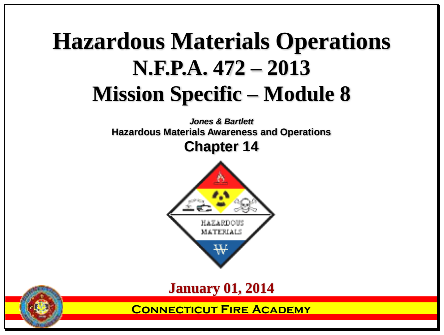
Slide 1



To understand hazardous materials incidents, it is important to know the chemical and physical properties of the substances involved. Chemical and physical properties are the characteristics of a substance that are measurable, such as vapor density, flammability, and water reactivity.

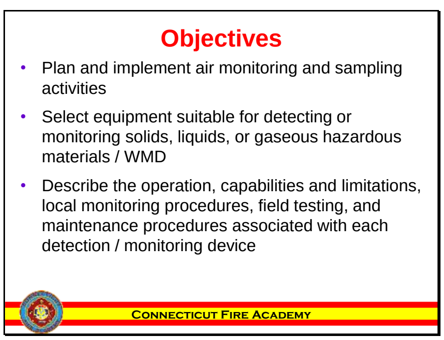
When responding to hazardous materials/WMD incidents, responders must fully understand the hazards to minimize the potential for exposure. This includes knowing the routes of entry into the body and avoiding contamination. Caution and the use of proper equipment can offer protection and help ward off acute and chronic health effects.

Slide 2

Detection and monitoring devices have greatly improved over the years. Today, responders have access to a vast array of high-tech instruments, increasing the ability of responders to assess potentially hazardous atmospheres more effectively. Some devices can even determine the exact identify of a substance down to the brand name.

Many fire departments carry flammable gas detection equipment, and there are instruments designed to detect single hazards, such as carbon monoxide or hydrogen sulfide. No single device on the market today can do it all. Intelligent use of detection and monitoring equipment requires some technical expertise, a lot of common sense, and a commitment to continual training.

Slide 3



6.7.1.1.1 The operations level responder assigned to perform air monitoring and sampling shall be that person, competent at the operations level, who is assigned to implement air monitoring and sampling operations at hazardous materials / WMD incidents.

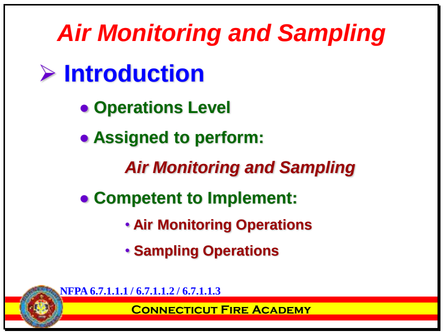
6.7.1.1.2 The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall be trained to meet all competencies at the awareness level (Chapter 4), all core competencies at the operations level (Chapter 5), all mission-specific competencies for personal protective equipment (Section 6.2), and all competencies in this section.

6.7.1.1.3 The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall operate under the guidance of a hazardous materials technician, an allied professional, or standard operating procedures.

Instructor's Note:

Important to explain 6.7.1.1.3: Operational can work under the control of Technician and or "Written" SOPs / SOGs … all within ICS

Slide 4



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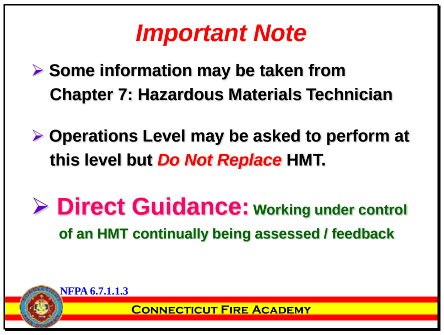
Slide 5



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Some Mission-Specific competency information may be taken from Chapter 7: Hazardous Materials Technician, It should be pointed out that the Operations Level Responder with a Mission-Specific competencies are not replacements for the Technician.

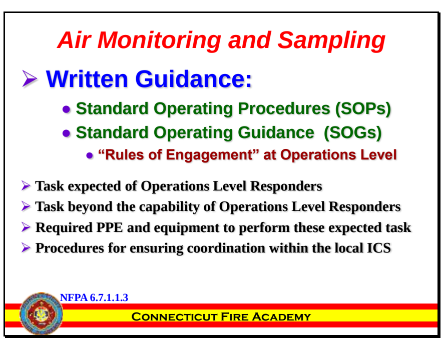
Operations Level Responders may be asked to perform some technician level skills but they do not have the broader skills and competencies required of an HMT, particularly in Risk Assessment and selection of Control Options.

Below are two ways or examples of how guidance can be provided to ensure Operations level Responders do not go beyond their level of training and equipment.

Direct Guidance: Working under control of an HMT who has the ability to (1) continually assess and / or observe actions and (2) provide feedback. This can be provided through direct visual observation or through assessment reports.

Written Guidance: (See Next Slide)

Slide 6



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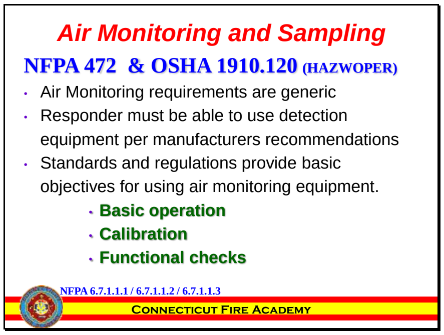
Written Guidance:
Standard Operating Procedures (SOPs)
Standard Operating Guidance (SOGs)
Both should give clear guidance on the "Rules of Engagement" at Operations Level

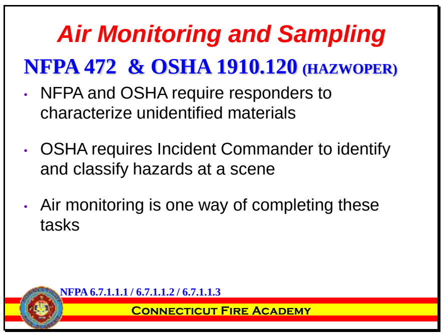
Emphasis should be placed on the following:
- Task expected of Operations Level Responders
- Task beyond the capability of Operations Level Responders
- Required PPE and equipment to perform these expected task
- Procedures for ensuring coordination within the local ICS

Slide 7



6.7.1.1.1
6.7.1.1.2
6.7.1.1.3

Slide 8



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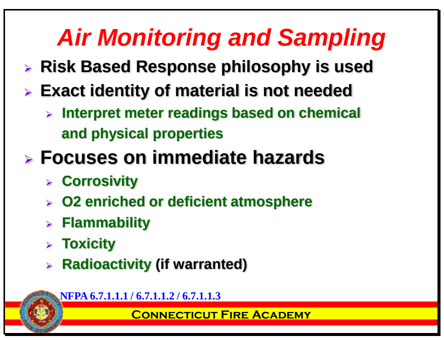
Slide 9



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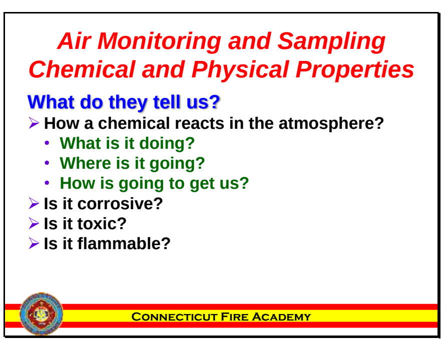

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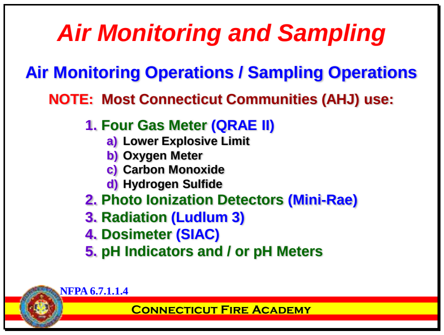
Slide 11



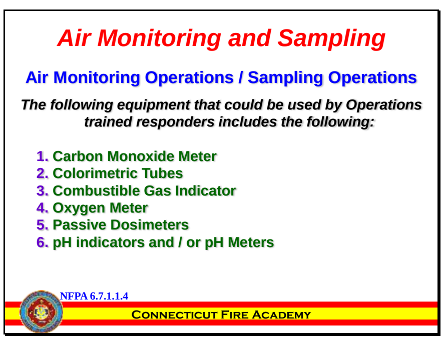
6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

NOTE: Most Connecticut Communities (AHJ) use:

- Four Gas Meter (Such as the QRAE II)
  - Lower Explosive Limit
  - Oxygen Meter
  - Carbon Monoxide
  - Hydrogen Sulfide
- Photo Ionization Detectors (Such as the Mini-Rae)
- Radiation (Such as the Ludlum 3)
- Dosimeter (Such as the SIAC)
- pH indicators and / or pH Meters

Instructor's Note:
Important to point out that these are name brand and there are many manufacturers that produce similar technology units

Slide 12



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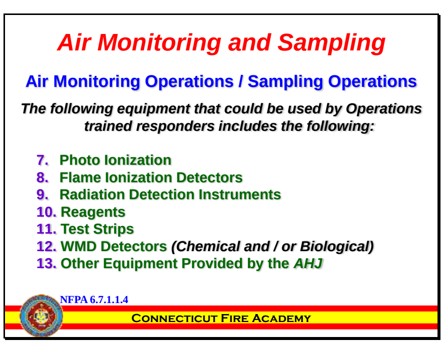
These individual types of meters will be covered in coming slides

Slide 13



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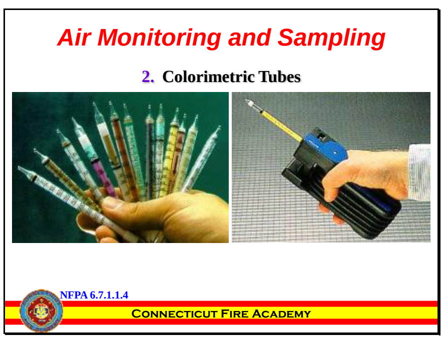
Slide 14

6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

About Carbon Monoxide
Carbon monoxide is a toxic gas that has no odor or color.
It is the most common type of fatal poisoning in many countries.
CO is the result of combustion in fuel-burning appliances such as oil and gas furnaces, gas water heaters, gas ranges and ovens, gas dryers, gas or kerosene space heaters, fire places and wood stoves.
It is also generated by any 2-stroke or 4-stroke gasoline engine that does not use a catalytic converter on the exhaust.

Recommended Levels
Symptoms of mild CO poisoning include headaches and dizziness at concentrations less than 100 ppm.
Concentrations as low as 667 ppm can be life-threatening.
In the United States, OSHA limits long-term workplace exposure levels to 50 ppm.

Slide 15



6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

Short Term tubes are used to measure to concentration of specific contaminants instantaneously. Currently, about 160 short term Draeger tubes are available for determining and measuring more than 350 different gases, vapors and aerosols. The majority of the short term Draeger Tubes are scaled tubes, operating on a defined sample volume drawn through the tube by performing a specified number of pump strokes. The concentration of the contaminant is read directly from the calibrated scale by assessing the length of the discoloration.

The one handed operation of the accuro pump allows the other hand to be free for maneuvering into position or handling a weapon. The Draeger CLIK measure Ammonia,
Phosphine and Hydrochloric Acid. Draeger tubes are available for measuring many other gases which be present in clandestine labs.

Slide 16

6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

The combustible gas indicator is designed to measure combustible gas or vapor content in air. This instrument is capable of detecting the presence of any gas or vapor which, when combined with oxygen in free air, presents a potential hazard due to flammability/explosion.

The combustible gas indicator will not indicate the combustible gas content in atmospheres containing less than 10% oxygen.

It should be noted that each instrument has its own set of operating procedures and instructions. Consequently, it is impractical to list, in this memo, all precautions and warnings for each oxygen/combustible gas detector in use. However, by way of illustration, other precautions and warnings not already discussed above, and specifically applicable to the MSA MicroGard Portable Alarm, are as follows:

- The instrument should not be used where the oxygen concentration exceeds that of fresh air (oxygen enriched atmosphere) when sampling for gases like acetylene and hydrogen.

Instructor's Note:

There is a copy of an OSHA informational bulletin referring to CGI's in the resource file:
http://www.osha.gov/dts/hib/hib_data/hib19900118.html

Slide 17

6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

A reliable oxygen detection and monitoring system should:

- Identify possible Oxygen enriched areas. While detection systems will not pinpoint a leak, they may or may not indicate the presence of one depending on the wind or type of detection method. Leak detection by observation alone is not adequate.
  Although the cloud and moisture that accompanies LOX leaks is visible, leak detection by observing such clouds is not reliable.
- Warn whenever the worst allowable condition is exceeded. Visual alarms should be
  considered for the system to indicate that a problem exist

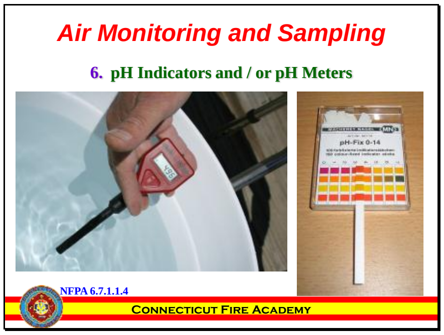
Detectors are normally set to alarm at 19.5% Oxygen Content – Too Lean.
This is the lowest allowable limit without SCBA identified in 29CFR1910.134
Or at 23.5% Oxygen Content – Too Rich, dangerous atmosphere created

Slide 18

6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

Passive Dosimeter
A passive dosimeter is a device used to record Personal Exposure to Radiation (and sometimes Environmental Exposure). Examples are the Film Badge and the Thermo Luminescent Dosimeter (TLD). An alternative is to use an Active Dosimeter which provide real time instant measure of Dose accrued and Dose Rate.

Slide 19



6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

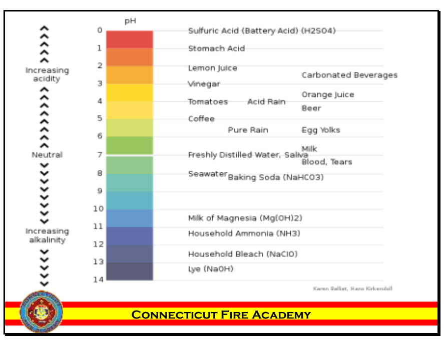
pH meter is a device used for potentiometric pH measurements. pH can be measured using either pH indicators (like phenolphtaleine) - in form of solution or pH strips - or using potentiometric method. Strips are very useful when all you need is 0.2
0.5 pH unit accuracy. When you need higher precision, pH meter is the only way to go.

In potentiometric methods you measure potential difference between known reference electrode and the measuring pH electrode. Potential of the pH electrode depends on the activities of hydronium ions. This dependence is described by Nernst equation, thus once the potential has been measured you can calculate the activity. As a first approximation activity is identical to the ions concentration.

pH meter is nothing else but precise voltmeter, connected to the pH electrode, and scaled in such a way that it displays not the measured potential, but ready pH value.

potentiometric an instrument for measuring electromotive forces

Slide 20



6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

This is a measure of how acidic or alkaline a substance is.
The initials pH stand for "Potential of Hydrogen."
Acids have pH values under 7, and alkalis (aka: Bases) have pH values over 7.
If a substance has a pH value of 7, it is neutral-neither acidic or alkaline.

Because the pH scale is logarithmic, a difference of one pH unit represents a tenfold, or ten times change. For example, the acidity of a sample with a pH of 5 is ten times greater than that of a sample with a pH of 6. A difference of 2 units, from 6 to 4, would mean that the acidity is one hundred times greater, and so on.

Slide 21

6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

Typical photo-ionization detectors measure volatile organic compounds and other gases in concentrations from sub parts per billion to 10 000 parts per million (ppm).
The photo-ionization detector is the most efficient and inexpensive type of gas detector.
They are capable of giving instantaneous readings and monitoring continuously.
They are widely used in military, industrial, and confined working facilities for safety.

PIDs are used as monitoring solutions for:

- Lower explosive limit measurements
- Ammonia detection
- Hazardous materials handling
- Arson investigation
- Industrial hygiene and safety
- Indoor air quality
- Environmental contamination and remediation
- Clean room facility maintenance

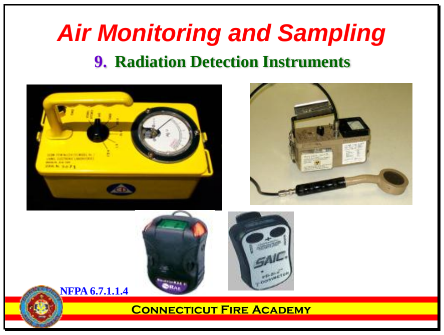
Slide 22

6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

The detection of organic compounds is most effectively done with flame ionization.
Biochemical compounds such as proteins, nucleotides, and pharmaceuticals can be studied with flame ionization as well as other detectors, like thermal conductivity, thermionic, or electrolytic conductivity due to the presence of nitrogen, phosphorus, or sulfur atoms or because of the universality of the thermal conductivity detector. However, typically the biochemical compounds have a greater amount of carbon present than other elements. This means that a particular compound may be more easily detected using flame ionization over the other methods because of higher carbon concentration and also flame ionization's sensitivity.

FIDs are best for detecting hydrocarbons and other easily flammable components.
They are very sensitive to these components, and response tends to be linear across a wide range of concentrations.
However, an FID destroys most - if not all - of the components it is detecting.

Slide 23



6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

Radiation Monitoring and Radiation Monitoring Equipment

Different types of radiation monitoring instruments have been designed for different purposes. In general, this equipment is designed to measure either:

- The total amount of radiation emitted from a source (the "gross" radiation); or
- The specific type and energy level of radiation emitted from a source.

For example, if a utility wished to determine whether there was elevated radiation from some source, they would most likely use some type of "screening"-type equipment to measure the gross radiation from the source. If a high level of radiation was detected, the utility may identify individual species of radionuclides and their energy levels using equipment specifically designed for this purpose. This would allow the calculation of radiation doses and exposure levels and an evaluation of the potential health effects of the radiation exposure.

Slide 24

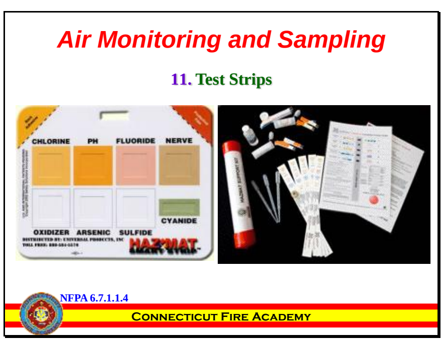
6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

A **reagent** or **reactant** is a substance or compound consumed during a chemical reaction. Solvents and catalysts, although they are involved in the reaction, are usually not referred to as reactants.
Although the terms *reactant* and *reagent* are often used interchangeably, a *reagent* is more specifically "a test substance that is added to a system in order to bring about a reaction or to see whether a reaction occurs". Such a reaction is used to confirm the presence of another substance. Examples of such *analytical reagents* include Fehling's reagent and Tollens' reagent. In organic chemistry, reagents are compounds or mixtures, usually composed of inorganic or small organic molecules, which are used to affect a transformation on an organic substrate. Examples of organic reagents include the Collins reagent, Fenton's reagent, and Grignard reagent.

In another use of the term, when purchasing or preparing chemicals, "reagent-grade" describes chemical substances of sufficient purity for use in chemical analysis, chemical reactions or physical testing. Purity standards for reagents are set by organizations such as ASTM International. For instance, reagent-quality water must have very low levels of impurities like sodium and chloride ions, silica, and bacteria, as well as a very high electrical resistivity.

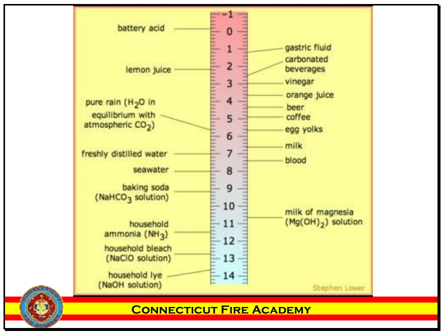
Example: Haz Cat Test Kit

Slide 25



6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.
These are pieces of reactive paper that react with specific chemicals.
If the chemical that the test strip indicates is present, you see a color change.
Most test strips have a chart or color comparison guide for results comparison (see slide).
Some strips are designed to be worn in an environment, some can be dropped into a liquid puddle.
A more accurate method would be to use a pipette / dropper to drop a small sample onto a test area.

Slide 26



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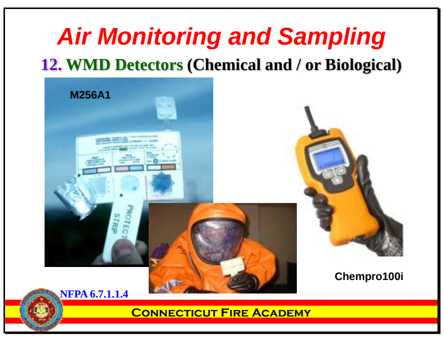
If a substance has a pH value of 7, it is neutral-neither acidic or alkaline.

Because the pH scale is logarithmic, a difference of one pH unit represents a tenfold, or ten times change. For example, the acidity of a sample with a pH of 5 is ten times greater than that of a sample with a pH of 6. A difference of 2 units, from 6 to 4, would mean that the acidity is one hundred times greater, and so on.

Slide 27



6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

Weapons of Mass Destruction or WMD cover a wide range of chemical / Biological / Radiological or Explosive materials used to intimidate or attack a population.
An example of a WMD detection device in the slide shows a Military M256A1 hand held kit that test for various types of agents also shown is the Chempro 100i detector which covers large range of agents, some as simple as tear gas.

An example of another type kit is described below:
The HazCat Weapons of Mass Destruction Kit, detects radioactive, biological and chemical agents used in weapons of mass destruction. This new kit will detect solid and liquid forms of nerve, blister and enhanced agents as well as dusty agents.

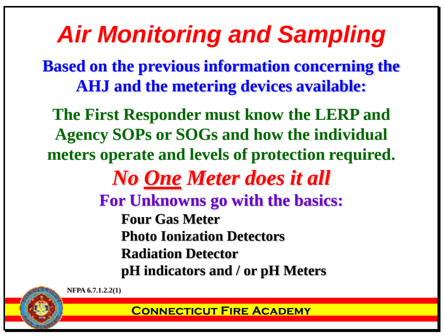
Slide 28

6.7.1.1.4* The operations level responder assigned to perform air monitoring and sampling at hazardous materials / WMD incidents shall receive the additional training necessary to meet specific needs of the jurisdiction.

New technology is being developed at a fast pace, there may also be site specific equipment provided by a local vendor or manufacturer that is for a special process.

The AHJ should be aware of any and all requirements in their Area of Responsibility (AOR)
The AHJ should have written SOPs / SOGs to cover any such special needs.

Slide 29



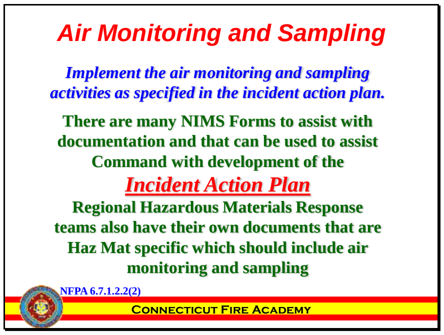
6.7.1.2.2
6.7.1.2.2(1) Plan the air monitoring and sampling activities within the capabilities and competencies of available personnel, personal protective equipment, and control equipment and in accordance with the emergency response plan or standard operating procedures describe the air monitoring and sampling options available to the operations level responder.

Based on the previous information concerning the AHJ and the metering devices Available, levels of P.P.E., Decontamination Procedures and written documentation:

The First Responder must know the LERP and Agency SOPs or SOGs and how the
Individual meters operate and levels of protection required.

For Unknowns go with the basics:
- Four Gas Meter
- Photo Ionization Detectors
- Radiation Detector
- pH indicators and / or pH Meters

Slide 30



6.7.1.2.2
6.7.1.2.2(2) Implement the air monitoring and sampling activities as specified in the incident action plan.

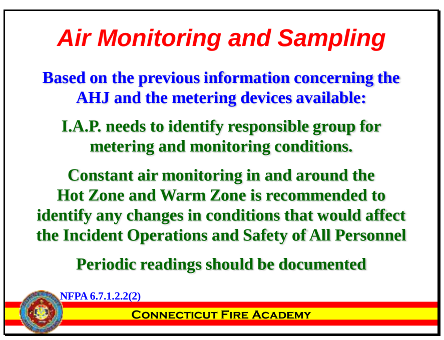
There are many NIMS Forms to assist with documentation and that can be used to assist Command with development of the *Incident Action Plan.* The NIMS 201 is a good start towards gathering the required information to formulate an Incident Action Plan.

Regional Hazardous Materials Response teams also have their own documents that are Haz Mat specific which should include air monitoring and sampling.

These documents and readings may be important for medical purposes for First Responders and Civilians that have been contaminated or affected by the product.

Documentation may also be required in later years in the event of litigation and a history of what actions were taken after product identification

Slide 31



6.7.1.2.2
6.7.1.2.2(2) Implement the air monitoring and sampling activities as specified in the incident action plan.

Based on the previous information concerning the AHJ and the metering devices available: The LERP / SOPs / SOGs should identify metering abilities and limitations.

I.A.P. needs to identify responsible group for metering and monitoring conditions. List by name and even list meters being used for a history in the event of failure or false Readings that require follow-up.

Constant air monitoring in and around the Hot Zone and Warm Zone is recommended to identify any changes in conditions that would affect the Incident Operations and Safety of All Personnel. Personnel should be assigned to the task of monitoring air quality and reporting significant changes to the proper chain of command

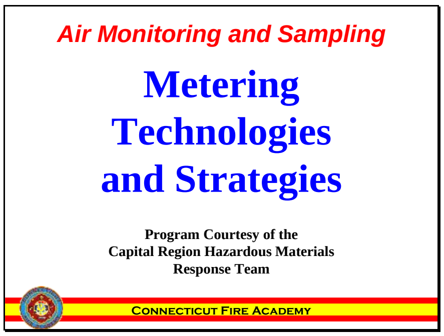
Periodic readings should be documented; readings need to be documented for medical purposes for exposure, concentrations for safety of working personnel and legal purposes for future litigation.

Slide 32

6.7 Mission-Specific Competencies: Air Monitoring and Sampling.

6.7.3 Competencies – Planning the Response.

Slide 33



6.7.3 Competencies – Planning the Response.
6.7.3.2

Slide 34

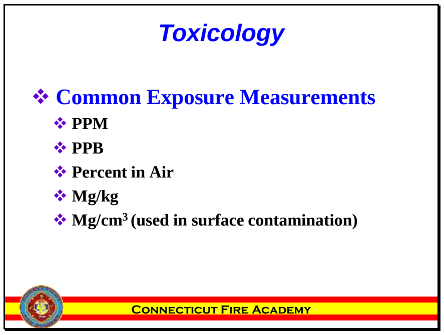
6.7.3 Competencies – Planning the Response.
6.7.3.2

Slide 35

6.7.3 Competencies – Planning the Response.
6.7.3.2

Instructor's Note:
This is a brief review, Students should already have a basic knowledge of these terms from Chapter 4 "Awareness level: and Chapter 5 "Operational Core".

Slide 36



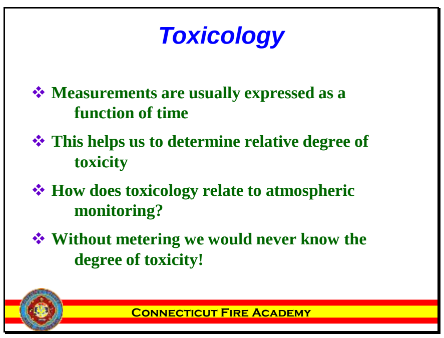
6.7.3 Competencies – Planning the Response.
6.7.3.2

PPM – Parts Per Million
PPB – Parts Per Billion
Percent in Air
Mg/Kg – Milligram per Kilogram

- A milligram of medication per kilogram of the body weight of the person taking the medication

Mg/cm^3 – milligram per cubic centimeter
Mg/m^3 – milligrams per cubic meter – typical for dust

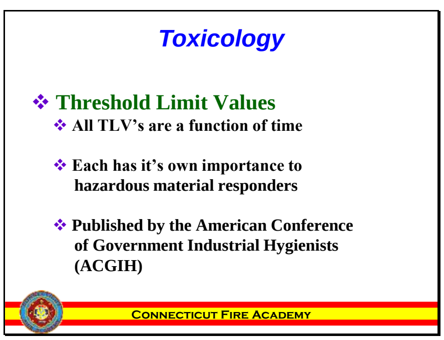
Slide 37



6.7.3 Competencies – Planning the Response.
6.7.3.2

Measurements are usually expressed as a function of time
This helps us to determine relative degree of toxicity
How does toxicology relate to atmospheric monitoring?
Without metering we would never know the degree of toxicity!

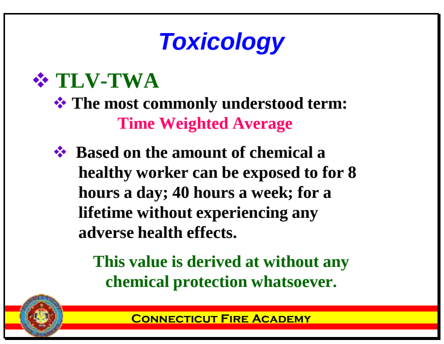
Slide 38



6.7.3 Competencies – Planning the Response.
6.7.3.2

Threshold Limit Values
All TLV's are a function of time
Each has it's own importance to hazardous material responders
Published by the American Conference of Government Industrial Hygienists (ACGIH)

Slide 39



6.7.3 Competencies – Planning the Response.
6.7.3.2

TLV/TWA: Threshold Limit Value / Time Weighted Average
The maximum concentration of a material an average person can be exposed to
8 hours per day; 40 hours per week without suffering adverse health effects.

Measured in ppm or mg/m^3

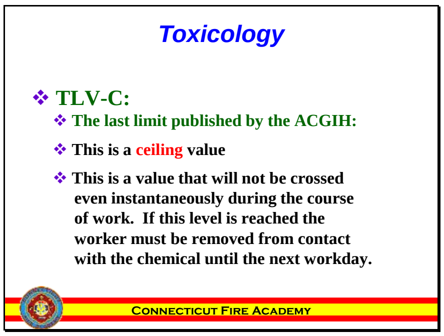
Slide 40

6.7.3 Competencies – Planning the Response.
6.7.3.2

TLV-STEL: Threshold Limit Value / Short Term Exposure Limit
Maximum allowable concentration not to be exceeded during a 15 minute period with
no more than 4 exposures per day

- Minimum 1 hour rest period between exposures
- Measured in ppm or mg/m^3

Slide 41

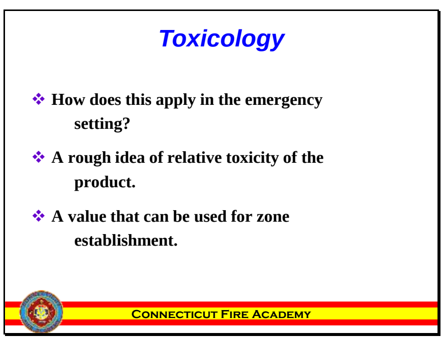


6.7.3 Competencies – Planning the Response.
6.7.3.2

TLV-C: Threshold Limit Value – Ceiling
The last limit published by the ACGIH:

ACGIH: American Conference of Governmental Industrial Hygienists
The maximum concentration which should never be exceeded for any period of time.
Measured in ppm or mg/m^3

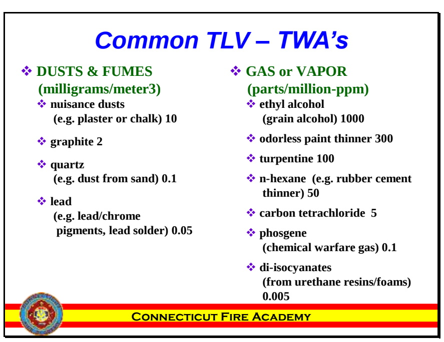
Slide 42



6.7.3 Competencies – Planning the Response.
6.7.3.2

How does this apply in the emergency setting?
A rough idea of relative toxicity of the product.
A value that can be used for zone establishment.

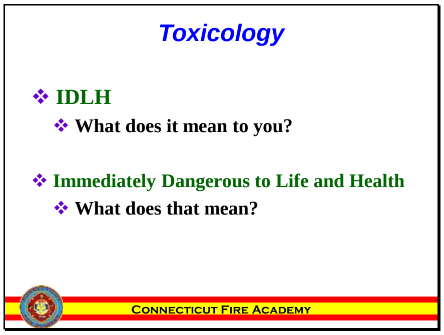
Slide 43



6.7.3 Competencies – Planning the Response.
6.7.3.2

Instructor's Note: Point out to Students:
Notice the smaller the number, the more toxic it is!

Slide 44

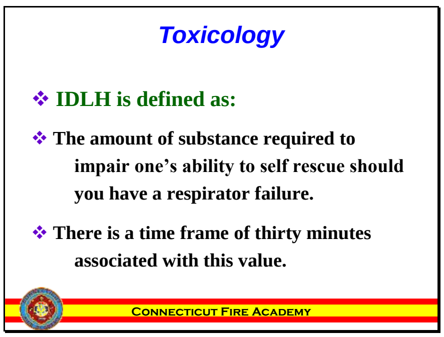


6.7.3 Competencies – Planning the Response.
6.7.3.2

IDLH
What does it mean to you?

Immediately Dangerous to Life and Health
What does that mean?

Slide 45

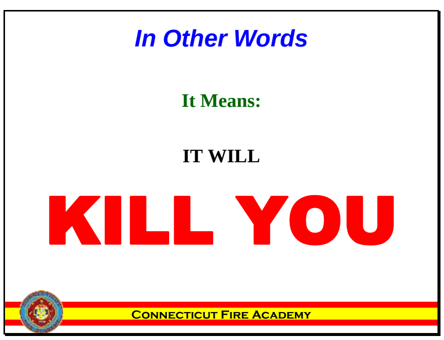


6.7.3 Competencies – Planning the Response.
6.7.3.2

IDLH: Immediately Dangerous to Life and Health
The concentration of a substance in the atmosphere that is immediately dangerous to life
and health and will interfere with one's ability to escape from that atmosphere without
the use of a respirator

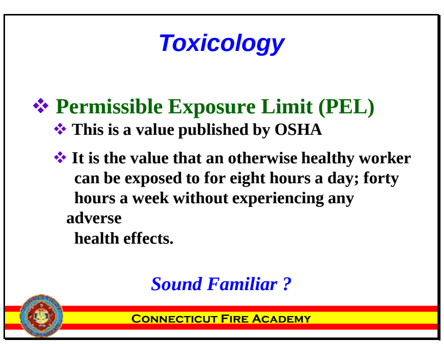
- Death or irreversible health effects are expected.
- Measured in ppm or mg/m^3

Slide 46



6.7.3 Competencies – Planning the Response.
6.7.3.2

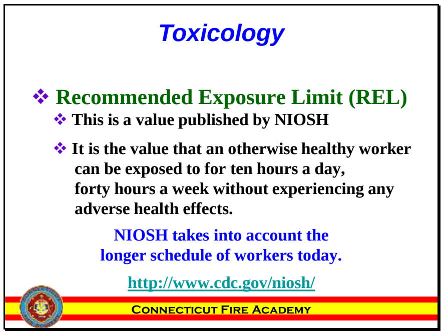
Slide 47



6.7.3 Competencies – Planning the Response.
6.7.3.2

PEL: Permissible exposure limit
Similar to TLV-TWA
Adopted by OSHA
Maximum allowable exposure in an 8 hour day; 40 hours per week
Measured in ppm or mg/m^3

Slide 48



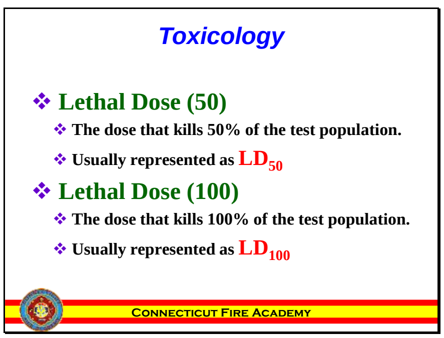
6.7.3 Competencies – Planning the Response.
6.7.3.2

Recommended Exposure Limit (REL)
This is a value published by NIOSH
It is the value that an otherwise healthy worker can be exposed to for ten hours a day,
Forty (40) hours a week without experiencing any adverse health effects.

NIOSH takes into account the longer schedule of workers today.
RELs for chemical exposures are usually expressed in parts per million (ppm), or sometimes in milligrams per cubic meter (mg/m3).
Although not legally enforceable limits, NIOSH RELs are considered by OSHA during the promulgation of legally-enforceable PELs.

NIOSH Website: http://www.cdc.gov/niosh/

Slide 49



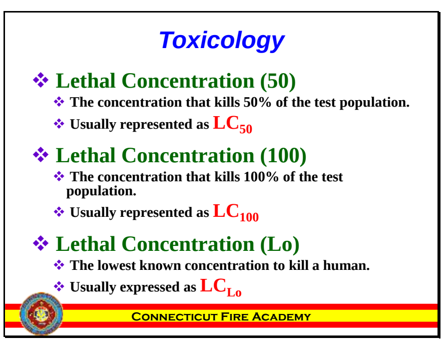
6.7.3 Competencies – Planning the Response.
6.7.3.2

Lethal Dose: Typical for Solids and Liquids
Lethal Dose (50)
- The dose that kills 50% of the test population.
- Usually represented as LD_{50}

Lethal Dose (100)
- The dose that kills 100% of the test population.
- Usually represented as LD_{100}

Most test utilize animals like rats, frogs, monkeys.
Exactly how does that translate to actual humans?

Slide 50



6.7.3 Competencies – Planning the Response.
6.7.3.2

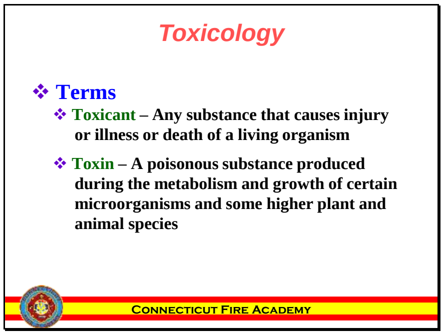
Lethal Concentration: Typical for Vapors or Gas
Lethal Concentration (50)
- The concentration that kills 50% of the test population.
- Usually represented as LC_{50}

Lethal Concentration (100)
- The concentration that kills 100% of the test population.
- Usually represented as LC_{100}

Lethal Concentration (Lo)
- The lowest known concentration to kill a human.
- Usually expressed as LC_{Lo}

Most test utilize animals like rats, frogs, monkeys.
Exactly how does that translate to actual humans?

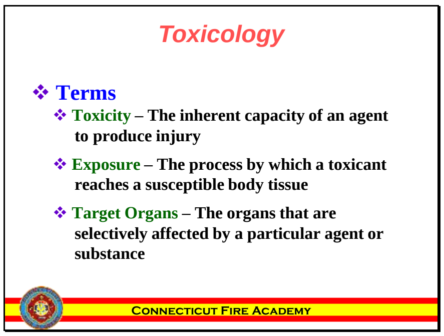
Slide 51



6.7.3 Competencies – Planning the Response.
6.7.3.2

Toxic: Generalized shortened term used for Toxicant
Toxin: This term is commonly misused for Toxicant

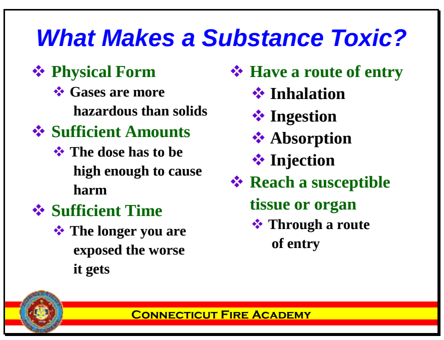
Slide 52



6.7.3 Competencies – Planning the Response.
6.7.3.2

Toxicity: The inherent capacity of an agent to produce injury
Exposure: The process by which a toxicant reaches a susceptible body tissue
Target Organs: The organs that are selectively affected by a particular agent or substance

Slide 53



6.7.3 Competencies – Planning the Response.
6.7.3.2

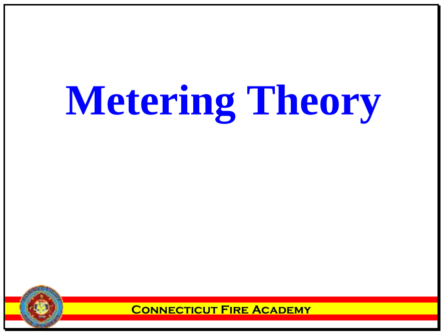
Most important route to protect is: **Inhalation**

- Lungs are wet.
- Contain a large surface area.
- Are a direct entry into the Bloodstream other than Ingestion

Note that everything can be Toxic; Even Water

- Sufficient amounts of water can kill you .. Called; Water Intoxication
- Too much water in the body depletes important electrolytes

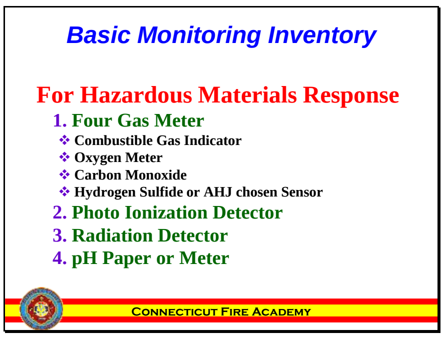
Slide 54



6.7.3 Competencies – Planning the Response.
6.7.3.2

Important Instructor's Note:
These are just some of the basic meters out there, common to most First Responders.
This doesn't cover all meters

Slide 55



6.7.3 Competencies – Planning the Response.
6.7.3.2

For Hazardous Materials Response
1. Four Gas Meter
   - Combustible Gas Indicator
   - Oxygen Meter
   - Carbon Monoxide
   - Hydrogen Sulfide or AHJ chosen Sensor
2. Photo Ionization Detector
3. Radiation Detector
4. pH Paper or Meter

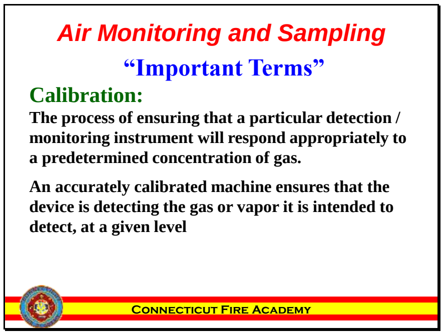
Slide 56

6.7.3 Competencies – Planning the Response.
6.7.3.2

For Weapons of Mass Destruction
- Chempro 100i
- Photo Ionization Detector
- Radiation Detector
- M-8, M-9 and M256A1 Kit
- 20/20 BioCheck – Protein Check
- Dräger CDS

Note: Same common Hazardous Materials Meters that can also be used for
Weapons of Mass Destruction (WMD):
- Photo Ionization Detector
- Radiation Detectors

Slide 57

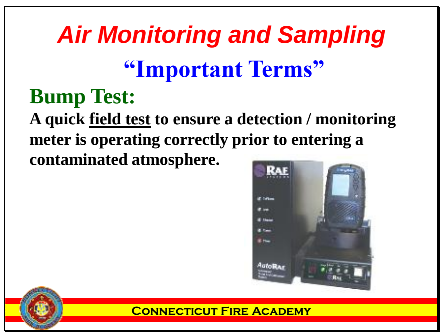


6.7.3 Competencies – Planning the Response.
6.7.3.2

Calibration:
The process of ensuring that a particular detection / monitoring instrument will respond
appropriately to a predetermined concentration of gas.

An accurately calibrated machine ensures that the device is detecting the gas or vapor it is intended to detect, at a given level

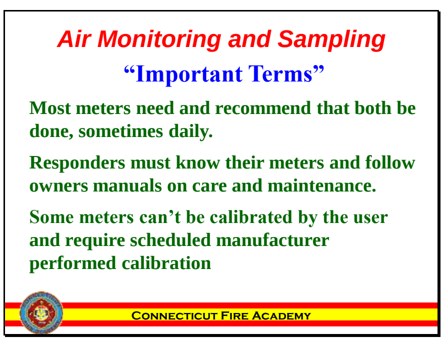
Slide 58



6.7.3 Competencies – Planning the Response.
6.7.3.2

Bump Test:
A quick <u>field test</u> to ensure a detection / monitoring meter is operating correctly prior to entering a contaminated atmosphere.

Slide 59



6.7.3 Competencies – Planning the Response.
6.7.3.2

Most meters need and recommend that both be done, sometimes daily.
Responders must know their meters and follow owners manuals on care and maintenance.
Some meters can't be calibrated by the user and require scheduled manufacturer
performed calibration

Slide 60

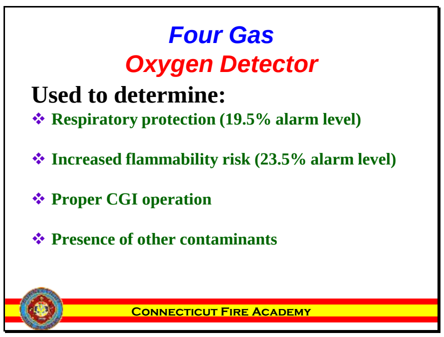
6.7.3 Competencies – Planning the Response.
6.7.3.2

Slide 61

6.7.3 Competencies – Planning the Response.
6.7.3.2

Important that First Responders learn their specific meter. Information provided is generalized for all Basic Four Gas Meter Properties.

Slide 62



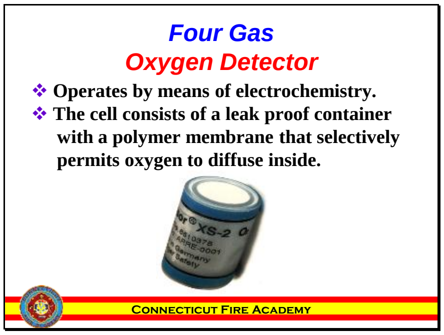
6.7.3 Competencies – Planning the Response.
6.7.3.2

Normal Reading: 20.9 %
Low Alarm Level: 19.5 %
High Alarm Level: 23.5 %

Presence of other contaminants – In round numbers, air consists of about 79 percent
nitrogen and other gases and about 21 percent oxygen, so the approximate ratio of nitrogen to oxygen is about 4 to 1. This means that, as atmospheric air is displaced from a space, every 1 percent change in the oxygen level will be accompanied by a 4 percent change in the nitrogen level because both gases are displaced at the same rate. In other words, if we start dumping argon into a tank, it won't push out just the oxygen, it pushes out both oxygen and nitrogen in the same proportions that they exist in ambient air, about 4 to 1. Using round numbers, if the oxygen level drops 1 percent from 21 percent to the "safe" level of 20 percent, the nitrogen level also must have changed by 4 percent, because four times 1 percent is 4 percent. Thus, a total 5 percent, or 50,000 parts per million (ppm), of some other substance must be present to cause the oxygen level to drop by just 1 percent.

This is also known as the 1/5 rule which is explained in a couple slides

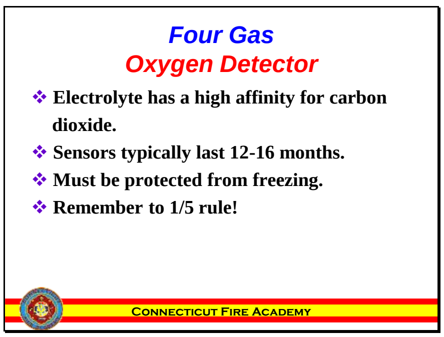
Slide 63



6.7.3 Competencies – Planning the Response.
6.7.3.2

Operates by means of electrochemistry.
Sensor is made up of an electrolytic material covered by a semi-permeable membrane.
The cell consists of a leak proof container with a polymer membrane that selectively permits oxygen to diffuse inside.
Reaction between O_2 and electrolyte causes change in current and reading on meter

Slide 64



6.7.3 Competencies – Planning the Response.
6.7.3.2

O_2 is always present so the sensor is always exposed
Along with CO_2, chemicals with Oxygen in their structure that can release it like
"Oxidizers" will shorten the life of the sensor, also could give increased readings

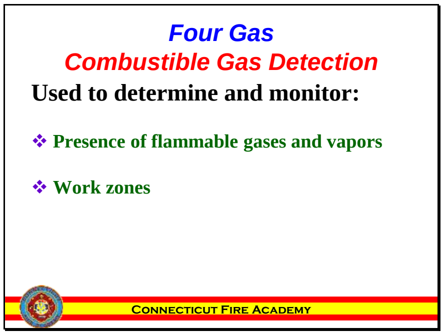
Colder the weather, the slower the response: Remember calibrating in the same temperature environment as you will operate the unit may help.

"Know Your Meter" – sensors have "float" – fluctuation in the reading despite their being no real atmospheric change. Ie. O2 should be at 20.9% but the meter may go back and forth; 20.7% to 21.0%. It should resolve itself after warming up, consider though as a real reading if it occurs in the same area consistently.

1/5 Rule: Air is made up of about 79% N_2 (Nitrogen) and 21% O_2 (Oxygen). Therefore only 1/5 of air is O_2, so reading O_2 only shows you 1/5 of the picture.
If a Vapor or Gas occupies air space, it will occupy all of it not just the O_2, so you can see a drop in O_2 of 0.1%, there could be as much as 5,000 ppm of a substance present.

1% = 10,000 ppm: 0.1% = 1,000 ppm
Since O_2 = 1/5 of air, you multiply the change by 5 to get actual air displacement.
Hence: 02 at 1% decrease = 5,000 ppm of unknown substance

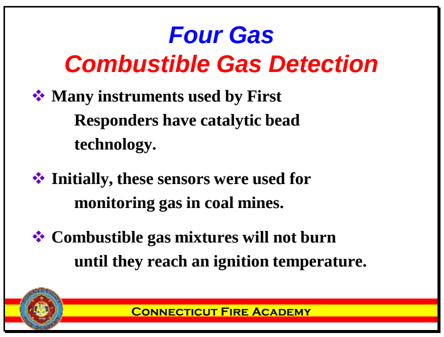
Slide 65



6.7.3 Competencies – Planning the Response.
6.7.3.2

Many instruments used by First Responders have catalytic bead technology.
Initially, these sensors were used for monitoring gas in coal mines.
Combustible gas mixtures will not burn until they reach an ignition temperature.

Slide 66



6.7.3 Competencies – Planning the Response.
6.7.3.2

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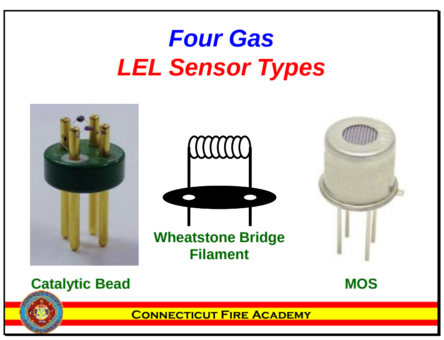
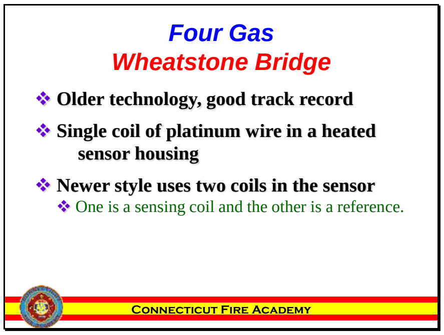
Slide 67



6.7.3 Competencies – Planning the Response.
6.7.3.2

Slide 68



6.7.3 Competencies – Planning the Response.
6.7.3.2

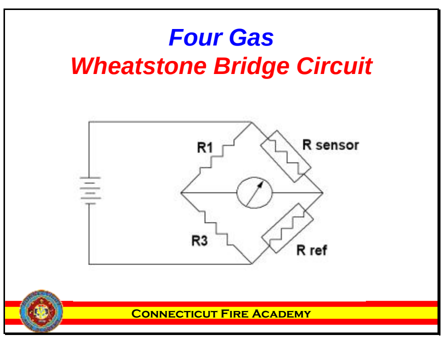
Wheatstone Bridge
Older technology, good track record
Single coil of platinum wire in a heated sensor housing

- Operation is the same as discussed earlier
- Increase in heat increases the resistance in the coil which is proportional to a change in current in the metering circuit.

Newer style uses two coils in the sensor

- One is the sensing coil and the other is a reference.
- The metering circuit compares the difference in resistance of the coils and displays this on the readout
- This allows for greater stability in the readings due to any changes in temperature or humidity.

Slide 69



6.7.3 Competencies – Planning the Response.
6.7.3.2

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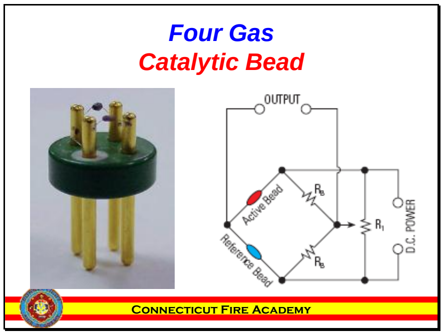
Slide 70

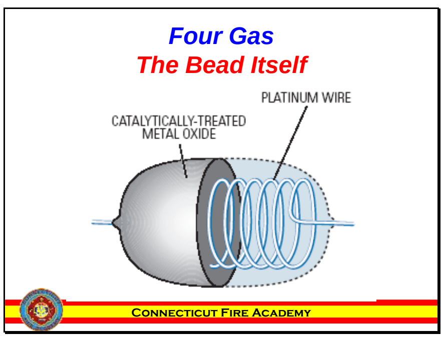


6.7.3 Competencies – Planning the Response.
6.7.3.2

Similar to the Wheatstone Bridge principle.
The Catalytic Bead sensor contains two beads.
One that serves as a neutral Reference.
The other that reacts with the gas / vapor present.
The difference is the resistance change which gives the reading

Reads 0 – 100% LEL
Some monitors will shutoff the sensor once 100% LEL is reached.
This keeps the sensor from saturating and "burning out"
It is important to watch the monitor at all times.
The responder may not be aware if they have reached 100% LEL.
One minute you may have a reading and the next the meter may be reading zero.

Slide 71



6.7.3 Competencies – Planning the Response.
6.7.3.2

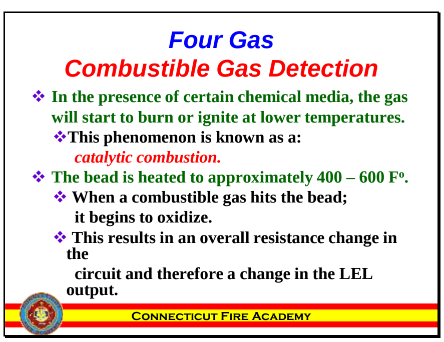
Catalytic Bead
Most common sensor type for LEL
Metal wire with catalytic metal bead in the middle

- Bead is covered with catalytic material to aide in burning the gas sample efficiently
- Bead sensor is more precise than the Wheatstone bridge
- Bead is less susceptible to breakage

Theory is the same as the Wheatstone bridge
Two sensors are used; 1 sensing and 1 reference

- As with the Wheatstone bridge, the difference in resistance between the two beads is
  proportional to what is displayed on the meter

Slide 72



6.7.3 Competencies – Planning the Response.
6.7.3.2

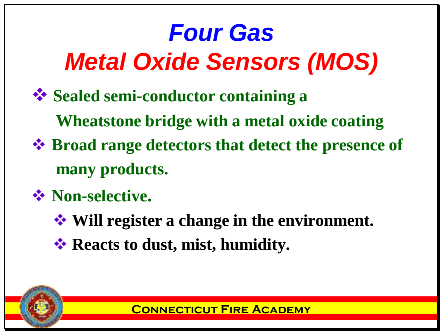
In the presence of certain chemical media, the gas will start to burn or ignite at lower temperatures.

- This phenomenon is known as a: *catalytic combustion.*

The bead is heated to approximately 400 – 600 F°.

- When a combustible gas hits the bead; it begins to oxidize.
- This results in an overall resistance change in the circuit and therefore a change in the
  LEL output.

Slide 73



6.7.3 Competencies – Planning the Response.
6.7.3.2

Sealed semi-conductor containing a Wheatstone bridge with a metal oxide coating

The Metal Oxide Sensor is a broadband sensor that "sees" not just gas but humidity, dust and other toxic chemicals. Can see some gases / vapors in the ppm range

Non-selective.
- Will register a change in the environment.

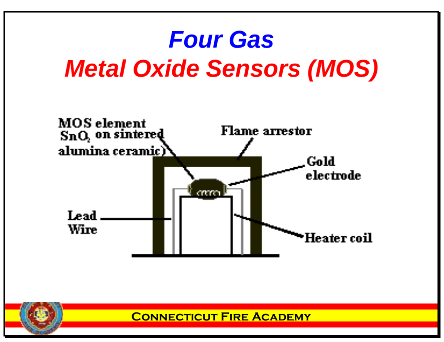
This amount of sensitivity may present problems if the meter is not given sufficient time to warm up, stabilize and burn off anything that may have accumulated on the sensor.

The sensitivity can be useful in that it can provide information on air quality and potential contaminants in the air.

Compared to other LEL sensors the MOS is sensitive enough that it can be used to
pinpoint small leaks in pipes, is an ideal sensor to find leaks, especially small ones

This sensor requires frequent calibration and zeroing before each use

Slide 74



6.7.3 Competencies – Planning the Response.
6.7.3.2

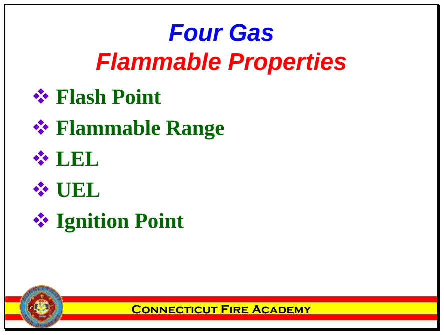
Very different proprietary blends of Iron, Zinc and Tin Oxides make up the sensor.

Burns at lower temperature than catalytic bead.
Heater coils provide constant temperature
Sample air passes over heated bridge and combines with oxygen produce by the metal oxide. **Anything** that enters the sensor house is "burned off" and registers a current change and a corresponding reading on the meter display. This is different than the Wheatstone bridge and Catalytic bead sensors which only burn off flammable gases.

Reaction on the element causes change in resistance then gives a reading.
Can produce sound, light or actual unit readings depending on model and manufacturer

Example: TIF Tracer Meter

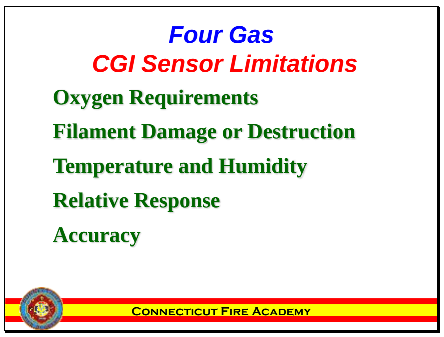
Slide 75



6.7.3 Competencies – Planning the Response.
6.7.3.2

Can it burn?
Will it burn?
What and will it ignite?
The range circle drawing

Slide 76



6.7.3 Competencies – Planning the Response.
6.7.3.2

Oxygen Requirements: CGI sensors are "burning" the sample. Oxygen level will have an effect on the accuracy of the readings. If the oxygen level is too low <19.5% sample will not burn efficiently and if the oxygen level is too high >23.5% samples will burn too quickly, thus producing either low or high readings

Filament Damage or Destruction: Certain Chemicals will degrade sensor operation while others may damage sensor.

Temperature and Humidity: Temperature will have the greatest effect on the sensors operation. Sensors and monitors alike have an optimum temperature range. Monitors should be warmed up prior to operation. Care should be taken when using the monitor outside of that optimum range.

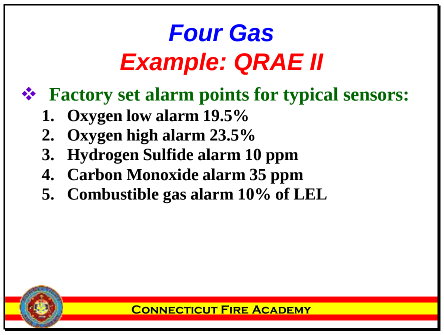
Humidity can also effect operation and readings. Condensation can build up on the sensor and also effect readings. The monitor once warmed up should be allowed to stabilize in the environment it will eventually be used in

Relative Response: Know what you are monitoring for. The monitor will be accurate and precise for the calibration gas only. If the atmosphere is not the same as the calibration gas but is known and the relative response for that gas is known, then a relative response or correction factor can be used to determine the percent concentration of that known atmosphere.

Accuracy: Accuracy of the monitor can be affected by any one of the above factors.

Know your meter and how to operate it properly.

Slide 77



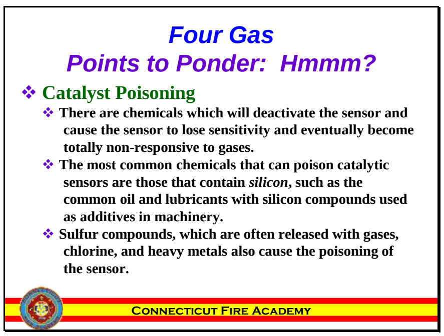
6.7.3 Competencies – Planning the Response.
6.7.3.2

If you are monitoring an unknown atmosphere great caution must be observed because the meter will not be giving you a true reading.

SOG's should dictate action levels for unknown atmospheres.
Examples:

- Alarm level of 10% indicates "Hot Zone"
- Meter reading greater than 1% indicates "Hot Zone"

Slide 78



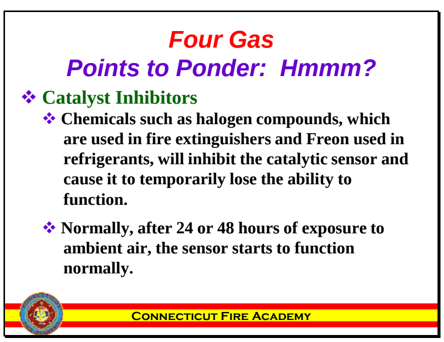
6.7.3 Competencies – Planning the Response.
6.7.3.2

Catalyst Poisoning
There are chemicals which will deactivate the sensor and cause the sensor to lose sensitivity and eventually become totally non-responsive to gases.

The most common chemicals that can poison catalytic sensors are those that contain *silicon*, such as the common oil and lubricants with silicon compounds used as additives in machinery.

Sulfur compounds, which are often released with gases, chlorine, and heavy metals, also cause the poisoning of the sensor.

Slide 79

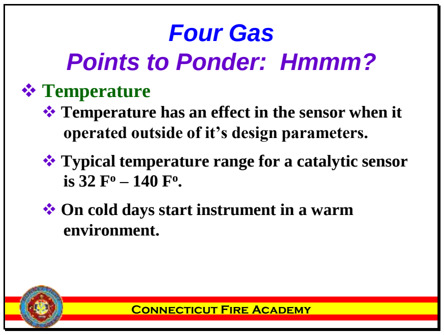


6.7.3 Competencies – Planning the Response.
6.7.3.2

Catalyst Inhibitors
Chemicals such as halogen compounds, which are used in fire extinguishers and Freon used in refrigerants, will inhibit the catalytic sensor and cause it to temporarily lose the ability to function.

Normally, after 24 or 48 hours of exposure to ambient air, the sensor starts to function normally.

Slide 80



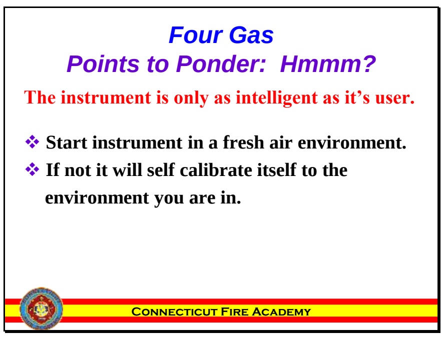
6.7.3 Competencies – Planning the Response.
6.7.3.2

Temperature
Temperature has an effect in the sensor when it operated outside of its design parameters.

Typical temperature range for a catalytic sensor is 32 F^{o} – 140 F^{o}.

On cold days start instrument in a warm environment.

Slide 81

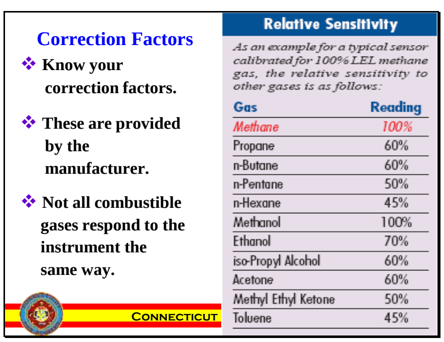


6.7.3 Competencies – Planning the Response.
6.7.3.2

The instrument is only as intelligent as it's user.

Start instrument in a fresh air environment.
If not it will self-calibrate itself to the environment you are in.

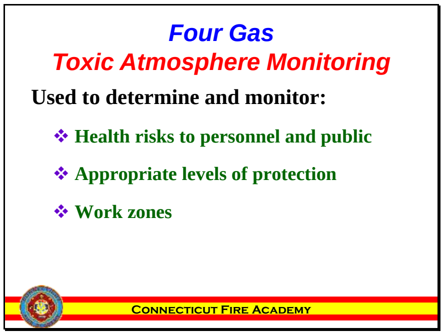
Slide 82



6.7.3 Competencies – Planning the Response.
6.7.3.2

Correct factors vary per Meter.
Responders must know their Meter and the Correction Factors

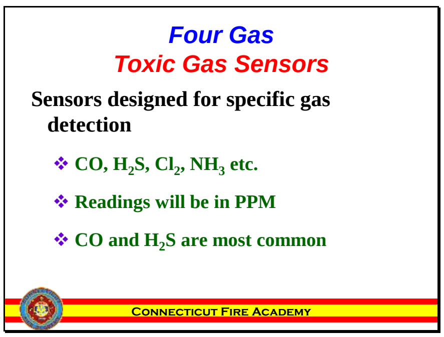
Slide 83



6.7.3 Competencies – Planning the Response.
6.7.3.2

Used to determine and monitor:
- Health risks to personnel and public
- Appropriate levels of protection
- Work zones

Slide 84



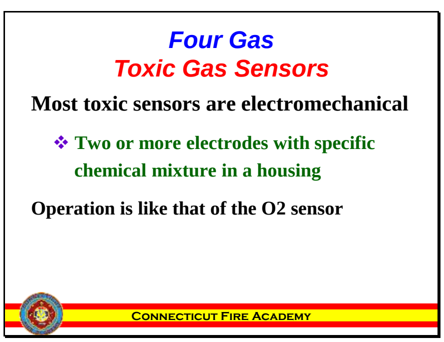
6.7.3 Competencies – Planning the Response.
6.7.3.2

Designed for specific gas detection
- CO, H2S, Cl2, NH3 etc.
- While some reading may be seen on the monitor, unless the atmosphere is known to be one that the sensor is designed to read, accuracy of the reading should be questioned.

Readings will be in PPM

CO and H2S are most common
Cl2 and NH3 are also high priorities due to the fact they are 2 of the top 10 most released chemicals.

Slide 85

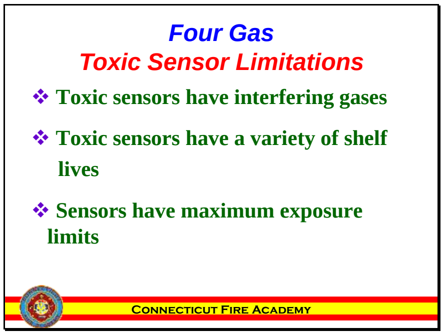


6.7.3 Competencies – Planning the Response.
6.7.3.2

Most toxic sensors are electromechanical
- Two or more electrodes with specific chemical mixture in a housing

Operation:
- Gas passes over sensor and creates a chemical reaction
- Reaction causes electrical charge with in sensor
- Charge is proportional to amount of product in the atmosphere

Slide 86



6.7.3 Competencies – Planning the Response.
6.7.3.2

Toxic sensors will have interfering gases

- These can cause inaccurate readings on the meter.
- Some can be filtered out. For example H2S is an interfering gas for Co sensors.
- The manufacturers have designed filters for the sensor to ensure that H2S will not interfere with the CO sensor operation

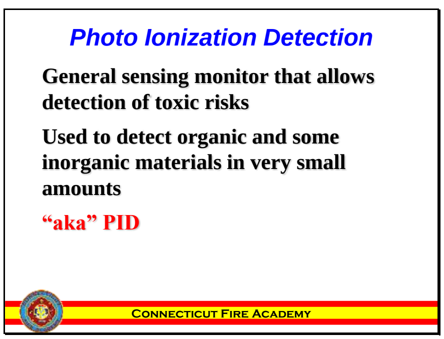
Toxic sensors have a variety of shelf lives

- Typically 12 to 18 months depending on the manufacturer

Sensors have maximum exposure limits

- Exposing the sensors to atmospheres at the maximum exposure limits will usually destroy the sensor

Slide 87



6.7.3 Competencies – Planning the Response.
6.7.3.2

General sensing monitor that allows detection of toxic risks

- Chemicals with a PEL or TLV/TWA of less than 500ppm are considered to be toxic
- Ionization detectors can assist responders in evaluating areas of concern or determine the source of possible leaks during "sick building" and "smells and bells" responses.
- They can also help evaluate differences in concentration from one area to another.
- The PID will not identify the chemical present but it will tell you something is there and what the relative concentration is.

Used to detect organic and some inorganic materials in very small amounts

- These materials are referred to as:
  - Volatile Organic Compounds or VOCs,
  - Toxic Industrial Chemicals or TICs
  - Toxic Industrial Materials or TIMs
- These products are toxic at very small levels.
- Examples: Ammonia – IDLH 300 ppm; Arsine – IDLH 3ppm; Benzene – IDLH 500ppm
- Some of the inorganic gases are ammonia, arsine, bromine, iodine and phosphene
- Chemical warfare agents can also be detected

"aka" PID – Photo Ionization Detector

Slide 88

6.7.3 Competencies – Planning the Response.
6.7.3.2

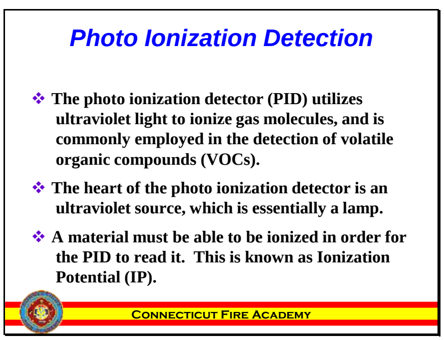
The PID has a detection range from 0.1 – 10,000 ppm (depending on manufacturer)

- This is important because most of the LEL sensors in use today need relatively high levels of chemical in the atmosphere to begin reading, 50 ppm or more.
- The one exception are the MOS sensors.
- If we convert 50 ppm to % we get .005%. Most LEL monitors do not start to read until they hit 1% LEL. CGI or LEL monitors generally read in whole numbers so a level of anything less than 1 would be indicated by a 0 on the meter
- 1% equals 10,000 ppm

The PID gives responders the ability to detect toxic levels before most LEL sensors begin to read.

- Many response organizations rely solely on a 4 gas for their air monitoring. This can lead to poor decision making in relation to toxic atmospheres and responder safety. Remember, the toxic sensors in the 4 gas are chemical specific and cannot be relied upon to determine if an atmosphere is toxic unless it is known and the sensor is able to read it.

Slide 89



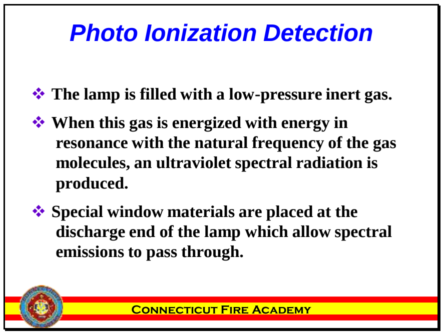
6.7.3 Competencies – Planning the Response.
6.7.3.2

The photo ionization detector (PID) utilizes ultraviolet light to ionize gas molecules, and is commonly employed in the detection of volatile organic compounds (VOCs).

The heart of the photo ionization detector is an ultraviolet source, which is essentially a lamp.

A material must be able to be ionized in order for the PID to read it. This is known as Ionization Potential (IP).

Slide 90



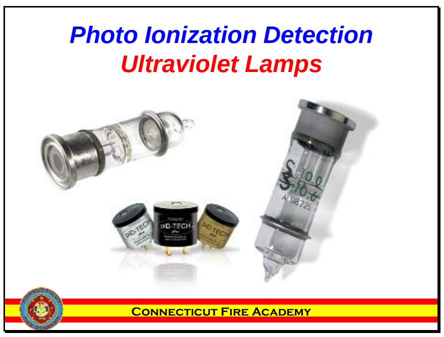
6.7.3 Competencies – Planning the Response.
6.7.3.2

The lamp is filled with a low-pressure inert gas.

When this gas is energized with energy in resonance with the natural frequency of the gas molecules, an ultraviolet spectral radiation is produced.

Special window materials are placed at the discharge end of the lamp which allows spectral emissions to pass through.

Slide 91



6.7.3 Competencies – Planning the Response.
6.7.3.2

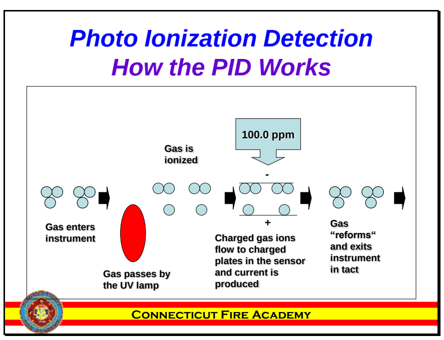
A material must be able to be ionized in order for the PID to read it.

- Ionization is the splitting of a vaporized molecule into separate electrical charges both positive and negative.
- This is known as Ionization Potential (IP). Ionization potential is measured in electron volts (eV).

The PID uses an ultra-violet lamp to ionize the gas.

- Several lamp types are available. 10.2eV, 10.6eV (most common and broadest range) and 11.7eV.

Slide 92



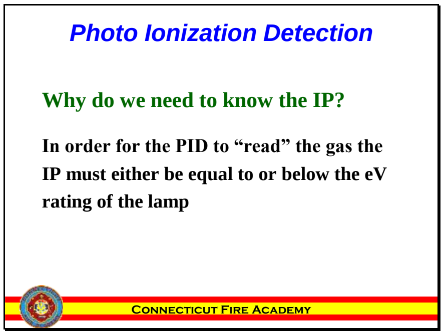
6.7.3 Competencies – Planning the Response.
6.7.3.2

It is an optical system using Ultraviolet light to breakdown vapors and gases for
measurement

Once the gas is ionized the device detects a change in electrical activity and this is read by the meter.

These readings are compared to a known source or calibration gas.
If the atmosphere is the same as the calibration gas the readings will be a true one to one.
If the atmosphere known and is other than the calibration gas, a correction factor or relative response factor will be needed to convert the reading so it is accurate.

Slide 93



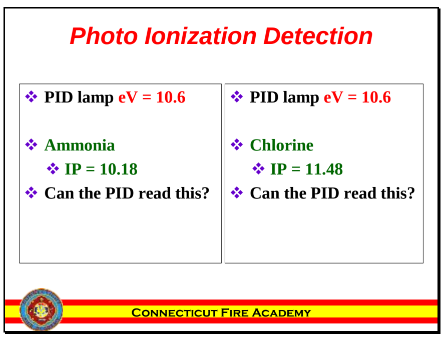
6.7.3 Competencies – Planning the Response.
6.7.3.2

Why do we need to know the IP?

In order for the PID to "read" the gas the IP must either be equal to or below the eV rating of the lamp.

If the IP is greater than the eV rating of the lamp there my some type of reading but it
will not be accurate

Slide 94

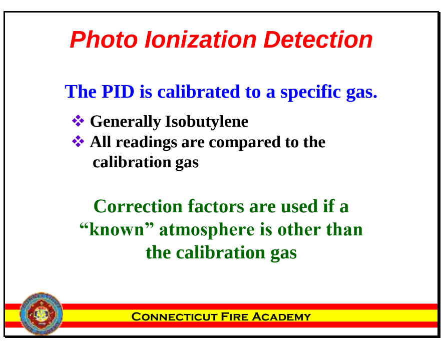


6.7.3 Competencies – Planning the Response.
6.7.3.2

Can the PID read this?
Left – Ammonia – **YES,** IP is less than 10.6

Right – Chlorine – **Not Properly,** IP is more than 10.6

Slide 95

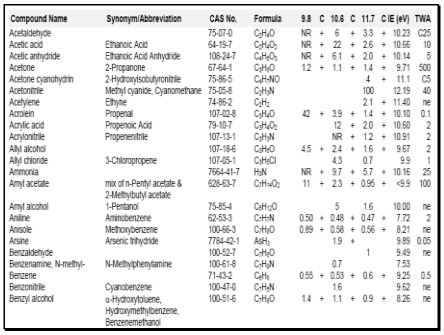


6.7.3 Competencies – Planning the Response.
6.7.3.2

The PID is calibrated to a specific gas.
Generally Isobutylene
All readings are compared to the calibration gas

Correction factors are used if a "known" atmosphere is other than the calibration gas

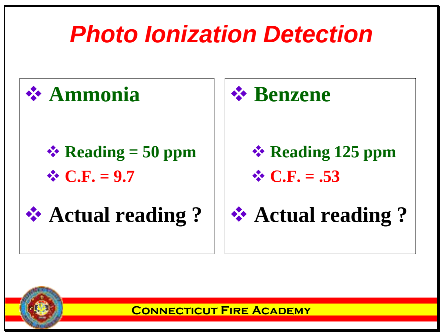
Slide 96



Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Acetaldehyde		75-07-0	C_2H_4O	NR	+	6	+	3.3	+	10.23	C25
Acetic acid	Ethanoic Acid	64-19-7	$C_2H_4O_2$	NR	+	22	+	2.6	+	10.66	10
Acetic anhydride	Ethanoic Acid Anhydride	108-24-7	$C_4H_6O_3$	NR	+	6.1	+	2.0	+	10.14	5
Acetone	2-Propanone	67-64-1	C_3H_6O	1.2	+	1.1	+	1.4	+	9.71	500
Acetone cyanohydrin	2-Hydroxyisobutyronitrile	75-86-5	C_4H_7NO					4	+	11.1	C5
Acetonitrile	Methyl cyanide, Cyanomethane	75-05-8	C_2H_3N					100		12.19	40
Acetylene	Ethyne	74-86-2	C_2H_2					2.1	+	11.40	ne
Acrolein	Propenal	107-02-8	C_3H_4O	42	+	3.9	+	1.4	+	10.10	0.1
Acrylic acid	Propenoic Acid	79-10-7	$C_3H_4O_2$			12	+	2.0	+	10.60	2
Acrylonitrile	Propenenitrile	107-13-1	C_3H_3N			NR	+	1.2	+	10.91	2
Allyl alcohol		107-18-6	C_3H_6O	4.5	+	2.4	+	1.6	+	9.67	2
Allyl chloride	3-Chloropropene	107-05-1	C_3H_5Cl			4.3		0.7		9.9	1
Ammonia		7664-41-7	H_3N	NR	+	9.7	+	5.7	+	10.16	25
Amyl acetate	mix of n-Pentyl acetate & 2-Methylbutyl acetate	628-63-7	$C_7H_{14}O_2$	11	+	2.3	+	0.95	+	<9.9	100
Amyl alcohol	1-Pentanol	75-85-4	$C_5H_{12}O$			5		1.6		10.00	ne
Aniline	Aminobenzene	62-53-3	C_6H_7N	0.50	+	0.48	+	0.47	+	7.72	2
Anisole	Methoxybenzene	100-66-3	C_7H_8O	0.89	+	0.58	+	0.56	+	8.21	ne
Arsine	Arsenic trihydride	7784-42-1	AsH_3			1.9	+			9.89	0.05
Benzaldehyde		100-52-7	C_7H_6O					1		9.49	ne
Benzenamine, N-methyl-	N-Methylphenylamine	100-61-8	C_7H_9N			0.7				7.53	
Benzene		71-43-2	C_6H_6	0.55	+	0.53	+	0.6	+	9.25	0.5
Benzonitrile	Cyanobenzene	100-47-0	C_7H_5N			1.6				9.62	ne
Benzyl alcohol	α-Hydroxytoluene, Hydroxymethylbenzene, Benzenemethanol	100-51-6	C_7H_8O	1.4	+	1.1	+	0.9	+	8.26	ne

6.7.3 Competencies – Planning the Response.
6.7.3.2

Slide 97



6.7.3 Competencies – Planning the Response.
6.7.3.2

What are the IDLH values for both of these materials?
Are we safe?
Should we be wearing SCBA?

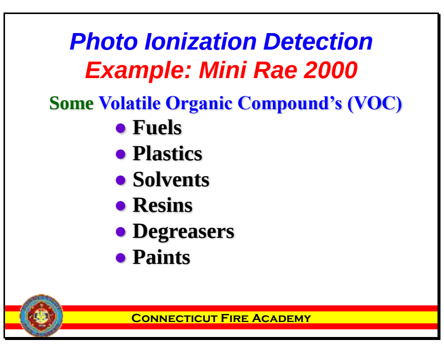
Ammonia:
50 x 9.7 = 485 ppm

Benzene:
125 x 0.53 = 66.25 ppm

Slide 98

6.7.3 Competencies – Planning the Response.
6.7.3.2

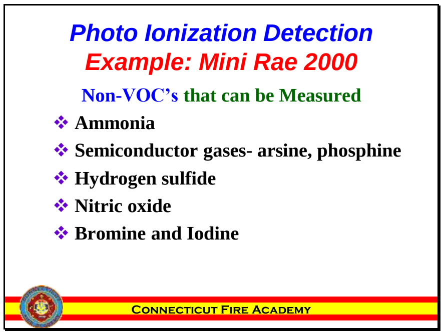
Slide 99



6.7.3 Competencies – Planning the Response.
6.7.3.2

Volatile organic compounds (VOCs) are organic chemical compounds that have high enough vapor pressures under normal conditions to significantly vaporize and enter the earth's atmosphere. Volatile organic compounds are numerous and varied. Although ubiquitous in nature and modern industrial society, they may also be harmful or toxic.
VOCs, or subsets of the VOCs, are often regulated.

Slide 100

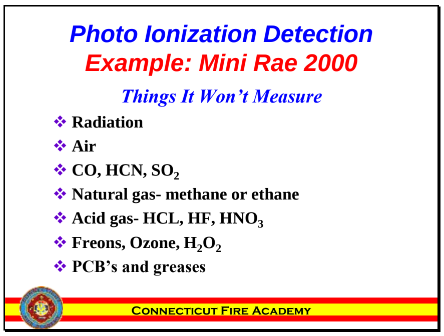


6.7.3 Competencies – Planning the Response.
6.7.3.2

Non-VOC's that can be Measured

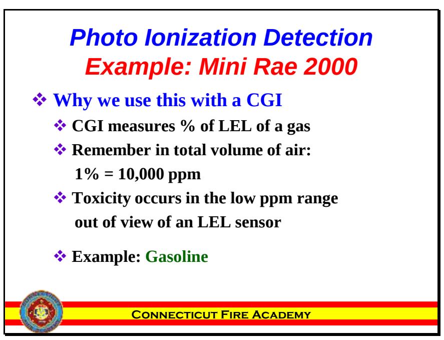
- Ammonia
- Semiconductor gases- arsine, phosphine
- Hydrogen sulfide
- Nitric oxide
- Bromine and Iodine

Slide 101



6.7.3 Competencies – Planning the Response.
6.7.3.2

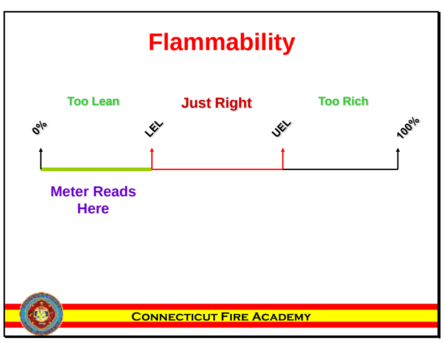
Slide 102



6.7.3 Competencies – Planning the Response.
6.7.3.2

LEL of gasoline is 1.4% = to 14,000 ppm
IDLH not determined so use 10% rule get 1,400 ppm for IDLH
can't see that with a LEL sensor it would be equivalent to 0.14%

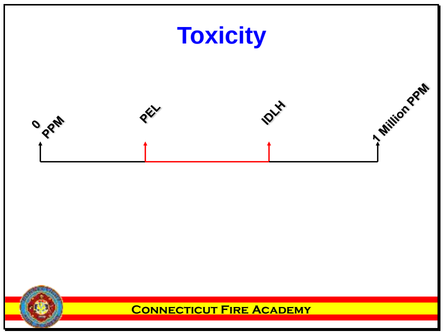
Slide 103



6.7.3 Competencies – Planning the Response.
6.7.3.2

Remember These?
LEL: Lower Explosive Limit
UEL: Upper Explosive Limit

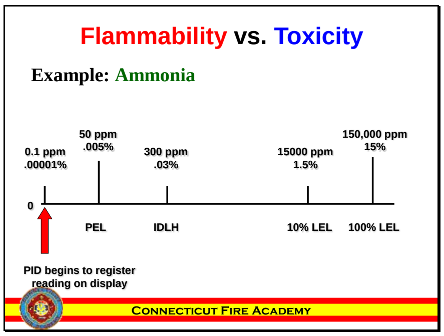
Slide 104



6.7.3 Competencies – Planning the Response.
6.7.3.2

Remember These?
PPM: Parts Per Million
PEL: Permissible exposure limit
IDLH: Immediately Dangerous to Life and Health

Slide 105



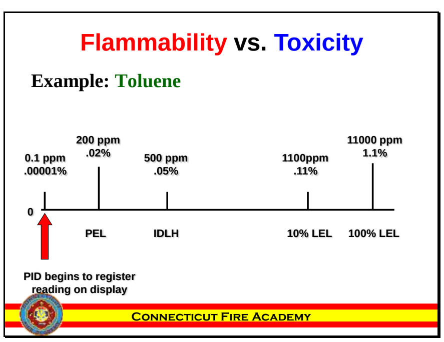
6.7.3 Competencies – Planning the Response.
6.7.3.2

The PID will begin to indicate a reading at approximately 0.1ppm.
The IDLH level is well below the alarm level for the CGI (10 % LEL)

Many fire departments and other response organizations will use the alarm levels (10% LEL) to begin making decisions like donning SCBA and setting up exclusion zones.
If that practice was used here and no SCBA was being worn, the responder would be at
50 times the IDLH.

This example shows a vast difference between IDLH and flammability.
There are many chemicals that the difference between toxicity and flammability is much narrower. See Toluene slide

Slide 106

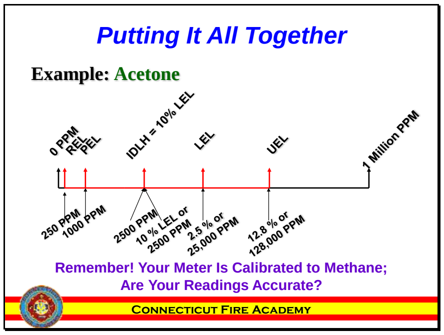


6.7.3 Competencies – Planning the Response.
6.7.3.2

Again, it can be seen here that Toluene is toxic before it is flammable.
The range between the two is much narrower but, if only a CGI were used to monitor for the hazard the responders would be in an atmosphere that is 2 times the IDLH when the CGI begins to alarm.

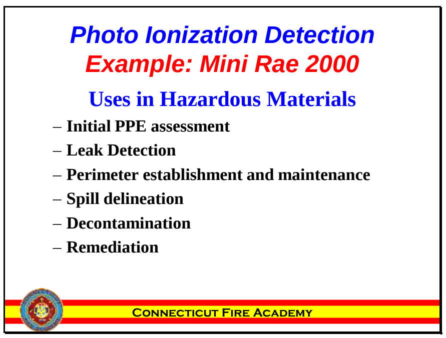
In both cases it can be seen that the materials are toxic well before they become flammable. Using the PID during initial meter operations along with a CGI will allow responder to make intelligent decisions that include PPE selection and setting up control zones.

Slide 107

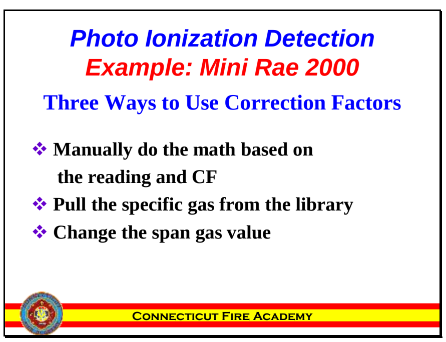


6.7.3 Competencies – Planning the Response.
6.7.3.2

Slide 108



Slide 109



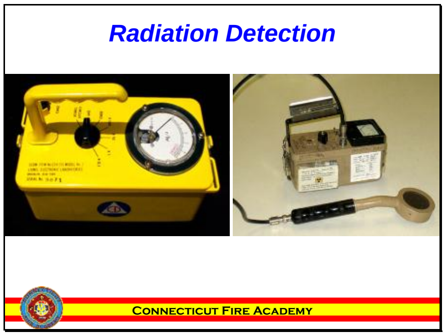
6.7.3 Competencies – Planning the Response.

6.7.3.2

Uses in Hazardous Materials

- Initial PPE assessment
- Leak Detection
- Perimeter establishment and maintenance
- Spill delineation
- Decontamination
- Remediation

Slide 110



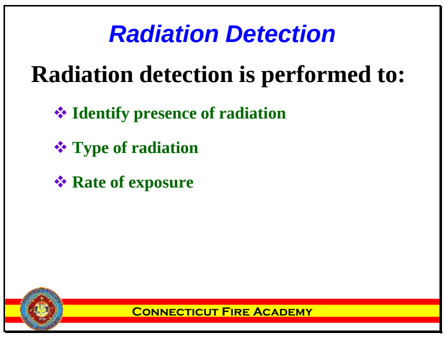
6.7.3 Competencies – Planning the Response.

6.7.3.2

Three Ways to Use Correction Factors

- Manually do the math based on the reading and CF
- Pull the specific gas from the library
- Change the span gas value

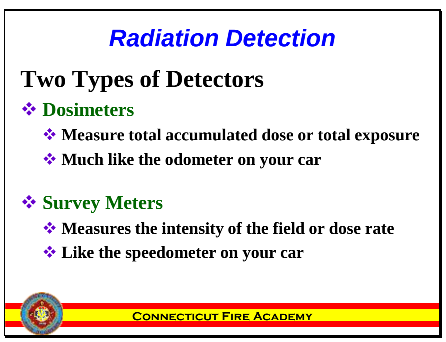
Slide 111



6.7.3 Competencies – Planning the Response.

6.7.3.2

Slide 112



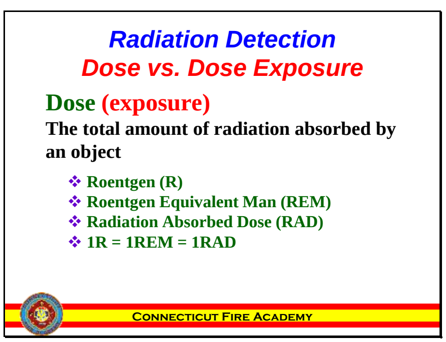
6.7.3 Competencies – Planning the Response.

6.7.3.2

Radiation detection is performed to:

- Identify presence of radiation
- Type of radiation
- Rate of exposure

Slide 113



6.7.3 Competencies – Planning the Response.

6.7.3.2

Two Types of Detectors

Dosimeters

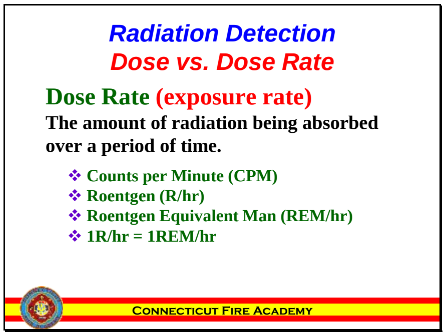
Measure total accumulated dose or total exposure

- Much like the odometer on your car

Survey Meters

- Measures the intensity of the field or dose rate
- Like the speedometer on your car

Slide 114



6.7.3 Competencies – Planning the Response.

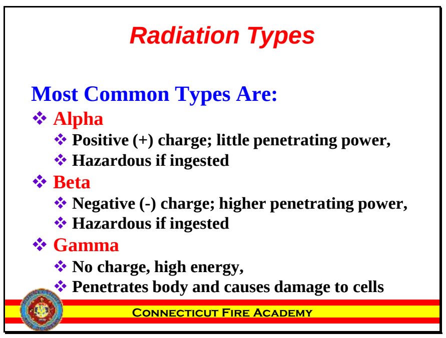
6.7.3.2

Dose (exposure)

The total amount of radiation absorbed by an object

- Roentgen (R)
- Roentgen Equivalent Man (REM)
- Radiation Absorbed Dose (RAD)
- 1R = 1REM = 1RAD

Slide 115



6.7.3 Competencies – Planning the Response.

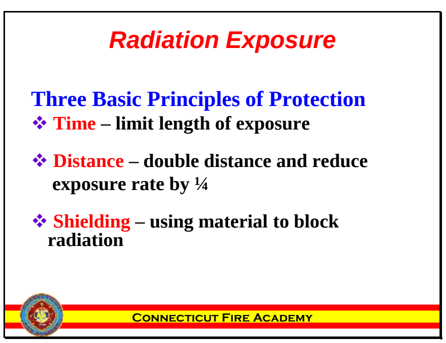
6.7.3.2

Dose Rate (exposure rate)

The amount of radiation being absorbed over a period of time.

- Counts per Minute (CPM)
- Roentgen (R/hr)
- Roentgen Equivalent Man (REM/hr)
- 1R/hr = 1REM/hr

Slide 116



6.7.3 Competencies – Planning the Response.

6.7.3.2

Most Common Types Are:

Alpha

- Positive (+) charge; little penetrating power,
- Hazardous if ingested

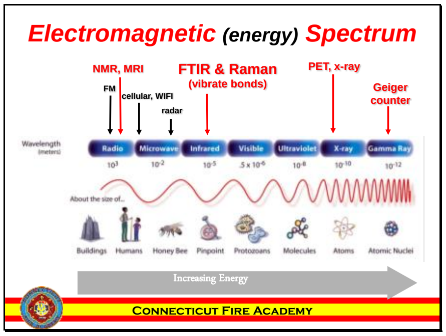
Beta

- Negative (-) charge; higher penetrating power,
- Hazardous if ingested

Gamma

- No charge, high energy,
- Penetrates body and causes damage to cells

Slide 117



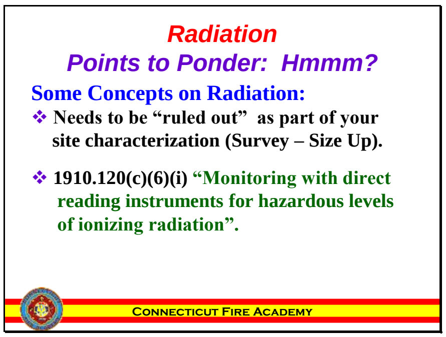
6.7.3 Competencies – Planning the Response.

6.7.3.2

Three Basic Principles of Protection

- Time – limit length of exposure
- Distance – double distance and reduce exposure rate by ¼
- Shielding – using material to block radiation

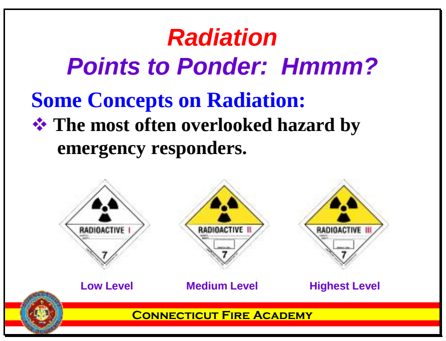
Slide 118



6.7.3 Competencies – Planning the Response.

6.7.3.2

Slide 119



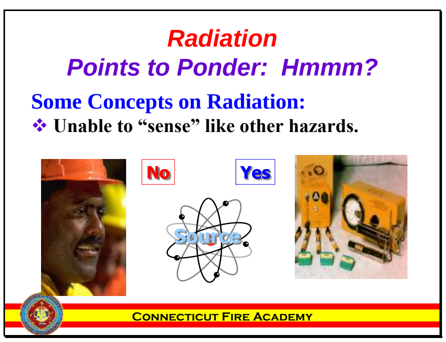
6.7.3 Competencies – Planning the Response.

6.7.3.2

Define the transportation index

Do an inverse square calculation for the transportation index

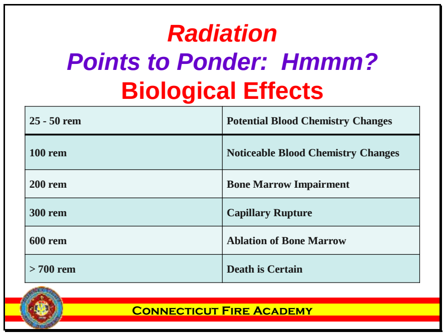
Slide 120



6.7.3 Competencies – Planning the Response.

6.7.3.2

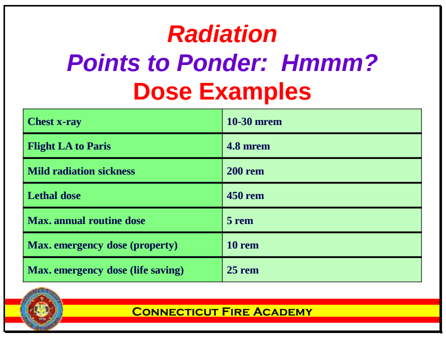
Slide 121



6.7.3 Competencies – Planning the Response.

6.7.3.2

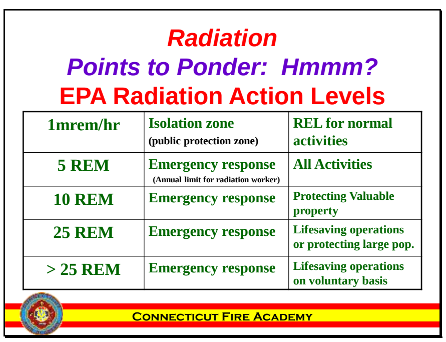
Slide 122



6.7.3 Competencies – Planning the Response.

6.7.3.2

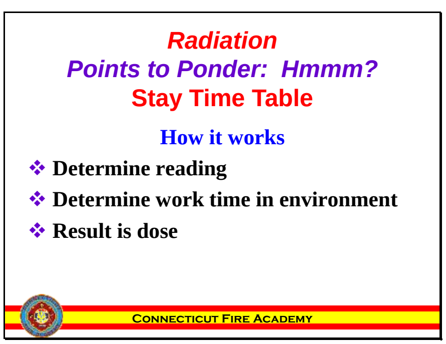
Slide 123



6.7.3 Competencies – Planning the Response.

6.7.3.2

Slide 124



6.7.3 Competencies – Planning the Response.

6.7.3.2

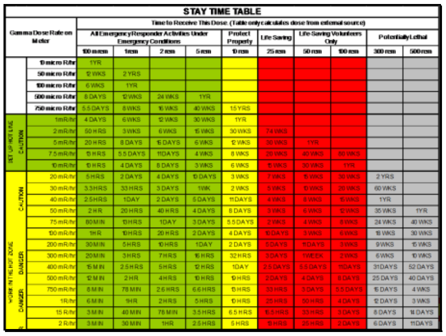
How it works

Determine reading

Determine work time in environment

Result is dose

Slide 125

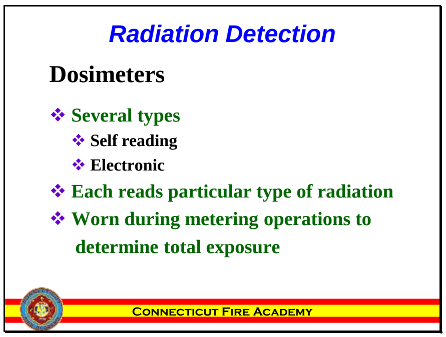


STAY TIME TABLE											
	Gamma Dose Rate on Meter	Time to Receive This Dose. (Table only calculates dose from external source)									
		All Emergency Responder Activities Under Emergency Conditions				Protect Property	Life Saving	Life Saving Volunteers Only		Potentially Lethal	
		100 mrem	1 rem	2 rem	5 rem	10 rem	25 rem	50 rem	100 rem	300 rem	500 rem
	10 micro R/hr	1YR									
	50 micro R/hr	12 WKS	2 YRS								
	100 micro R/hr	6 WKS	1YR								
	500 micro R/hr	8 DAYS	12 WKS	24 WKS	1YR						
	750 micro R/hr	5.5 DAYS	8 WKS	16 WKS	40 WKS	1.5 YRS					
SET UP HOT LINE CAUTION	1 mR/hr	4 DAYS	6 WKS	12 WKS	30 WKS	1YR					
	2 mR/hr	50 HRS	3 WKS	6 WKS	15 WKS	30 WKS	74 WKS				
	5 mR/hr	20 HRS	8 DAYS	16 DAYS	6 WKS	12 WKS	30 WKS	1YR			
	7.5 mR/hr	13 HRS	5.5 DAYS	11 DAYS	4 WKS	8 WKS	20 WKS	40 WKS	80 WKS		
	10 mR/hr	10 HRS	4 DAYS	8 DAYS	3 WKS	6 WKS	15 WKS	30 WKS	1YR		
WORK IN THE HOT ZONE CAUTION	20 mR/hr	5 HRS	2 DAYS	4 DAYS	10 DAYS	3 WKS	7 WKS	15 WKS	30 WKS	2 YRS	
	30 mR/hr	3.3 HRS	33 HRS	3 DAYS	1 WK	2 WKS	5 WKS	10 WKS	20 WKS	60 WKS	
	40 mR/hr	2.5 HRS	1 DAY	2 DAYS	5 DAYS	11 DAYS	4 WKS	8 WKS	15 WKS	1YR	
	50 mR/hr	2 HR	20 HRS	40 HRS	4 DAYS	8 DAYS	3 WKS	6 WKS	12 WKS	35 WKS	1YR
	75 mR/hr	80 MIN	13 HRS	1 DAY	3 DAYS	5.5 DAYS	2 WKS	4 WKS	8 WKS	24 WKS	40 WKS
	100 mR/hr	1 HR	10 HRS	20 HRS	2 DAYS	4 DAYS	10 DAYS	3 WKS	6 WKS	18 WKS	30 WKS
DANGER	200 mR/hr	30 MIN	5 HRS	10 HRS	1 DAY	2 DAYS	5 DAYS	11 DAYS	3 WKS	9 WKS	15 WKS
	300 mR/hr	20 MIN	3 HRS	7 HRS	16 HRS	32 HRS	3 DAYS	1 WEEK	2 WKS	6 WKS	10 WKS
	400 mR/hr	15 MIN	2.5 HRS	5 HRS	12 HRS	1 DAY	2.5 DAYS	5.5 DAYS	11 DAYS	31 DAYS	52 DAYS
	500 mR/hr	12 MIN	2 HR	4 HRS	10 HRS	19 HRS	2 DAYS	4 DAYS	8 DAYS	25 DAYS	40 DAYS
DANGER	750 mR/hr	8 MIN	78 MIN	2.6 HRS	6.6 HRS	13 HRS	33 HRS	3 DAYS	5.5 DAYS	16 DAYS	4 WKS
	1 R/hr	6 MIN	1 HR	2 HRS	5 HRS	10 HRS	25 HRS	50 HRS	4 DAYS	12 DAYS	3 WKS
	1.5 R/hr	3 MIN	40 MIN	78 MIN	3.5 HRS	6.5 HRS	16.5 HRS	33 HRS	3 DAYS	8 DAYS	14 DAYS
	2 R/hr	3 MIN	30 MIN	1 HR	2.5 HRS	5 HRS	13 HRS	25 HRS	2 DAYS	6 DAYS	11 DAYS

6.7.3 Competencies – Planning the Response.

6.7.3.2

Slide 126



6.7.3 Competencies – Planning the Response.

6.7.3.2

Dosimeters

Several types

- Self reading
- Electronic

Each reads particular type of radiation

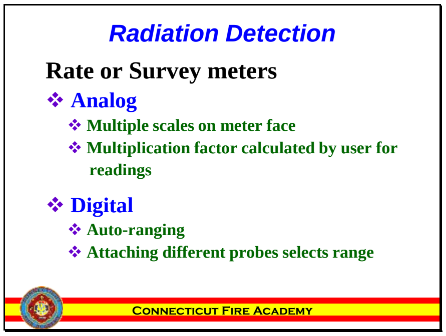
Worn during metering operations to determine total exposure

Slide 127

6.7.3 Competencies – Planning the Response.

6.7.3.2

Slide 128



6.7.3 Competencies – Planning the Response.

6.7.3.2

Rate or Survey meters

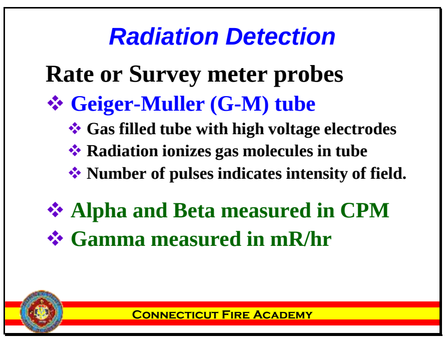
Analog

- Multiple scales on meter face
- Multiplication factor calculated by user for readings

Digital

- Auto-ranging
- Attaching different probes selects range

Slide 129



6.7.3 Competencies – Planning the Response.

6.7.3.2

Rate or Survey meter probes:

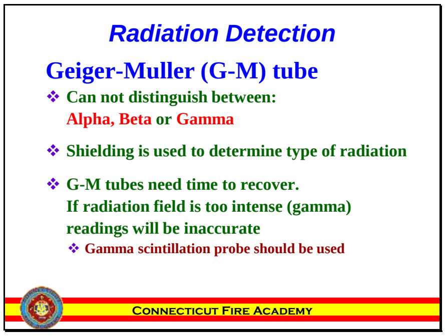
Geiger-Muller (G-M) tube

- Gas filled tube with high voltage electrodes
- Alpha, beta or gamma radiation enters the tube
- Radiation ionizes gas molecule in tube
- Free electron accelerates toward positive electrode by high voltage. This accelerating electron ionizes other electrons and so on down the line.
- The number of pulses indicates the intensity of the field.

Alpha and beta measured in CPM

Gamma measured in mR/hr

Slide 130



6.7.3 Competencies – Planning the Response.

6.7.3.2

Geiger-Muller (G-M) tube

Cannot distinguish between: Alpha, Beta or Gamma

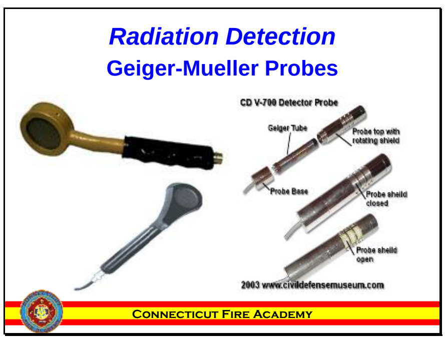
Shielding must be used to determine type of radiation

- Paper or a latex glove will stop Alpha
- Thin metal sheet or ¼" plastic sheet stops Beta or very low energy Gamma

G-M tubes need time to recover. Recovery time is between 50 and 100 micro seconds.

This limits the maximum count rate. In high level gamma fields the G-M tube may not have time to recover from one pulse to the next. If radiation field is to intense (gamma) readings will be inaccurate

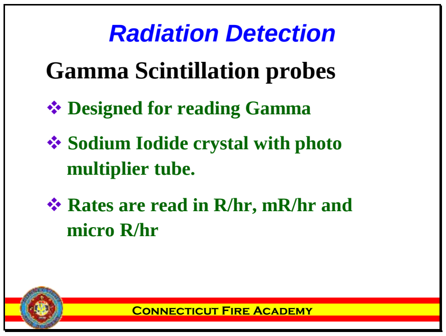
Slide 131



6.7.3 Competencies – Planning the Response.

6.7.3.2

Slide 132



6.7.3 Competencies – Planning the Response.

6.7.3.2

Gamma Scintillation probes

Designed for reading Gamma

- Some scintillation probes are designed to read Alpha and Beta radiation

Sodium Iodide crystal with photo-multiplier tube.

- The sodium iodide crystal emits light (scintillates) when struck with gamma radiation.
- This light is captured by a photomultiplier tube, amplified, collected and transformed into pulses that are read by the meter.

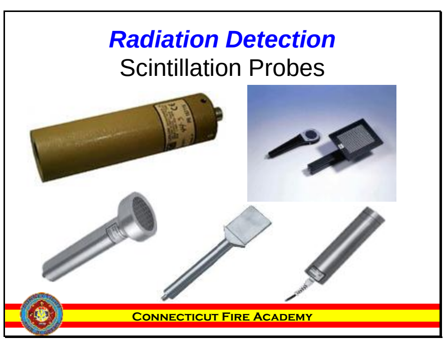
Rates are read in:

R/hr, Roentgens Per Hour

mR/hr millirem Per Hour

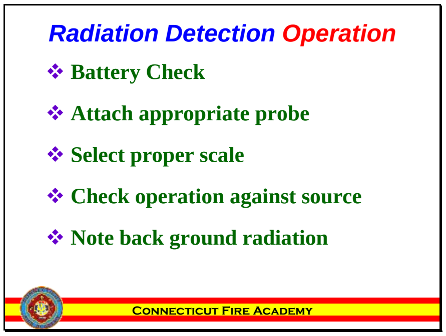
microR/hr

Slide133



6.7.3 Competencies – Planning the Response.
6.7.3.2

Slide 134



6.7.3 Competencies – Planning the Response.
6.7.3.2

Battery Check
- Analog vs Digital

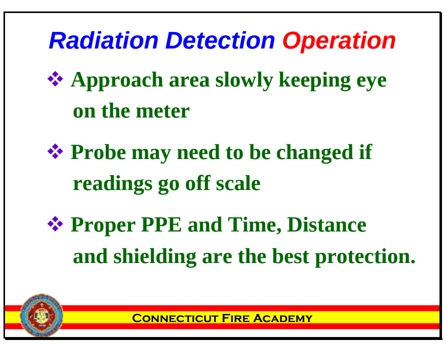
Attach appropriate probe
- Probe selection will be based on research and any other information obtained at the scene. If no information is known start with most sensitive probe, generally the pancake.

Select proper scale
- Start with the most sensitive (lowest). Analog only. If the readings move the needle on the meter off the scale switch to the next highest scale.
- Digital meters will auto select the range depending on the probe attached.

Check operation against source
- The closer to the source the higher the readings. The farther away the lower. The scale may have to be changed to get reading

Note back ground radiation
- Background level radiation will vary depending on area of country.
- The Background radiation will end up being the “Zero” point for all other readings.

Slide 135



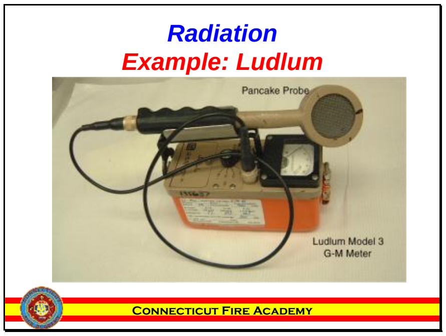
6.7.3 Competencies – Planning the Response.
6.7.3.2

Approach area slowly keeping eye on the meter
- As readings increase scale may need to be changed on analog meters, digital meters will auto-range.

Probe may need to be changed if readings go off scale
- Both analog and digital meters may over range depending on the type of probe and the type of radiation. If a G-M probe is being used in a gamma environment and the meter is no longer reading. The probe may need to be changed.

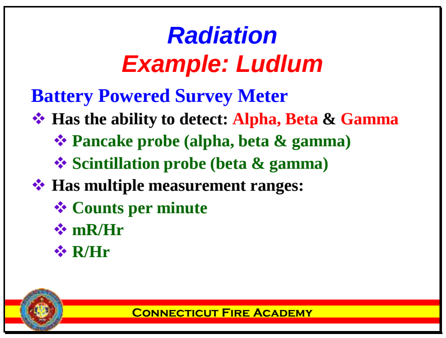
Proper PPE and Time, Distance and shielding are the best protection.

Slide 136



6.7.3 Competencies – Planning the Response.
6.7.3.2

Slide 137

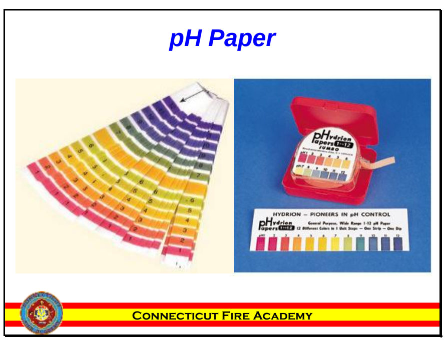


6.7.3 Competencies – Planning the Response.
6.7.3.2

Battery Powered Survey Meter
Has the ability to detect: Alpha, Beta & Gamma
- Pancake probe (alpha, beta & gamma)
- Scintillation probe (beta & gamma)

Has multiple measurement ranges:
- Counts per minute
- mR/Hr
- R/Hr

Slide 138



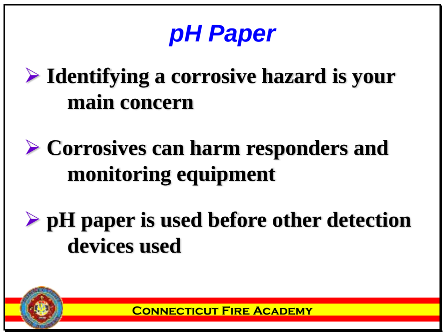
6.7.3 Competencies – Planning the Response.
6.7.3.2

Knowing the exact pH is not necessary
- Responders should know if the atmosphere or material is corrosive

Responders should look for color change
- If there is a color change further monitoring must be done with appropriate PPE

Wetting pH paper increases sensitivity
- This is good for corrosive atmospheres
- Neutral water is recommended but anything you have on hand will do. As long as the water does not create a color change on the pH paper.

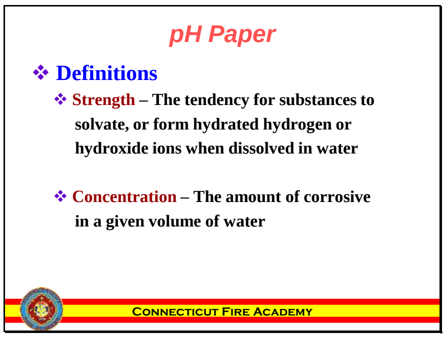
Slide 139



6.7.3 Competencies – Planning the Response.
6.7.3.2

Identifying a corrosive hazard is your main concern
Corrosives can harm responders and monitoring equipment
pH paper is used before other detection devices used

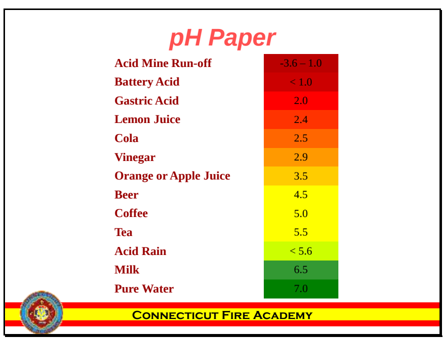
Slide 140



6.7.3 Competencies – Planning the Response.
6.7.3.2

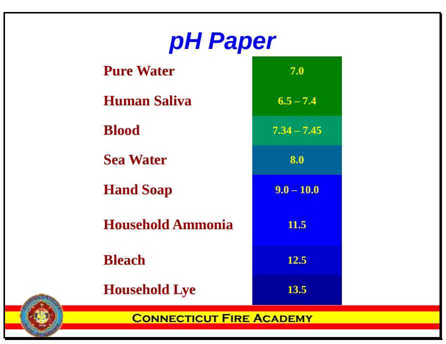
Example:
H_2SO_2 (sulfuric Acid) is a "strong" acid.
It will give off a lot of hydrated "H" (Hydrogen)
But if you put a little H_2SO_2 in a lot of Water (H_2O)
The concentration would be low, having a higher pH number

Slide 141



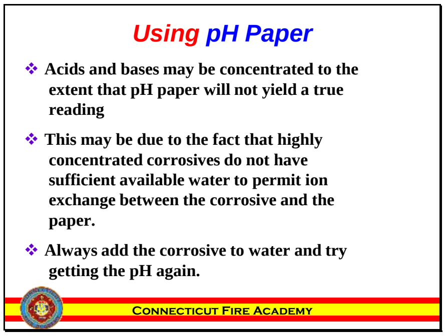
6.7.3 Competencies – Planning the Response.
6.7.3.2

Slide 142



6.7.3 Competencies – Planning the Response.
6.7.3.2

Slide 143



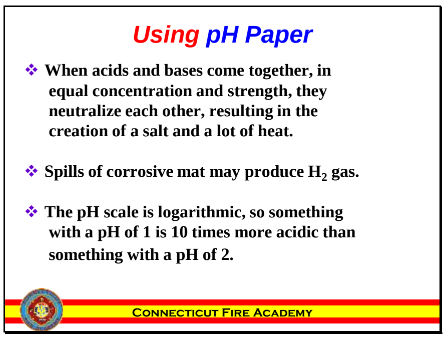
6.7.3 Competencies – Planning the Response.
6.7.3.2

Acids and bases may be concentrated to the extent that pH paper will not yield a true reading

This may be due to the fact that highly concentrated corrosives do not have sufficient available water to permit ion exchange between the corrosive and the paper.

Always add the corrosive to water and try getting the pH again.

Slide 144



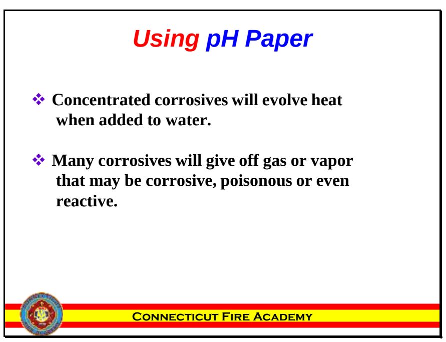
6.7.3 Competencies – Planning the Response.
6.7.3.2

When acids and bases come together, in equal concentration and strength, they neutralize each other, resulting in the creation of a salt and a lot of heat.

Spills of corrosive mat may produce H_2 gas.

The pH scale is logarithmic, so something with a pH of 1 is 10 times more acidic than something with a pH of 2.

Slide 145

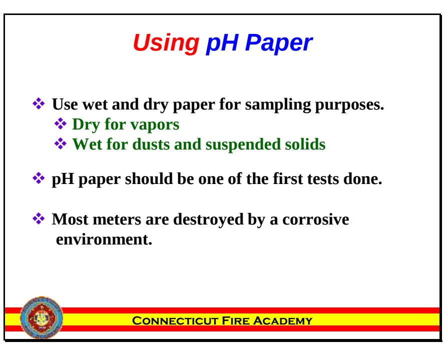


6.7.3 Competencies – Planning the Response.
6.7.3.2

Concentrated corrosives will evolve heat when added to water.

Many corrosives will give off gas or vapor that may be corrosive, poisonous or even reactive.

Slide 146



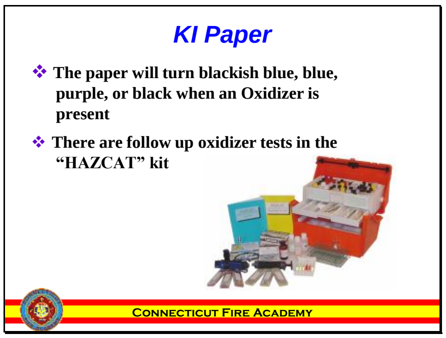
6.7.3 Competencies – Planning the Response.
6.7.3.2

For pH's between 4 and 8 check the leading edge
If jagged the reading is considered correct.
If straight – question the reading, likely with hydrocarbons

Slide 147

6.7.3 Competencies – Planning the Response.
6.7.3.2

Slide 148

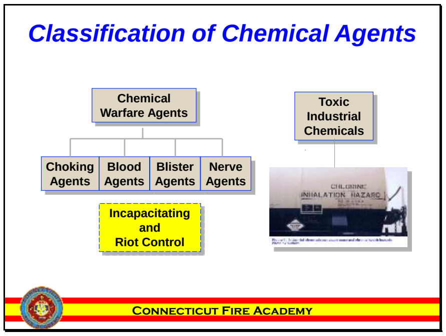


6.7.3 Competencies – Planning the Response.
6.7.3.2

Slide 149

6.7.3 Competencies – Planning the Response.
6.7.3.2

Slide 150



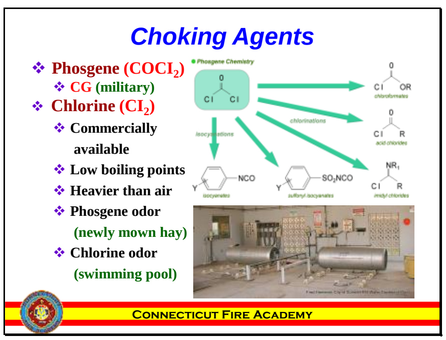
6.7.3 Competencies – Planning the Response.
6.7.3.2

Chemical agents are classified according to their physical state, physiological effects, and use—including persistent, non-persistent, toxic, and incapacitating.

In addition, chemical agents can exist in solid, liquid, or gaseous physical states. The different states in which chemical agents normally exist determine to some extent the length of time and physiological effectiveness.

To help minimize miscommunication and misunderstanding when interacting with federal agencies, military classifications are often used. Knowledge and understanding of the special vocabulary used in emergency response promotes an ease of communication within the interacting disciplines and agencies.

Slide 151



6.7.3 Competencies – Planning the Response.
6.7.3.2

Choking agents primarily attack the airway and lungs, causing irritation of the entire airway from the nose to the lungs. As a result, fluid fills the lungs, and pulmonary edema occurs. This is also known as *dry-land drowning*.

There are many choking industrial chemicals and agents. Phosgene (CG) and chlorine (Cl) are two that have been used as military agents. Both of these industrial chemicals are commercially available and could be obtained and used by terrorists. Because they have low boiling points, they will rapidly become a gas when released under normal conditions. This also makes them non persistent, meaning that they will quickly disperse and not remain in an area for any length of time.

Because phosgene and chlorine choking agents are heavier than air, they will settle into low places in the surrounding terrain. Subways, sewers, and manholes would, for instance, be likely concentration areas if phosgene or chlorine were used. Therefore, evacuation to higher floors in buildings, evacuations of subways, and so forth would be appropriate.

Pay attention to what the victims and patients say; they might possibly mention a specific odor. In addition, observe physiological signs and symptoms. There may be sufficient indicators to identify a certain chemical intoxicant or agent. If responders are able to detect an odor, they are not wearing proper protection, and are too close to the incident. They must evacuate themselves from the immediate area or suffer the physiological impacts of the agents.

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6.7.3 Competencies – Planning the Response.
6.7.3.2

Although some agents have distinct odors (phosgene smells much like newly mown hay, and chlorine smells like a swimming pool), smell is not a good means of detection because, once
inhaled, these agents cause immediate physiological damage that may range from mild transient irritation of the sinuses, pharynx, and bronchi upon initial exposure of phosgene, to pronounced immediate irritation of the upper and lower respiratory tract when exposed to chlorine. Victims may cough or appear to be choking, but it could be two to four hours after exposure before the victims begin to show serious symptoms. Exposure to a high concentration of chlorine vapor can react with body moisture, causing serious burns and degradation to clothing. Self-aid is simply a matter of getting out of the contaminated area, decontaminating by flushing with water, and aeration

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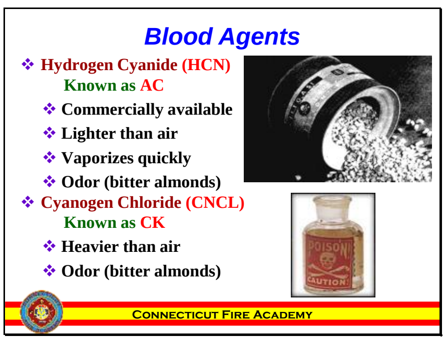

6.7.3 Competencies – Planning the Response.
6.7.3.2

Blood agents, or cyanides, include common industrial chemicals – such as potassium cyanide, which can cause heart and brain damage and death.

Blood agents enter the body primarily through breathing. They interact with the enzyme cytochrome oxidase, which blocks the exchange of oxygen between red blood cells and other cells in the body. As a result, the oxygen-deprived tissue rapidly digresses especially central nervous system tissue—and death will follow.

There are two blood agents: hydrogen cyanide (AC) and cyanogen chloride (CK). Both are commercially available and used in various manufacturing processes, such as electroplating, metallurgy, metal cleaning, and photography. Both would probably be made into weapons or packaged as liquids. Once released into the atmosphere, they will rapidly vaporize—becoming true gases at normal temperatures.

Hydrogen cyanide is lighter than air and, unlike the other agents, will rise. Cyanogen chloride, conversely, is heavier than air. Both are non-persistent and smell like bitter almonds (peach pits).

If hydrogen cyanide (AC) were used, sheltering in place would require people to remain on ground floors because it will evaporate and rise rapidly; however, cyanogen chloride (CK) is heavier than air, and sheltering in place considerations for it are the same as for phosgene and chlorine—uphill or upstairs. ***Found in Cigarette Smoke***

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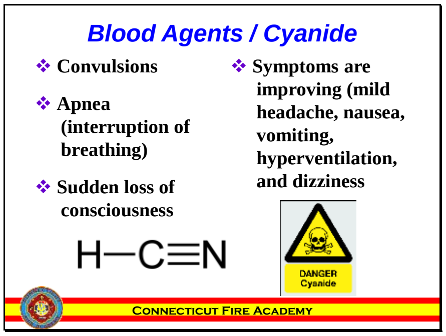

6.7.3 Competencies – Planning the Response.
6.7.3.2

Both are inhalation threat agents and, once inhaled, will take effect immediately. First, victims will gasp for air (they may appear to be gulping air), froth or vomit, lose consciousness, and die. (This process will occur very rapidly.) First aid is a matter of leaving the contaminated area. Decontamination is best accomplished by aeration.

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6.7.3 Competencies – Planning the Response.
Vesicants (blister agents) attack the skin, eyes, respiratory system, and gastrointestinal tract. Mustard agent exposure results in immediate skin penetration that is, at first, painless and unnoticed. When erythema (redness of skin) appears, it is accompanied by severe itching and blisters. Eye penetration also occurs painlessly. Lacrimation (tearing) and inflammatory reactions begin to appear one to several hours after exposure bringing pain, extreme light sensitivity, and spasmodic winking.

Four to six hours after exposure, the respiratory system begins to exhibit symptoms: nasal secretions, burning pain, hoarseness, progressive coughing, loss of voice, and difficult breathing. Gastrointestinal effects result in destruction of mucus membranes.
Symptoms include pain, bloody diarrhea, nausea, vomiting, and *extreme* weakness.
Shock is possible. The effect upon exposed tissue is somewhat similar to that of a corrosive chemical, such as lye or a strong acid.
There are a number of blister agents: mustards (H) (referred to as mustard agents), lewisite (L), and phosgene oxime (CX). Of this group, mustard (H) is the most likely to be used, as it is the easiest to produce. These agents are normally disseminated as liquids. Under normal temperatures, they have low volatility, so they are persistent.
Mustard freezes at 56 to 58oF, so it probably would not be used outdoors during cold periods. Mustard has a definite garlic-like odor and appears as an oily liquid. It is
primarily designed for liquid skin contact; however, the vapors are extremely dangerous
in the lungs, and, in sufficient concentration, the vapors will cause blistering of the skin.

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Although the agents immediately begin to cause damage upon contact with human tissue, victims of mustards will not immediately feel pain. Visible effects may take from six to 24 hours to appear; thus, one may not immediately realize that he or she has been contaminated. The agent is absorbed rapidly into the skin. A few hours after exposure, one will notice a reddening of the skin accompanied by severe itching where the contamination occurred and, later, the formation of a large, well defined blister, hence the name *blister agent*.

For the purpose of this instruction, the only major difference between the signs and symptoms of the mustards (H) and lewisite (L) or phosgene oxime (CX) is that L and CX cause immediate pain upon contact with the skin.

Blister agents affect both the respiratory tract and the skin; therefore, full respiratory and skin protection is essential.

First aid involves removing the agent from any exposed skin as quickly as possible and then flushing with water. Decontamination is essentially the same, removal followed by flushing with water. A 0.5% hypochlorite solution, which can be obtained by mixing household bleach and water in a 1:10 dilution, will aid in skin decontamination.
However, information published in the *Journal of the American Medical Association* (JAMA) has begun to question whether soap and water may be just as effective in decontaminating the skin.

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There are four significant military agents: tabun (GA), sarin (GB), soman (GD), and
VX; these nerve agents are some of the most toxic chemicals known. They are hazardous in both their liquid and vapor states, and can cause death within minutes of exposure.

Nerve agents interrupt the normal functioning of nerve systems, causing a variety of lethal effects. Although nerve agents are not as readily available as the choking agents, they are much more toxic, and some are easy to produce.

Each of these agents is extremely fast acting, with victims exhibiting symptoms within seconds to a few minutes after exposure. The G agents are generally volatile and will evaporate—depending on concentration, temperature, and terrain—in a matter of hours to two or more days. These agents are generally considered non-persistent, and present both inhalation and skin contact threats.

Agents with a "G" are derived from German Origin, the second letter is believed to be the initial of the name of the scientist who invented it.

Agent VX – V represents "Venom" like, the X is the typewriter version of the Skull and
Crossbones for Poison

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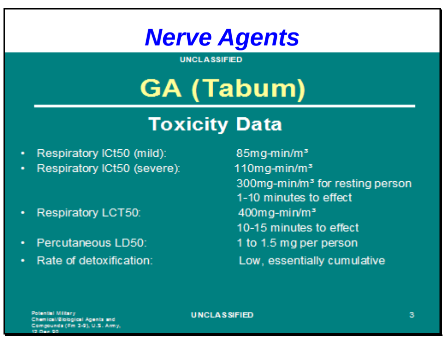

VX has a low volatility and will evaporate about as quickly as motor oil; it is considered a persistent agent. Because of its low volatility, it is primarily a skin contact threat.
However, if it were disseminated in aerosol form, it would also be an inhalation threat.
Like choking agents, nerve agents are heavier than air. When pure, the G agents are both colorless and odorless; however, if they contain impurities, GA and GB may have
a slight fruity odor, and GD may smell like camphor. VX is odorless when pure.
However, VX is normally not found in a pure state. In its impure state, VX may have a slight yellow color (light-weight motor oil) and will usually smell like sulfur.

Protection from these agents requires full respiratory and skin protection. Fire service bunker gear, properly worn, will provide some limited protection, but for operations in the hot zone, Level A protection is vital.

For those who are contaminated, antidotes are available (atropine and 2-Pam chloride injections). Decontamination will work if the agent is quickly removed from skin.
Flushing with water will work, but a 0.5% hypochlorite solution is better.

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6.7.3 Competencies – Planning the Response.
6.7.3.2

Ricin: Most potent toxin available, can be made by anyone at home

Contact with human skin surface will kill

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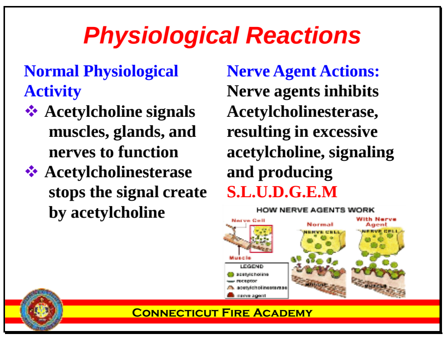

6.7.3 Competencies – Planning the Response.
6.7.3.2

SLUDGEM

Salivation	Saliva forming in the mouth, drooling
Lacrimation	Tearing of the Eye ducts
Urination	Loss of Urinary control – Peeing in the pants
Defecation	Loss of Bowel Control – Poop in the pant
Gastrointestinal Upset	Upset Lower Abdomen and Stomach
Emesis	Vomiting – Throwing Up
Miosis	Constriction of the pupils - Pinpoint

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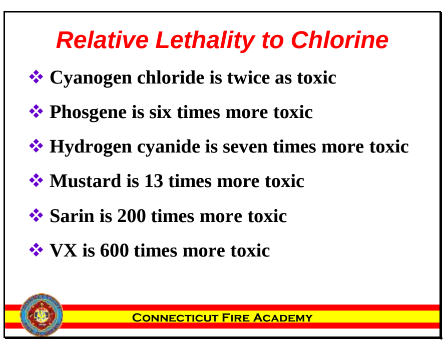

6.7.3 Competencies – Planning the Response.
6.7.3.2

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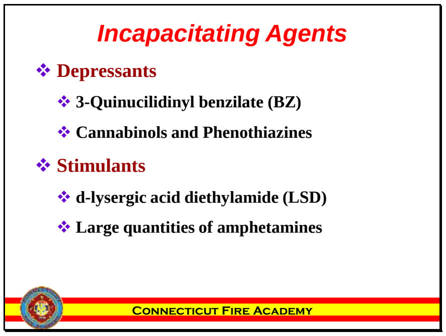

Incapacitating agents are chemicals that cause physiological or mental changes that lead to temporary disability. Unlike the effects of riot control agents, which last generally only a few minutes, incapacitating agent effects last for hours to days. Additionally, incapacitating agents differ from other chemical agents in that the lethal dose is many times greater than the incapacitating dose. This difference allows the use of incapacitating agents without endangering life or producing permanent injury to the target population. There are two general types of incapacitating agents capable of disrupting the central nervous system: depressants and stimulants.

Depressant incapacitating agents include 3-Quinuclidinyl benzilate (BZ), which affects the ability to pay attention, understand instructions, remember, and solve problems; and Cannabinols and phenothiazine-type compounds that primarily produce effects which sedate and destroy motivation but do not inhibit conscious thought.

Stimulant incapacitating agents result in disproportionate nervous system activity frequently by increasing or facilitating the communication effects needed to allow central nervous system communication at the synapses. This over communication floods the brain with information causing an inability to concentrate, indecisiveness, and the inability to act appropriately. The most common drug that appears to produce this kind of effect is d-lysergic acid diethylamide (LSD); additionally, large quantities of amphetamines occasionally produce similar physiological effects.

First aid and decontamination for incapacitating agents is minimal, as the effects of small amounts of incapacitating agents are completely temporary.

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6.7.3 Competencies – Planning the Response.
6.7.3.2

Riot control agents—also called irritants, lachrymators, and tear gas—produce discomfort and eye closure that render the receiver temporarily incapable of fighting or resisting. Victims are exposed through inhalation and absorption of small particles suspended in the air. Despite the common names, *these are not gases*; they are micro pulverized solids.

Riot agents cause pain, burning, or discomfort to exposed mucous membranes and skin; these effects occur within seconds of exposure, but seldom persist more than a few minutes after exposure has ended.

Riot control agents are relatively easy to obtain. If used in conjunction with any of the agents already discussed, they could easily mask the use of a more serious agent. Many of these agents are commercially available as self-protection devices.

First aid and decontamination for riot control agents are relatively simple. Move the victims into an uncontaminated area and face them into the wind. In extreme cases, rinse the victims with large amounts of water and provide fresh clothing.

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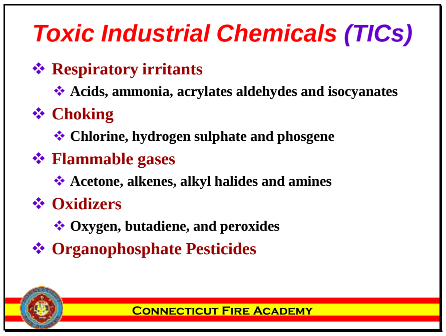

6.7.3 Competencies – Planning the Response.
6.7.3.2

Terrorists, warring factions, and saboteurs are known to use chemicals commonly found within local communities in industrialized nations to create improvised explosives, incendiaries, and chemical agents.

Common chemicals may be used because standard military chemical agents may be difficult or dangerous to manufacture, access, or disperse.

Terrorists sponsored by states—and those independent terrorist factions with substantial financial resources and technical expertise—may purchase or develop explosives, incendiaries, and chemical agents similar to those used by military services. However, several factors limit the use of these weapons by many terrorists—including controlled access to precursor chemicals, difficulty and danger in producing the agents, problems with dispersion of liquid droplets without military munitions, security surrounding government chemical agent stockpiles, and binary chemical agent storage.
Industrial chemicals have been used by terrorists as improvised explosives, incendiaries, and poisons in several recent incidents. While the improvised chemical agents may be less toxic than military agents, many are perceived by the public to be highly dangerous; they have rapid, highly visible impacts on health; they are accessible; and they can be dispersed by smoke, gas clouds, or food and medicine distribution networks.

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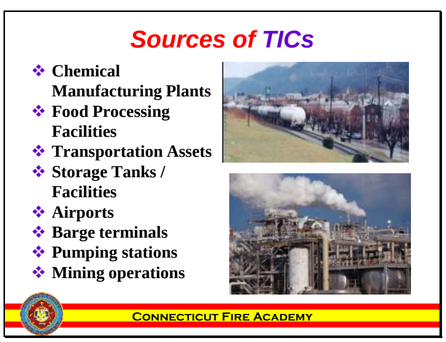

6.7.3 Competencies – Planning the Response.
6.7.3.2

What types of Chemicals would you find at these places?

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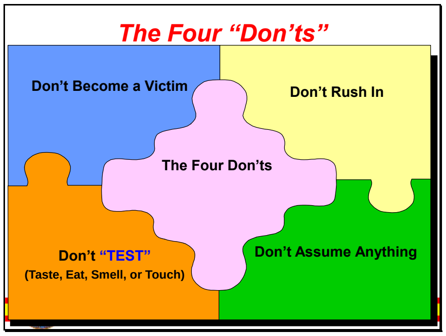

6.7.3 Competencies – Planning the Response.
6.7.3.2

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Indicating Papers

- **M-8 paper:**
- **Screens for G and V nerve and H blister agents (and liquid organophosphorus and carbamate insecticides and pesticides)**
- **M-9 Tape / Paper:**
- **Screens for H and L blister and G and V nerve agents (and liquid organophosphorus and carbamate insecticides and pesticides).**

CONNECTICUT FIRE ACADEMY

6.7.3 Competencies – Planning the Response.
6.7.3.2

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6.7.3 Competencies – Planning the Response.
6.7.3.2

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6.7.3 Competencies – Planning the Response.
6.7.3.2

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6.7.3 Competencies – Planning the Response.
6.7.3.2

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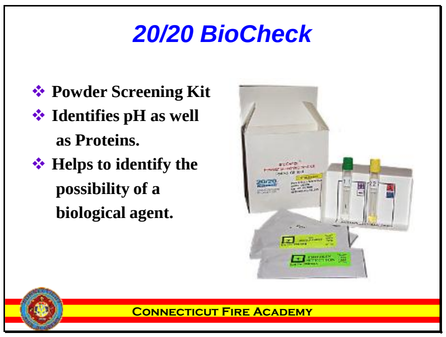

6.7.3 Competencies – Planning the Response.
6.7.3.2

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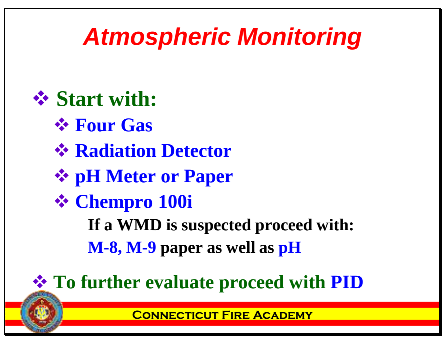

6.7.3 Competencies – Planning the Response.
6.7.3.2

Start with:
- Four Gas
- Radiation Detector
- pH Meter or Paper
- Chempro 100i

If a WMD is suspected proceed with:
- M-8, M-9 paper as well as pH

To further evaluate proceed with PID

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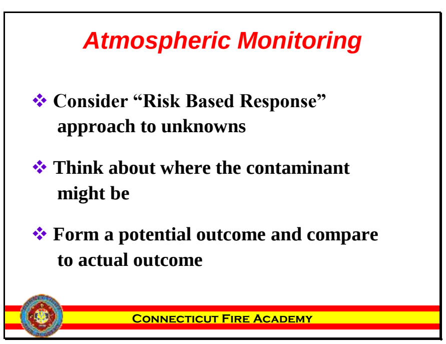

6.7.3 Competencies – Planning the Response.
6.7.3.2

Consider "Risk Based Response" approach to unknowns
Think about where the contaminant might be
Form a potential outcome and compare to actual outcome

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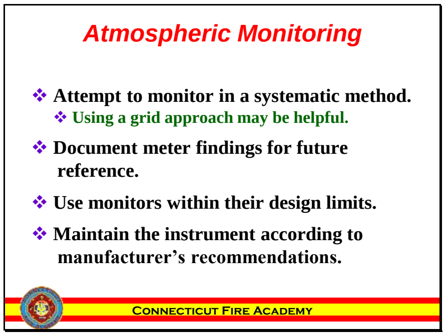

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