Confined Space Gas Detection Issues and Answers

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Confined Space Gas Detection Issues and Answers

- Webinar goals:
  - Understand confined space gas detection requirements.
  - Identify your gas detection needs.
  - Understand the available gas solutions.
  - The questions you should ask!
    - Asking better questions leads to better solutions and ensures the instruments you specify and use, are fit for purpose!

Asking the right questions:

- Confined Space entry is one of the largest uses (and markets) for gas detection.
- Over 500,000 companies or departments in USA with CS programs.
- Over 1,000,000 CS entries per day.
- Over last 10 years on average 129 workers per year killed in the USA – <u>many</u> more injured.
- In almost every accident that stemmed from atmospheric conditions, CS gas detectors were not being used at the time the accident occurred.
- Ask questions when assessing you CS program!
- Make sure you understand your needs before deciding on a solution.
- Drill down to make sure you understand what is most important.

History of OSHA Confined Space Entry Requirements

- In 1993 OSHA enacted 29 CFR 1910.146 “Permit-Required Confined Spaces.”
  - Provisions applied only to general industry work.
  - 1910.146 does not apply to industries with their own vertical standards:
    - Agriculture
    - Construction
    - Shipyard employment
- Original intent was to extend 1910.146 to include construction.
- However, it was quickly recognized that 1910.146 did not fully address issues unique to the construction industry, such as:
  - Higher employee turnover rates
  - Worksites that change frequently
  - Multi-employer business model

29 CFR 1926 Subpart AA: Confined Spaces in Construction

- Until recently, this left a gap in construction related CS procedures.
- As of 2015, Construction finally has its own standard: 29 CFR 1926 Subpart AA “Confined Spaces in Construction.”
- Many construction contractors have still not implemented the updated requirements!
- Most of the requirements in the construction CS rule are applicable to industrial CS entry as well.

safeopedia

How does the Construction CS rule differ with the General Industry CS rule?

- It doesn't really differ; it expands and explains the requirements common to both standards.
- The Construction CS rule is similar in content and organization to the general industry confined spaces standard but incorporates additional information and requirements.
- Strengthens requirements for CS gas detection, as well as performing bump test, calibration and maintenance.

Characteristics of Confined Spaces

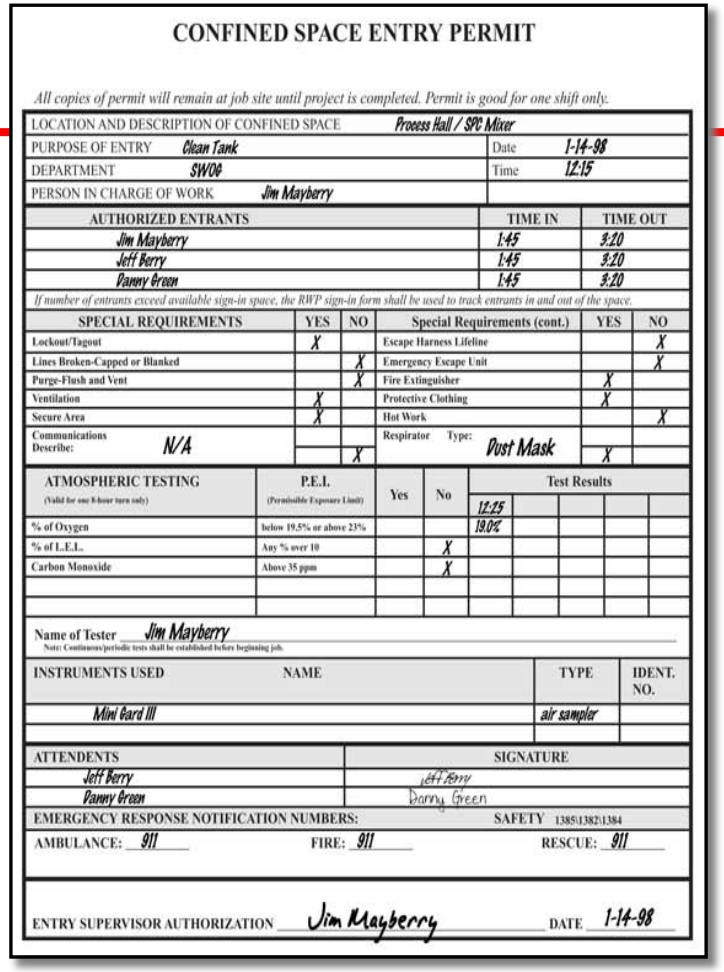
- Large enough for worker to enter.
- Are not designed for continuous worker occupancy.
- Limited openings for entry and exit.

Permit Required Confined Spaces

- One or more of the following:
  - Hazardous atmosphere (known or potential).
  - Material with the potential for engulfment.
  - Inwardly sloping walls or dangerously sloping floors,

    or

  - Contains any other serious safety hazard.



CONFINED SPACE ENTRY PERMIT

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LOCATION AND DESCRIPTION OF CONFINED SPACE	Process Hall / SPC Mixer		
PURPOSE OF ENTRY	Clean Tank	Date	1-14-98
DEPARTMENT	SWOC	Time	12:15
PERSON IN CHARGE OF WORK	Jim Mayberry		

AUTHORIZED ENTRANTS	TIME IN	TIME OUT
Jim Mayberry	1:45	3:20
Jeff Berry	1:45	3:20
Danny Green	1:45	3:20

If number of entrants exceed available sign-in space, the RWP sign-in form shall be used to track entrants in and out of the space.

SPECIAL REQUIREMENTS	YES	NO	Special Requirements (cont.)	YES	NO
Lockout/Tagout	X		Escape Harness Lifeline		X
Lines Broken-Capped or Blanked		X	Emergency Escape Unit		X
Purge-Flush and Vent		X	Fire Extinguisher	X	
Ventilation	X		Protective Clothing	X	
Secure Area	X		Hot Work		X
Communications Describe: N/A		X	Respirator Type: Dust Mask	X	

ATMOSPHERIC TESTING (Valid for one 8-hour turn only)	P.E.I. (Permissible Exposure Limit)	Yes	No	Test Results				
				12:15				
% of Oxygen	below 19.5% or above 23%			19.0%				
% of L.E.L.	Any % over 10		X					
Carbon Monoxide	Above 35 ppm		X					

Name of Tester Jim Mayberry

Note: Continuous/periodic tests shall be established before beginning job.

INSTRUMENTS USED	NAME	TYPE	IDENT. NO.
Mini Gard III		air sampler	

ATTENDENTS	SIGNATURE
Jeff Berry	Jeff Berry
Danny Green	Danny Green

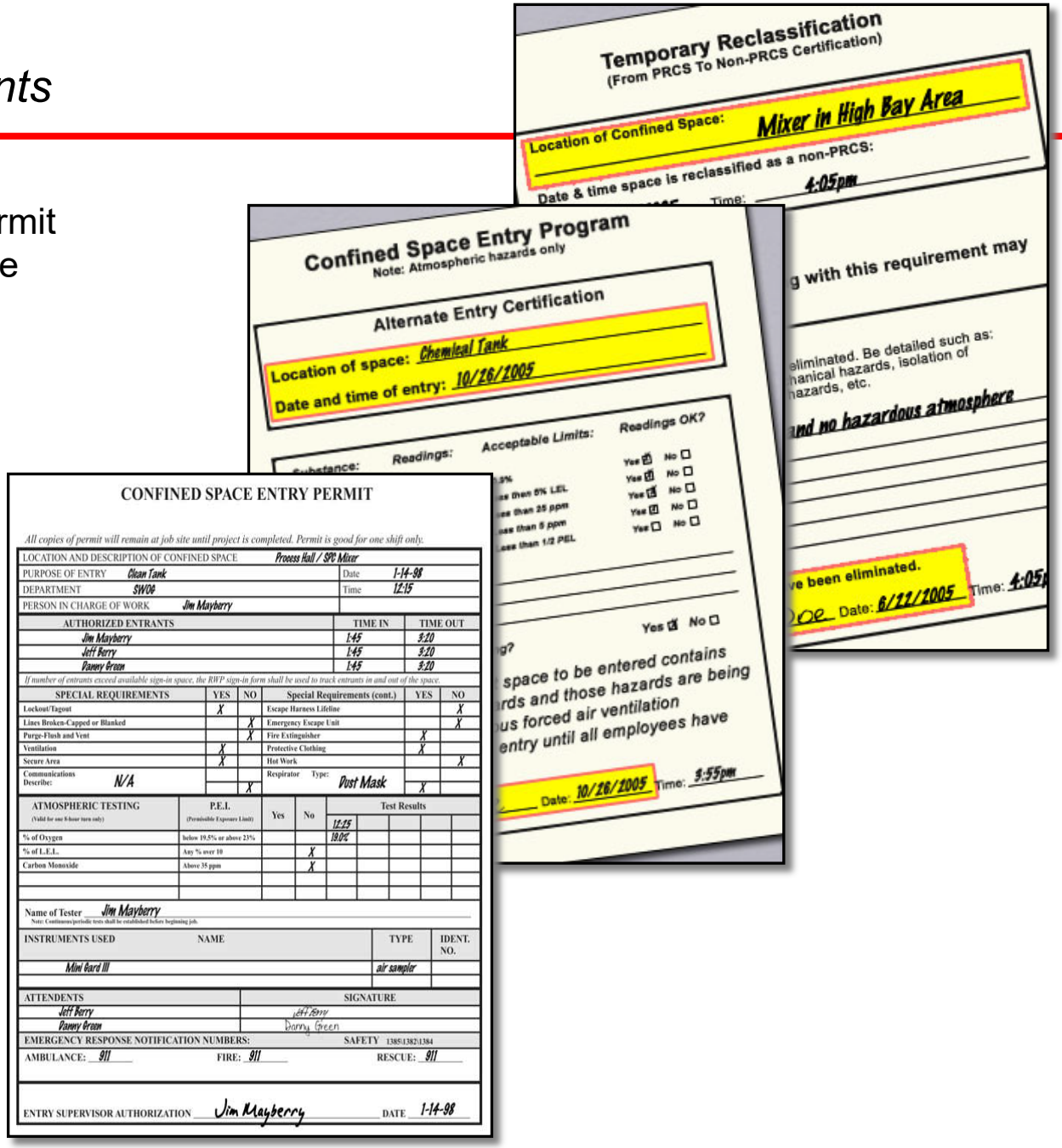
EMERGENCY RESPONSE NOTIFICATION NUMBERS: SAFETY 1385\1382\1384

AMBULANCE: 911 FIRE: 911 RESCUE: 911

ENTRY SUPERVISOR AUTHORIZATION Jim Mayberry DATE 1-14-98

General Requirements

- Options for entry into Permit Required Confined Space (PRCS):
  - Reclassification
  - Alternate entry procedures
  - Permit program



Temporary Reclassification
(From PRCS To Non-PRCS Certification)

Location of Confined Space: Mixer in High Bay Area

Date & time space is reclassified as a non-PRCS: 4:05pm

Confined Space Entry Program
Note: Atmospheric hazards only

Alternate Entry Certification

Location of space: Chemical Tank

Date and time of entry: 10/26/2005

Substance: | Readings: | Acceptable Limits: | Readings OK?

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Lines Broken-Capped or Blanked		X	Emergency Escape Unit		X
Purge-Flush and Vent		X	Fire Extinguisher	X	
Ventilation	X		Protective Clothing	X	
Secure Area	X		Hot Work		X
Communications Describe: N/A		X	Respirator Type: Dust Mask	X	

ATMOSPHERIC TESTING (Valid for one 8-hour turn only)	P.E.L. (Permissible Exposure Limit)	Yes	No	Test Results 12:15
% of Oxygen	below 19.5% or above 23%			19.0%
% of L.E.L.	Any % over 10		X	
Carbon Monoxide	Above 35 ppm		X	

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ENTRY SUPERVISOR AUTHORIZATION: Jim Mayberry DATE: 1-14-98

Reclassification as non PRCS

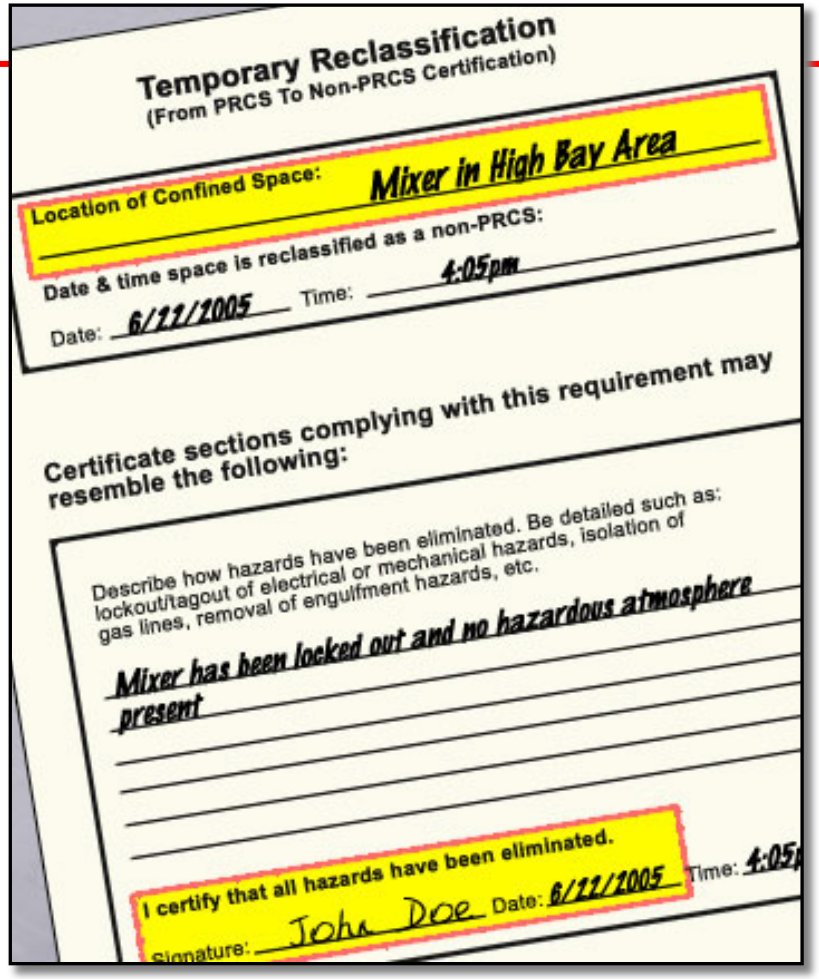
- A PRCS can be reclassified as a non-permit space IF AND ONLY IF the space contains no actual or potential atmospheric hazards, and if all other hazards can be eliminated without entry into the space.
  - Reclassification requires that no ongoing measures are required to keep the space safe.
  - The reclassification is valid only as long as the hazard is eliminated.
  - When hazards are reintroduced into a space, the space becomes a permit space again.

Elimination of hazardous conditions

- In order to reclassify the space, all serious hazards must be eliminated prior to entry.
- “Serious” recognized hazard is broadly defined.

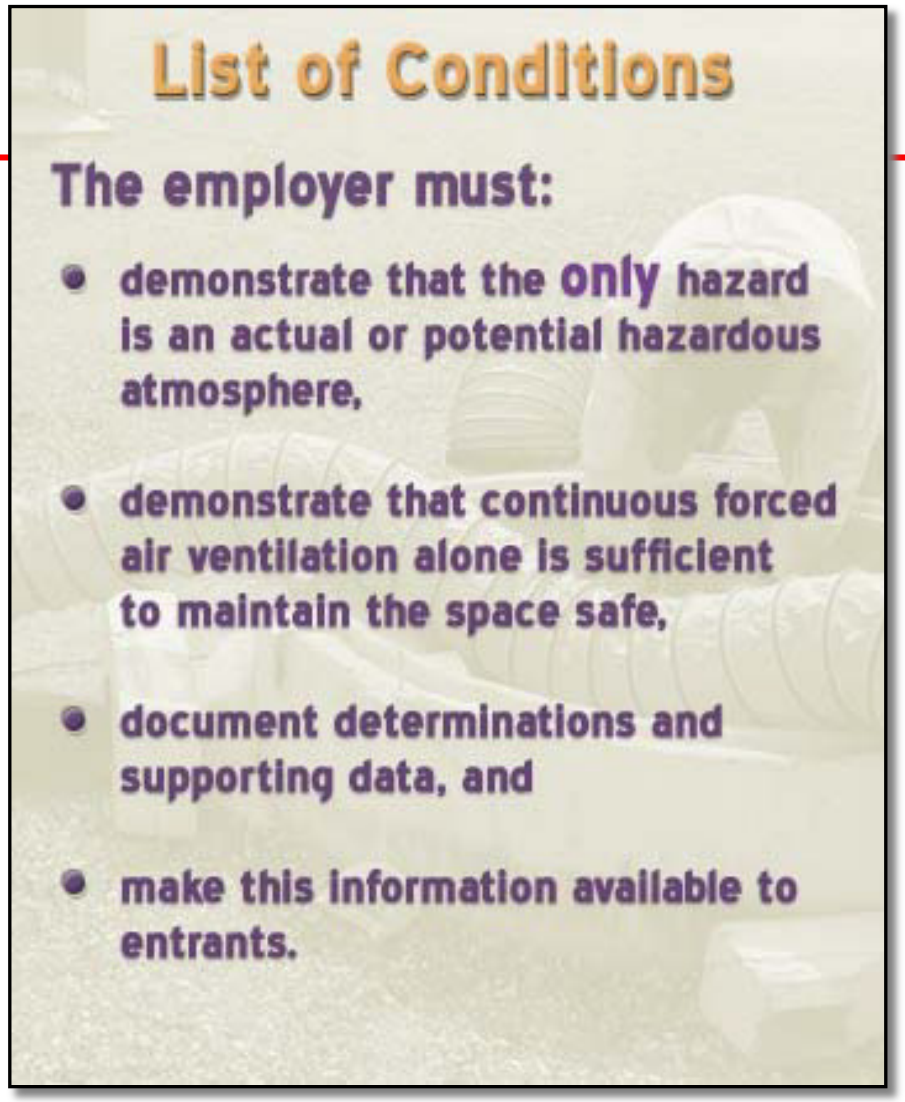
Reclassification as non PRCS

- The employer must certify that all hazards from the space have been eliminated and provide that certification to all employees entering that space.
- The reclassification is valid only as long as the hazard remains eliminated.



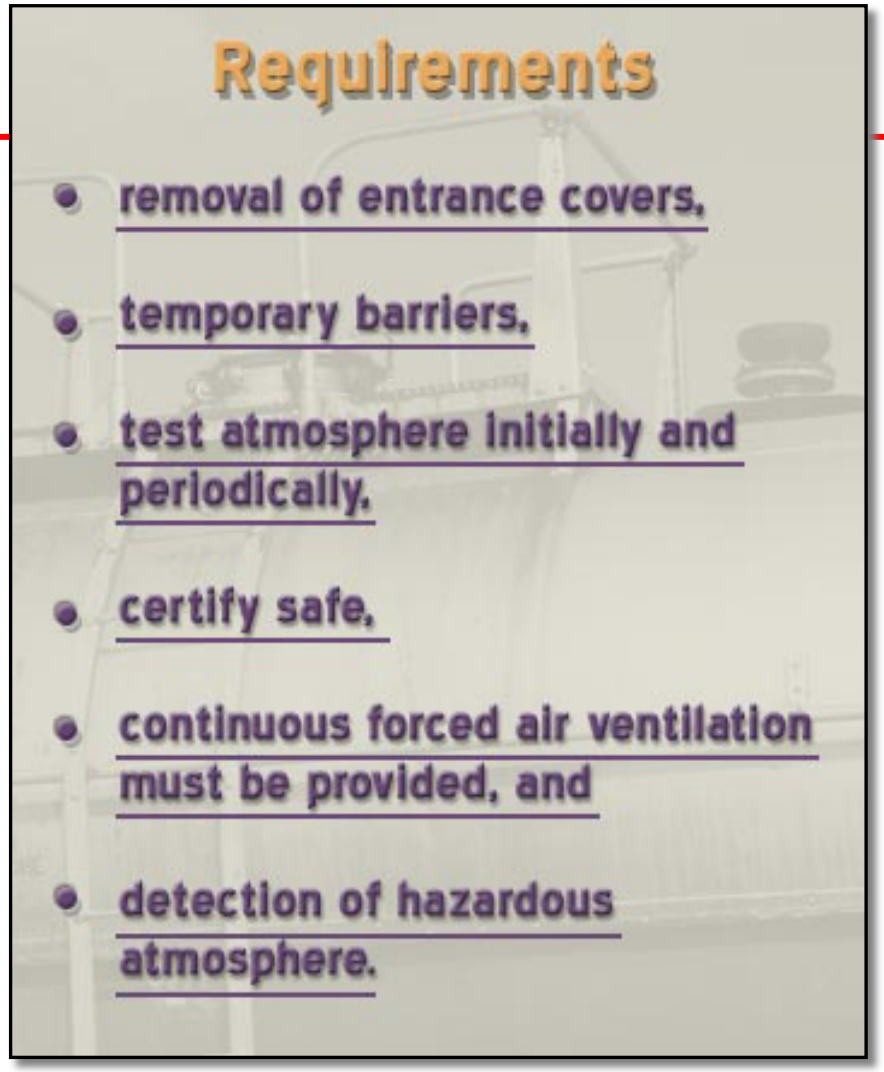
Alternate Entry Procedures

- If a hazard cannot be eliminated, but can be controlled by continuous forced air ventilation, then alternate entry procedures can be used.
- Both standards list the same conditions under which alternate entry procedures can be used.
- Benefits:
  - Substantially lower equipment requirements.
  - No attendants required.
  - Solo entries permitted.



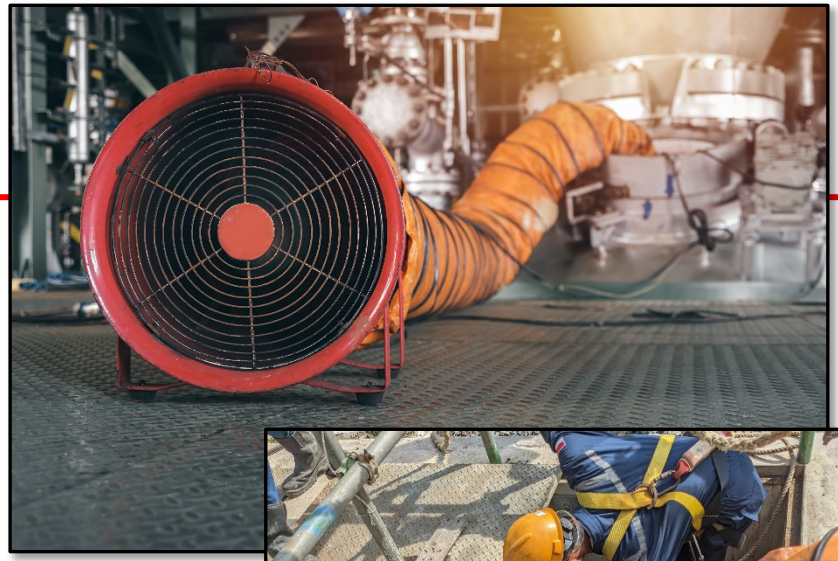
Alternate Entry Procedures

- Before employee enters the space, internal atmosphere must be tested with a calibrated, direct-reading instrument for oxygen, flammable gases and vapors, and for potential toxic air contaminants.
- The CS may not be disturbed in an unsafe manner prior to being tested!
- The atmosphere within the space must continue to be tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere.
- There may be no hazardous atmosphere within the space whenever any employee is inside the space.



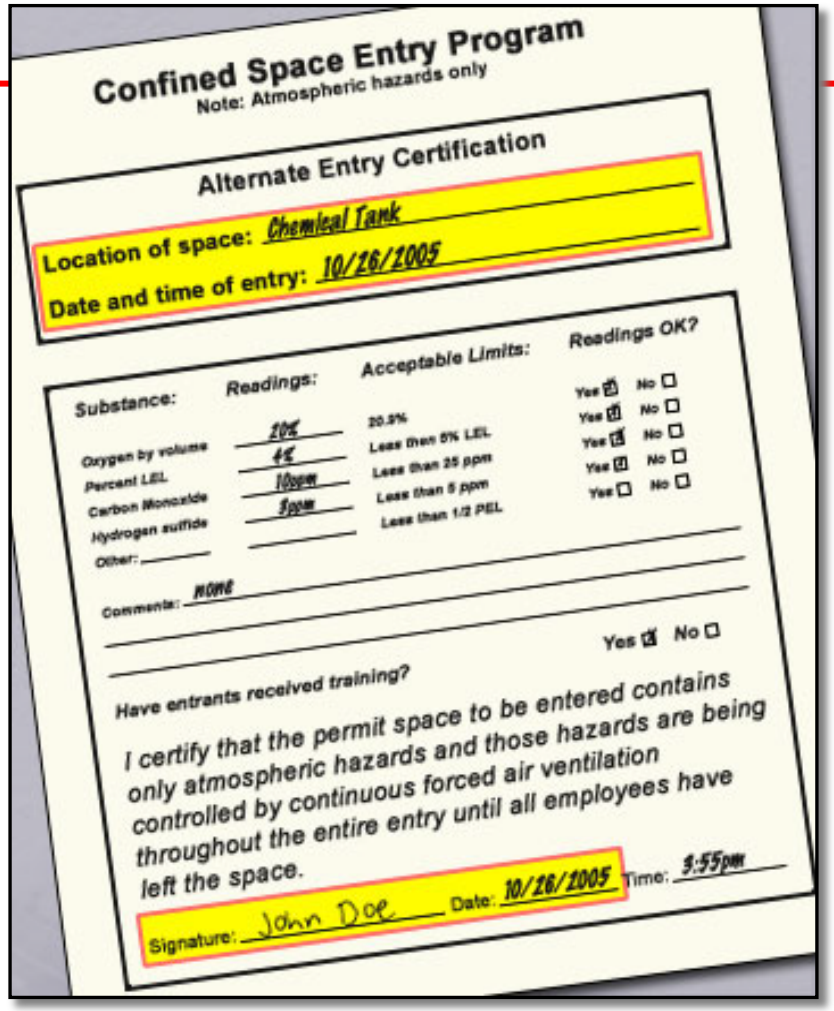
Alternate Entry Procedures

- Continuous forced air ventilation must be used for the entire duration of the entry.
- Entry under the alternate entry permit is voided if the ventilation stops, or if a hazardous condition is detected.
- Sufficient time must be available for an entrant to safely exit the space if the ventilation stops.



Alternate Entry Procedures

- The employer must certify that the space is safe for entry.



Confined Space Entry Program
Note: Atmospheric hazards only

Alternate Entry Certification

Location of space: Chemical Tank
Date and time of entry: 10/26/2005

Substance:	Readings:	Acceptable Limits:	Readings OK?
Oxygen by volume	20%	20.8%	Yes ☑ No ☐
Percent LEL	4%	Less than 5% LEL	Yes ☑ No ☐
Carbon Monoxide	10ppm	Less than 25 ppm	Yes ☑ No ☐
Hydrogen sulfide	5ppm	Less than 5 ppm	Yes ☑ No ☐
Other:		Less than 1/2 PEL	Yes ☐ No ☐

Comments: NONE

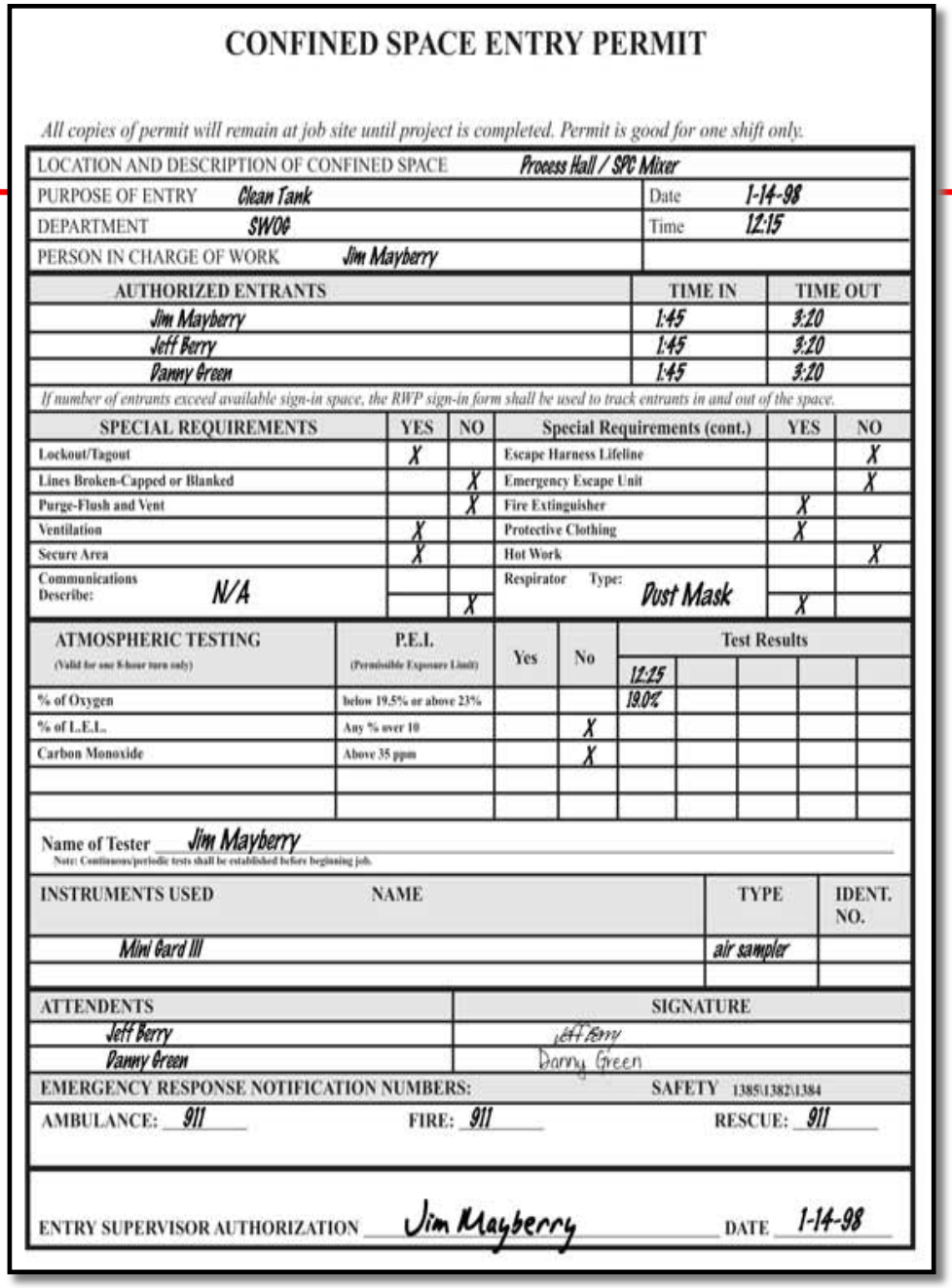
Have entrants received training? Yes ☑ No ☐

I certify that the permit space to be entered contains only atmospheric hazards and those hazards are being controlled by continuous forced air ventilation throughout the entire entry until all employees have left the space.

Signature: John Doe Date: 10/26/2005 Time: 5:55pm

Permit Program

- If hazards cannot be eliminated or controlled, only remaining option is implementation of comprehensive permit space program.
- Permit specifies means, procedures, and practices for safe entry.
- Establishes all protective measures have been taken.



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Lines Broken-Capped or Blanked		X	Emergency Escape Unit		X
Purge-Flush and Vent		X	Fire Extinguisher	X	
Ventilation	X		Protective Clothing	X	
Secure Area	X		Hot Work		X
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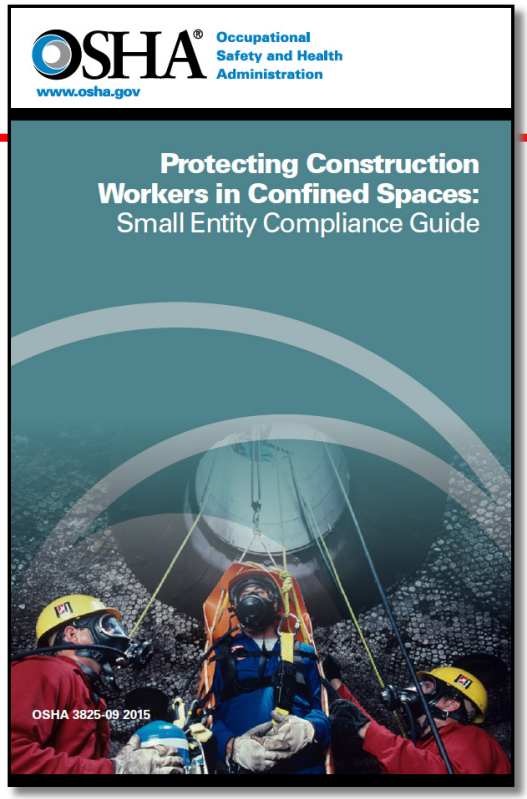
Types of confined spaces

- 29 CFR 1926 includes a lengthy list of confined spaces that are covered by the new rule.
- The list should be deemed to be permit confined spaces under <u>both</u> CS standards.

Have you made a complete survey of the permit confined spaces at the site?

- Boilers
- Manholes (sewer, storm drain, electrical, communication, utility, etc.)
- Precast concrete manhole units
- Tanks (fuel, chemical, water, other liquid, solid or gas)
- Incinerators
- Concrete pier columns
- Sewers and storm drains
- Transformer vaults
- Heating, ventilation, and air-conditioning (HVAC) ducts
- Cesspools
- Mixers/reactors
- Bag houses
- Turbines
- Silos
- Chillers

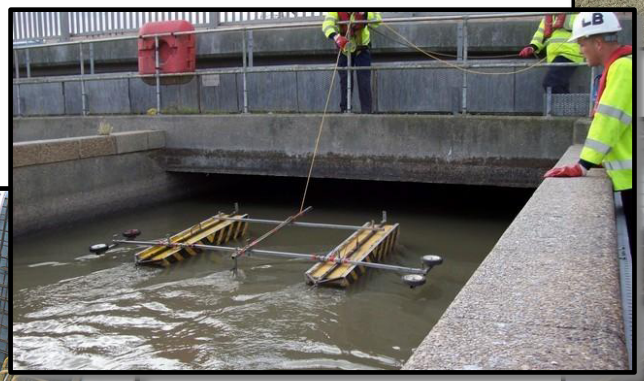


https://www.osha.gov/Publications/OSHA3825.pdf

Are confined spaces always fully enclosed?

- Open-topped water tanks
- Digesters and lift stations
- Bins
- Degreasers
- Pits (elevator, escalator, pump, valve, etc.)

https://www.osha.gov/Publications/OSHA3788.pdf



Are crawl spaces and attics confined spaces?

- Even if the space is not a PRCS <u>after</u> construction, it may represent a dangerous permit space at certain stages during construction.
  - The rule includes residential as well as commercial and industrial construction.
- Confined space hazards in crawl spaces and attics have led to worker deaths:
  - Two workers died while applying primer to floor joists in a crawl space. They were burned when an incandescent work lamp ignited vapors from the primer.
  - A flash fire killed a worker who was spraying foam insulation in an enclosed attic. The fire was caused by poor ventilation.

What are the General Requirements?

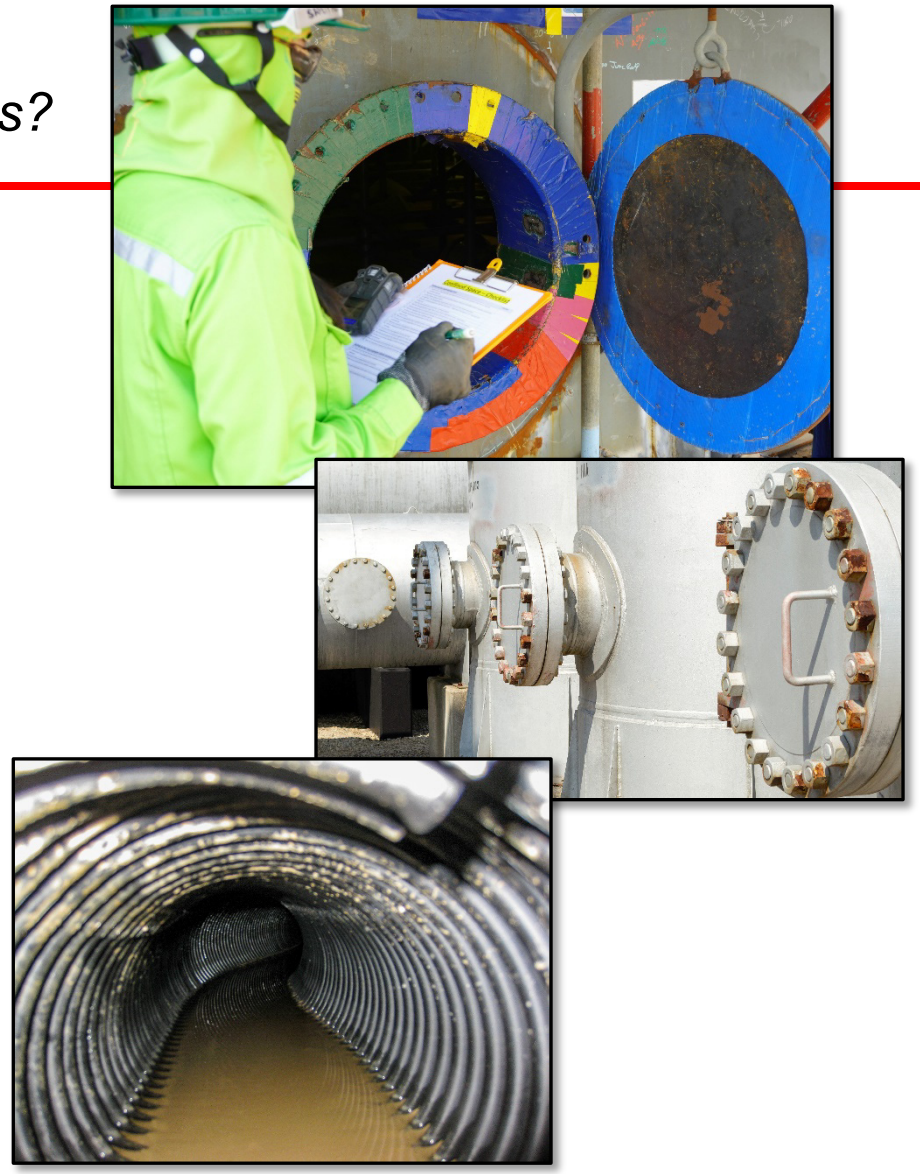
- Employers Must:
  - Identify Confined Space hazard areas
  - Inform employees by posting signs where feasible
  - Prevent entry by unauthorized persons

What are the General Requirements?

- Employers must ensure the required equipment is available:
  - Testing and monitoring
  - Ventilation
  - Communications
  - Lighting
  - Barriers
  - Other personal protective equipment
  - Any required rescue and emergency equipment

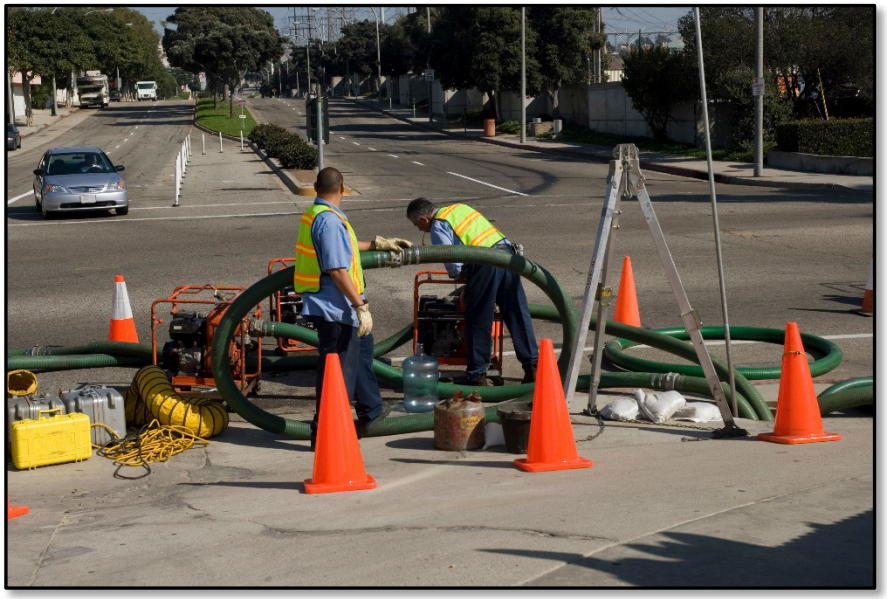
What are the General Requirements?

- Employers Must:
  - Establish procedures and practices to allow safe entry (Permit system)
  - Train employees / verify workers are competent
    - Only workers who have been assigned and trained to work in a permit space may do so.
  - Ensure required equipment is available and used
  - Control hazards where possible through engineering or work practices



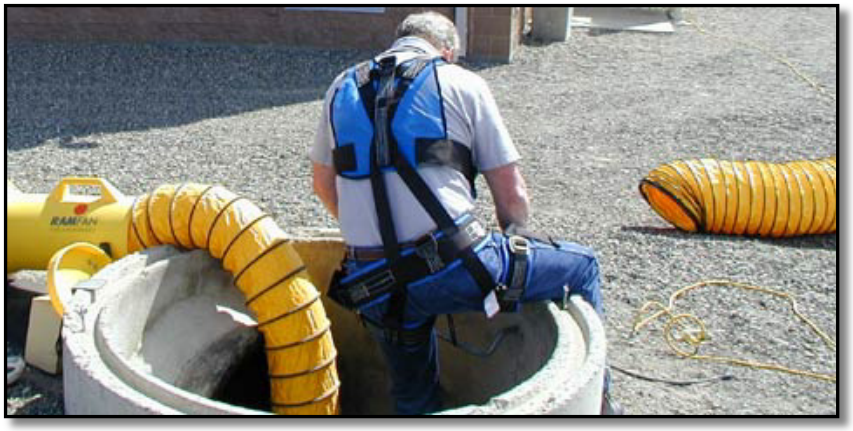
What are the General Requirements?

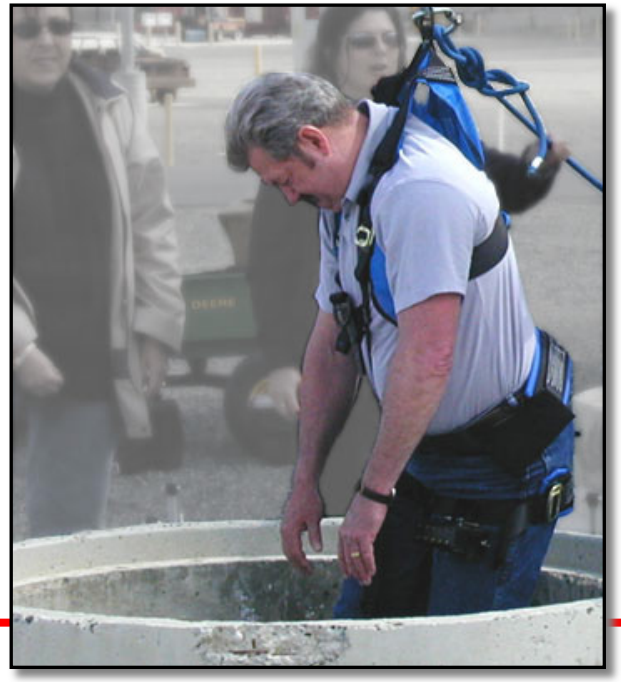
- Employers Must:
  - Protect entrants from external hazards
  - Enforce established procedures
  - Ensure procedures and equipment necessary for rescue
    - Calling 911 after the accident occurs is not a plan!



Emergency Procedures

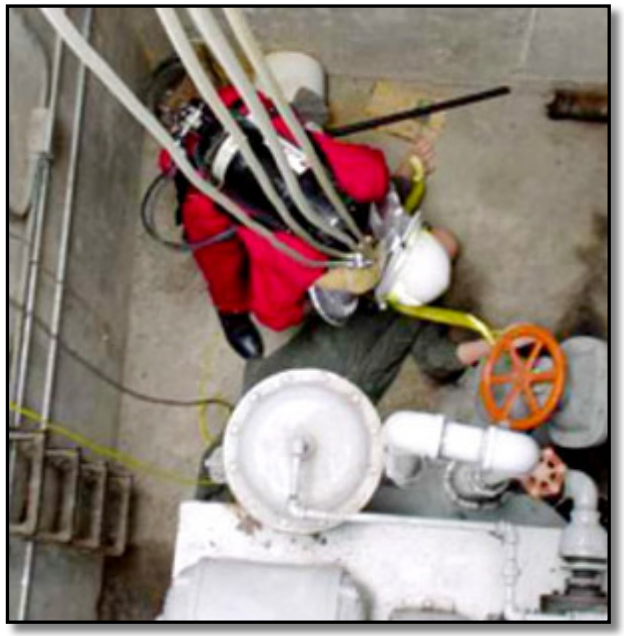
- Must reflect the specific dangers of the confined space.
- Attendant should not enter confined space until help arrives.
- Two out of three workers killed in confined space accidents are would-be rescuers!





What are the requirements for rescue plans and procedures?

- Self rescue: Entry procedures should aim at getting workers out under their own power BEFORE conditions become life threatening.
- Non-entry rescue: Second best approach is to use procedures that allow rescue without having to enter the space.
- Rescuer entry: Least desirable, highest risk, most equipment and personnel intensive approach.



Increased emphasis on training

- Dangers associated with construction confined spaces can change from day-to-day because of the work being performed.
- Even more important that workers are trained to recognize potential dangers!
- Employer must ensure employees possess knowledge and necessary skills and are competent for the safe performance of their assigned duties.
    - Understand the hazards and the methods used to isolate, control and protect employees.
    - Understand the dangers of attempting rescues unless trained, equipped and authorized to do so!

Increased emphasis on communication

- Workers and contractors at construction site can change from day to day.
- The Entry Employer must ensure that all Entry Supervisors, Authorized Entrants and Attendants are properly trained, and that they properly follow the requirements of the Employer's confined space entry program.
- Whenever responsibility for a PRCS is transferred the Entry Supervisor determines that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained.

1926.1203(e)(2): Requires calibrated direct reading instrument

- Perform “bump test” or “calibration check” on all sensors before each day’s use.
- Calibrate and maintain instrument per manufacturer requirements.
- Maintain records that prove these requirements are being met.
- GfG Application Note 1007: Calibration and Bump Test Requirements

http://goodforgas.com/wp-content/uploads/2014/09/AP1007_calibration_requirements_for_direct_reading_portable_gas_monitors_8_AUG_14.pdf

AP 1007:
Calibration and Bump Test Requirements for Direct Reading Portable Gas Monitors

Manufacturers and regulatory agencies agree the safest and most conservative approach is to perform a functional test by exposing your gas detector to test gas before each day’s use.

Oxygen deficiencies, explosive atmospheres, and exposure to toxic gases and vapors injure hundreds of workers every year. The atmospheric conditions that lead to these accidents and fatalities are usually invisible to the workers who are involved. The only way to ensure atmospheric conditions are safe is to use an atmospheric monitor. The only way to know whether an instrument is capable of proper performance is to expose it to test gas. Exposing the instrument to known concentration test gas verifies that gas is properly able to reach and be detected by the sensors. It verifies the proper performance of the instrument’s alarms, and (if the instrument is equipped with a real-time display), that the readings are accurate. Failure to periodically test and document the performance of your atmospheric monitors can leave you open to regulatory citations or fines, as well as increased liability exposure in the event that a worker is injured in an accident.

There has never been a consensus among manufacturers regarding how frequently direct reading portable gas detectors need to be calibrated. However, manufacturers do agree that the safest and most conservative approach is to verify the performance of the instrument by exposing it to test gas before each day’s use. Performing a functional “bump test” is very simple and takes only a few seconds to accomplish. It is not necessary to make a calibration adjustment unless the readings are found to be inaccurate. The regulatory standards that govern confined space entry and other activities that include the use of direct reading instruments are in agreement with this approach.

However, the definition of “bump test” has always been a little slippery. Some manufacturers differentiate between a “bump test” that provides a qualitative evaluation of the instrument’s ability to detect gas and a “calibration check” that verifies that the response of the sensor(s) when exposed to known concentration test gas are within the manufacturer’s requirements for accuracy. All manufacturers agree that instruments that fail either a “bump test” or “calibration check” should be put through a “full calibration” before further use.

ISEA Statement on Validation of Operation for Direct Reading Portable Gas Monitors

The International Safety Equipment Association (ISEA) is the leading international organization of manufacturers of safety equipment, including environmental monitoring instruments. The ISEA is dedicated to protecting the health and safety of workers through the development of workplace standards and the education of users on safe work practices and exposure prevention. In 2010 the ISEA updated their protocol for, *“Validation Procedures of Operation For Direct Reading Portable Gas Monitors”* to clarify the Association’s recommendations for the procedures used to verify proper operation, and the accuracy of the readings.

The protocol was designed to reemphasize to OSHA and other standards writing bodies the importance of verifying the calibration of instruments used to monitor the atmosphere in potentially hazardous locations, to clarify the differences

Figure 1: Performing a functional "bump test" by exposing the instrument to test gas takes only a few moments perform.

GfG Instrumentation
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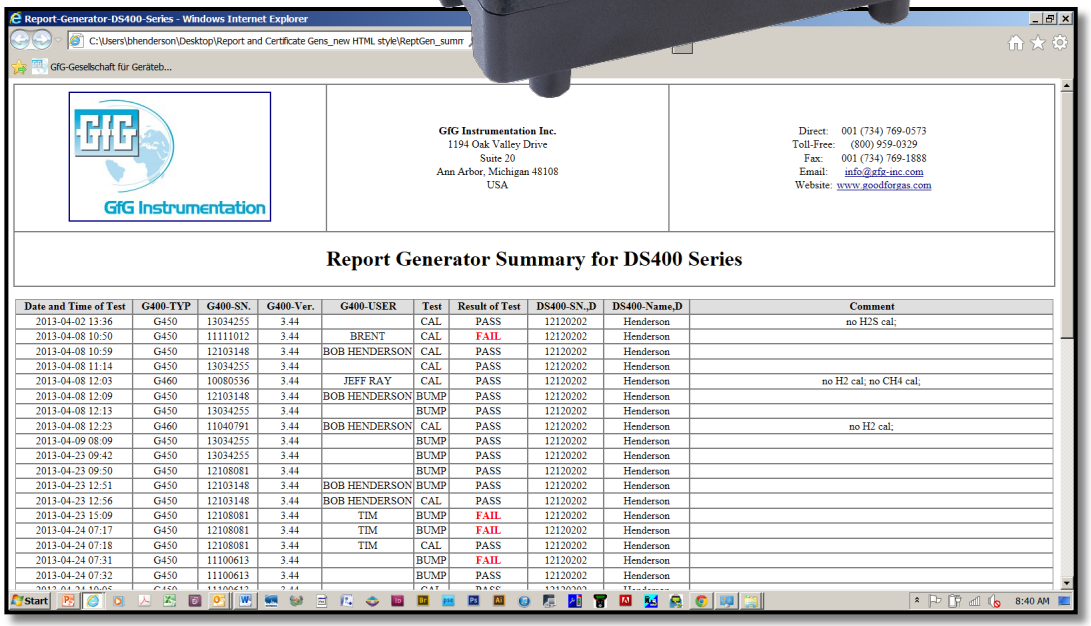
800-959-0329 • 734-769-0573 • 734-769-1888 fax
Worldwide Manufacturer of Gas Detection Solutions
www.goodforgas.com

AP1007_8_AUG_14

Docking stations

- Make performing “Bump check” and “Calibration” easy and automatic
- Verifies readings are accurate
- Verifies audible alarms and LED alarms are properly activated when exposed to gas
- Documents the results



Report-Generator-DS400-Series - Windows Internet Explorer

C:\Users\bhenderson\Desktop\Report and Certificate Gens_new HTML style\ReptGen_summr

GfG-Gesellschaft für Geräteb...

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Fax: 001 (734) 769-1888
Email: info@gfg-inc.com
Website: www.goodforgas.com

Report Generator Summary for DS400 Series

Date and Time of Test	G400-TYP	G400-SN.	G400-Ver.	G400-USER	Test	Result of Test	DS400-SN_D	DS400-Name,D	Comment
2013-04-02 13:36	G450	13034255	3.44		CAL	PASS	12120202	Henderson	no H2S cal;
2013-04-08 10:50	G450	11111012	3.44	BRENT	CAL	FAIL	12120202	Henderson	
2013-04-08 10:59	G450	12103148	3.44	BOB HENDERSON	CAL	PASS	12120202	Henderson	
2013-04-08 11:14	G450	13034255	3.44		CAL	PASS	12120202	Henderson	
2013-04-08 12:03	G460	10080536	3.44	JEFF RAY	CAL	PASS	12120202	Henderson	no H2 cal; no CH4 cal;
2013-04-08 12:09	G450	12103148	3.44	BOB HENDERSON	BUMP	PASS	12120202	Henderson	
2013-04-08 12:13	G450	13034255	3.44		BUMP	PASS	12120202	Henderson	
2013-04-08 12:23	G460	11040791	3.44	BOB HENDERSON	CAL	PASS	12120202	Henderson	no H2 cal;
2013-04-09 08:09	G450	13034255	3.44		BUMP	PASS	12120202	Henderson	
2013-04-23 09:42	G450	13034255	3.44		BUMP	PASS	12120202	Henderson	
2013-04-23 09:50	G450	12108081	3.44		BUMP	PASS	12120202	Henderson	
2013-04-23 12:51	G450	12103148	3.44	BOB HENDERSON	BUMP	PASS	12120202	Henderson	
2013-04-23 12:56	G450	12103148	3.44	BOB HENDERSON	CAL	PASS	12120202	Henderson	
2013-04-23 15:09	G450	12108081	3.44	TIM	BUMP	FAIL	12120202	Henderson	
2013-04-24 07:17	G450	12108081	3.44	TIM	BUMP	FAIL	12120202	Henderson	
2013-04-24 07:18	G450	12108081	3.44	TIM	CAL	PASS	12120202	Henderson	
2013-04-24 07:31	G450	11100613	3.44		BUMP	FAIL	12120202	Henderson	
2013-04-24 07:32	G450	11100613	3.44		BUMP	PASS	12120202	Henderson	

Start

8:40 AM

Monitor and ventilate continuously

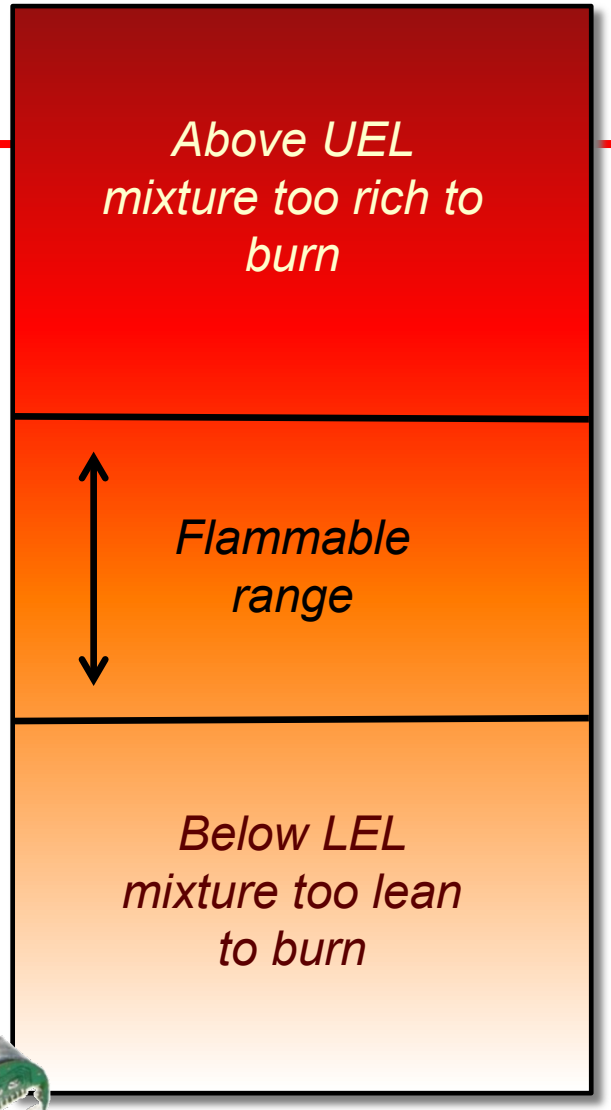
- Before entry it is mandatory to determine that the CS atmosphere is safe!
- Many accidents result from changes in the CS atmosphere which occur <u>after</u> the entry is initiated.
- Monitoring determines the air is safe, ventilation keeps it that way.
- The only way to pick up changes before they become life threatening is to monitor continuously!

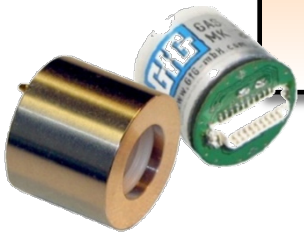
What are the most common CS atmospheric hazards?

- Oxygen deficiency
- Oxygen enrichment
- Presence of toxic gases
- Presence of combustible gases
- Typically use a 4 gas or 5 gas detector with:
  - LEL
  - O_2
  - CO
  - H_2S
  - PID

Choosing the right type of LEL sensor increasingly important issue!

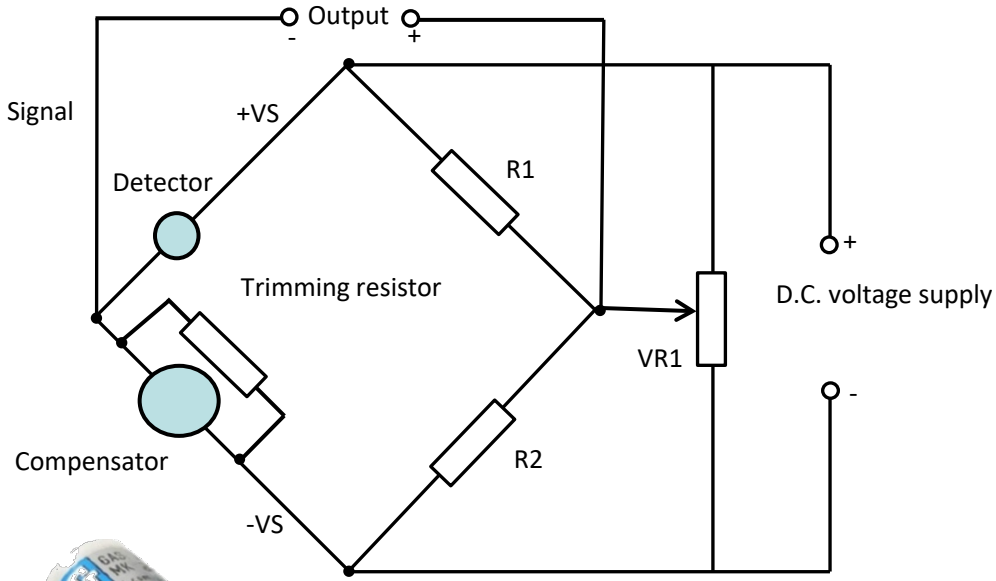
- Make sure the LEL sensor you specify is fit for purpose!
  - None are perfect!
  - All have limitations!
- Several types of LEL sensors are widely available.
  - Traditional catalytic (Wheatstone bridge) LEL sensor
  - Infrared (NDIR) LEL sensor
  - MPS (Molecular Spectrometer) LEL sensor

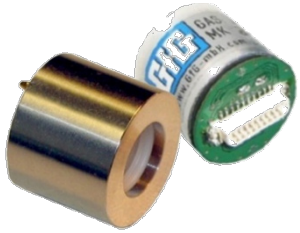




Catalytic "Hot Bead" Combustible Sensor

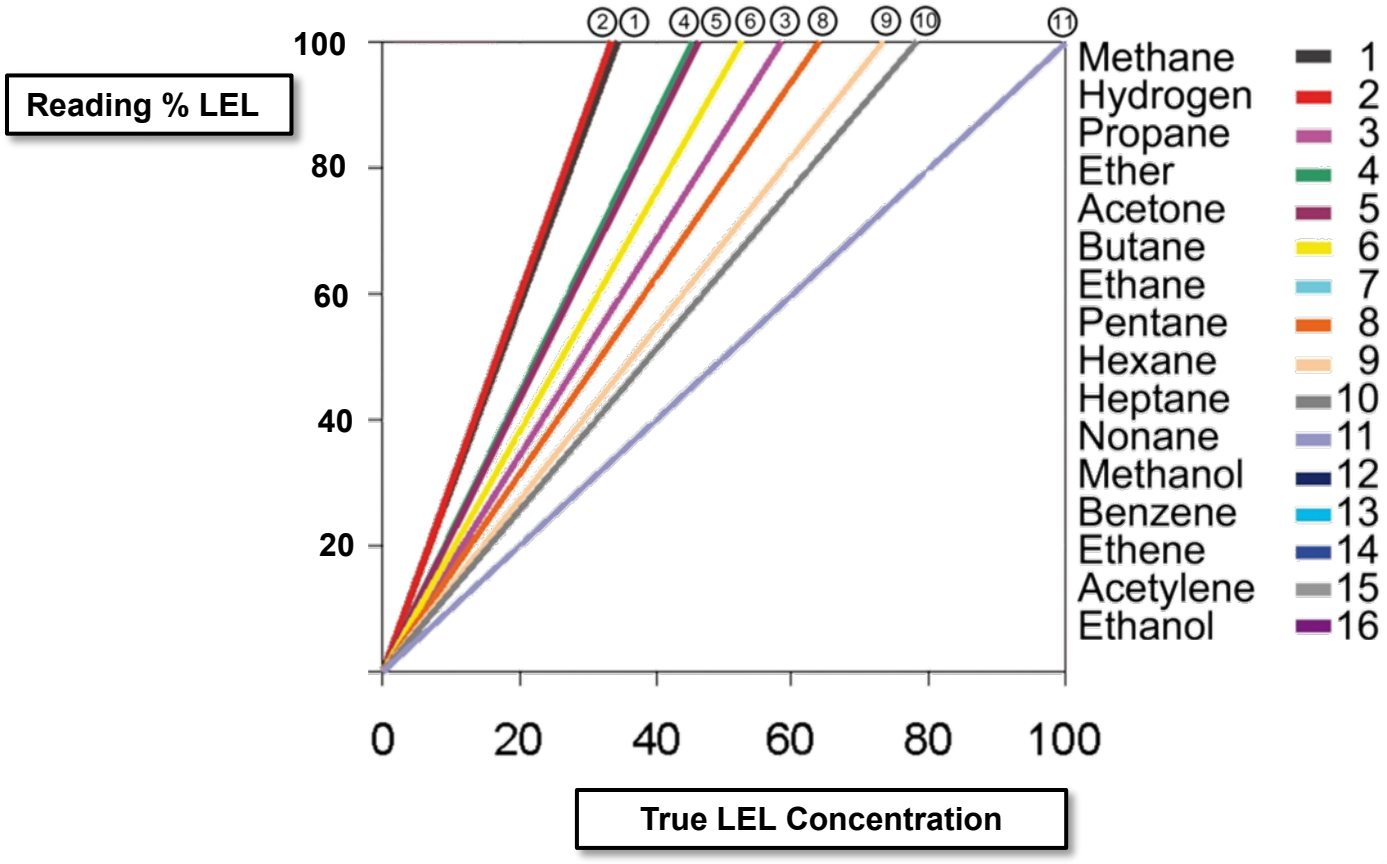
- Detects combustible gas by catalytic oxidation
- When exposed to gas oxidation reaction causes the active (detector) bead to heat.
- Requires oxygen to detect gas!





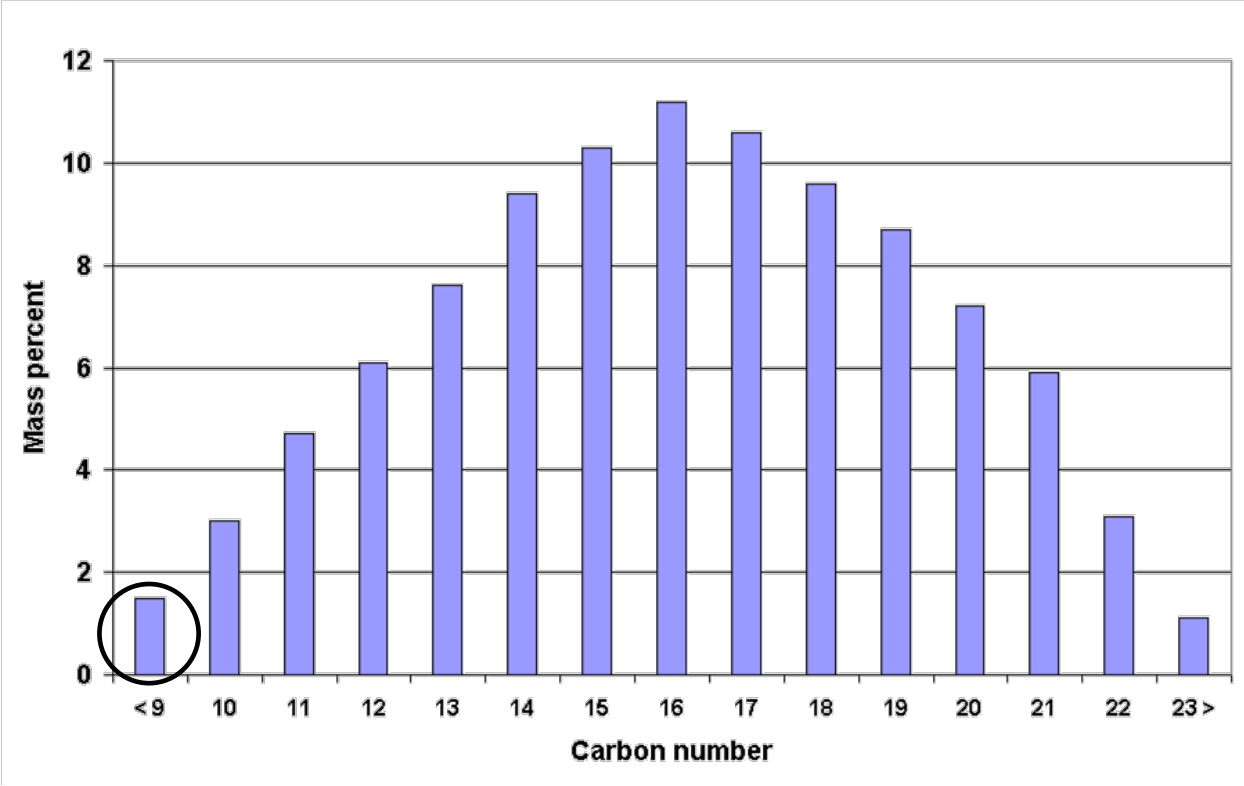
Catalytic (CC) LEL combustible gas sensor response curves

- The larger the molecule, the lower and slower the relative response.
- Molecules larger than nonane (C9H20) very difficult for CC LEL sensor to detect.



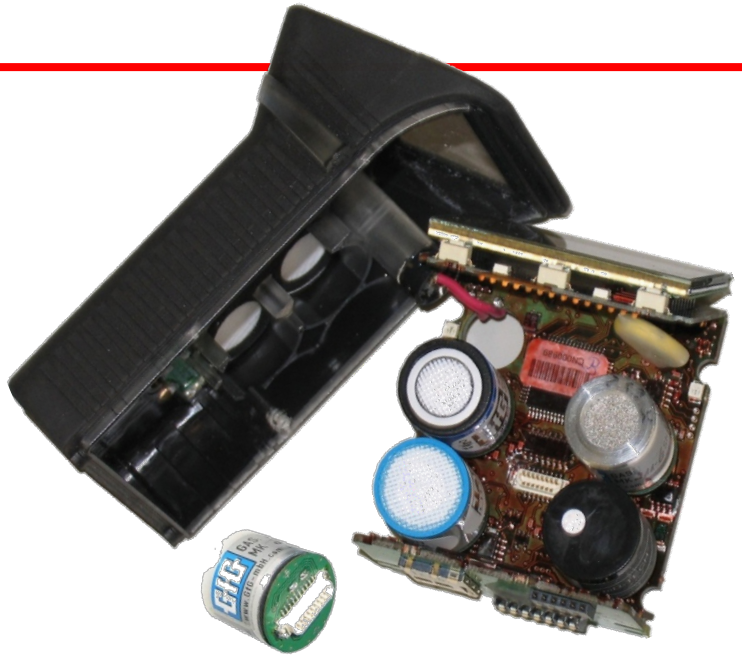
Typical carbon number distribution in No. 2 Diesel Fuel (liquid)

- Less than 2% of molecules in diesel vapor are small enough to be measured by means of standard catalytic percent LEL range sensor.
- Even if you can smell the diesel vapor, a standard CC LEL sensor may not show a response!

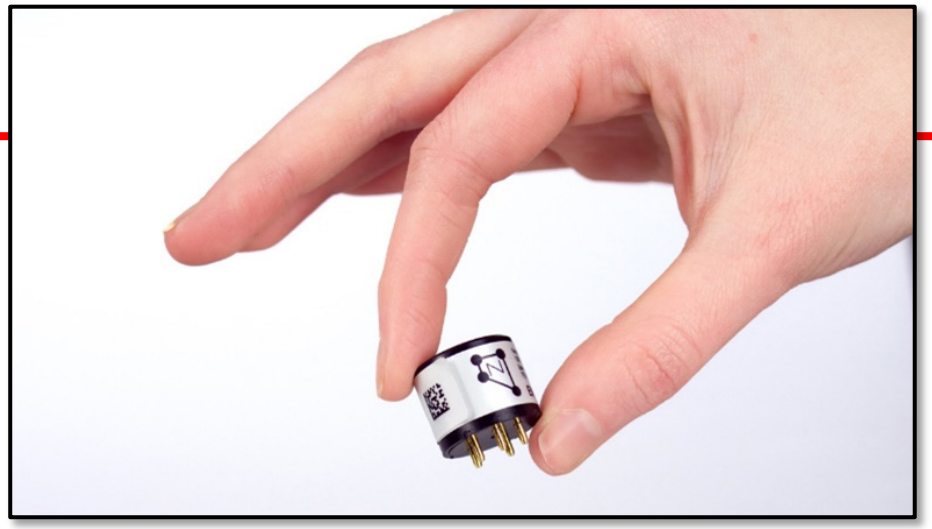


Advantages and disadvantages of catalytic LEL sensors

- Able to detect most LEL gases including H_2 and acetylene.
- Cross sensitivity to other gases well understood, and most instruments include built-in library of correction factors.
- Takes a lot of power to operate.
- Poor response to larger molecules.
- Slower response to larger molecules vapors).
- Easily poisoned (especially by silicone vapors).
- Exposure to high concentration combustible gas damaging to sensor.
- Must have minimum of 10% O_2 to accurately detect gas.



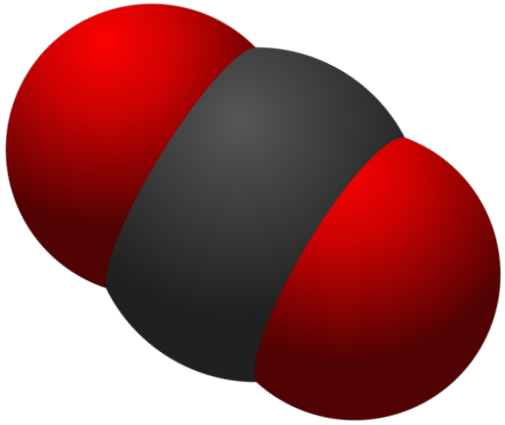
Molecular Properties Spectrometer (MPS) sensor



- Extremely low power — 29 mW average
- Intrinsically safe
- Extremely poison-resistant
- Can detect most common flammable gases/vapors including H_2 and acetylene.
- Factory does not require periodic calibration (bump test or calibration check still required)
- 5-year expected lifetime.
- Detects gas on the basis of changes in density not flammability characteristics of the gas.

MPS sensor limitations

- MPS readings affected by barometric pressure and humidity – must be zero adjusted before use in the area where used.
- MPS sensor not advised for use in confined spaces!
  - Differences in humidity can strongly affect (reduce) readings for heavier than air gases like propane, butane and pentane
  - Presence of CO_2 or unusual inert gas mixtures (e.g., Argon) can affect (increase) readings.
    - MW CO_2 = 44.01 g/mol
    - MW propane = 44.1 g/mol
    - CO_2 exposure limit = 5,000 ppm
    - 2,100 ppm CO_2 = same density as10% LEL propane



CO_2

How do IR LEL sensors detect gas?

- When IR light passes through a sensing chamber the C–H bonds in the molecules being measured absorb some of the light.
  - The rest of the light is transmitted through the chamber without hindrance.
  - The amount of light absorbed is proportional to concentration.
- IR LEL sensors measure at a specific range of wavelengths associated with a particular gas or class of gases.
  - Presence of double bonds (in olefins) and rings (in aromatics) reduces absorbance.

What are IR LEL sensor advantages and limitations?

- Advantages:
  - Cannot be poisoned.
  - Does not require oxygen to detect gas.
  - Responds well to large hydrocarbon molecules that cannot be measured by means of standard LEL sensor.
    - The more C–H bonds in the molecule, the higher the response.
- Disadvantages:
  - Molecule must include chemical bonds that absorb at the wavelength(s) used for measurement.
  - Not all combustible gases can be detected!
    - Hydrogen (H_2) DOES NOT absorb IR and cannot be detected
    - Wavelength used for portable IR LEL sensors can't detect acetylene.
    - NDIR sensors with short optical path-lengths may have limited ability to measure VOC gases with lower relative responses.

Proprietary long pathlength GfG IR LEL sensor.

Low power micro-miniaturized IR LEL sensor optimized for detection of CH_4 and natural gas – accuracy may be affected when used for other gases, may not respond at all to some VOCs.

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[1]	Expected response at 20% LEL target gas[2]
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[3]	6% LEL to 26% LEL
Hydrogen	No response
Acetylene	No response

[1]For any gases not listed, please contact Honeywell Analytics to find the best solution for your application.

[2]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.

[3]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.

What if there are other contaminants?

- Many toxic gases and vapors cannot be measured by four gas meters.
  - Additional sensors may be required.
  - Substance-specific electrochemical (EC) and infrared (IR) sensors are available for many common gases such as CO_2, H_2, SO_2, NO_2, Cl_2, NH_3, HCN, etc.
  - Photoionization detector (PID) sensors used to measure volatile organic chemical (VOC) vapors.
  - 5 gas meters with PID usually the first instrument used during CS entry at many chemical plants and oil refineries.

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.

Critical PID Performance Issues: Effects of Humidity and Contamination

PID design determines performance!

- 3-electrode PID Design Benefits:
  - Diffusion design includes "fence electrode" to provide mechanical short circuit between sensing and counter electrodes
  - Electrodes housed in replaceable "stack"
  - Diffusion of molecules into and out of glow zone means less ionic fragments or particulates left behind
- Results:
  - Need to clean lamp less frequently.
  - Reduced "moisture leakage" (spikes) due to humidity.
  - Reduced “humidity quenching.”
  - Much more accurate reading!

There are <u>many</u> 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

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

- Make sure you understand the requirements.
  - Have the requirements recently changed?
  - Don’t limit the discussion to a specific category of gas detection equipment.
- Ask the manufacturers and distributors you work with for help.
  - Download comparison charts if the manufacturer has them.
  - Make sure you know enough that what you hear makes sense.
  - Be leery of unsupported claims!

How well is your current equipment performing?

- This is a critical starting point in the conversation.
  - Are you happy?
  - Are you experiencing problems?
  - How old is your current equipment?
  - What features have you heard about that you are interested in?
  - Do you have any to update, expand, replace or change the equipment you are currently using?
  - What brand(s) and model(s) of gas detectors are you considering?
- When surveying or discussing the issues with you colleagues and employees make sure you listen to the answers!
- The issues can look very different as a function of your role in the company's CS procedures!

Avoid being overly focused on price!

- Eventually, the decision of whether to proceed involves price and affordability.
  - However, it's better to bring price into the considerations later, not at the beginning of the process.
  - There is a difference between the purchase price and the true cost of ownership.
- The questioning process is designed to uncover how your decision can benefit and reduce the pain of any issues you are having with your current products.
  - Once you fully identify the problems and how the new product is going to help, it's easier to understand the costs.

Identify "cost of ownership" issues

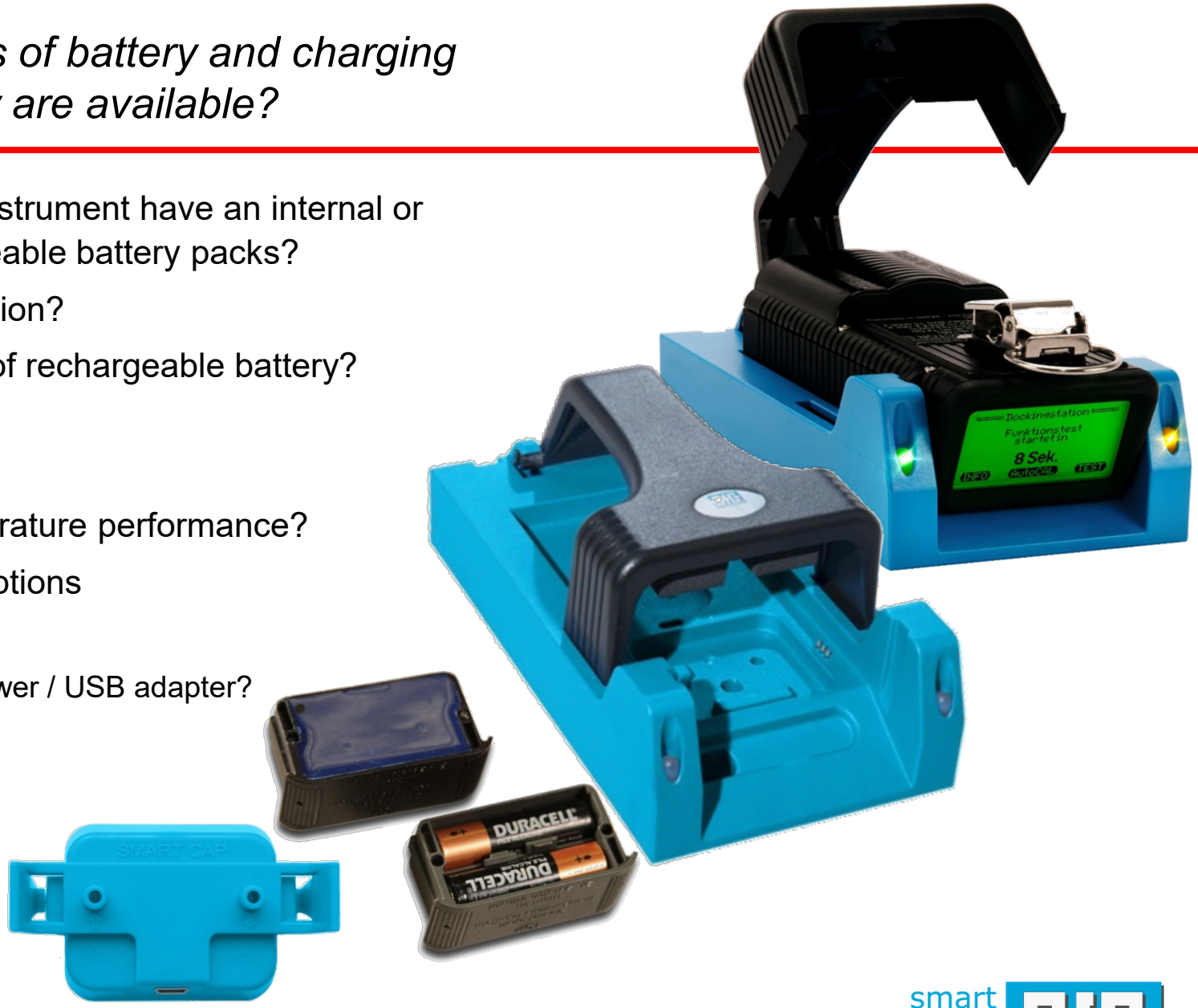
- Are you spending a fortune keeping the equipment in service?
- Are you being charged a monthly fee for reports and factory support?
- Do you trust your gas detectors?
- Do you have many sensor failures?
  - If so, what kinds of sensors are failing?
- Do you have battery problems?
- How often do you 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?
- <u>Do you feel you are currently getting a good deal?</u>

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

- Are you currently using 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 a 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?

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 deserve to 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?

Visit the GfG website for all the latest technical and marketing support materials!

- GfG Instrumentation website:
  www.gfgsafety.com/us-en

Questions?

Thank you!

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For additional information or gas detection help:
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