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CALIBRATION TECHNOLOGIES INC.

GAS DETECTION SPECIALISTS

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Gas Detection Specialists

- CTi manufactures and sells gas detection equipment for many gases, including most refrigerant gases.
- We make great equipment for R410A, Propane, Carbon Monoxide, Carbon Dioxide, Chlorine and many other gases.
- However, Ammonia is our favorite!

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History of Refrigeration

- As early as 1,000 BC - Chinese, Greek, Hebrew, and Roman civilizations used ice blocks that were harvested from nature to keep food cool.
- 1700's – Experiments with compressed air, ether, and alcohol.
- 1858 – Ferdinand Carre discovered Ammonia refrigeration, invented an ice machine fueled with Ammonia and introduced it at the Universal London Exhibition in 1862.

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History of Refrigeration

Ammonia is an excellent refrigerant because:

1. It is inexpensive. It occurs naturally and no one owns a patent on it. It's easy to make and has multiple uses.
2. It's been used for a very long time and we know how it acts and what it does.
3. It is efficient. A small amount can refrigerate a large space and reduce the temperature drastically and quickly.
4. It does not harm the environment. It has an ozone depletion potential of zero and a global warming potential of less than one.

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History of Refrigeration

Unfortunately, Ammonia has two flaws.

- It stinks.
- It can kill you.
  - Ammonia is a BL2 compound – it is highly toxic, but only mildly flammable
  - Large concentrations in confined areas can burn you and/or kill you

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History of Refrigeration

- Because of Ammonia's smell and toxicity, chemical companies in the 1920's began experimenting with man-made, synthetic refrigerants to replace Ammonia.
- The first result was a class of chemicals known as Chlorofluorocarbon (CFC) refrigerants. Commonly known as Freon or R12.
- These miracle chemicals were non-toxic, non-flammable, and non-reactive. They were odorless and efficient. The chemical companies marketed them heavily and customers loved them. We put CFC's in our factories, our stores, our homes, and our cars.
- Unfortunately, we soon discovered that they did terrible damage to the ozone layer. CFC's were banned by the Montreal Protocol in 1987 and manufacturing completely stopped in 1996. It is now illegal to manufacture R12 and illegal to release it into the atmosphere.

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History of Refrigeration

- A flurry of other synthetic refrigerants were invented and sold, all with different pros and cons.
- Some that did not harm the ozone were later found to cause global warming and are now being phased out globally by the Paris Agreement.
  - R22 will become illegal in the U.S. on January 1, 2020. After that, it can no longer be manufactured or imported into the United States.
  - R404A is being phased out completely by January 1, 2020.
  - R410A is being phased down by 80%

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History of Refrigeration

- There is a sudden, renewed interest in natural refrigerants such as Ammonia, CO2, and Propane.
- What can our industry do to promote the use of Ammonia?
  - Keep it safe!
  - Prevent leaks with better valves, pipes, and compressors.
  - Detect leaks early and stop them before they become dangerous.

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The Importance of Detection

- Not only do we need to detect Ammonia, we need to measure its concentration.
- Measure in parts per million, different concentrations pose different dangers.

Level of Ammonia	Symptoms
5-10 ppm	Unpleasant, sharp odor is detectable by the human nose, but no adverse health effects.
25 ppm	The concentration at which a worker can be exposed to for a normal 40 hour work week without adverse effects.[1]
35 ppm	Workers should be able to withstand a 15-minute exposure with no ill effects. [2]
50 ppm	Irritation to the eyes, nose and throat after 2 hours of exposure.[3]
100 ppm	Rapid eye and respiratory tract irritation. [3]
250 ppm	Tolerable (but uncomfortable) by most people for 30-60 minutes. [3]
300 ppm	Immediately Dangerous to Life and Health. A person can survive at this level for 30 minutes without a respirator and without any escape-impairing or irreversible health effects, but they won't like it.[4]
700 ppm	Immediately irritating to eyes and throat. [3]
1500 ppm	Pulmonary edema, coughing, laryngospasm. Pulmonary edema occurs when fluid collects in air sacs of the lungs, making it difficult to breathe. [3]
2500-4500 ppm	Fatal within 30 minutes of exposure. [3]
5000+ ppm	Rapidly fatal due to airway obstruction, may also cause skin damage. [3]
Liquid Ammonia	Contact causes Frostbite and caustic burns. Immerse affected part in warm water.

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The Importance of Detection

- Speed and accuracy of detection is important.
- You want the detectors to take different actions based on the concentrations they find.

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The Problem with False Alarms

- They create complacency.
- They cost money.
- They waste time and productivity.
- They distract us from our core business.
- People become annoyed and shut off the system. Then accidents happen.

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Not all false alarms make it on the national news, but it is still in our best interest as an industry to prevent them.

Causes of False Alarms

1. Mismatch of sensor technology to the detection range and environment.
2. The sensor reacts to gases and smells that are not Ammonia.
3. The sensor reacts to moisture and condensation.
4. The sensor reacts to extreme temperature fluctuations.
5. Damage to the sensor by clean up crews.
6. Incorrect alarm set points.
7. Electrical interference.

1 Mismatch of sensor technology to the environment and detection range

There are different types of sensor element technology.

- Electrochemical
- Catalytic Bead
- Solid State
- Infrared
- Photoionization
- Each type has its own pros and cons.

1 Mismatch of sensor technology to the environment and detection range

Electrochemical	Catalytic Bead	Solid State	Infrared	Photoionization
Accurate at low alarm ranges: 10-1,000 ppm Very specific to NH3 Medium cell Life	Accurate at higher alarm ranges: 1,000 to 20,000 ppm Long cell life	Alarm range: 150-10,000 ppm Long life Non-specific to NH3 Poor accuracy in measuring concentrations	Very high alarm range: 5,000-20,000 ppm Ammonia specific Element is non-replaceable Expensive	Fast response/recovery time Good for low range detection Short cell life
Compressor Rooms Refrigerated Rooms Rooftop Units Processing Areas	Compressor Rooms Engine Rooms Vent Lines	Not recommended because of tendency to false alarm in presence of other gases	Compressor Rooms	Portables

2 The sensor reacts to a gas that is not Ammonia

- It is very difficult to build a cell that is specific to Ammonia.
- The technology that controls this is in the physical part of the cell, not in the housing or controllers.
- Make sure your cell reacts only to Ammonia.

- Other things that have set off alarms

3 The sensor reacts to moisture and condensation

- Food processing facilities are wet, dirty, and humid.
- Make sure your detection equipment is modified to function in this environment.

4 The sensor reacts to extreme temperature fluctuations

- Food processing facilities can quickly and rapidly change temperature during defrost cycles.
- Make sure your detection equipment is modified to function in this environment.

5 Damage to the sensor by cleanup crews

- Clean up crews use high pressure hoses.
- It’s best for the sensor cell to be protected from direct hits.

6 Incorrect alarm set points can cause a false alarm

- Use the 10% rule
- If your detector is set to detect a 0-250 ppm range, don’t set an alarm level less than 25 ppm.
- Some people try to use a 0-1,000 ppm detector to alarm at 25 ppm. You will get a lot of false alarms by doing this. The lowest alarm point for a 0-1,000 ppm detector is 100 ppm.

7 The sensor reacts to electrical interference

- To avoid electrical interference, use proper cables with shielding and drain wire. Avoid running sensor cables in the same conduit as AC cables.
- To prevent electrical interference, keep sensor and wire runs away from mercury vapor lights, variable speed drives, and radio repeaters.
- Applying a short time-delay to an alarm relay can also eliminate reactions to sudden signal spikes.

Calibrate According to Manufacturer's Instructions

- In addition to preventing false alarms, you also want to make sure that the detectors react correctly to real leaks.
- The best way to ensure this is to regularly calibrate and test your sensors.
- Replace them when needed.
- Life depends on how often they are exposed.

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- This is an exciting time to be a part of the Ammonia industry.
- Interest in natural refrigerants is on the rise.
- There is global expansion of cold storage.
- Governments are requiring phase downs of synthetic refrigerants and many companies are turning to Ammonia.
- There could be opportunities for Ammonia in places it has never gone before – household refrigerators and air conditioners, grocery stores, automobiles, alien planets.
- You are in the right place at the right time.
- Good luck to each of you and let us know if we can help!

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