

# *Oil and Petrochemical Industry Gas Detection Issues and Answers*

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# Oil and Petrochemical Industry Gas Detection Issues and Answers

- Webinar goals:
  - Provide overview of gas detection issues and answers for the Oil and Petrochemical Industry:
    - Workers
    - Employers
    - Contractors
    - Emergency responders.
  - Provide framework for assessing gas detection needs:
    - What questions should you ask and what issues should you consider?
    - What is the best gas detection solution?
    - Asking better questions leads to better solutions, and to better results for your company!



## *Gas detection issues and considerations*

- “Oil Industry” is a very broad category!
- Oil / chemical industry managers deal with extremely wide range of atmospheric hazards, monitoring applications and activities.
- Hazards can be generally present or associated with specific activities (like CS entry).
- Managers need to anticipate critical requirements ahead of time
- Dealing with atmospheric hazards is a constant concern!



# What are your most urgent gas detection concerns and problems?

- The more detailed grasp you have of the activities and risks that involve atmospheric hazards, the better.
- Drill down to make sure you understand what is most important.
- Are you currently meeting all requirements?
- Where do you need to make improvements?
- Gas detection issues are not necessarily limited to safety!
- And gas detection solutions are definitely not limited to portable instruments!



## *Oil and chemical industry gas detection requirements can include*

- Personal protection
- Production
- Process
- Facilities
- Industrial hygiene
- Community (such as fence line or nuisance odor)
- Regulatory (EPA)
- Disaster response (explosion, spill or fire)
- Construction (shut-downs)
- Confined space
  - Routine entries
  - Large scale ongoing-entries
  - Entries into inerted vessels
  - Hot work
  - Special procedures (catalyst rebuilding)



## Fixed or Portable solution?

- When hazards are generally present or associated with specific activities (like CS entry) gas detection solutions focus more on portable instruments.
- When hazards are chronically present, or present in specific areas, fixed gas detection should be considered as well.
- Optimal solution often includes both fixed and portable instruments!




## Don't overlook fixed detection system options

- Don't be afraid of fixed system solutions!
- Most common solution is often small standalone system with 1 to 4 points of detection.
- Larger systems can be complicated, but your manufacturer, integrator and distributor partners are there to help you through the specification process.
- Make sure you involve everyone who has a role in fixed and engineered gas detection decisions at the site
  - Don't overlook contractors involved in installation and maintenance
  - Don't overlook decision makers involved at the corporate level.
  - Good starting point is simple manufacturer questionnaire




# Example Fixed System Questionnaire

- Simple information but critical to know
- The questionnaire will help you to ask the right questions
- Vital to provide the best solution!


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**FIXED SYSTEMS APPLICATION QUESTIONNAIRE**

Company: \_\_\_\_\_  
 Name and title: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 E-mail: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 City/State/Zip: \_\_\_\_\_  
 Date: \_\_\_\_\_  
 Salesperson: \_\_\_\_\_

The information requested on this survey is for GfG Project Engineers.  
 Exact specifications will help insure proper equipment for your application.

**APPLICATION DATA**

Describe your application: \_\_\_\_\_


Is the area considered  Hazardous/Classified  General purpose  
 Is the area currently being monitored?  No  Yes, list technology: \_\_\_\_\_

**TRANSMITTERS**

Output  4-20 mA  Modbus  Two wire  Three wire  Other: \_\_\_\_\_  
 Gas detecting  CO  NH<sub>3</sub>  O<sub>2</sub>  CH<sub>4</sub>  Other: \_\_\_\_\_  
 Calibration gas  Standard  Special \_\_\_\_\_  
 Range required: \_\_\_\_\_ to \_\_\_\_\_  PPM  %LEL  %volume  \_\_\_\_\_  
 Temperature range: \_\_\_\_\_ to \_\_\_\_\_  °F  °C Humidity: \_\_\_\_\_ %  
 Possible background gases / sensor poisons  No  Yes, please list: \_\_\_\_\_  
 Climate  Indoor  Outdoor  
 Voltage input: \_\_\_\_\_ VDC  
 Interfacing with PLC?  No  Yes, load: \_\_\_\_\_ ohms  
 Display required?  No  Yes

Modifications: (explain) \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

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**CONTROLLERS**

2-1 mA  Modbus  N/A

MA \_\_\_\_\_  
 Indoor \_\_\_\_\_  
 Modbus  Two wire  Three wire  Other: \_\_\_\_\_

Inductive load Current required: \_\_\_\_\_ amp  
 Open  Normally closed

Yes  
 Network, what interface is required? \_\_\_\_\_

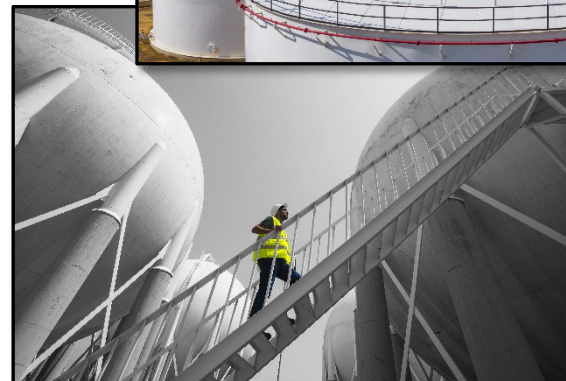
\_\_\_\_\_ Threshold  Ascending  Descending  
 \_\_\_\_\_ Threshold  Ascending  Descending  
 \_\_\_\_\_ Threshold  Ascending  Descending  
 O<sub>2</sub>  CH<sub>4</sub>  Other: \_\_\_\_\_  
 \_\_\_\_\_  °F  °C Humidity: \_\_\_\_\_ %

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# What are the major categories of oil and chemical industry sites and products?

- Different types of oil / petrochemical business have very different gas detection requirements
- “Upstream” exploration and production
  - Crude oil
  - Natural gas
  - Bitumen
- “Midstream” transportation and wholesale marketing of crude or refined products
  - Pipeline
  - Rail
  - Tanker (truck)
  - Marine transport
- “Downstream” refining and processing
  - Crude oil and bitumen into fuels (gasoline / diesel / jet fuel / fuel oil)
  - Processing and purifying raw natural gas
- Chemical plants convert “feedstock” into new products
  - Olefins
  - Aromatic
  - Multitude of additional products



# What are typical “Upstream” gas detection concerns?

- “Upstream”
  - Exploration and production
    - Crude oil
    - Natural gas
    - Bitumen
- What are some typical upstream concerns?
  - Personal protection
  - Lone worker
  - Confined space entry
  - Local site protection (fixed systems)
- Rely on single and basic multi-gas instruments
  - H<sub>2</sub>S
  - 4 Gas with LEL / O<sub>2</sub> / CO / H<sub>2</sub>S
  - 5 Gas with PID
  - Benzene
  - Other specific toxic gases



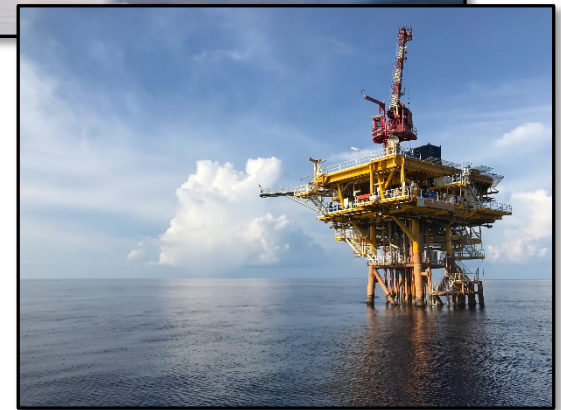
# What are typical “Midstream” gas detection concerns?

- “Midstream”
  - Transportation and wholesale marketing of crude or refined products
    - Pipeline
    - Rail
    - Tanker (truck)
    - Marine transport
- What are some typical midstream concerns?
  - Personal protection
  - Lone worker
  - Confined space
- Rely on single and basic multi-gas instruments
  - H<sub>2</sub>S
  - 4 Gas with LEL / O<sub>2</sub> / CO / H<sub>2</sub>S
  - 5 Gas with PID
  - Other specific toxic gases (SO<sub>2</sub> / NO<sub>2</sub> / benzene / etc.)



# *What are some of the special concerns that affect maritime gas detection?*

- Special regulations for platforms, marine terminals, loading docks, shipyards, maritime vessels and shoreside facilities
- Different toxic and safety exposure limits
  - Enforced by USCG rather than OSHA
  - Exposure limits tied more closely to TLV
  - LEL settings in high risk “Zone 0” areas often at 5% LEL rather than 10% LEL
- Different CS entry requirements
  - 1912 Sub-part B rather than 1910.146
  - Hot work requirements per NFPA 306
  - Marine chemist sign-off on “gas free” conditions prior to entry
  - Entry by “Competent Persons” only
- Instruments may require additional certifications
  - UL / CSA Zone 0 Certification
  - Marine “Steering Wheel”



# What are typical “Downstream” gas detection concerns?

- “Downstream”
  - Refining and processing of crude oil and bitumen
  - Processing and purifying raw natural gas
  - “Upstream / downstream” categorization is sometimes not clear cut
- What are some typical downstream concerns?
  - Personal protection
  - Toxic exposure monitoring
  - Confined space
  - Shut-downs
  - Fixed systems
- Rely on single and multi-gas instruments
  - H<sub>2</sub>S
  - 4 Gas with LEL / O<sub>2</sub> / CO / H<sub>2</sub>S
  - 5 Gas with PID
  - Other specific toxic gases (SO<sub>2</sub> / NO<sub>2</sub> / benzene / etc.)



# What happens during the refining process?

- Oil refineries produce olefins and aromatics by fluid catalytic cracking of petroleum fractions.
  - Cracking converts high molecular weight HCs to more useful, low molecular weight ones
  - Catalytic cracking uses and produces hydrogen!
    - IR LEL sensors are unable to detect H<sub>2</sub>.
    - H<sub>2</sub> may also interfere with CO sensors.
    - Make sure instrument includes sensor that can detect H<sub>2</sub>.
    - If using IR LEL sensor, consider adding substance specific EC H<sub>2</sub> sensor.
  - Chemical plants produce olefins by steam cracking of natural gas liquids (feedstock) like ethane and propane.
  - Olefins and aromatics are the building-blocks for a wide range of materials such as plastics, solvents, resins, fibers, elastomers, lubricants, detergents, and adhesives.



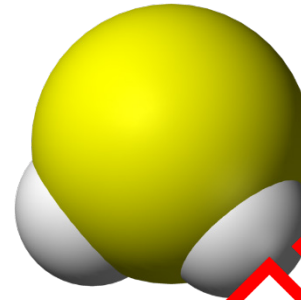
# What are the most common oil industry atmospheric hazards?

- Oxygen deficiency
- Oxygen enrichment
- Presence of toxic gases
  - H<sub>2</sub>S
- Presence of combustible gases
- VOC vapors
- Typically use single-gas H<sub>2</sub>S or a 4 gas or 5 gas detector with:
  - LEL
  - O<sub>2</sub>
  - CO
  - H<sub>2</sub>S
  - PID (for VOC)



## Why is $H_2S$ so common?

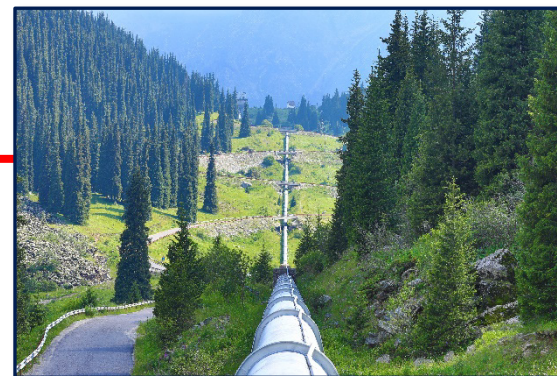
- Produced by anaerobic sulfate-reducing bacteria
- The higher the sulfur content the greater the potential for  $H_2S$
- Older fields more prone to  $H_2S$  than new fields
- Heavier than air
  - Collects in vessels, pits, within protective berms, or in other low-lying areas
  - Half-life in air = 12 to 37 hours
  - Eventually breaks down in sunlight
- Extremely toxic!
  - 1000 ppm leads to immediate “knockdown”
- Particularly dangerous in oil production areas subject to cold winter temperatures
  - During very cold and dry conditions, half-life can exceed 37 hours





# What is the best type of LEL sensor?

- It depends on the specific applications!
- There are several LEL sensor options, all have advantages and disadvantages:
  - Traditional catalytic “pellistor” LEL
    - Detects gas by oxidation (heating) pellistor bead in sensor
  - Full size IR LEL
    - Detects gas by absorbance of IR light over longer optical path
  - Miniaturized (low power) MEMS IR LEL
    - Detects gas by absorbance of IR light over extremely small optical path (low power)
  - Miniaturized (low power) MEMS Molecular Properties Spectrometer (MPS)
    - Presence of a flammable gas causes changes in the thermo-conductive properties of the air/ gas mixture that are measured by the sensor transducer



# What are advantages and limitations of catalytic pellistor LEL sensors?

- Advantages:
  - Predictable, well understood technology
  - Predictable cross sensitivities, (most instruments have built-in CF library)
  - Able to detect H<sub>2</sub>, acetylene and unsaturated HCs
- Disadvantages:
  - Uses more power
  - Poor response to larger molecules
  - Slower response to larger molecules
  - Easily poisoned
  - Exposure to high concentration combustible gas damaging to sensor
  - Must have minimum of 10% O<sub>2</sub> to accurately detect gas



# What are IR LEL sensor advantages and limitations?



- Advantages:
  - Sensor cannot be poisoned
  - Does not require oxygen to detect gas
  - Can be used for high-range combustible gas measurement
  - Responds well to large hydrocarbon molecules that cannot be measured by means of standard LEL sensor
    - Larger molecules have more C–H bonds that can absorb IR
- Disadvantages:
  - Molecule must include chemical bonds that absorb at the wavelength(s) used for measurement
  - Not all combustible gases can be detected!
    - NDIR sensors with short optical path-lengths may have limited ability to measure gases with lower relative responses
    - Wavelength used for portable IR LEL sensors can't detect acetylene
    - IR LEL sensors cannot detect hydrogen at any wavelength!

## *Different IR LEL sensors may have very different performance characteristics*

- Different IR LEL sensors can have very different capabilities
- Read the owner's manual!
- Make sure to verify with manufacturer before attempting to use the sensor to measure unsaturated hydrocarbons, aromatic VOCs or other gases not specifically listed in the owner's manual!

## Appendix B

### Detectable Combustible Gases

Gas <sup>1</sup>	Expected response at 20% LEL target gas <sup>2</sup>
Methane	20% LEL
Propane	15% LEL to 45% LEL
Butane	15% LEL to 35% LEL
Pentane	15% LEL to 45% LEL
Hexane	8% LEL to 28% LEL
Methanol/Ethanol <sup>3</sup>	6% LEL to 26% LEL
Hydrogen	No response
Acetylene	No response

<sup>1</sup>For any gases not listed, please contact Honeywell Analytics to find the best solution for your application.

<sup>2</sup>The BW Clip4 LEL sensor is optimized to see methane. While the unit can detect and respond to the other combustible gases listed in the above table, the accuracy of the readings may be in-consistent. If the primary need is to detect a specific combustible gas other than methane, please contact Honeywell Analytics to discuss an alternative product.

<sup>3</sup>Please use caution when using the BW Clip4 around Methanol and/or Ethanol. The BW Clip4 CO sensor may become inhibited by prolonged exposure to concentrations of Methanol and/or Ethanol thus causing the unit to alarm. This condition can last up to 12 hours before the CO sensor recovers to normal levels.

# Why use photoionization detector equipped instruments?

- For most VOCs, long before you reach a concentration sufficient to register on a combustible gas indicator, you will have easily exceeded the toxic exposure limits for the contaminant
- PID equipped instruments are generally the best choice for measurement of VOCs at exposure limit concentrations
- Whatever type of instrument is used to measure these hazards, it is essential that the equipment is used properly, and the results are correctly interpreted



## *There are many new developments in gas detection!*

- New products
- New sensors
- Wireless communication
- Integrated fixed and portable networks
- Third party support through call centers
  - Emergency response
  - Record keeping and notifications
  - Internet based maintenance programs



## *Do you intend to update, expand, replace or change the equipment you are currently using?*

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- If you intend to update or replace your current equipment, make sure to get input from everyone involved in the process of maintaining and using the equipment.
- Gas detection decisions are usually made by a buying team.
  - Different individuals have different roles in the decision process, including process or facilities management, safety, hygiene, purchasing, and (often) union representatives.
    - Make sure you don't leave anyone out!
    - The same issue often looks considerably different to a manager with different responsibilities.
- If you have relationships with gas detection manufacturers and distributors you trust, get them involved!
  - Distributors generally have more than one manufacturer option.
  - Gas detection manufacturers are happy to discuss issues directly with end-user customers.
  - The Internet and social media are terrific tools for finding out what's new, and what customers have to say.
  - You have multiple sources of information!

# What brand(s) and model(s) of gas detection equipment do you currently use?

- Before making a change or investigating new products, make sure you understand your current products and requirements
  - If you are not sure, make sure to find out the brands and models currently in service.
  - Make sure you understand the capabilities; the strong points as well as the weak points, of the products you are currently using.
- Ask the manufacturers or distributors of the products you work with (or are interested in) for help.
  - Download specifications and comparison charts if the manufacturer has them.
  - Discuss ways the manufacturer and distributor can help meeting your needs with regards to product, capabilities or support.





# How well is your current equipment performing?

- This is a critical starting point in the conversation.
  - Are you generally happy?
  - Are you experiencing problems?
  - How old is your current equipment?
  - What features have you heard about that you are interested in?
  - What brand(s) and model(s) of gas detectors are you considering?
  - What are the alternatives?
- Distributors are a great source for product information!
- When in doubt, or with regards to advanced technical questions, ask the manufacturer!



## Avoid being overly focused on price!

- Eventually, the decision of whether to proceed involves price and affordability.
- However, there is a difference between the initial purchase price and the true cost of ownership.
  - The questioning process is designed to uncover your needs, and what would provide the optimal solution.
  - Once you fully identify the problems and how the new product is going to help, it's easier to understand the costs.
  - Once you have clarified the tradeoff between benefits and costs is when to widen or restrict choices as a function of price.



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# Identify “cost of ownership” issues

- Are you spending a fortune keeping your current equipment in service?
- Are you being charged a monthly fee for reports and factory support?
- Do you trust your gas detectors?
- Do you have many sensor failures?
  - If so, what kinds of sensors are failing?
- Do you have battery problems?
  - Do the instruments run long enough on a single charge or set of batteries?
- How often do you test and calibrate your instruments?
  - Do you do it yourself or use a service?
- Are there any special conditions or contaminants that are causing problems?
- Do you feel you are getting a good deal?



## Who is currently looking after your instruments?

- Do you do it yourself, use a third-party service, or work directly with the factory?
- If you like the equipment you are currently using, and want to keep it in service, you might want to talk about maintenance agreements or refurbishment programs.
- Ask your local distributor whether they offer calibration or repair services.
- Ask your current manufacturer whether they have factory maintenance programs, or a loaner or replacement instrument policy.
- You should expect excellent after the sale support!



## *In terms of units sold, personal protection is still the largest gas detection segment*

- For personal protection instruments do you mostly use:
  - Single gas H<sub>2</sub>S?
  - 4 gas meters?
  - Other single gas meters?
- Some of the other most commonly used personal single gas instruments include:
  - NO<sub>2</sub>
  - SO<sub>2</sub>
  - Ozone
  - HF
  - NH<sub>3</sub>
  - As well as many others!



## What if you need a second sensor?

- G222E compact personal gas monitors available with 2 toxic gas, H<sub>2</sub> or O<sub>2</sub> sensors
  - One or two sensors
  - Wide range of available combinations
  - Alkaline battery provides up to 9 months of 10 hours per day use
  - Full 5-year warranty on O<sub>2</sub>, and 3-year on CO and H<sub>2</sub>S sensors
  - Event / Datalogging standard
  - Programmable ceiling, STEL & TWA alarms
  - AutoCal<sup>®</sup> automatic manual calibration or use DS 400 Docking Station!



## Highly configurable, Smart-sensor design

- Notable two gas combinations:
  - H<sub>2</sub>S / SO<sub>2</sub>
  - NO / NO<sub>2</sub>
  - CO / HCN
  - O<sub>2</sub> / CO
  - O<sub>2</sub> / H<sub>2</sub>S
  - HCl / Cl<sub>2</sub>
  - H<sub>2</sub>S / THT
  - H<sub>2</sub>S / TBM.....and many more!



### Micro 5 G222E

Sturdy and compact  
dual gas detector for  
toxic gases, H<sub>2</sub> and O<sub>2</sub>

[www.gfggasdetection.co.uk](http://www.gfggasdetection.co.uk)

Support materials posted on [www.gfgsafety.com/us-en](http://www.gfgsafety.com/us-en) include:

- Data sheet
- Manual
- Operation Guide
- Excellent marketing video:

<https://youtu.be/GWFBk19WAJA>





## Multi-gas portable instrument considerations

- Do you have other gases of concern beyond the basic four most common atmospheric hazards (O<sub>2</sub>, LEL, CO and H<sub>2</sub>S)?
  - SO<sub>2</sub>?
  - VOCs?
  - Benzene?
  - Hydrogen?
  - CO<sub>2</sub>?
  - NO<sub>2</sub>?
  - Other gases?
- Do you use pump equipped or diffusion for toxic gas measurement?
  - Is it possible to equip your single-gas meters with a pump?



# What sensor configurations do you currently use for confined space entry?

- Do you have the right configuration, or are you thinking about a change?
- How many / what kinds of sensors are installed in your instruments?
  - Traditional 4 gas (LEL / O<sub>2</sub> / CO / H<sub>2</sub>S)?
  - 5 gas with PID?
  - Some other sensor configuration?
- What type of sensor are you using (or interested in using) for LEL?
  - Traditional CC LEL?
  - IR LEL?
  - MPS?
- Does the type of LEL sensor require changes in use or types of the other installed sensors?
  - Do you use different multi-sensor instruments for different activities or types of CS entry?
  - Confined spaces that contain VOC vapors?
  - CS entry into inerted vessels?



## Even more multi-gas questions

- Do you have alcohol, heavy fuels or VOCs on site?
  - VOC vapors are potentially explosive, but toxic at much lower concentrations.
  - Especially true for VOCs like benzene, toluene and xylenes.
  - Consider including a PID in multi-gas instruments used for fuel spills and other situations that involve VOC vapor.
- Do you run into VOCs during confined space entry?
  - If so, CS instruments should have PID sensor as well.



## Further multi-gas considerations

- Do you have any other contaminants or toxic gas concerns?
  - Oil and chemical industry sites have a long list of potential contaminants.
  - Consider including additional sensors in the multi-gas instrument, or
  - Use specialty sensors in separate instrument.
  - Watch out for compatibility issues!



# How do you sample the atmosphere from within the confined space?

- What instruments are you considering?
  - Is the instrument a diffusion only design?
  - Does the instrument have an attachable sample pump?
  - Does the instrument have a built-in pump?
  - Does the instrument have the option of switching from diffusion to sampling by means of the built-in pump?



# What types of battery and charging technology are available?

- Does the instrument have an internal or interchangeable battery packs?
- Alkaline option?
- What type of rechargeable battery?
  - Li Ion?
  - NiMH?
- Cold temperature performance?
- Charging options
  - Cradle?
  - Wall power / USB adapter?



## *What about periodic testing and calibration?*

- How often do you perform a bump test?
  - Before each day's use?
  - Do you keep bump test kits (with gas) with the instruments?
  - How do you prove your instruments have been bumped?
  - What do you do if you fail a bump test?
- How often do you perform a full calibration?
  - Do you use a docking station for bump tests and calibrations?
  - How do you prove your instruments are properly maintained and calibrated?
  - How do you retain maintenance and calibration records?
- Is your current strategy working?
  - Is it easy?



## *Complete kits specifically designed for oil industry customers*

- Complete G450 ecoBump kit with G450 with O<sub>2</sub>, LEL, CO and H<sub>2</sub>S sensors, push-button regulator, cylinder of test gas and foam lined carrying case.
- Each compact ecoBump cylinder provides up to 250 daily bump tests!
- Available with alkaline AA or rechargeable NiMH battery packs





# Are your gas detectors wirelessly enabled (or are you considering this option)?

- Most manufacturers now offer a “wireless” communication option.
  - Each manufacturer has its own strategy, with its own benefits and limitations.
  - Make sure you understand the wireless options and competitive benefits!
- Common communication methods:
  - Blue Tooth
  - Cellular
  - ISM RF
- Do you intend to use wireless communication during CS entry?
  - How do you get the information out of the space?



# Have you addressed “third-party” issues?

- Do you intend to use a remote call center service to coordinate emergency response?
- Do you intend to use a third-party rescue service (such as a corporate emergency response team, or the local fire department)?
- How will you coordinate real-time emergency information with all involved parties?



# What about after the sale support?

- Satisfaction is a function of ongoing support.
  - Atmospheric monitors and systems are life critical safety equipment.
  - You should expect excellent after the sale support!
- Don't forget to consider:
  - Warranty
    - Sensors
    - Instrument
- Technical support
  - Is your vendor there to provide help?
- Training
  - Videos?
  - In person?
  - Internet resources?



## Take advantage of free gas detection needs assessment!

- Finding out ways to improve worker safety
- Recognizing what's needed to for regulatory compliance
- Confidence you know the best solution!



### Request a **FREE** gas detection safety assessment from the experts at your local AD – Safety Network Distributor

Find out if your current gas detection program is up to date, safe and compliant

Whatever your application, chances are your Safety Distributor experts have seen it and solved it. They are here to help.

#### What's in it for you?

- A yours-to-keep listing of recommendations
- Knowing what's needed to keep your workers safe
- Knowing what's needed to ensure compliance
- Confidence you know the best solution
- Special savings on the industry leading gas detectors from GfG Instrumentation

Signup for your no-obligation assessment today!

Register

*Brand new, totally awesome, updated GfG website*

- GfG Instrumentation website: [www.gfgsafety.com/us-en](http://www.gfgsafety.com/us-en)



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Personal safety and gas sampling

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**Questions?**

**Thank you!**

**Bob Henderson**

**[bhenderson@goodforgas.com](mailto:bhenderson@goodforgas.com)**

***For additional information or gas detection help:***

***Website: <https://www.gfgsafety.com/us-en>***

***GfG Technical Support:***

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