chlorine	-10	0	-20	-20	-25	10	100	60	-20	6	-20	0	0	-50
Chlorine Dioxide	—	—	—	—	—	—	20	100	—	—	—	—	—	—
Hydrogen Cyanide	15	5	-1	-5	50	1	0	0	100	35	4	0	30	5
Hydrogen Chloride	3	—	0	0	5	0	2	0	0	100	0	15	0	0
Phosphine	80	415	60	55	20	-130	-225	-100	425	300	100	10	-30	15
Nitric Oxide	25	40	1	-0.2	1	5	10	—	-5	—	-1	100	30	0
Hydrogen	22	3	0.3	0.08	0.5	0	0	0	0	0	0	0	100	0
Ammonia	0	0	0	0	0	0	0	0	0	0	0	0	0	100
Acetylene	202	177	0	0	138	0	—	—	—	8	—	—	—	—
Ethylene	77* (100)	55*	0	0	—	—	—	—	—	—	—	—	—	—
Ethanol	0* (50)	0* (65)	0	0	—	—	—	—	—	—	—	—	—	—
Methyl Mercaptan	—	—	—	77	—	—	—	—	—	—	—	—	—	—
Ethyl Mercaptan	—	—	—	34	—	—	—	—	—	—	—	—	—	—

*new sensor () aged sensor or saturated filter — No data available

Table is current as of July 24, 2019

NOTES: The table above reflects the percentage response provided by the sensor listed across the top of the chart when exposed to a known concentration of the target gas listed in the left hand column.

The specified cross interference numbers apply to new sensors only and may vary with time. They also vary from sensor to sensor.

The numbers are measured under environment of 20 °C, 50% RH and 1 atm.

This table is given as a guide only and is subject to change.



Biased and Non-Biased Sensor Operation

Bias sensor operation requires the sensing electrode potential to be higher than the reference electrode potential to operate correctly. Sensors that require a bias voltage are Hydrogen Chloride and Nitric Oxide sensors. If sensors are stored out of the instrument, a bias board must be used.

Bias Sensor Board



Hydrogen Chloride and Nitric Oxide sensor: MX6 iBrid, & GasBadge Pro Bias Board: Nitric Oxide or Hydrogen Chloride 350 mv.

Oxygen Sensor



If installing a new Oxygen sensor the shorting clip must be removed. If storing an Oxygen sensor (out of instrument) a shorting clip must be used. For Ventis MX4.

4-Series Sensor



4 Series sensors used in MX6 iBrid, & Ventis Pro5.

6-Series Sensor



No shorting pins are required on 6 Series sensors used in the Ventis MX4, Ventis Pro5 & Tango TX1.

SafeCore Sensor



SafeCore sensors have a boot on them to keep them secure and stable when installed in the SafeCore module. Do not remove the boot from the sensor.

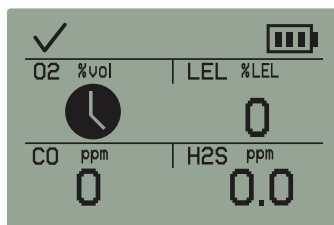
Long-Life Oxygen Sensor

The Ventis Pro5 long-life Oxygen sensor (part number 17155304-Y) is designed to perform in the field for three to five years.

Biased Oxygen sensor readings will become unstable if:

1. The battery has been removed from the instrument
2. The instrument powered off after the critical-battery warning

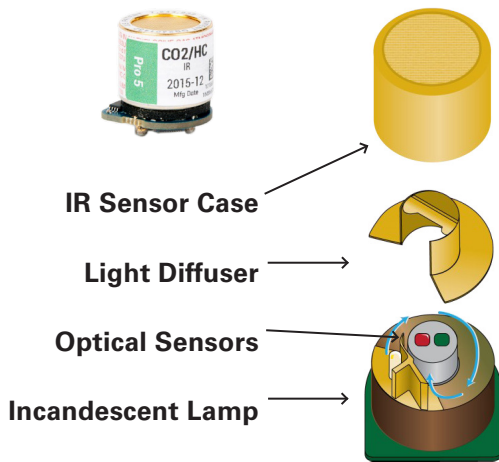
The clock icon will remain onscreen for 10 minutes or until the O₂ readings fall below 21.5% vol.



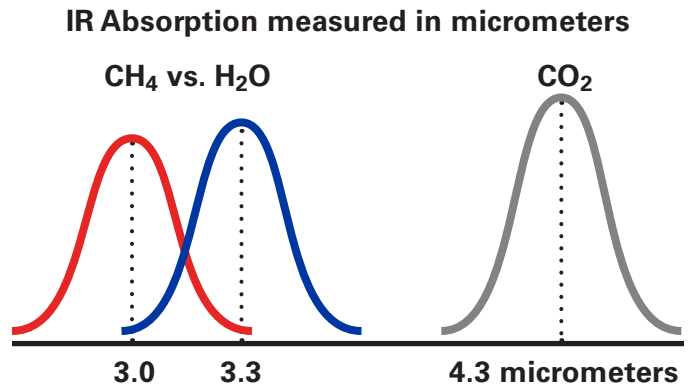
UNPOWERED TIME	CHARGING TIME TO STABILIZE
15 minutes	15 minutes
1 hour	25 minutes
10 hours	75 minutes
1 day	2 hours
1 week	3 hours

NOTE: Do not attempt to disassemble a sensor; if the sensor is cracked, dented, or otherwise visibly damaged, the sensor must be packaged and returned to Industrial Scientific or disposed of according to official regulations. For additional information, please contact your local Industrial Scientific representative. Global contact information can be found at www.indsci.com/offices.

Infrared Sensor (NDIR)



- Based on the principle that all gases absorb light energy at a specific wavelength
- Gas concentration is proportional to amount of light energy absorbed
- Utilizes optical sensor to measure IR absorption at specific wavelength



Advantages of Infrared Sensor

- Can detect gas in inert environment (0% Oxygen)
- Not susceptible to poisons, ie. silicones and lead
- Fast response time limited by time for gas sample to reach sensor

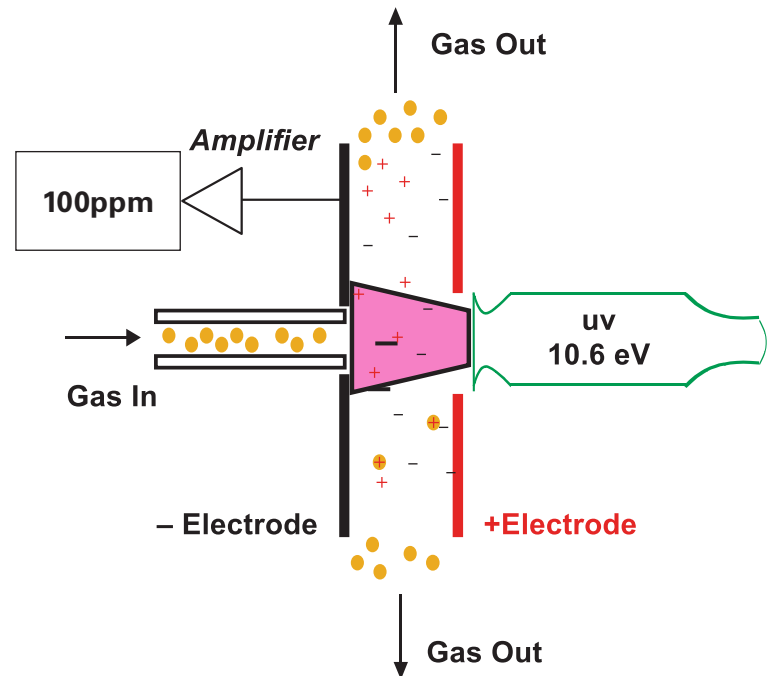
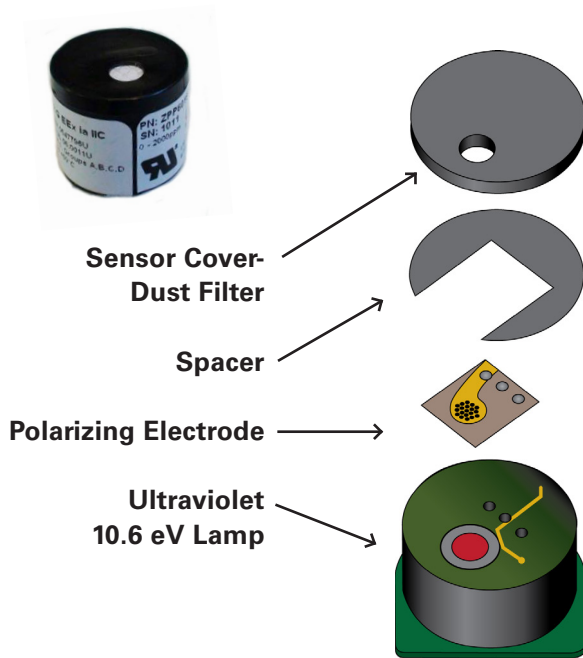
Disadvantages of Infrared Sensor

- Not recommended to detect O₂, N₂, H₂, Cl₂, etc.
- Some interference from water vapor (H₂O)

Hydrocarbon Infrared Sensor LEL Correlation Chart

TARGET GAS	CORRELATION FACTOR TO PROPANE
Butane	0.97
Pentane	0.89
Hexane	0.8
Ethanol	1.65
Ethylene	3.43
Propylene	1.69
Ethane	1.01
Cyclopentane	1.62
Methane	3
Chloromethane	0.966
Ethylene Oxide	0.845
Methanol	2.22
Toluene	1.18
Isopropanol	1.43
Acetone	3.28
Xylene	1.51
Ethyl Acetate	1.69
Dichloroethane	8.57

Photoionization Detector



Advantages

- Detects a broad range of gases over a large concentration range
- Has very low ppm resolution
- Not affected by poisons or damaged by gas in high concentrations

Disadvantages

- Not specific to any gas
- Not recommended to detect some gases eg. CO, H₂S, SO₂, etc...
- Can be affected by relative humidity
- Typically more expensive than electrochemical or catalytic-based detectors

NOTE: Do not attempt to disassemble a sensor; if the sensor is cracked, dented, or otherwise visibly damaged, the sensor must be packaged and returned to Industrial Scientific or disposed of according to official regulations. For additional information, please contact your local Industrial Scientific representative. Global contact information can be found at www.indsci.com/offices.

Photoionization Detector

Lamp Construction and Specifications

LAMP ENERGY	GAS FILL	WINDOW MATERIAL	EXPECTED LIFE(HRS) OF OPERATION
10.6 eV	Krypton	Magnesium Fluoride (MgF ₂) Hydrophilic window material, degraded transmittance with continued exposure to moisture	Typical: 6,000

Ionization Potential (IP) less than the photon energy of the UV lamp will be ionized. IP can be found in NIOSH pocket guide.

CHEMICAL NAME	IP (eV)	DETECTED WITH A 10.6 eV LAMP
m-Xylene	8.56	Yes
Ethylbenzene	8.77	Yes
Toluene	8.82	Yes
Benzene	9.25	Yes
Ammonia	10.20	Yes
Methylene Chloride	11.32	No
Water	12.60	No
Oxygen	13.62	No
Carbon Monoxide	14.01	No

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Calibration Policy

Gas detection instruments are potential lifesaving devices. Recognizing this fact, Industrial Scientific Corporation recommends that a functional “bump” test be performed on every instrument prior to each day’s use. A bump test is defined as a brief exposure to a known concentration of gas(es) to the monitor for the purpose of verifying sensor and alarm operation. This test is not a measure of the instruments accuracy.

Industrial Scientific further recommends that a full instrument calibration be performed using a certified concentration of calibration gas(es) monthly to ensure maximum accuracy.

If an instrument fails to operate properly following any bump test, a full instrument calibration should be performed prior to use.

DualSense Technology

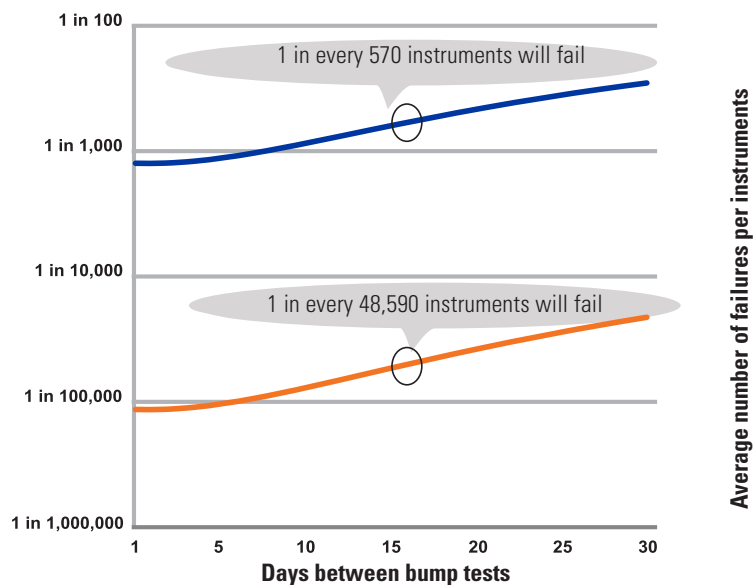
Industrial Scientific’s instruments with DualSense® Technology are safer than traditional instruments without this technology. The frequency of bump testing for instruments with DualSense Technology is best determined by company policy or local agencies based upon regulatory, environmental, and other company specific factors. These conclusions and recommendations are based on field data, safe work procedures, industry best practices, and regulatory standards to ensure worker safety.

Manual Bump Test Procedure

No one can dispute the importance of having a properly calibrated instrument. Industrial Scientific Corporation recommends a full calibration at least monthly. To verify proper operation of the instrument between calibrations, a bump test or function check is recommended. This check is performed by applying a known concentration of gas to verify sensor performance and alarm operation. Following the steps below will aid you in performing your bump test.

1. Turn the instrument on and warm-up.
2. Apply test gas.
3. Allow sensors to respond to test gas.
4. Verify proper alarm function.
5. Remove gas and allow the monitor to clear.
6. If any of the sensors fail to respond:
 - a. Verify cylinder has not emptied.
 - b. Verify regulator is turned on (if applicable).
 - c. Verify tubing is in place and not clogged.
 - d. Verify sensor ports are not plugged.
 - e. Remove the instrument from service and perform a complete calibration to verify sensor operation. If unit will not calibrate, replace the defective sensor, calibrate, or return it to an authorized service center.

NOTE: MX6 iBrid, Ventis MX4, Ventis Pro5, Tango TX1 and GasBadge Pro have selectable automated bump test routines.



Calibration Gases

National Institute of Standards and Technology (NIST) traceable gravimetric blends are recommended for most critical applications (gas monitors). These mixtures are prepared by the most appropriate method by weighing the components into a cylinder using a high-load, high-sensitivity balance, calibrated with weights traceable to the NIST. Weighing accuracy generally exceeds

the accuracy of instrumentation analysis. However, these mixtures are always analyzed to ensure that the listed composition is actually being supplied. Industrial Scientific Corporation calibration gas is NIST traceable and carries an accuracy per the chart below.

MIXTURE TOLERANCE

Minor components are certified to the following analytical accuracy:

51-250 ppm	+/- 2%
21-50 ppm	+/- 5%
1-20 ppm	+/-10%

The example to the right is a label from a four gas cylinder of calibration gas. You should be able to locate and identify:

1. Part Number
2. Expiration Date
3. Gases and Concentrations
4. Lot Number



**INDUSTRIAL
SCIENTIFIC**

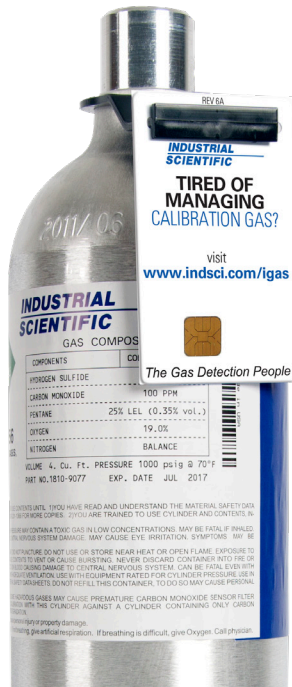
PART NO: 1810 2187

EXPIRATION DATE: Oct 2021 **SDS NO:** 3588
Volume 4. Cu. Ft. PRESSURE 1000 PSIG @ 70°F

GAS COMPOSITION

COMPONENTS	CONCENTRATION
HYDROGEN SULFIDE	25 PPM
CARBON MONOXIDE	100 PPM
PENTANE	25% LEL (0.35% vol)
OXYGEN	18.0%
NITROGEN	BALANCE

Lot: 1400120 Cyl: 9
25 PPM H2S/100 PPM CO/25% LEL/ 19% O2/N2



Calibration Gas Cylinder Expiration

GROUP	EXPIRES	GASTYPE
I	36 months	LEL (Pentane, Methane, H ₂ , etc)
		O ₂
		CO
		CO ₂
II	24 months	H ₂ S
	24 months	SO ₂
	18 months	NH ₃
	18 months	NO
	18 months	HCN
III	8 months	Cl ₂
	12 months	HCl
	6 months	NO ₂
	18 months	PH ₃
IV	12 months	4 Gas Bumper Cylinder
		CO Bumper Cylinder

NOTE: Group I as well as H₂S, NO₂ and SO₂ from Group II and Group III can be used in a combination cylinder. If using a combination cylinder, the expiration date will default to the gas that will expire first.

Criteria For Determination of Sensor Integrity

Sensors, whether for combustible gases, oxygen, or toxic gases, have a finite life. The factors which determine if a sensor should be replaced are realized during the calibration process.

Calibration is the process of challenging an instrument to respond by applying a metered calibration gas concentration to a specific sensor. A functional sensor should yield readings in proportion to the concentration of gas being applied. Variances between the known concentration of calibration gas and the steady state reading of the instrument will be adjusted through the instrument's microprocessor. Typical response time is approximately 2 minutes for most toxic sensors, although the more reactive toxic gas sensors may take longer.

1. Check the volume of the calibration cylinder to insure proper flow of gas for the entire calibration process.
2. Check the gas composition in the cylinder matches the sensors in the instrument.
3. Check the expiration date and ensure that the cylinder has not expired.
4. Check the water barriers and filters on the instrument. Replace filters as needed.

If the sensor fails calibration, replace the sensor then calibrate the instrument.

NOTE: For sensor replacement and calibration, follow the recommended procedures listed in the instrument's instruction manual.

Sensor Replacement Guidelines

The following factors affect sensor performance. These factors should be verified before a sensor can be determined acceptable. A failure in any category below shall be a reason to have the sensor replaced. For more accurate results, these checks should be done in a clean environment.

Visual Inspection

Check for contaminated screens and Goretex membranes, blocked inlet ports, loose or corroded connections, leaks, and cracks.

NOTE: Cracked toxic sensors are acceptable to use provided that they work electrically. Discolored combustible sensor screens are common and acceptable provided that they work electrically.

Cross Sensitivity

A sensor's reaction to an interfering gas. Exposing a sensor to a gas that is not the target of the sensor can reduce sensor longevity or inhibit sensor response.

Response

The sensor's ability to react to its particular design gas in the time specified, the instrument should be calibrated.

EXAMPLE: 90% of reading in 30 seconds

NOTE: Combustible sensors should be tested to a second type of gas; preferably methane and/or pentane.

Span Reserve

The amount of sensor life left assuming normal usage. Prior to testing the span reserve, the sensor should be properly zeroed and stable. When monitoring the display of an instrument, the following guidelines should be used when viewing a span reserve:

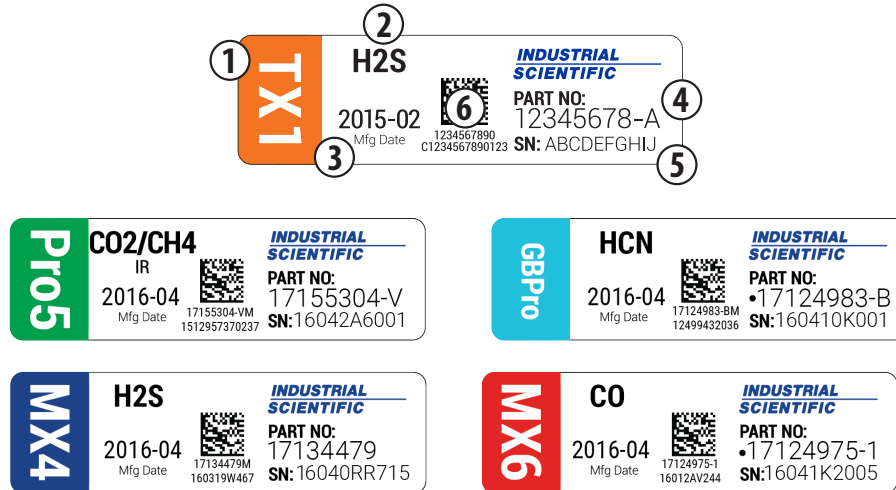
- **Good** Calibration is above 70% applied cal gas
- **Marginal** Calibration is between 69-50% applied cal gas
- **Failed** Calibration is below 50% applied cal gas

NOTE: These span reserve guidelines are for servicing purposes. The sensor should be replaced if guidelines are not met. These guidelines can be used by the user as a reference for "when to order" replacement sensors.

Sensor Replacement Guidelines

Sensor Age

The age of a sensor can be determined by decoding the sensor serial number (S/N) (bar code).



- | | |
|----------------------------------|-----------------------------------|
| 1. Color-coded instrument name | 4. Part number / reorder number |
| 2. Sensor gas type | 5. Serial number |
| 3. Date of manufacture (YYYY-MM) | 6. Industrial Scientific use only |

TYPICAL LIFE SPAN OF SENSORS

Combustible Sensors	all units	2-3 years normal usage
Toxic Sensors	all units	1-3 years normal usage (varies with type)
Oxygen Sensors	all units	2 years
Oxygen Long-Life Sensors	Ventis Pro5	3 years
Infrared Sensors	MX6 iBrid, Ventis Pro5	5 years
PID Sensors	MX6 iBrid	Approximately 6,000 hours

Four Steps of Operation to a Successful Gas Detection Program

Manual Operations

1. Turn on instrument and check battery level and type of installed sensors
2. Zero the instrument
3. Bump Test (functional test) instrument
4. Clear the Peaks

Bump Test

Gas Detection instruments are life saving devices. The only way to verify proper sensor and alarm operation is to perform a bump test. Bump testing is the process of briefly exposing the installed sensors to an expected concentration of calibration gas that is greater than the low alarm set point. Also referred to as a "functional test," the bump test checks for sensor and alarm functionality but does not measure sensor accuracy and no adjustments are made to the instrument during a bump test.

Zero

Zeroing sets each installed sensor to recognize the ambient air as clean air. If the ambient air is not truly clean air, any gasses that are present and relevant to the installed sensor type will be measured and displayed as zero. Readings will be inaccurate until the unit is correctly zeroed in truly fresh air or with a zero air cylinder.

Docking Station

1. Dock the instrument
2. Turn on instrument and check battery level and type of installed sensors
3. Zero the instrument
4. Clear the Peaks

Peak Readings

The instrument stores the highest detected gas reading, the "peak reading" or "peak." Bump testing and calibration will often register new peak readings. Therefore, the clearing of the peak reading should follow each calibration. The instrument operator may also wish to clear the peak reading after a bump test, before a change in location, or after an alarm is addressed and cleared.

Calibration

All sensors gradually degrade over time. Without regular calibrations, sensor readings during instrument use will not accurately display true gas concentrations. During the calibration process, the instrument self-adjusts so that the sensors retain their ability to correctly measure and accurately display gas concentration values. When a sensor has degraded beyond an acceptable level, it has reached its end of life and will no longer pass a calibration.

Technicians Four Steps for Proper Instrument Setup

1. Allow one hour of temperature stabilization.

Required when changing bias sensors, or before sensors are replaced if sensors and instruments were stored in different locations.

2. Check or change the alarm values.

Performed when sensor type is changed or when regulations change.

3. Check or change the span gas values.

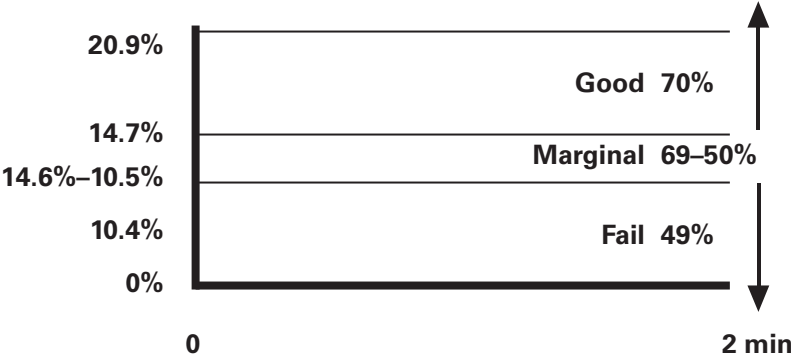
Performed when sensor type is changed or span gas value is different from original span gas.

4. Calibrate the instrument.

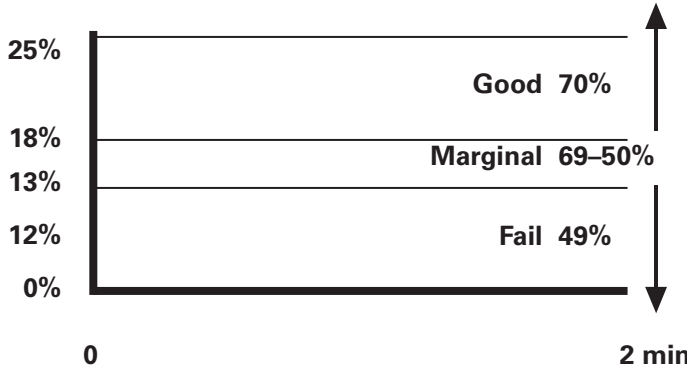
Always performed to ensure instrument accuracy.

Microprocessor Calibration Charts

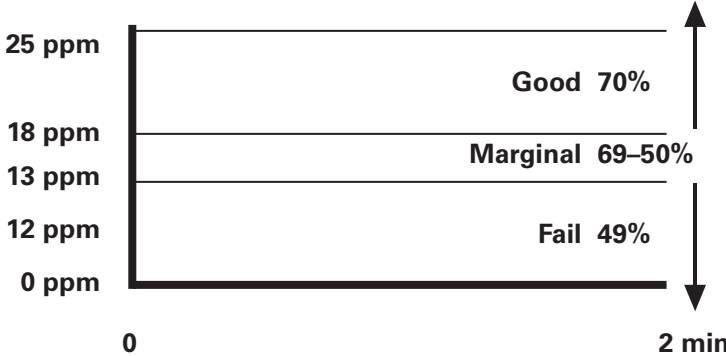
OXYGEN



PENTANE % LEL

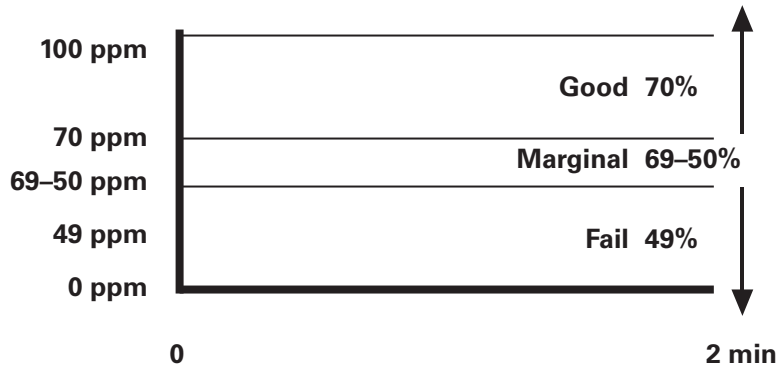


HYDROGEN SULFIDE

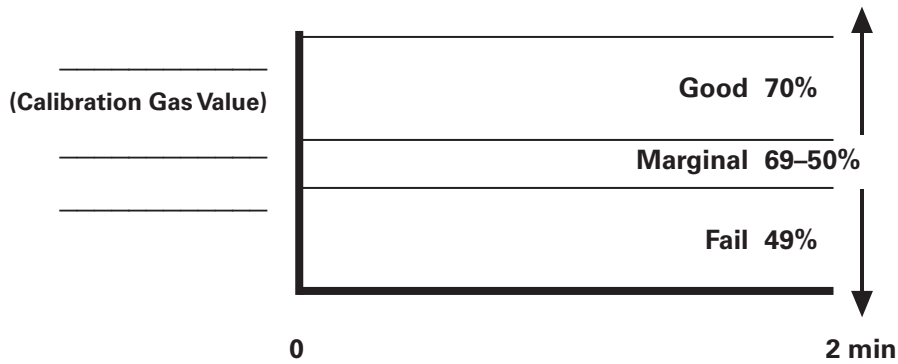


Microprocessor Calibration

CARBON MONOXIDE



MICROPROCESSOR CALIBRATION



Notes:

Industrial Alarm Settings

GAS	EXPOSURE LIMIT	TYPICAL INDUSTRIES
O ₂	19.5 vol Low, 23.5 vol High *should not be used without LEL for confined space evaluation	Natural gas utilities, liquid oxygen and nitrogen carriers, tank cleaning
LEL	10% LEL *should not be used without O ₂ for confined space evaluation	Natural gas utilities, refineries, pipelines, tank removal
CO	35 ppm (NIOSH REL) 50 ppm (OSHA PEL)	Fire service, steel mills, parking garages
CO	50 ppm (MSHA) 100 ppm (MSHA)	Mining
H ₂ S	10 ppm	Oil industry, water treatment, paper mills
Cl ₂	0.5 ppm	Water treatment, paper bleaching
NO ₂	3 ppm	Diesel emissions monitoring, underground mining, farms (silos)
NO ₂	3 ppm (MSHA) 5 ppm (MSHA)	Mining
SO ₂	2 ppm	Paper mills, coal fired generation stations
NH ₃	25 ppm	Refrigeration facilities, fertilizer plants, poultry farms, fire service
HCN	10 ppm	Chemical manufacturing, precious metal recovery, fire service
NO	25 ppm	Diesel emissions monitoring, underground mining
ClO ₂	0.1 ppm	Pulp and paper mills, waste water treatment plants, metal treatment
HCl	5 ppm	Vinyl and cotton products, semi-conductors, petro gas wells
CO ₂	5,000 ppm (0.5% vol) (OSHA PEL)	Landfills, mines, breweries
PH ₃	0.3 ppm	Pesticides and fumigation, chemical intermediate, clandestine drug labs

NOTE: Due to the diversity of chemical plants, any of the gases could be present depending on the process.

Notes:

Gas Hazards by Industry

HAZARDOUS GAS

INDUSTRY	HAZARDOUS GAS																
	Combustible Gases	O ₂ Deficient /Enrichment	Ammonia (NH ₃)	Carbon Dioxide (CO ₂)	Carbon Monoxide (CO)	Chlorine (Cl ₂)	Chlorine Dioxide (ClO ₂)	Hydrogen (H ₂)	Hydrogen Chloride (HCl)	Hydrogen Cyanide (HCN)	Hydrogen Sulfide (H ₂ S)	Nitric Oxide (NO)	Nitrogen Dioxide (NO ₂)	Benzene (C ₆ H ₆)	Phosphine (PH ₃)	Sulfur Dioxide (SO ₂)	Volatile Organic Compounds (VOCs)
Agriculture	•	•	•	•	•						•	•	•		•		
Aviation	•	•		•	•												
Chemical	•	•	•		•	•		•	•		•	•	•			•	
Construction	•	•			•						•	•	•				
Electric Utilities	•	•	•		•						•					•	
Fire Service	•	•	•	•						•	•						
Food Processing & Beverage Production	•	•	•	•	•				•	•	•				•		
Gas Utilities	•	•			•						•						
Hazmat	•	•	•		•	•		•	•	•	•				•	•	•
Iron & Steel Production	•	•			•					•	•	•	•			•	
Manufacturing	•				•				•								
Marine Shipyard	•	•		•	•						•						
Mining	•	•	•	•	•					•	•	•	•				
Oil & Gas Production	•	•	•		•						•			•			•
Petrochemical	•	•	•		•						•			•			
Paper & Pulp	•	•			•	•	•				•					•	
Pharmaceutical	•	•	•			•			•		•					•	
Power Plants	•	•			•			•			•					•	
Public Works	•	•			•						•	•	•			•	
Water/Waste Water Treatment	•	•	•		•	•					•					•	•
Welding	•	•			•				•			•	•				

Agriculture/Farming

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Manure Storage, Manure Pits	LEL, H ₂ S, O ₂	Manure transfer, pit/silo clean out, beef, dairy, hog (swine)	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1; All with Sampling Pump
Silo Storage, Silage	LEL, NO, NO ₂ , O ₂ , CO, CO ₂	Filling or emptying silos, silo fillers disease (see notes)	MX6 iBrid, Ventis MX4, GasBadge Pro, Tango, Ventis Pro5, Radius BZ1
Grain Transportation	PH ₃	Filling railcars PH ₃ is a fumigant	MX6 iBrid, GasBadge Pro, Radius BZ1
Greenhouse	CO ₂ , O ₂	Enhance growing process	MX6 iBrid, Ventis Pro5, Radius BZ1
Ripening	Ethylene, CO ₂ , O ₂	Climatic fruits and plants	MX6 iBrid, Ventis Pro5, Radius BZ1

APPLICATION NOTES

CONTACTS: Farmers, Business owners, Co-ops

NOTES: Silo Gases are commonly associated with "Silo fillers disease." Look for warning signs around the bottom of the silo; examples include dead flies, cats, rodents, birds, or sick farm animals.

Aviation

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Fuel Tank Entry	O ₂ , LEL, CO, VOCs	Confined space entry, fuel tank inspection, repair & cleaning	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1,
General Maintenance & General Safety	O ₂ , LEL, CO, H ₂ S	Confined space entry area monitoring	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1,
Hanger Monitoring	CO, LEL, O ₂	Area monitoring, fire suppression	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1,

APPLICATION NOTES

NOTES: All JP fuels can be monitored with combustible sensors, (kerosene based fuel). Jet A is equivalent to JP-8, JPs are typically military grade fuels and Jet A is commercial grade.

Chemical Plants

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Confined Space Entry	O ₂ , LEL, CO, H ₂ S, VOCs	Maintenance work, shut down & turnaround	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1
Hot Work	O ₂ , LEL, CO, H ₂ S, VOCs	Working on "live" pipes and tanks	MX6 iBrid, Ventis MX4, Ventis Pro5, GasBadge Pro, Tango, Radius BZ1
General Safety	All Gases detected by ISC instruments	Personal protection	MX6 iBrid, Ventis MX4, Ventis Pro5, GasBadge Pro, Tango, Radius BZ1

APPLICATION NOTES

NOTES: Generally all typical gas hazards exist in chemical plants. Knowing the final products will assist in hazard selection. If the plant is large enough, a WWTP may be on property, check WWTP in this manual.

Construction

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Confined Space Entry	O ₂ , LEL, CO, H ₂ S, NO ₂	Trenching, tank entry	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1
General Safety	O ₂ , LEL, CO, H ₂ S, NO ₂	Personal safety	All Portable Monitors, Radius BZ1

APPLICATION NOTES

NOTES: Performing any below-grade work requires monitoring for H₂S. If diesel powered equipment is used, CO, NO & NO₂ can be produced. In general safety, NO₂ and CO monitoring will cover the safety requirements of diesel emissions. All internal combustion engines produce CO.

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Electrical Utilities

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Coal Storage	CO, CH ₄ , spontaneous combustion	Coal loading, bin inspection	All Portable Monitors, Radius BZ1
Boiler Operations	O ₂ , LEL, SO ₂ , CO, NO ₂ , % vol. CH ₄	Confined spaces, boiler start-up, maintenance	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1; All with Sampling Pump
Power Generation	H ₂ , LEL, NH ₃	Hydrogen is used for cooling bearings on generators & turbines	Instruments w/ ppm HC; MX6 iBrid, Ventis Pro5, Radius BZ1, Fixed LEL Sensor
Nuclear Power	Freon, HF, NH ₃ , O ₂	Refueling, confined spaces	MX6 iBrid, GasBadge Pro, Tango, Radius BZ1
Transmission & Distribution (T & D)	O ₂ , LEL, CO, H ₂ S	Confined spaces	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1

APPLICATION NOTES

CONTACTS: Industrial Hygiene Dept., Safety

NOTES: T & D, confined spaces include transformer vaults and manholes.

The MX6 iBrid with a CO/H₂ low sensor with work for the hydrogen cross sensitivity.

Ethanol & Bio-Diesel

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Confined Space Entry	O ₂ , LEL CO, H ₂ S	Maintenance work, shut down & turnaround	MX6, Ventis MX4, Ventis Pro5, Radius BZ1
Silo Work	O ₂ , LEL, NO ₂ , SO ₂	Silo entry, maintenance	All Portable Monitors, Radius BZ1
General Safety	O ₂ , LEL, CO, H ₂ S, NO ₂	Personal safety	All Portable Monitors, Radius BZ1

APPLICATION NOTES

NOTES: Some general rules apply for this application that are similar to farming. Typically, all raw materials (corn and sugar beets) for the production of ethanol and bio-diesel come from farms.

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Fire Service

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Salvage & Clean-up, Overhaul	CO, HCN, O ₂	Front line firefighters, CO response team, HAZMAT	All Portable Monitors, Radius BZ1
Confined Space Rescue	O ₂ , LEL, CO, H ₂ S; any known toxic gases	Confined space rescue teams following guidelines in CFR 1910.146	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1; All with Sampling Pump
Carbon Monoxide Response Team	CO	First responders when home CO detectors are activated	All Portable Monitors, Radius BZ1
HAZMAT	All possible – O ₂ , combustibles, toxics, VOCs, etc., first responders on HAZMAT calls	(HAZMAT teams)	All Portable Monitors, Radius BZ1
Arson Investigation	LEL, toxic, O ₂	PPM hydrocarbon detection	MX6 iBrid, Radius BZ1
Clandestine Drug Labs	PH ₃ , NH ₃ , HCL, O ₂ , LEL, H ₂ S, CO	First responders on HAZMAT calls	All Portable Monitors, Radius BZ1

APPLICATION NOTES

CONTACTS: Chief, Asst. Chief, Training Officer, Building Inspectors, Fire Prevention Office, Local Safety Professional (may serve on local Volunteer Fire Department), “hi-tech” member of department.

NOTES: To field zero an instrument in an unknown atmosphere, use the facepiece from the SCBA for clean air. The two methods of methamphetamine production are “Red Phosphorus and Nazi”. Both methods use HCL to purify the methamphetamine. Nazi method uses NH₃. Red Phosphorus produces PH₃.

TOXICITY: The electrochemical NH₃ sensor has a range of 0 – 500 ppm, and the IDLH for ammonia is 300 ppm. When entering a facility with an ammonia leak where NH₃ is expected at levels of 700 ppm and higher, the electrochemical ammonia sensor is already exceeding the sensors limits; the responders are wearing hazmat gear to protect against toxicity, the concern at this point would be its explosive limit, which is far above the range of the NH₃ electrochemical sensor. Placing the NH₃ sensor into an environment with high ammonia levels (>500 ppm) for an extended period of time will destroy the sensor, even if it is turned off. The electrochemical component of the sensor will react with the ammonia even when the sensor is powered off, and the high levels will destroy it.

EXPLOSIVE LIMIT: The LEL of ammonia is 15% by volume, or 150,000 ppm. Detecting 1% LEL (1,500 ppm) NH₃ using the PID sensor places readings at sensor’s upper operating range. Maximum sampling is 2,000 ppm.

ALTERNATIVE: Use a catalytic bead LEL sensor to detect explosive levels. The correlation factor between CH₄ and NH₃ is 1:1 with a catalytic bead sensor, so if you calibrate to methane, the LEL sensor will allow you to detect danger of an ammonia explosion. Set the LEL sensor correlation factor to methane when the sensor is calibrated with pentane.

Food & Beverage Production

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Confined Space Entry	O ₂ , LEL, H ₂ S, CO ₂	Maintenance work, shut down & turnaround	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1
Cold Storage	NH ₃ , O ₂ , CO	Flash freezing, bulk storage	MX6 iBrid, Radius BZ1
Grain Delivery & Storage	PH ₃ , NO ₂ , LEL, H ₂ S, O ₂	Unloading grain from railcars and silos	MX6 iBrid, GasBadge Pro, Tango, Radius BZ1
General Safety	O ₂ , LEL, CO, H ₂ S, NO ₂	Personal safety	All Portable Monitors, Radius BZ1
Beer & Wine	SO ₂ , CO ₂ , O ₂ , CO, H ₂ S, LEL	Confined space, fermentation	MX6 iBrid, Ventis MX4, Ventis Pro5, GasBadge Pro, Tango, Radius BZ1

APPLICATION NOTES

NOTES: Refer to Agriculture/Farming Application, Silo Storage Process of this manual.

Gas Utilities

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Confined Space Entry	O ₂ , LEL, CO, H ₂ S	Maintenance work, shut down & turnaround	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1; All with Sampling Pump
Pipeline Construction	O ₂ , LEL, CO, H ₂ S	See trenching in construction section	All Portable Monitors, Radius BZ1
Meter Pits	O ₂ , LEL, CO, H ₂ S	Meter reading, maintenance	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1; Good option to use Sampling Pumps
General Safety	O ₂ , LEL, CO, H ₂ S	Personal safety	All Portable Monitors, Radius BZ1
Leak Detection	CH ₄ % vol., PPM, LEL	Fire department backup, emergency response, consumer complaint	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1

Marine & Shipping

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Shipping Fertilizer	LEL, O ₂ , CO, SO ₂ , H ₂ S	Unloading fertilizer, using a (tractor)	All Portable Monitors, Radius BZ1
Pontoon Inspection	LEL, O ₂ , H ₂ S	Confined spaces, maintenance inspections, repairs	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1; All with Sampling Pump
Engine Maintenance	LEL, O ₂ , CO, NO ₂ , NO, SO ₂	Inspection, repairs	All Portable Monitors, Radius BZ1
Sump and Bilge Inspection	LEL, O ₂ , H ₂ S	Maintenance, clean out, and repairs	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1

APPLICATION NOTES

CONTACTS: Ship Engineers, Ship owners, Vessel Skippers, Maintenance shops

NOTES: The application "Pontoon Inspection" above was brought about by a fatality in December 2000 where 2 men lost their lives while entering a pontoon moored on Kelso Reef near Townsville, QSL, Australia. Their deaths were caused by asphyxiation due to oxygen deficiency in the confined space. There are natural enzymes in sea water that will consume oil products. This process produces CO₂ and H₂S and reduces O₂.

Metal Production

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Production Coke Ovens	CO, H ₂ S, SO ₂ , NH ₃ , LEL, VOC	Oven inspection, operation & maintenance	All Portable Monitors, Radius BZ1
Blast Furnace	CO, LEL, O ₂ , SO ₂ , NO ₂	Operations & maintenance	All Portable Monitors, Radius BZ1
Soaking Pits	CO, O ₂	Inspection of pits, maintenance	All Portable Monitors, Radius BZ1
Shutdown, Turnaround, Maintenance	O ₂ , LEL, CO, H ₂ S	All confined space, operations & area monitoring	All Portable Monitors, Radius BZ1, Instrument Rental
Pickling & Plating	HCl, HCN, SO ₂ , O ₂ , LEL, H ₂ S, SO ₂	Scale removal for Steel, most Plating applications	All Portable Monitors, Radius BZ1
Aluminum Smelting	O ₂ , LEL, CO, NO ₂ , SO ₂	Personal safety, area monitoring	All Portable Monitors, Radius BZ1

APPLICATION NOTES

CONTACTS: Safety Dept., Engineering, Contractors, and Maintenance

NOTES: Typically, alarm set points for instruments used around blast furnaces may be set differently from OSHA regulations. This is due to the high concentrations of gas at these locations. Be aware of the electromagnetic interference (EMI) from the large current loads on the smelting equipment in aluminum mills. ISC instruments typically have no problems in this area. Tango TX1 is designed to resist EMI.

Mining (Metal/Non-Metal & Coal)

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Inspection Coal Pre-shift	CH ₄ , O ₂ , CO	Fireboss walk out, seal inspection	MX6 iBrid, Ventis MX4, Ventis Pro5
Exhaust & Emissions Testing	CO, NO ₂ , NO, O ₂ , CH ₄ (LEL)	MSHA and CSA emissions requirement	MX6 iBrid, Ventis MX4, Ventis Pro5
Coal Storage	CO, O ₂ , CH ₄	Silo monitoring	MX6 iBrid, Ventis MX4, Ventis Pro5
Ore Processing	HCN, HCl, SO ₂ , O ₂ , CH ₄ (LEL)	Leaching metals for ore refining	MX6 iBrid, Ventis MX4, Ventis Pro5, GasBadge Pro

APPLICATION NOTES

NOTES: Notes: Spontaneous combustion occurs in coal storage producing large quantities of CO.

Municipal Waste Water

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Collection Storm & Waste Water	O ₂ , LEL, H ₂ S, CO	Dry/wet wells, manholes, sumps, WWT plants	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1; All with Sampling Pump
Treatment	O ₂ , LEL, H ₂ S, SO ₂ , NH ₃	Gas treatment & gas storage areas	All Portable Monitors, Radius BZ1
Discharge	O ₂ , LEL, H ₂ S, CO, Cl ₂ , SO ₂ , CLO ₂	Dry/wet wells, manholes, sumps, WWT plants	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1

APPLICATION NOTES

CONTACTS: Managers, Safety Dept., Workers (on the street), Dept. of Public Works, Larger Cities - Purchasing Dept.

NOTES: Confined spaces include meter pits, vaults, underground tunnels, access ways, dry & wet wells.

Municipal Water (Fresh Water)

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Collection Storm & Waste Water	O ₂ , LEL, H ₂ S, CO	Any confined space application, dams, reservoirs, lakes, rivers	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1
Treatment	O ₂ , Cl ₂	Treatment & storage areas, injection stations	MX6 iBrid, Radius BZ1
Transmission & Distribution	O ₂ , LEL, H ₂ S, CO, Cl ₂	Meter pits, vaults, pipelines, trenches	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1; All with Sampling Pump

APPLICATION NOTES

CONTACTS: Managers, Safety Dept., Workers (on the street), Dept. of Public Works, Larger Cities - Purchasing Dept.

NOTES: Confined spaces include meter pits, vaults, underground tunnels, access ways, dry & wet wells

Oil & Gas Industry

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Exploration SIC 1382	CO, Chloromethane, Ethylene, Hydrochloric Acid, H ₂ S, Nitric Acid, SO ₂ , H ₂ SO ₄ , Cl ₂ , NH ₃	Shallow drilling, blasting, seismic activity	All Portable Monitors, Radius BZ1
Drilling SIC 1381	LEL, H ₂ S, O ₂ , SO ₂	Spudding, drilling, Re-drilling, directional drilling, flaring	All Portable Monitors, Radius BZ1
Production	LEL, H ₂ S, O ₂ , SO ₂ , CO ₂	Water/steam, CO ₂ Injection, well head & flow station maintenance	MX6 iBrid, Ventis MX4, Ventis Pro5 GasBadge Pro, Tango, Radius BZ1
Transportation, Storage & Distribution	LEL, H ₂ S, O ₂ , SO ₂ , CO ₂ , % vol. Gas	Pipelines, tanker truck, tank farms, inert gas blaketing, pipeline monitoring	MX6 iBrid, Ventis MX4, Ventis Pro5, GasBadge Pro, Tango, Radius BZ1
Refining	O ₂ , H ₂ S, CO, SO ₂ , NH ₃ , Cl ₂ , HF, H ₂ , LEL, Total Hydrocarbons	Crude to gasoline, oil separation, CAT cracking, fugitive emissions	All Portable Monitors, Radius BZ1
Contractor Services	All Previous	Maintenance, hot work, tank cleaning, turnaround, shutdown	All Portable Monitors, Radius BZ1

APPLICATION NOTES

CONTACTS: Safety Dept., Foremen & Supervisors, and Engineering

NOTES: Applications may use either personal monitoring or confined space monitoring. Any confined space application must use an instrument with a display. Most maintenance & turnaround applications will require confined space monitoring. Most refineries have on site fire departments. Refer to Fire Service section.

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Petrochemical Industry

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Acid Production	CO, Chloromethane, Ethylene, Hydrochloric Acid, H ₂ S, Nitric Acid, SO ₂ , H ₂ SO ₄ , Cl ₂ , NH ₃	Operations & maintenance, fuel leaks	All Portable Monitors, Radius BZ1
Hydrocarbon Production	Ethylene, Propylene, Benzene, Xylene, Toluene, Acetone, MEK, Methylene Chloride, Ethylene Oxide	Personal monitoring, confined space entry, fixed point, hot work, shut down, datalogging	MX6 iBrid, Radius BZ1
Specialty Chemical Production	Cl ₂ , NH ₃ , Bromine, Phosphine, ClO ₂	Personal monitoring, confined space entry, fixed point, hot work, shut down, datalogging	MX6 iBrid, GasBadge Pro, Radius BZ1
Shutdown & Turnaround	Cl ₂ , NH ₃ , Bromine, Phosphine, ClO ₂	Personal monitoring, confined space entry, fixed point, hot work, shut down, datalogging	All Portable Monitors, Radius BZ1, Instrument Rentals
Emissions Testing	VOCs	Valve and flange check points	MX6 iBrid, Radius BZ1

APPLICATION NOTES

CONTACTS: (Portables) - Instrument Shop, Safety Dept., Industrial Hygiene Dept., Purchasing, and Maintenance Fixed Systems - Engineering, Safety Dept., Instrument & Electrical Shops

NOTES: Refer to Fire Service Application Notes for additional information.

Pharmaceuticals

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
General Safety	O ₂ , LEL, NH ₃ , SO ₂ , Cl ₂ , HCl	Personal safety	All Portable Monitors, Radius BZ1
Confined Spaces	O ₂ , LEL, NH ₃ , SO ₂ , Cl ₂ , HCl	Storage, silo work, vat cleaning	MX6 iBrid, Radius BZ1; All with Sampling Pump

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Pulp & Paper

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Chlorine Production, Storage & Bleaching	Cl ₂ , ClO ₂ , SO ₂	Operations & maintenance	MX6 iBrid, GasBadge Pro, Tango, Radius BZ1
Chipping	Combustibles, O ₂ , CO, H ₂ S	Chippers & chip conveyors	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1 (typical usage - Confined Space & Maintenance)
Digesters Paper Process	H ₂ S, O ₂ , SO ₂ , CO, LEL	Operations & maintenance	All Portable Monitors, Radius BZ1
Liquor Recovery & Production	Acids, H ₂ S, SO ₂ , LEL (turpentine), O ₂ , CO (recovery boilers)	Operations & maintenance	All Portable Monitors, Radius BZ1
Pulp Machines & Presses	Residual Toxics, H ₂ S, Cl ₂	Operations & maintenance	All Portable Monitors, Radius BZ1
Finishing	CO, H ₂ S, LEL, O ₂ , Cl ₂ , ClO ₂	Operations & maintenance	All Portable Monitors, Radius BZ1
Power Plants	CO, SO ₂ , H ₂ S, O ₂ , LEL/CH ₄ , NH ₃	Confined space entry, fuel leaks, maintenance	All Portable Monitors, Radius BZ1
WWTP & Fire Departments	See application notes below	See application notes below	All Portable Monitors, Radius BZ1

APPLICATION NOTES

CONTACTS: Lab Managers, I & E, Safety, Area Foremen or - I & E, Engineering

NOTES: CH₄ should be a consideration on all boiler applications. Waste water treatment, fire service, and power generating applications can be located within a pulp and paper facility. Refer to these applications before you visit.

Telecommunications

PROCESS	HAZARDS	APPLICATIONS	ISC PRODUCT
Controlled Environments	CO, H ₂ S, O ₂ , H ₂ from Batteries	Battery charging, personal safety, property protection, energy management	MX6 iBrid, Radius BZ1 CO w/H ₂ low
Confined Space Entry	O ₂ , CO, H ₂ S, LEL	Personal safety	MX6 iBrid, Ventis MX4, Ventis Pro5, Radius BZ1; All with Sampling Pump
Switching Station, Vaults	H ₂	Battery charging, personal safety, property protection	MX6 iBrid, Radius BZ1 CO w/H ₂ low
Fleet Garages	CO, LEL, NOx	Personal safety, property protection	All Portable Monitors, Radius BZ1

APPLICATION NOTES

CONTACTS: Safety Dept., Fleet Manager, Network Manager, Personal Safety, Purchasing, Construction, Maintenance, Unions

NOTES: Confined spaces include vaults, tunnels, manholes, trenches, etc. NOx refers to all Oxides of Nitrogen

What Is Intrinsic Safety?

Intrinsic safety is a design technique applied to electrical equipment and wiring for hazardous locations. The technique is based on limiting energy, electrical, and thermal, to a level below that required to ignite a specific hazardous atmospheric mixture.

How Is Intrinsic Safety Defined?

Intrinsically safe equipment and wiring shall not be capable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a flammable or combustible atmospheric mixture in its most easily ignitable concentration.

National Electrical Code Article 504-2 Definition of an Intrinsically Safe Circuit © 1996

A circuit in which any spark or thermal effect is incapable of causing ignition of a flammable or combustible material in air under prescribed test conditions.

Multiple Instrument Approvals: Is There A Difference?

Anyone familiar with the latest Industrial Scientific Corporation instruments can easily note the multiple certification agency labels placed on enclosures.

The Same Intrinsic Safety Principles Are Applied

When making a comparison keep in mind the principles of intrinsic safety are the same for all approval agencies.

Multiple Approvals

Industrial Scientific Corporation instruments carry multiple approvals because they meet the standards set by those agencies. The certification of an independent party increases the level of confidence for our customers. For users who do not have a need for specific approval requirements, the certification is an unbiased statement that Industrial Scientific instruments meets given safety standards.

The approval labels reflect the general conditions for the approval, the approving agency, the approved instrument and some precautions for the operator. Since the same principles are applied, similar conditions for the instrument approval are going to be listed from agency to agency.

Although the wording may not be identical and some of it might be in a different language, the general format for all intrinsic safety markings is almost the same. Markings is the term that the agencies use. As one looks at a label, he/she can identify the following:

Manufacturers' Name and/or Instrument Model Number

On the approval labels you will see Industrial Scientific Corporation label and model designation.

Serialized Date of Manufacture

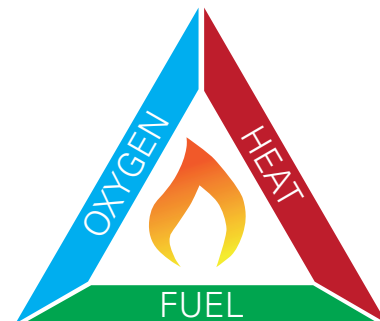
On the instrument is a serial number which is date coded.

Hazardous Location Class and Group

As defined in the National Electric Code, Article 500 (USA) and the Canadian Electric Code, Section 18 (Canada), the hazardous location to which the intrinsic safety certification applies is stated. Our labels will say "INTRINSICALLY SAFE FOR USE IN CLASS I, DIVISION 1, GROUPS A,B,C & D LOCATIONS..." MSHA which certifies our instruments for underground locations where methane is the hazard. Our instruments are certified to an equivalent Group D level only. For European approvals, typically the markings will be "EE x ia IIC" with the Epsilon-x hexagon mark.

Approved Batteries

Since many of our instruments are portable, acceptable battery cells or batteries must be approved for intrinsic safety. After the hazardous location class and group the sentence will continue "...WHEN USED WITH <BRAND NAME OR ISC P/N> BATTERIES." An alternative to stating specific batteries is to reference a list in the User's Manual.



Temperature Code

Industrial Scientific instruments are rated at 160° C which is designated by 'T3C', or 'T4' (135° C)

Intrinsic Safety Symbol

The internationally recognized symbol for intrinsic safety is "Ex i" or "Ex ia"

Combustible Performance Standard

CSA certification requires combustible instrument performance to standard C22.2 No.152. CSA certified combustible monitors carry the "C22.2 No.152" designation.

Warnings and Cautionary Statements

Industrial Scientific has the responsibility for building and servicing intrinsically safe equipment. The operator has the responsibility to take precautions in properly using the instrument.

The certification process considers the design and the normal use of an instrument so the warnings and cautionary statements are the precautions which need to be exercised. If label differences exist it is usually in this area, but on the other hand, sometimes a warning statement can appear once to satisfy the same requirement for more than one agency.

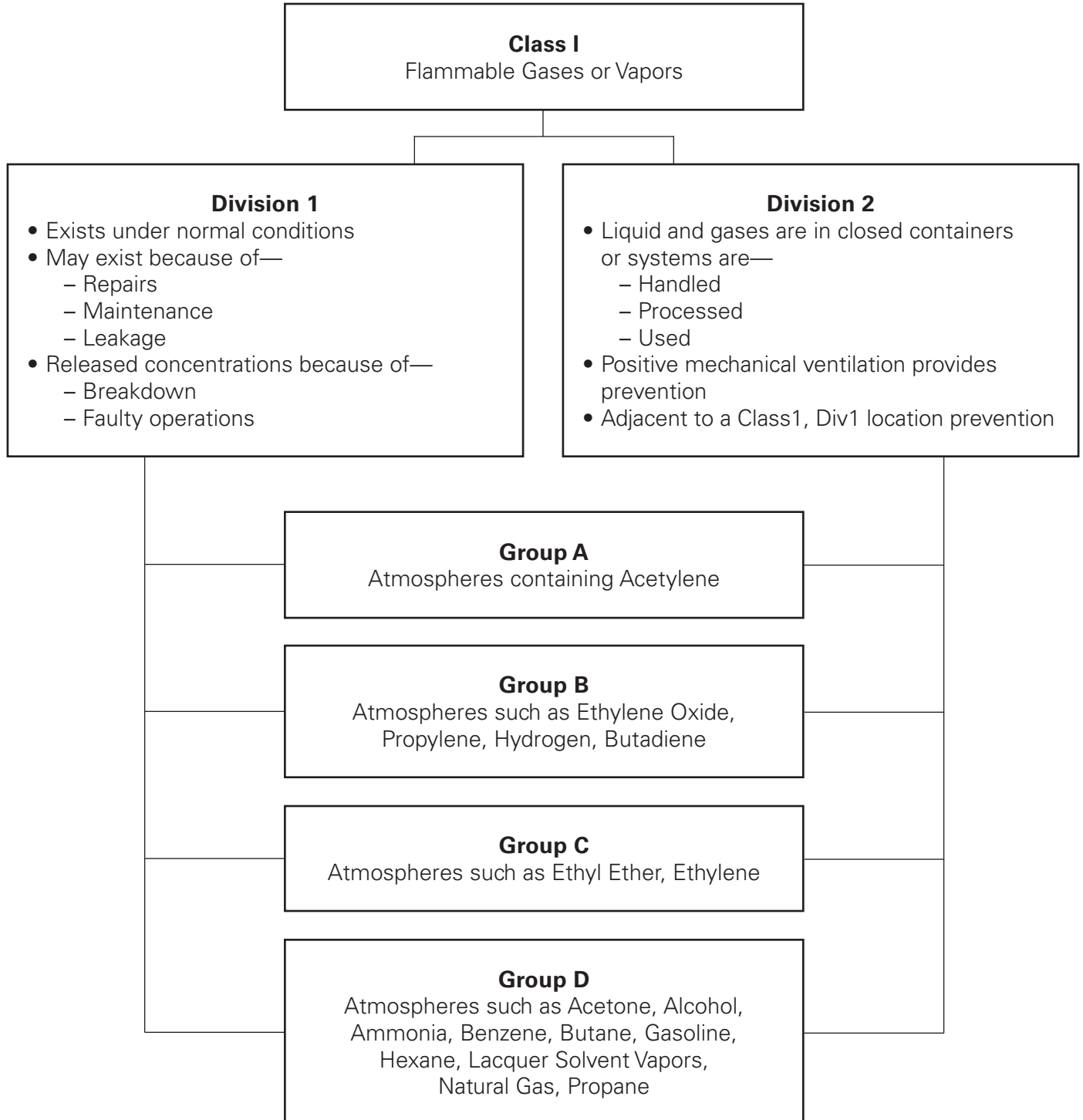
AGENCY	INST. TYPE	INTRINSIC SAFETY	PERFORMANCE
Mine Safety and Health Admin.	Toxic	Yes	No
	Methanometer	Yes	Yes
Underwriters Laboratories Inc.	Toxic	Yes	No
	Combustible	Yes	No
Canadian Standards Association	Toxic	Yes	No
	Combustible	Yes	Yes
Factory Mutual Research Corp.	Toxic	Yes	Yes
	Combustible	Yes	Yes
ATEX (Europe)	Toxic	Yes	Yes/No
	Combustible	Yes	Yes/No

Ingress Protection IP Codes

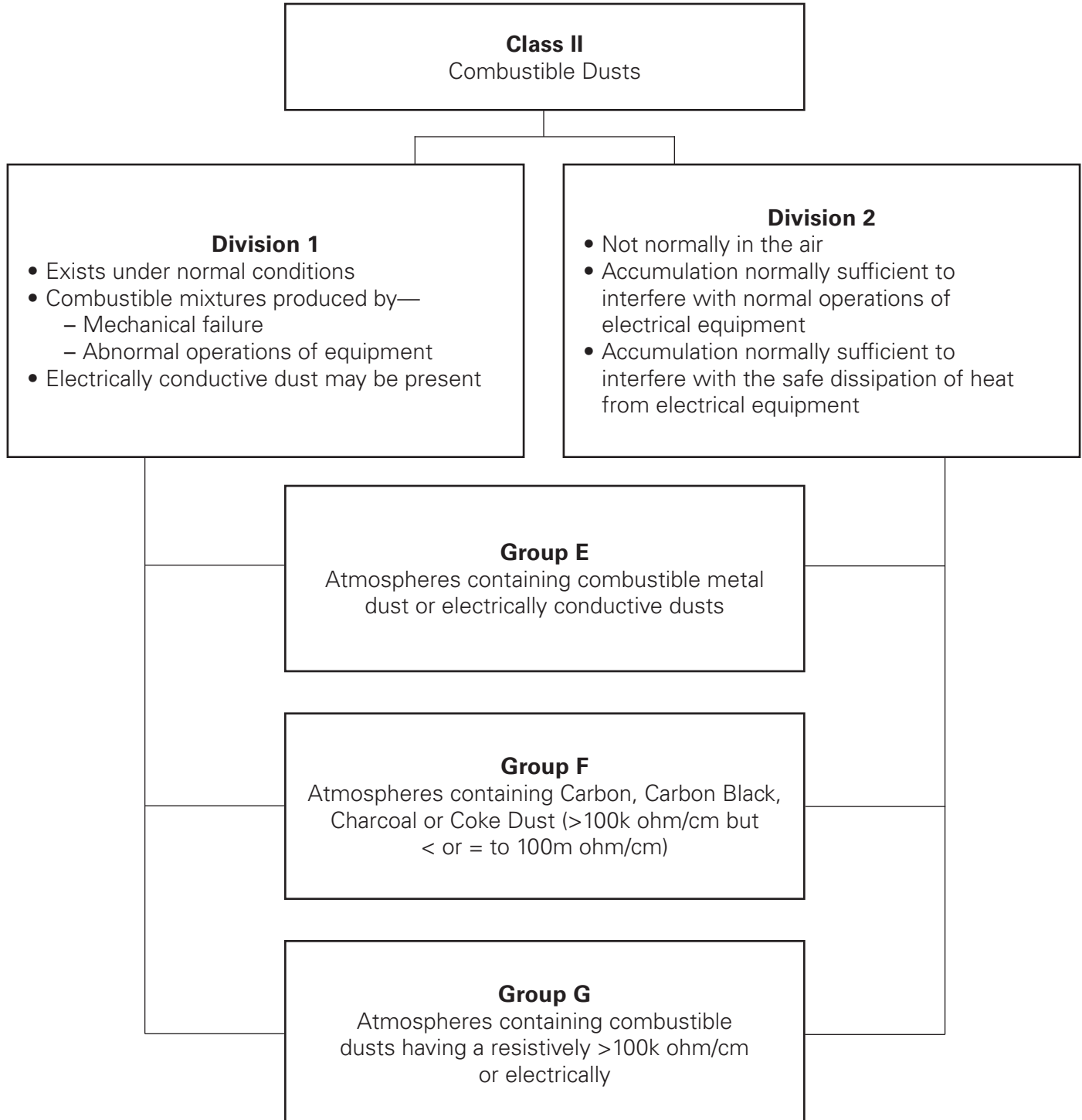
IEC/EN 60529

FIRST NUMERAL Protection against solid bodies	SECOND NUMERAL Protection against liquids
No protection 0	0 No protection
Objects > 50 mm 1	1 Vertically dripping water
Objects > 12 mm 2	2 Angled dripping water -75° to 90°
Objects > 2.5 mm 3	3 Sprayed water
Objects > 1.0 mm 4	4 Splashed water
Dust-protected 5	5 Water jets
Dust-tight 6	6 Heavy seas
	7 Effects of immersion
	8 Indefinite immersion

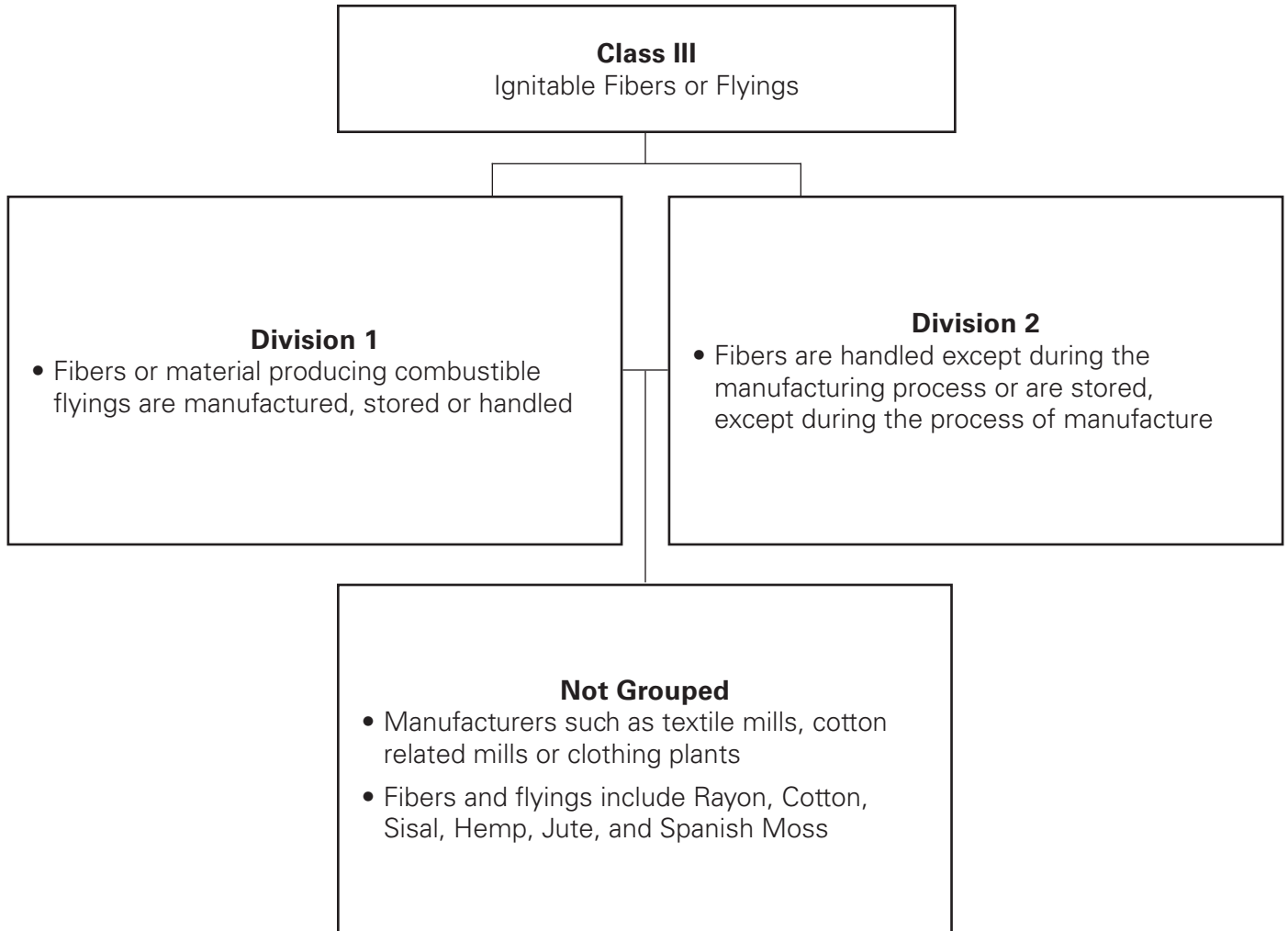
Example: Equipment is dust-tight and submersible to 1.5 m in water. Ventis Pro5 instruments are rated IP68.



For Reference Only! For complete information refer to Hazardous (Classified) Locations in Accordance with Article 500, National Electrical Code – NFPA 70



For Reference Only! For complete information refer to Hazardous (Classified) Locations in Accordance with Article 500, National Electrical Code – NFPA 70



Allocation of gas hazardous areas and typical ignition protection types	Class 1, Division 1 Explosion proof (comparable with Ex d, but more stringent requirement) Intrinsic Safety (Ex ia)		Class 1, Division 2 Non-incendive All Division 1 ignition protection types
	Zone 2 Ex ia "Intrinsic Safety"	Zone 1 Ex d "flameproof enclosure" Ex ib "intrinsic safety" All Zone 0 ignition protection types	Zone 2 Ex nA "non-sparking" All Zone 0 and Zone 1 ignition protection types
Description of hazardous areas	Explosive atmosphere is present continuously or very frequently and over a long time	In normal operations, explosive atmosphere is present occasionally	In normal operations, explosive atmosphere is normally not present or only for short times

For Reference Only! For complete information refer to Hazardous (Classified) Locations in Accordance with Article 500, National Electrical Code – NFPA 70

Gas Detection Related Agencies



OSHA

The Occupational Safety and Health Administration - A U.S. governmental agency organized under the Department of Labor. They assure safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance.



CCOHS

Canadian Centre for Occupational Health and Safety—Canadian federal department mandated to promote workplace health and safety, and encourage attitudes and methods that will lead to improved worker physical and mental health, through a wide range of products and services.



NIOSH

The National Institute for Occupational Safety and Health - NIOSH is part of the U.S. Centers for Disease Control and Prevention, in the U.S. Department of Health and Human Services. It has the mandate of helping to assure "every man and woman in the Nation safe and healthful working conditions and to preserve our human resources."



NIST

National Institute of Standards and Technologies - established by Congress to assist industry in the development of technology, to improve product quality, to modernize manufacturing processes, to ensure product reliability, and to facilitate rapid commercialization of products based on new scientific discoveries.



MSHA

The Mine Safety and Health Administration - A U. S. governmental agency organized under the Department of Labor. This group defines occupational safety and health laws for the underground mining and tunneling in the United States. They have the power to issue citations and levy fines. MSHA also approves equipment for underground use and also approves respirators.

Important Web Addresses



Underwriters Laboratories
www.ul.com



American Society of Safety Engineers
www.asse.org



Canadian Standards Association
www.csa.ca/cm/ca/en/home



Environmental Protection Agency
www.epa.gov/

Bill C-45 - An Act to Amend the Criminal Code



Bill C-45 – An Act to Amend the Criminal Code (Criminal Liability of Organizations – SI/2004-22) Came into Effect March 31, 2004

On June 12, 2003, the Honorable Martin Cauchon, Minister of Justice and Attorney General of Canada, introduced Bill C-45, an Act to amend the Criminal Code that imposes criminal liability on corporations and organizations, that fail to take reasonable measures to protect employee and public safety. The Bill received Royal Assent on November 7, 2003 and on February 25, 2004, the Library of Parliament announced that the Act will come into effect on March 31, 2004. Read the status of the Bill on the Parliament of

Canada web page.

<http://www.ccohs.ca/oshanswers/legisl/billc45.html>

Legislative Summary: BILL C-45: *An Act To Amend The Criminal Code (Criminal Liability Of Organizations)* Prepared by: David Goetz, Law and Government Division (July 3, 2003).

Canadian Standard for Functional Bump Testing

C22.2 No. 152-M1984(R2006) – Combustible Gas Detection Instruments applies to portable monitors intended to detect the presence of combustible gases. Within the standard, clause 5.3.1 states the manufacturer must convey in the owner's manual in both English and French:

“Caution: Before each day's usage sensitivity must be tested on a known concentration of _____ (specify gas) equivalent to 25-50% of the full scale concentration. Accuracy must be within 0 to - /+20% of actual accuracy and may be corrected by _____ (specify adjustment procedure).”

A

Alarm:

An audible sound, visual signal, or vibration that signals and alerts of dangerous levels of combustible gases, toxic gases, or oxygen deficient atmospheres.

Ambient Temperature:

Temperature existing in immediate surroundings.

Approval Agencies:

Agencies which have developed a set of electrical standards generally accepted in their country or field of activity as mandatory. Such agencies includes in the USA - Factory Mutual and Underwriters Laboratories, in Canada - Canadian Standards Association. Standards for various industries are also set by the specific approval agencies; ie. Coast Guard for instruments used at sea.

Aromatic Hydrocarbons:

A group of hydrocarbon compounds of the closed-ring formation and are derived from benzene. The most common ones are toluene and xylene.

Aspirate:

To draw in, as gas, by suction.

B

Background:

Constituents in the sample or space to be tested other than the specific gas being monitored.

Barhole:

An opening made from ground level to a pipeline for the purpose of allowing entry of a probe and hose to check gas leaks.

Bump Test (Functional Test):

Application of gas to an instrument to verify functionality. It is used to verify sensor and alarm response.

C

CCM:

Cubic centimeters per minute.

CFM:

Cubic feet per minute.

Calibrate:

A method of adjusting a measurement device to correct for inherent inaccuracies. A known gas concentration is used as a calibration standard to verify and adjust the output of the unit.

Calibration Curve:

A graph depicting the relationship between a meter scale reading and a concentration of gas. The abscissa (horizontal axis) usually depicts gas concentration and the ordinate (vertical axis) meter reading. Calibration curves are used to interpret readings of certain gases which do not normally correspond to the initial calibration of the instrument.

Catalyst:

A substance which accelerates or retards a chemical change but itself remains stable. In gas analysis the most often used catalyst is platinum. The platinum is used in wire form in the detection element (filament). When a mixture of air and combustible gas or vapor is brought in contact with a hot platinum wire (catalyst) rapid combination of the combustible with the oxygen of the air takes place at the surface of the wire (catalytic reaction) raising the temperature of the wire and increasing its electrical resistance.

Chassis:

The framework of an electronic instrument.

Circuit:

An electrical network in which there is at least one conducting path which can be closed.

Circuit Board:

A substrate upon which electronic components are configured so that electrical signals may be passed from one component to the next. Usually, the substrate is comprised of a Fiberglass Board, onto which conducting traces are deposited. The traces form a pathway between electronic components.

Class I Locations:

Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. A National Electrical Code classification.

Class II Locations:

Class II locations are hazardous because of the presence of combustible dust. A National Electrical Code classification.

Class III Locations:

Class III locations are hazardous because of the presence of easily ignitable fibers or flyings. A National Electrical Code classification.

Combustion:

The process of combination of a substance with oxygen, usually with liberation of heat.

Concentration:

The amount of a gas per unit volume, usually expressed in %, % LEL, or ppm.

Combustible Gas:

A gas which has a low enough flash point and a wide enough explosive range to make it potentially ignitable.

Condensation:

The reduction of vapor or gas to a liquid normally by cooling or a change in pressure.

Confined Space:

Any space: 1) that has limited or restricted means of entry or exit; 2) is large enough for a person to enter to perform tasks; 3) is not designed or configured for continuous occupancy.

Cross Sensitivity:

A sensor's reaction to an interfering gas. Exposing a sensor to a gas that is not the target of the sensor can cause an undesirable response, either positive or negative.

D**Data Logger:**

A memory device that stores information electronically inside an instrument.

Detector:

The sensing element of a gas detection device sometimes known as a filament and also sometimes called a sensor. The term detector is also applied to the assembly housing the sensing element.

Diffusion:

A spreading out and permeation of the space occupied. For a diffusion gas detector, a sensing element which is exposed continuously to the atmosphere it is to monitor, and over which the sample flows by natural movement of the gas rather than by action of a pump.

Dilution:

The act of weakening by a mixture. In the case of gas detection, a gas concentration can be weakened or diluted by the introduction of air.

Direct Current (DC):

Unidirectional current which flows continuously. Most portable gas indicators are powered by direct current, supplied by a battery of one type or another.

DualSense® Technology:

DualSense Technology uses two of the same type sensors for detection of a single gas. Readings are then passed through a proprietary algorithm and a single instrument reading is displayed. This lessens the likelihood of an instrument not being able to detect gas out in the field. In turn, this makes instruments with DualSense Technology safer than single sensor instruments.

E**Electrolyte:**

A substance which produces a conducting medium when dissolved in a suitable solvent, usually water. Thus the sulfuric acid in a storage battery would be termed an electrolyte. The potassium acetate used in some oxygen cells would also be termed an electrolyte.

Electrode:

A conductor by means of which a current passes into or out of a liquid, a gas, or an insulating material. Electrodes are used in toxic gas sensors. Their function in this connection is to pass current from the electrolyte to the instrument's measuring circuit.

Electromagnetic Interference (EMI):

Any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics and electrical equipment.

Explosive Limits:

The explosive range of gases, vapors, and dusts, measured in % volume, when presented with an ignition source. Gases, vapors, and dusts have Lower Explosive Limits (LEL) and Upper Explosive Limits (UEL). The LEL is the lowest or minimum concentration or mixture range where an explosion can take place. UEL is the upper or maximum concentration or mixture range where an explosion can take place. Gases in quantities below the LEL are too lean to explode. Gases in quantities above the UEL are too rich to explode. See LEL and UEL in Glossary.

Explosion Proof Enclosure:

An enclosure capable of withstanding an explosion.

F**Factory Mutual (FM):**

FM Approvals certifies industrial and commercial products and services for companies worldwide. When a product or service meets the standards of FM Approvals, it is issued the "FM APPROVED" mark to signify it will perform as expected and support property loss prevention.

Filament:

The sensing element used in a combustible gas detector, usually in the form of a coil of platinum wire.

Filter:

A device for cleaning and purifying the gas sample being drawn. For example, a cotton pad or cylinder is often used for trapping dust.

Flammable:

Explosive gas, capable of being ignited and burned.

Flame Arrestor:

A barrier for the active filament in an instrument operating on the catalytic reaction principle. The flame arrestor is often made of fire resistant porous material, such as sintered bronze, stainless steel, or Monel® and its purpose is to contain any flame which may result from combustible gas mixture passing over the filament.

Flame Propagation:

The spread of flame from the source of ignition through a flammable mixture.

Flash Point:

The temperature of a liquid at which it gives off vapor sufficient to form an ignitable mixture with the air near the surface of the liquid or within the vessel used.

Flow Meter:

A device to measure the rate of sample flow.

Functional Test (Bump Test):

Application of gas to an instrument to verify functionality. It is used to verify sensor and alarm response.

G**Gas:**

Fluid form of matter which is compressible within limits and which, owing to the relatively free movement of its molecules, diffuses readily in other like forms of matter and is capable of indefinite expansion in all directions.

Guaranteed for Life:

The Guaranteed for Life™ warranty covers every component of the product for as long as the product is supported by Industrial Scientific. This does not include the consumable items such as sensors, batteries, water barriers, and filters.

H**Hot Work:**

Welding or grinding where a source of ignition is normally present.

Humidity:

The amount of water vapor in the air. The three types of humidity: absolute, relative, and specific.

Hydrocarbon:

One of a large group of compounds that contain primarily hydrogen and carbon. Most gases to be detected by combustible gas indicators fall into this category.

I**Ignition Point:**

The temperature at which a substance will ignite and burn without necessity for introduction of a separate source of ignition.

Immediately Dangerous to Life and Health (IDLH):

Defined by the US National Institute for Occupational Safety and Health (NIOSH) as exposure to airborne contaminants that are "likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment." Examples include smoke or other poisonous gases at sufficiently high concentrations.

Inert Gas:

A gas devoid of active chemical properties - neutral. In this group are helium, neon and argon. In combustible gas analysis, nitrogen and carbon dioxide, although not strictly so, are treated as inert gases because they do not enter into combustible reactions or support them.

Inhibitors:

Substances which reduce the effectiveness of the catalyst action on the catalytic bead LEL sensor. Inhibitors only hinder the working of a catalyst.

Inorganic:

All elements and components, other than hydrocarbons or organic substances.

Intrinsically Safe:

This is a term applied to an instrument or device which is incapable of becoming a source of ignition because only low energy is available from its electrical circuits. Many applications exist where the atmosphere is so hazardous that no possible source of ignition can be allowed. In cases like this, instrumentation used in such location shall be approved by one of the approval agencies (FM or UL) as intrinsically safe.

Ions:

Atoms or groups of atoms that have picked up a positive or negative electrical charge.

Ionization:

Breaking up molecules into electrically charged atoms or groups of atoms.

Ionization Potential (IP):

The amount of energy required to split a chemical into electrically charged particles. Ionization potential is measured in units called electron Volts (eV).

L**Lean:**

A gas mixture with air containing too little combustible gas to be ignited.

Linearity:

The closeness to which a given percentage increase in gas produces the same percentage increase in reading.

Lower Explosive Limit (LEL):

The minimum concentration of a combustible gas mixed with air where an explosion may occur. This concentration is expressed in % of volume. For combustible gas instruments used to detect explosive atmospheres; the concentration is expressed as a percentage factor of the LEL point. A reading of 100% LEL corresponds to the % of volume concentration where combustion can occur.

M**Membrane:**

An inert material that has pores of uniform size. These pores allow the transfer of molecules in the gas state. Generally, the transfer of liquids are inhibited due to their density.

N**National Electric Code (NEC):**

A set of standards governing design and installation of electrical equipment in the USA, so as to ensure safe installation. The NEC is maintained and reviewed by the NFPA.

National Fire Protection Association (NFPA):

A non-profit organization whose aims are to improve methods of fire protection and prevention, to publish information on these subjects, and secure the cooperation of its members and the public in establishing proper safeguards against the loss of life and property.

O**Organic:**

Of or pertaining to the nature of organisms, of animals or plants. Any chemical compound typical of those formed by life processes, primarily hydrocarbons.

Orifice:

A small opening into a cavity. In gas measurements, a small hole of controlled dimensions placed in the flow stream and across which a predictable pressure difference is developed for a given flow.

Oxidation:

The act of uniting or causing to be united chemically with oxygen, the state of being so united, ie., rust.

Ozone:

A triatomic form of oxygen that is bluish in color gas with a pungent odor. Formed naturally in the upper atmosphere by a photochemical reaction with solar ultraviolet radiation or generated by electric discharge in normal oxygen.

P**Parts per Million (ppm):**

A unit of measurement used for small proportions or concentrations. It expresses the volume of a gas present in terms of its relationship to a whole of 1 million parts of air. 1% of volume = 10,000 ppm, 100% of volume = 1,000,000 ppm.

Parasitic Pump:

A pump that is powered by attaching to an instrument and relying on the instruments battery as a source of power.

Peak Reading:

The highest detected toxic gas and LEL gas reading, and the lowest oxygen reading.

Permeability:

The quality or condition of allowing passage, especially of liquids and gases.

Permissible Exposure Limit (PEL):

PELs are regulatory limits on the amount or concentration of a substance in the air. PELs are based on an 8 hour time-weighted average (TWA) exposure. (OSHA, 2010)

Photoionization Detector (PID):

An air monitoring instrument that detects hydrocarbons and some inorganic vapors by photoionization.

Photoionization:

Treating chemicals with ultraviolet light to convert their molecules into electrically charged ions.

Poisoning:

In gas detection, the desensitizing action of certain gases on the detection element. An example of this is the sensitivity loss which occurs on a platinum filament in the presence of silicone vapors.

Potentiometer:

A three-terminal variable resistance device in which a slider can move from one extreme to the other picking off various values of resistance. In instrumentation, potentiometers are used as zero adjusts, volt adjusts, and calibration controls.

Probe:

A rigid hollow extension for the gas sampling line to reach gas samples to be withdrawn from spaces which might be otherwise inaccessible.

Propagation of Flame:

The spread of flame from the source of ignition through a flammable mixture.

Purge:

The act of removing flammable, combustible, and toxic gases from a confined work space prior to entry or performing hot work. Instrument should read zero when properly purged.

R**Reaction Chamber:**

A cavity or enclosure in which a reaction or a conversion of gas occurs in the course of making a gas test.

Radio Frequency Interference (RFI):

Electromagnetic radiation which is emitted by electrical circuits carrying rapidly changing signals, as a by-product of their normal operation, and which causes unwanted signals (interference or noise) to be induced in other circuits.

Recommended Exposure Limits (REL):

NIOSH "TWA" indicates a time-weighted average concentration for up to a 10 hour workday during a 40 hour workweek. A short term exposure limit (STEL) designated by "ST" preceding the value; unless noted the STEL is a 15 minute TWA exposure that should not be exceeded at any time. A ceiling REL is designated "C" preceding the value; unless noted otherwise, the ceiling value should not be exceeded at any time.

Recorder:

An instrument capable of making graphic records of gas response.

Repeatability:

The closeness to which successive readings with the same instrument on the same sample agree with one another.

Resistance:

The tendency of all materials to resist the flow of an electrical current and to convert electrical energy into heat.

Response:

An indication on the readout device resulting from a change in the composition of the gas mixture being sampled.

Rich Mixture:

An excess of combustible gas in relation to the LEL, or range of detector.

S**Sample:**

A representative portion of the atmosphere being tested.

Sample Drawing:

The method used in gas detection whereby the sample is drawn to the detection portion of an instrument through hoses or tubing by means of suction.

Sensitivity:

In gas detection, the smallest change in gas composition which can be observed on the readout device.

Short-Term Exposure Limit (STEL):

A 15 minute time weighted average (TWA) exposure which can only be exceeded four times during a work day with a minimum of one hour of fresh air in between.

Span Reserve:

The amount of sensor life left assuming normal usage. Prior to testing the span reserve, the sensor should be properly zeroed and stable.

T**Threshold Limit Value (TLV):**

The maximum concentration of a substance to which a workman may be exposed without ill effects during a normal 8 hour, 5 day week. The commonly accepted values are found in the set of guidelines published by the American Conference of Governmental Hygienists to indicate limit of safe level of airborne concentrations of toxic substances, (ACGIH).

Time-Weighted Average (TWA):

Average gas exposure over time. Usually averaged over an 8 hour period.

Thermal Conductivity:

Ability of a substance to carry or transfer heat between two locations of different temperature. In gas analysis the ability of a gas sample to conduct heat away from or to a coil or heated filament. Each gas has its own thermal conductivity, some gases being much more conductive than others.

Toxic:

Poisonous. In industrial health, toxic is defined as having some adverse effect under some conditions of exposure.

U**Underwriters Laboratory:**

An independent testing and approval agency which examines electrically operated equipment and accessories, primarily from the standpoints of safety and freedom from hazard. Approved equipment is listed by UL and carries the UL label. A follow-up procedure assures that manufacturers do not make unapproved changes. UL does not have any connection with the Federal or other governments, but is recognized by many local government regulations which require UL labels on certain classes of electrical equipment.

Upper Explosive Limit (UEL):

The maximum concentration of a combustible gas, when mixed with air, where an explosion may occur. Also expressed as Upper Flammability Limit.

V

Vapor:

Any substance in the gaseous state which in ordinary conditions is usually a liquid or a solid; a gasified liquid or solid.

Volatile Organic Compound (VOC):

Organic chemicals that have a high vapor pressure at ordinary, room temperature conditions. Their high vapor pressure results from a low boiling point. They can have a chronic toxic effect. VOCs can be man made or naturally occurring chemicals.

Volatile:

Evaporating rapidly at ordinary temperatures upon exposure to air; capable of being vaporized at room temperature.

Voltage:

A difference in electric potential expressed in volts.

Volume Percent:

A percentage of 100% gas/air mixture, usually applied to the percentage of one certain gas of interest.

W

Water or Moisture Trap:

A container installed in the incoming sample line to a gas analyzer, where liquid can collect, used to prevent water or other liquids from being drawn into the gas analyzer. Used when there is danger of liquid or condensable vapor entering the sample line.

Wheatstone Bridge:

A four-leg electrical bridge circuit, in which all the legs are predominantly resistive; used for measurement of resistance. In gas detection instruments, an active and a reference filament usually occupy two legs of the bridge. The reference and two other resistive elements offer a fixed resistance while the active detection elements act as a variable resistance when exposed to a gas sample, thus unbalancing the bridge and giving a reading on the meter.

Z

Zero:

The term applied to the reference level of an instrument indicating no detection activity.

Zero Drift:

The condition which occurs when the meter gradually shifts upscale or downscale when no gas is present.

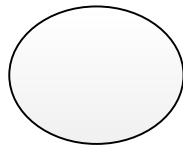
Flow Chart Key



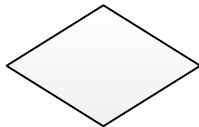
Display Box With Bold Border
Indicates the "home" screen. Also known as Gas Monitoring Screen, or Normal Gas Reading Screen.



Display Box
Shows user what will appear on the instrument display.



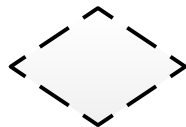
Action Box
Requires the user to perform an action to proceed.



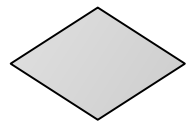
Decision Box
Gives the user an option to perform a function. Normally expressed with either Yes or No option.



Delay Box
User must wait while instrument is performing function.



Dashed Line Surrounding Display or Delay Box
Indicates an optional screen which may be visible based on instrument configuration.



Shaded Display, Action, or Delay Box
Indicates a screen within the Configuration or Settings Menu.



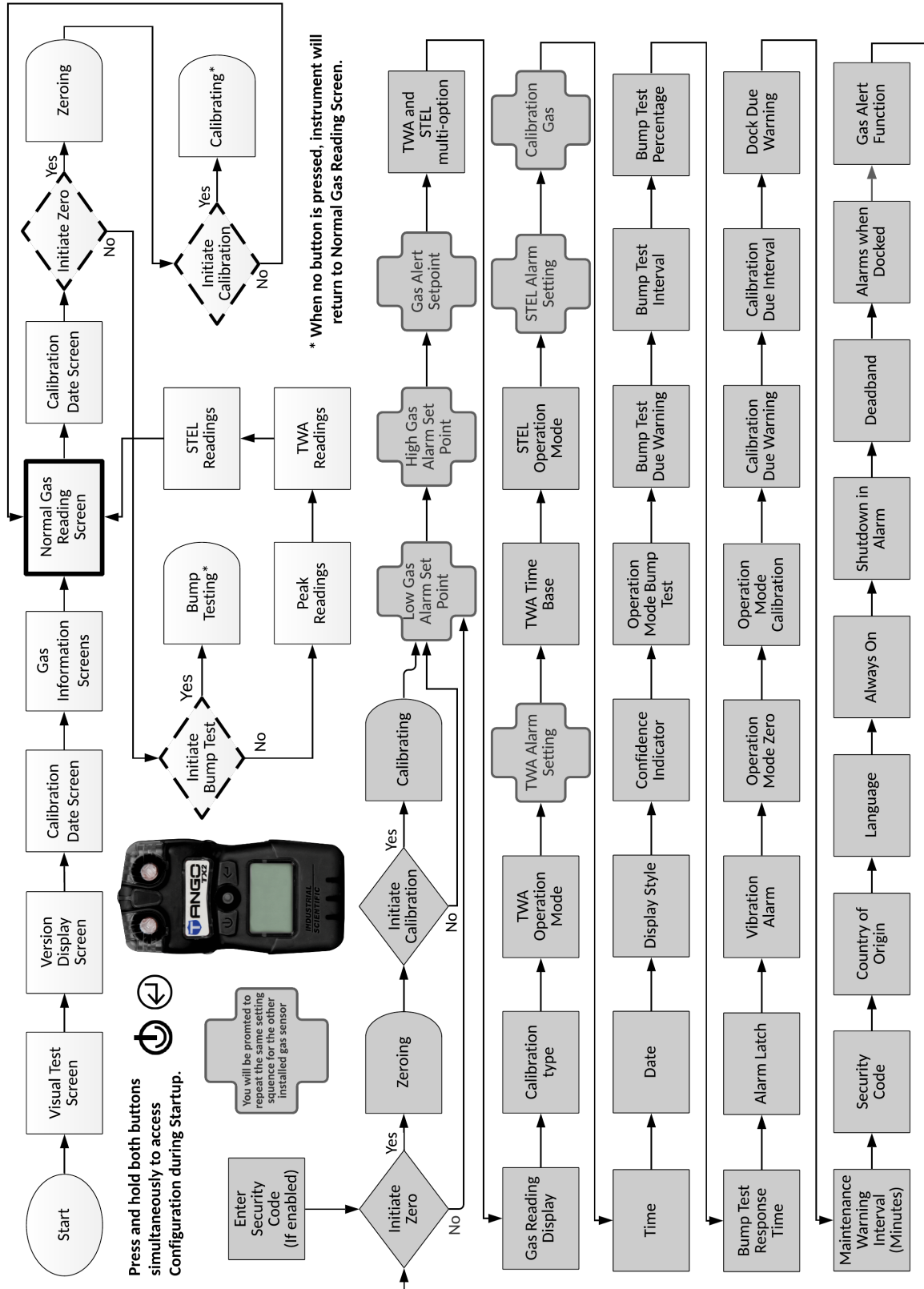
Directional Arrow
Shows direction of flow to next screen.



Bi-directional Arrow
Shows direction of flow to next or previous screen.

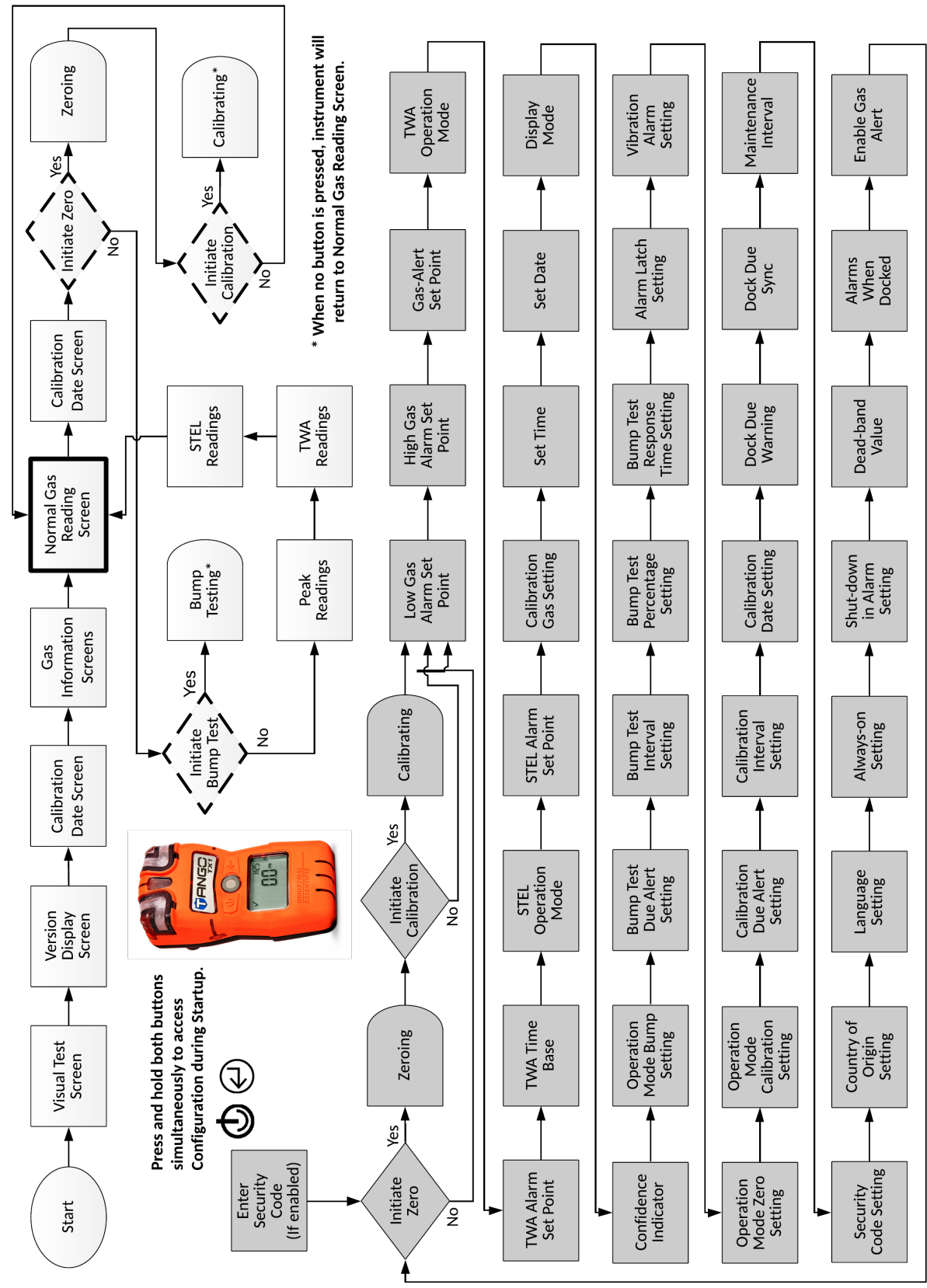
Tango TX2 Operational Flow Chart

Press Power button to advance through screens.
Press Enter button to execute functions or change values.



Tango TX1 Operational Flow Chart

Press Power button to advance through screens.
Press Enter button to execute functions or change values.

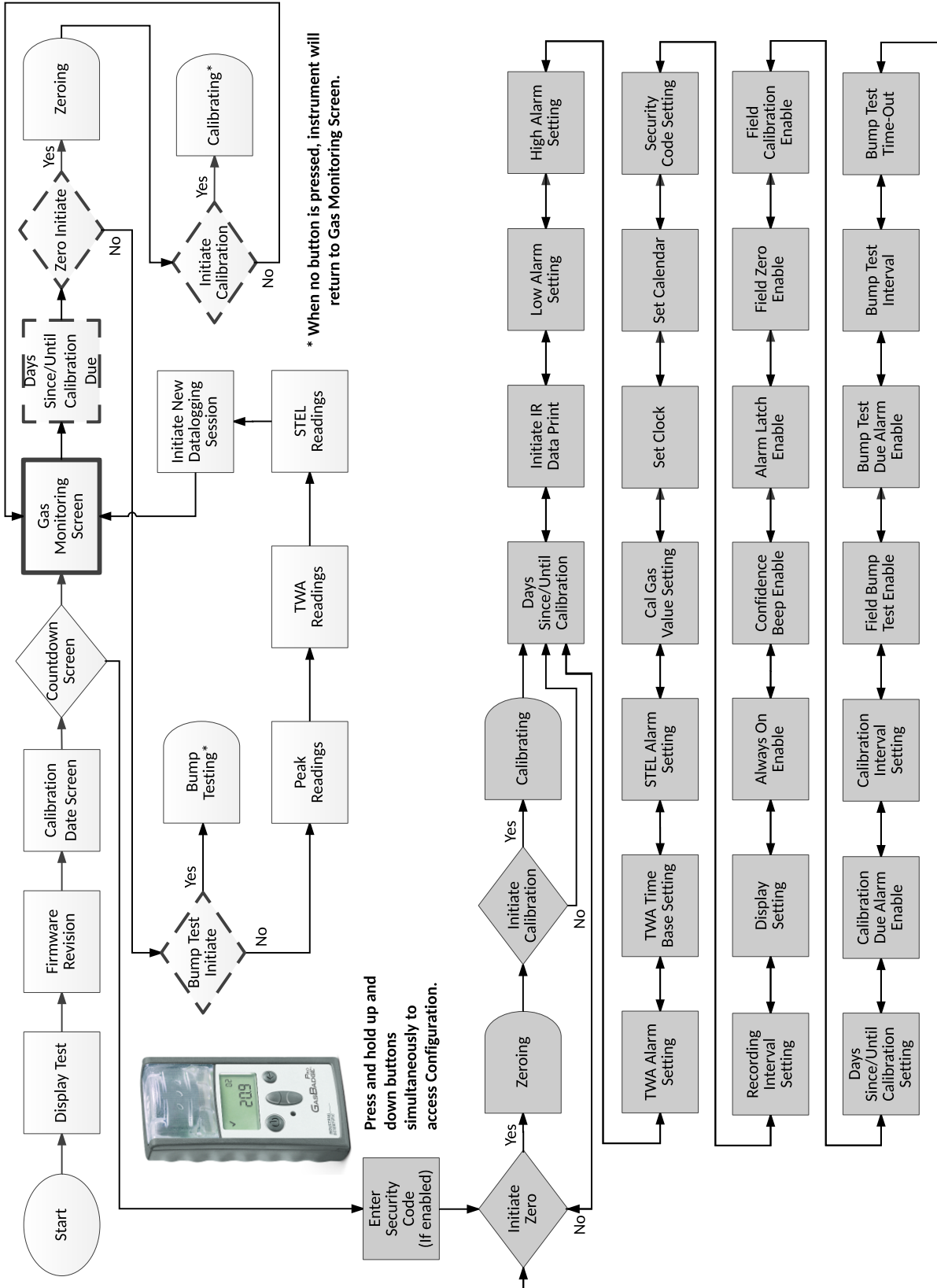


Press and hold both buttons simultaneously to access Configuration during Startup.

* When no button is pressed, instrument will return to Normal Gas Reading Screen.

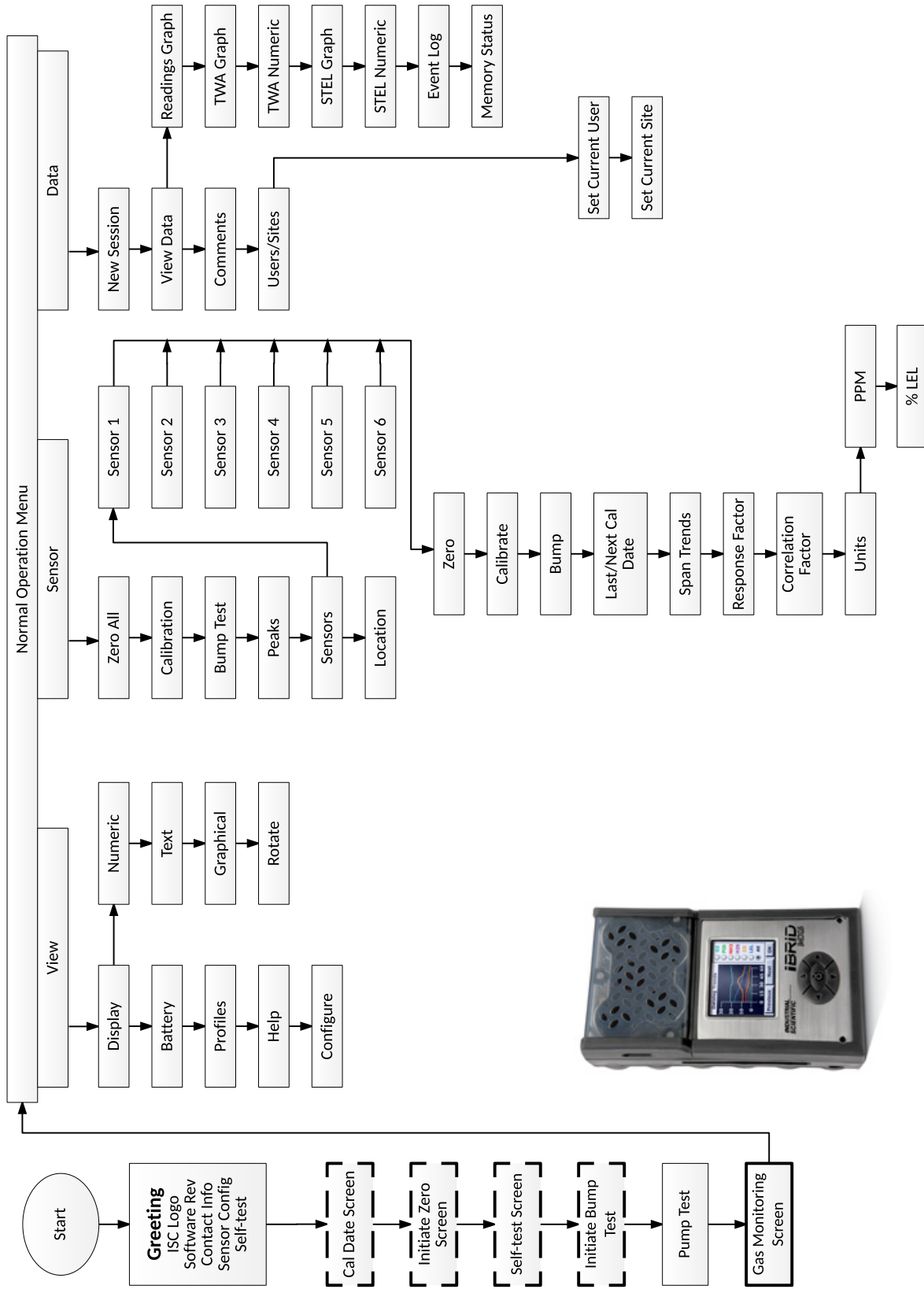
Gas Badge Pro Operational Flow Chart

Press up or down button to advance through screens.
Press Enter button to execute functions or change values.



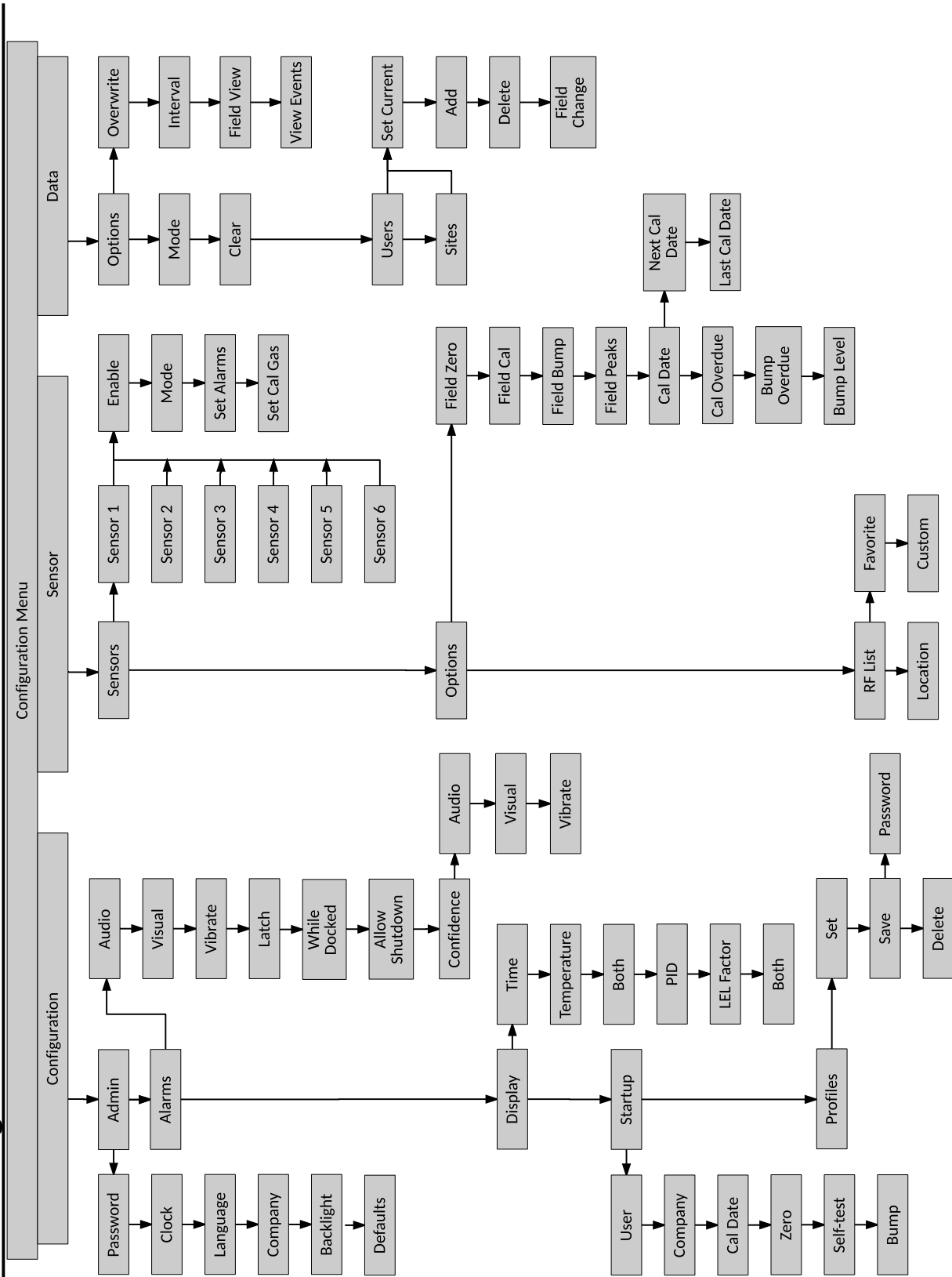
MX6 Operations Flow Chart

Use arrow keys to navigate through menus.
Power button to enter and save values.



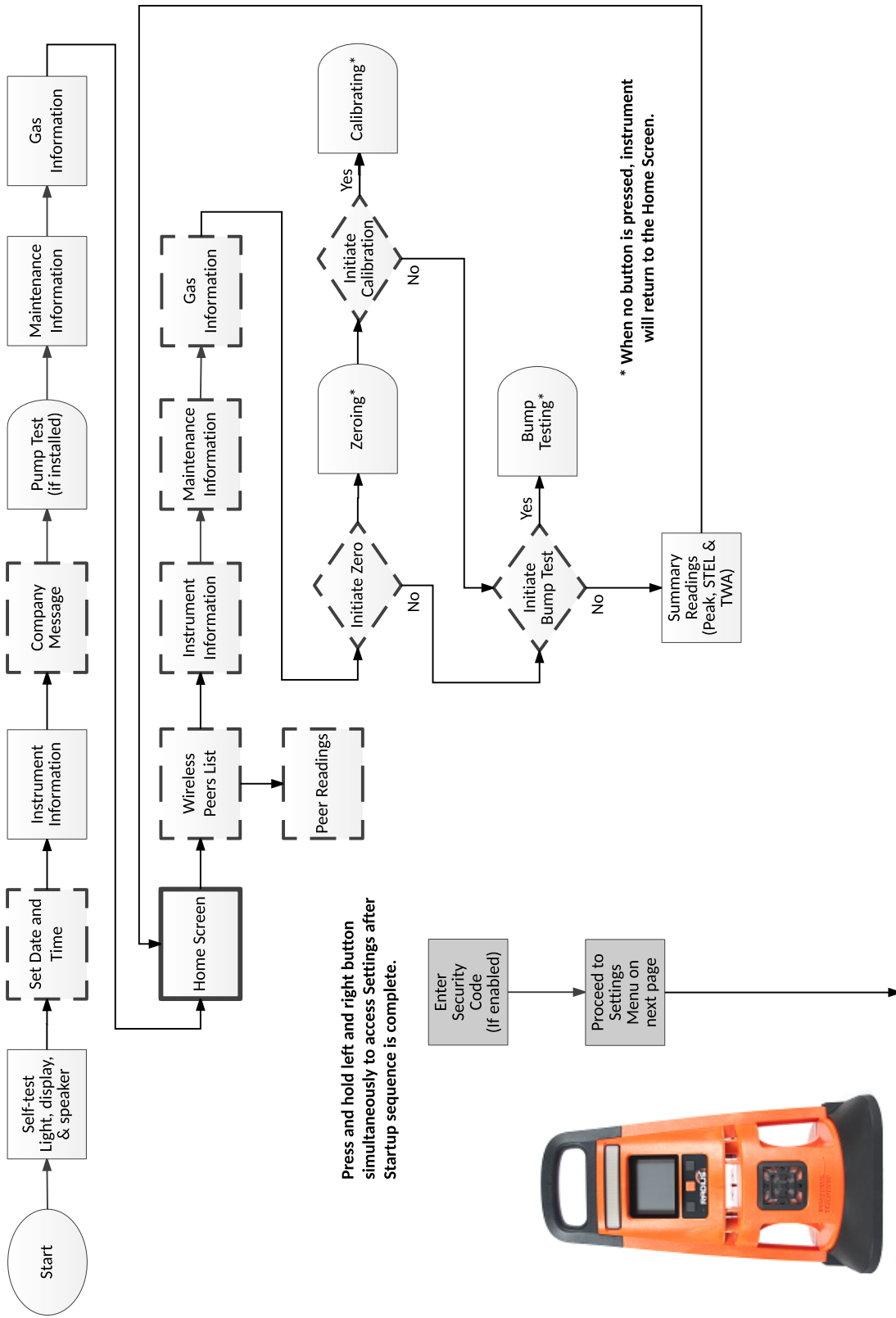
MX6 Configuration Flow Chart

Use arrow keys to navigate through menus.
Power button to enter and save values.

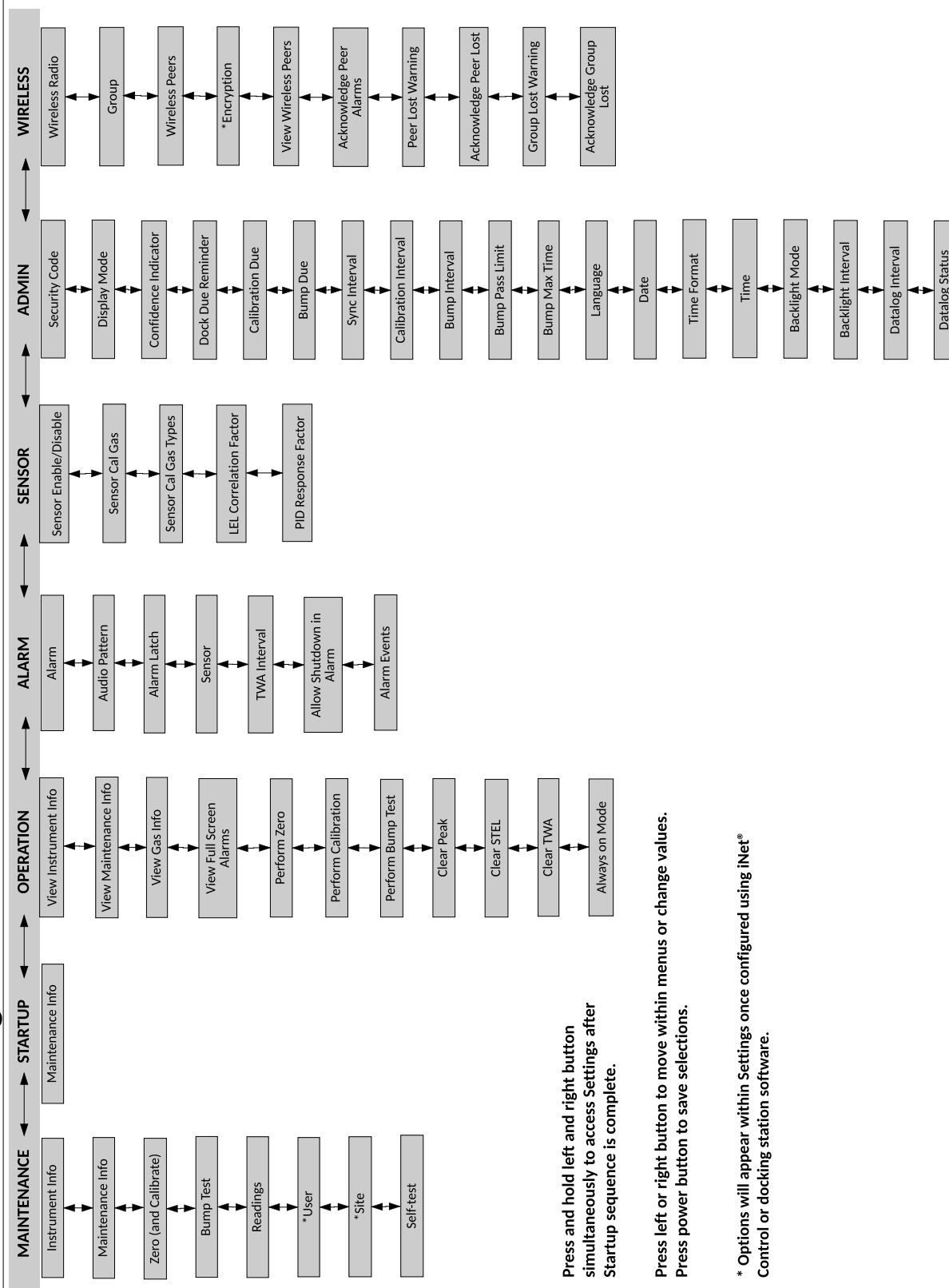


Radius BZ1 Operational Flow Chart

Press power button to advance through screens and save selections.
Press left or right button to move within menus or change values.



Radius BZ1 Settings Flow Chart



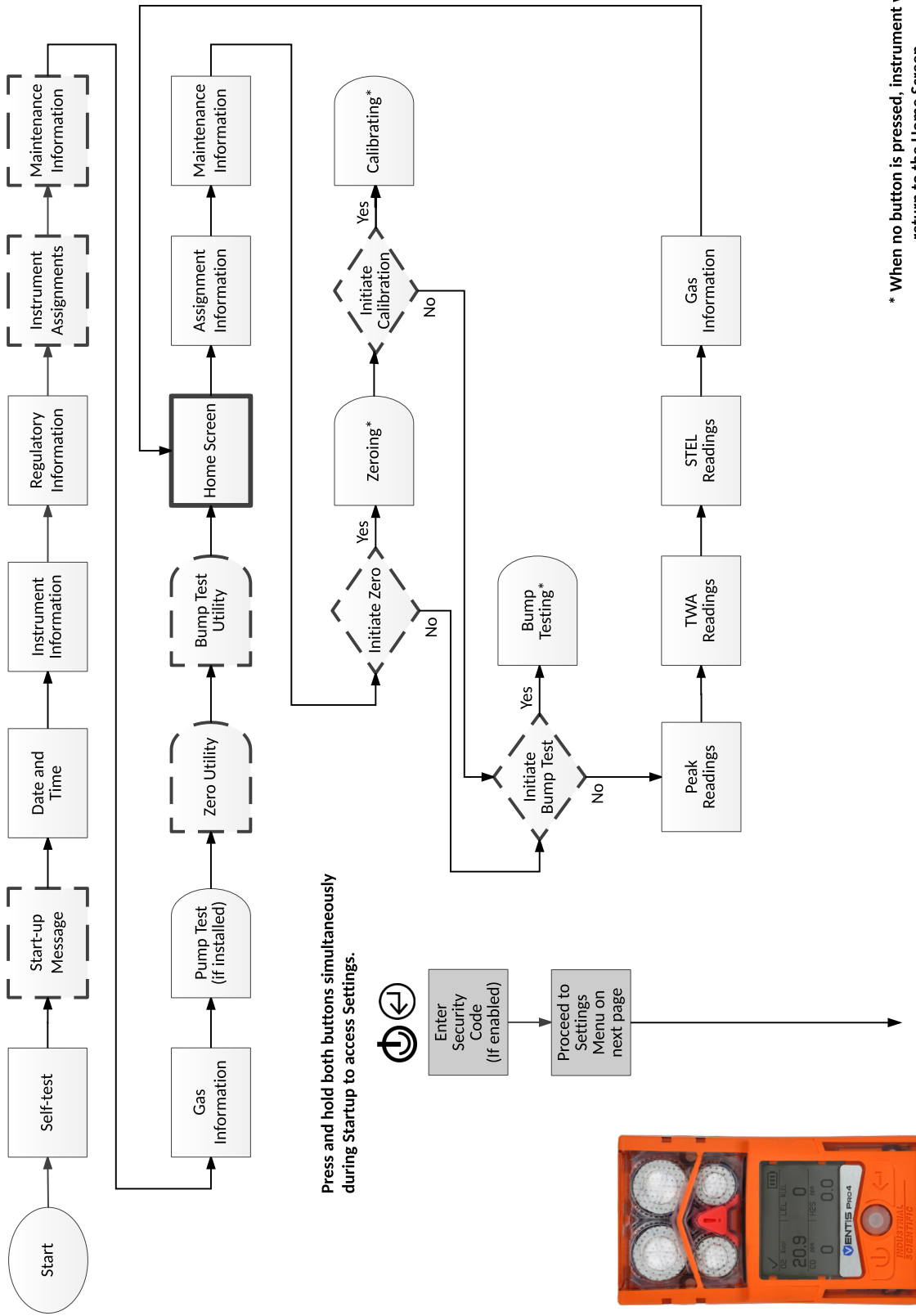
Press and hold left and right button simultaneously to access Settings after Startup sequence is complete.

Press left or right button to move within menus or change values.
Press power button to save selections.

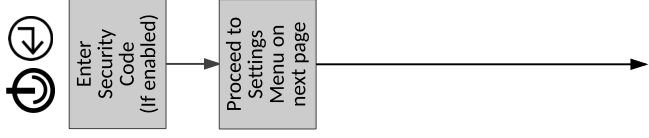
* Options will appear within Settings once configured using iNet® Control or docking station software.

Ventis Pro Operational Flow Chart

Press Power button to advance through screens.
Press Enter button to execute functions or change values.



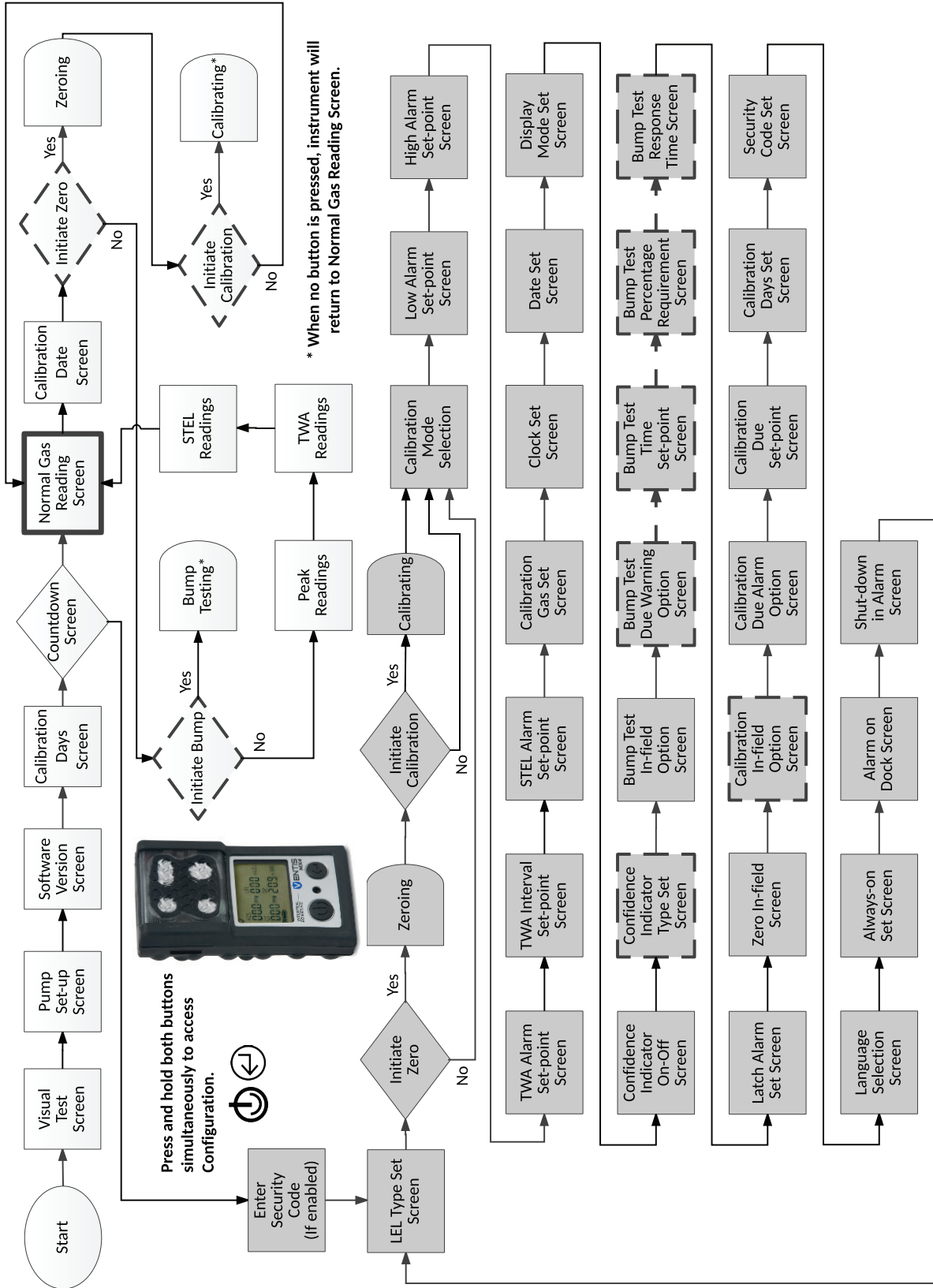
Press and hold both buttons simultaneously during Startup to access Settings.



* When no button is pressed, instrument will return to the Home Screen.

Ventis MX4 Operational Flow Chart

Press Power button to advance through screens.
Press Enter button to execute functions or change values.



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Training Program Evaluation Sheet

Name (optional): _____

Class Date: _____

I am satisfied with Industrial Scientific's Training Class:

Extremely Dissatisfied

1	2	3	4	5
---	---	---	---	---

 Extremely Satisfied

This class will improve your company's safety program:

Disagree

1	2	3	4	5
---	---	---	---	---

 Agree

Rate the value this class brings to your company's safety program:

Least Valuable

1	2	3	4	5
---	---	---	---	---

 Most Valuable

How likely are you to take a class in the future:

Least Likely

1	2	3	4	5
---	---	---	---	---

 Extremely Likely

The class information was relevant and met my expectations:

Least Relevant

1	2	3	4	5
---	---	---	---	---

 Most Relevant

How likely are you to recommend this training class to a colleague?

Least Likely

1	2	3	4	5
---	---	---	---	---

 Extremely Likely

What could be done to improve this class? _____

What is the biggest takeaway from this class? _____

Do you have any comments for this class? _____

Circle the products you would like more information on:

MX6 iBrid | Ventis MX4 | Ventis Pro5 | Tango TX1 | Tango TX2 | Radius BZ1 | RGX Gateway | iNet Control | iNet Now

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