

Chlorine Gas Detection System Operation & Maintenance

Maynard King
K&D Pratt Instrumentation

2011 Clean and Safe Drinking Water Workshop



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Chlorine Gas Detector Operation, Maintenance, Checks

1. Why you need a gas detection system
2. Gas Detection System Setup (Integration with the rest of your safety system)
3. Responding to Alarms
4. False Alarms, Misunderstandings
5. Common Failure Mechanisms
6. Maintenance Checks & Service



Toxicity of Chlorine Gas

- A toxic gas that irritates the respiratory system and mucus membranes
- 0.2 ppm: Odor can be noticeable
- 30 ppm: Coughing and vomiting
- 60 ppm: Lung damage
- 1000 ppm: death with a few deep breaths
- Used as a chemical weapon in WWI



“If I can smell it right away, and it’s irritating to breath it, why do I need a gas detection system anyways?”



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STEL and TLV of Chlorine

- American Conference of Governmental Industrial Hygienists (ACGIH) are the authority
- TLV for TWA of 8 hours = 0.5 ppm
That is, the Threshold Limit Value is 0.5 ppm as a Time Weighted Average for an 8-hour workday and 40-hour work week.
- STEL = 1.0 ppm
That is, the Short Term Exposure Limit is 1.0 ppm



STEL and TLV of Chlorine

- Why does ACGIH set the TLV so low at 0.5 ppm?
- Because CHRONIC exposure at this level causes eye & mucous membrane irritation which can lead to dermatitis, tooth enamel erosion, chronic sore throat, susceptibility to tuberculosis etc.



Why You Need a Detection System

- “If I can smell it right away, and it’s irritating to breath it, why do I need a gas detection system anyways?”
- To advise you of the low level chronic leaks that will cause chronic health problems
- To turn on ventilation to avoid breathing these low level vapors
- To annunciate through a loud alarm or auto-dialer while you’re not there...a small leak builds up over time



Gas Detection System Setup: what should it do besides go beep?

- All good systems have multiple configurable relays to turn on/off other equipment
- Ventilation: Minimum, turn on fan at 1.0 ppm. Best, turn on fan at 0.5 ppm
- Outside Horn – heard by nearby residents
- Outside Light – operator proceeds with caution
- Shut down?
 - Gas solenoid valves
 - Booster Pump Shutdown



Proper Response to Alarms

- Always assume it's real, follow your safety training & policies (wear PPE, determine area is safe, ensure ventilation etc)
- Verify what kind of alarm it is
 - Sensor / Fault?
 - Gas Leak Warning Level?
 - Gas Leak Alarm Level?



Proper Response to Alarms: Sensor / Fault Alarm

- Most systems have a “Sensor” alarm
 - Means the sensor isn’t showing the proper response to the electrical circuit
 - Sensor wiring may be disconnected, sensor board may be broken
 - Most likely NOT a gas leak
- Some systems only have a general “Trouble” or “Fault” alarm
 - Means there is an electronic or electrical malfunction of some kind
 - Again most likely NOT a gas leak



Proper Response to Alarms: Gas Warning Level

- A low level leak that is not immediate danger to life & health
- Your system should be set up to turn on ventilation at this level (preferably 0.5ppm)
- Possible to correct with gas feed system still running
- Usually easy to find with your ammonia & correct it



Proper Response to Alarms: Gas Alarm Level

- Usually above 1ppm
- Ventilation, Horns, Lights should be on
- May require SCBA
- Turn gas off at cylinders
- Do systematic leak check



False Alarms, Misunderstandings: Interference Gases

- A gas other than the target gas, that will cause a +/- response on the sensor
- Interference gases for chlorine:
 - Bromine 1.0
 - Fluorine 1.0
 - Chlorine Dioxide 1.0
 - Ozone 1.0
 - Nitrogen Dioxide 0.4
 - Hydrogen Sulfide -0.1
 - Methyl Mercaptan -0.04
 - Sulfur Dioxide -0.01



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False Alarms, Misunderstandings: “Failsafe” Relay Setup

- Relays are the contact closures that turn on your exhaust fan, outside buzzer, or auto-dialer
- Failsafe Relays (aka Normally Energized): configured so that system failure causes alarm to actuate...ensures system doesn't give you false confidence when it's actually dead



False Alarms, Misunderstandings: “Failsafe” Relay Setup

- If the power supply in the unit fails, or the breaker trips, or it has a “motherboard” failure, the relays will close
- When the relays close, your exhaust fan, lights and outside buzzers will go off!
- So if your outside buzzer is going, but there are no lights flashing on your gas detector, it’s probably a failure not a leak!



False Alarms, Misunderstandings: Radio Frequency Interference

- Most gas detector sensors with metal enclosures are immune to RFI (our MSA detectors are immune)
- Because of the extensive use of plastics in water treatment plants, RFI can be a problem
- Our W&T detectors are not immune to high-power pulsed RFI...if you key your portable radio next to the sensor, it will give a false alarm!



False Alarms, Misunderstandings: DRIFT

- Gas detectors experience ZERO drift, SPAN drift, and drift due to TEMPERATURE fluctuations
- Many gas detectors (including the W&T) have a ZERO adjustment
- Sensors should not be subject to huge swings in temperature....i.e. outdoor sensors not ideal



False Alarms, Misunderstandings: DRIFT

- Like any analog transmitter, gas detectors experience SPAN drift – gradual inaccuracy of measured concentration
- If you are alarming at a high concentration (eg. 3 ppm) span drift is not as problematic. If however you are alarming at a lower concentration (eg. 0.5 ppm) span drift can cause false alarms
- Only way to combat this: full calibration



False Alarms, Misunderstandings: DRIFT

- Sensor/Transmitter calibration – requires a “zero gas” and a “span gas”
- Chlorine span gas doesn't last on the shelf, so a chlorine generator is the best thing to use
- Recommend to get regular calibrations done by a service company that does this, every 6 months.



Some Companies in NL that Provide Gas Detector Calibration

- Enviromed Detection Services



- Cahill Instrumentation
- IEAS Ltd



Calibration or Replacement

- To maintain an accurately operating system, you have two options for best practice
 - 1) Get the unit calibrated every 6 months
 - 2) Replace sensor & transmitter unit every 2 years



Sensor FAILURE: water

- Most common cause in a water treatment plant is WATER
- Since chlorine is heavier than air sensors are often mounted in the damp “basement”
- Humidity is not so much a problem as splashing, dripping, flooding, and condensation



Sensor FAILURE: age

- Second most common cause is AGE
- 4-5 years on the shelf
- 2-4 years in operation (electrochemical sensors are like miniature heater elements)



Sensor FAILURE: 'spent' sensor

- The more chlorine leaks that a sensor sees, the shorter its life
- After a significant leak, you should replace outright or at least get a calibration done



Maintenance & Checks: Zero Adjustment

- Some gas detectors have a zero adjustment on the sensor which allows you to compensate for zero drift. Should be done every 2 months.
- On the W&T unit, you need a digital multimeter and a precision screwdriver
- While holding the DMM at the test leads, you adjust the zero pot until the voltage reads as close to zero volts as you can get it



Maintenance & Checks: “Bump Test”

- Again, the best overall insurance would be a regular calibration using Zero and Span gas
- At a BARE MINIMUM however, a “bump test” should be incorporated into your regular maintenance schedule (eg. Monthly)
- Involves mixing a “cocktail” in a plastic sealable bottle, that generates chlorine gas (eg. Vinegar and Javex)



Maintenance & Checks: “Bump Test”

- Mix around one ounce of vinegar and one ounce of javex in an empty water or pop bottle. (Mark the bottle “poison – chlorine” with a marker!)
- Remove cap, gently squeeze bottle so that vapors (NOT liquid) comes out around the gas detector sensor
- You should observe a gas alarm, and actuation of all safety equipment (exhaust fan, buzzer, etc)



Maintenance & Checks: Automatic “Bump Test”

- W&T has an Auto-Test Generator feature
- A small electrochemical chlorine generator attaches to the remote sensor
- Once a day the main panel performs a bump test on the remote sensor unit
- If the sensor fails you get a sensor alarm



Maintenance & Checks: Summary

- 3 things to incorporate into your maintenance schedule (and budget):
 - 1) Monthly: Bump Test with mixed javex & vinegar
 - 2) Bimonthly: Adjust zero with digital multimeter
 - 3a) Every 6 months: Calibration, or
 - 3b) Every 2 years: Sensor/Trans Replacement



Questions?

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