
Hydrogen Sulfide
H2S
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PRECAUTIONS

We can work safely, provided we understand:

- Characteristics
- Health effects
- Toxicity
- Detection
- Protection

DESCRIPTION

A Gas:

- Decomposition: By Bacteria
- Located: Oil & Gas Reservoirs, sewers, etc.
- Toxic: Yes - Extremely
- Flammable: Yes
- Immunity: None
- Tolerance:

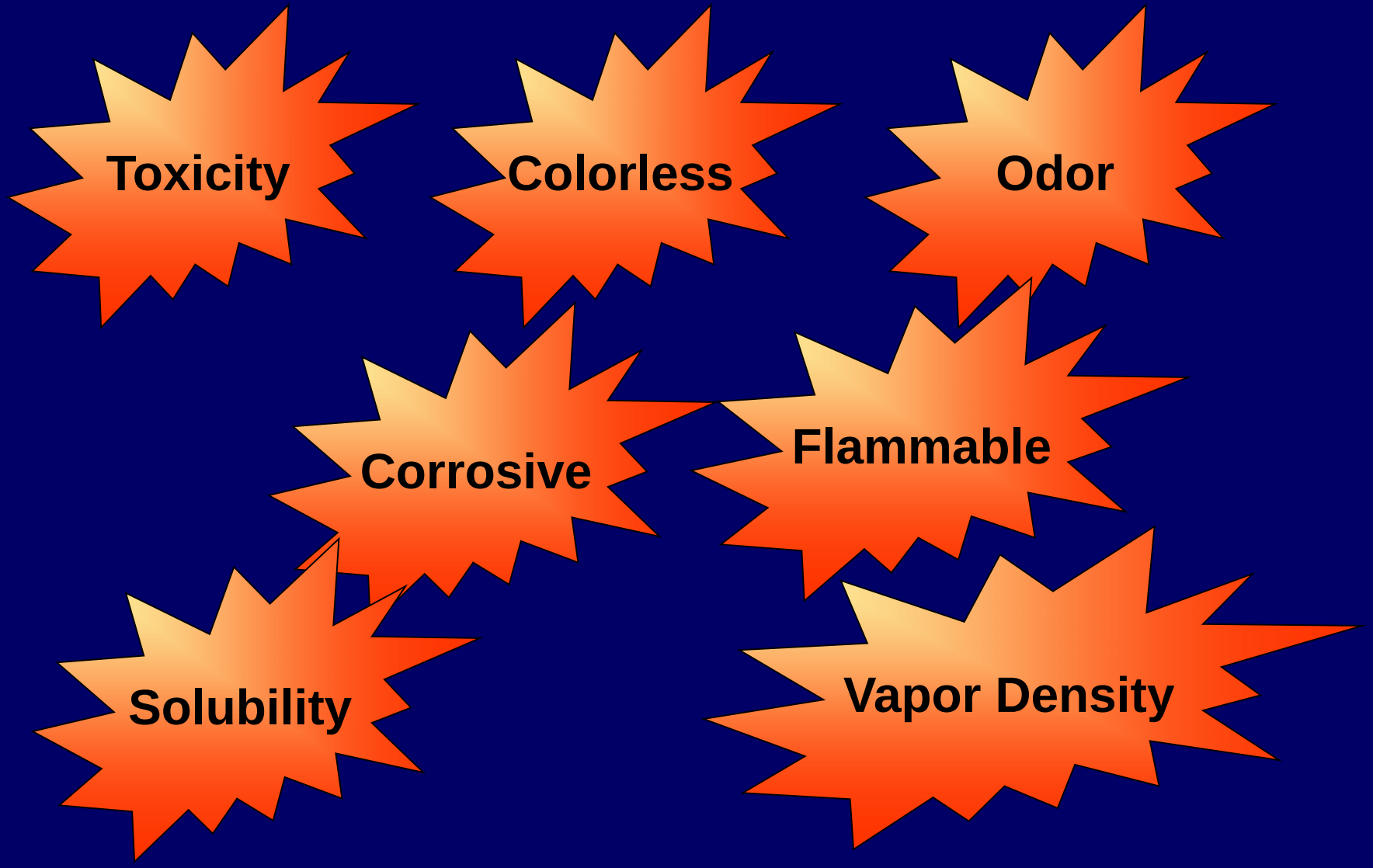
COMMON NAMES

- H2s
- Sour Crude/Gas
- Rotten Egg Gas
- Sulfurated Hydrogen
- Swamp Gas

SOURCES

- By-product of decaying material containing sulfur.
- Potential Areas:
  - Drilling
  - Tank Gauging
  - Well Maintenance
  - Workover Operations
  - Leaks in pumps, receivers, piping, etc.
  - And many other petroleum operations.

CHARACTERISTICS



HEALTH EFFECTS

Knowledge of the following can ensure, confidence, safety & proper planning.

A. **TOXIC:**

- Leading cause of sudden death
- No resistance
- High concentrations- fatal in short period of time

H2S is an **extremely toxic** and **irritating gas**, high concentrations may result in immediate collapse and death, due to **respiratory failure** & **asphyxiation**.

B. **Color**

– Clear (no color)

– Silent killer (invisible gas)

It is **clear** and cannot be detected by visual observation.

C. **ODOR:**

– Offensive – rotten eggs

– Do not indicate levels. (PPM)

– Paralyzes sense of smell

– Can't determine concentration by smell.

D. **SOLUBILITY:**

– Into most liquids

– Agitation- releases

E. **CORROSIVE:**

- Two types-
  - Hydrogen embitterment
  - Sulfide stress cracking
  - Softer metals- more resistant

F. VAPOR DENSITY:

- Heavier than air- 20%
- Vapor Density- 1.189
- Dispersion
- Collects in low lying areas

G. FLAMMABLE:

- H2S- 2 parts hydrogen
- Auto-ignition- 518°
- LEL- UEL

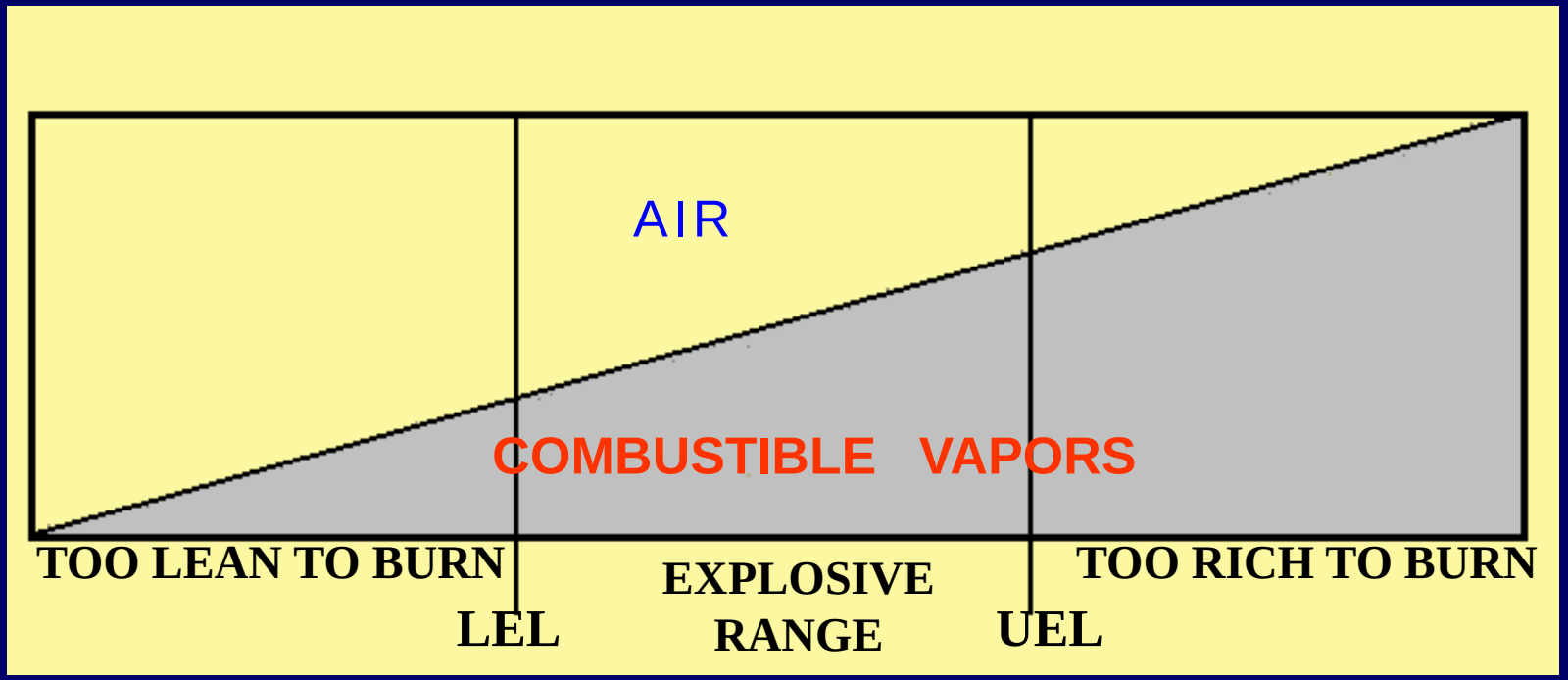
H. By-Products:

- SO2- Sulfur dioxide
- Flare stacks
- Vapor density- 2.2

PROPERTIES OF H_2S

- **Flammable**
  - **explosive** range between 4.2% - **4.3%** L.E.L. to **46%** U.E.L.
  - **automatically ignite** at 518°F
  - H_2S burns with a blue/white flame and gives off SO2, another toxic gas

Lower Explosive Limit vs. Upper Explosive Limit



What's That Smell

PPM	Effect
0.13 ppm	Minimal perceptible odor.
0.77 ppm	Faint, but readily detectable odor.
4.6 ppm	Easily detectable odor, moderate odor.
27.0 ppm	Strong, unpleasant odor, but not **yet** intolerable.

PROPERTIES OF H_2S

- **Toxic**
  - It is more deadly than carbon monoxide (CO), 2nd only to Hydrogen Cyanide (HCN).
    - **TLV-TWA** - Acceptable allowable concentration. **10 ppm** for **8** hrs.
    - **S.T.E.L.** - Short Term Exposure Limit **15 ppm** every **15 minutes 4 times per day**.
  - Ailments associated with H_2S
    - **Irritation of mucous membrane**
    - The **olfactory** nerve eliminates sense of smell. The phrenic nerve, stops sending impulses to the lungs.
    - **H2S decreases the blood capacity to carry O2**

PROPERTIES OF H_2S

Toxicity

PPM	Effect	Time
10 ppm	Permissible Exposure Level	8 Hours
50 - 100	Mild Irritation - eyes, throat	1 Hour
200 - 300	Significant Irritation	1 Hour
500 -700	Unconsciousness, Death	1/2 - 1 Hr.
>1000	Unconsciousness, Death	Minutes

RESULTS OF H2S ON HUMAN LIFE

PPM	0-2 M	2-15 M	15-30 M	30M -1 H	1 - 4 H	4 - 8 H	8 - 48 H
10-100							
100-150							
150-200							
200-350							
350-450							
450-700							
> 700							

Go to page 11 in student manuals.

1. Death - Inhalation

2. Effects are dependant upon:
   - Duration (Length of exposure)
   - Frequency (How many times)
   - Intensity (Concentration of vapors)
   - Sensitivity (Each person is different)

- 3. Special Problems:
  - Increase effects
    - Punctured ear drum
    - Emphysema
    - Asthma
    - Diabetes
    - Epilepsy
    - Eye infections
    - Alcohol

- 4. Symptoms
  - A. Poisoning:
    - Breathing
    - Coughing
    - Dizziness
    - Dryness
    - Fatigue
    - Headache
    - Behavior
    - Appetite
    - Lose consciousness
    - Nausea

- 4. Symptoms
  - B. Contact With Eyes
    - Burning
    - Vision
    - Tearing
  - C. Contact with Skin
    - Discoloration
    - Irritation

LAND LOCATIONS

1. **Observe flags** and conditions:
   - Green Flag - < 10 PPM = possible danger
   - Yellow Flag – 10 - 50 PPM = moderate danger
   - Red Flag – 50 PPM + = extreme danger
2. **Notice Wind Direction** – Always escape **up-wind** and **cross wind**.
3. **What are personnel doing** – is there any work activity going on?
4. **Enter slowly and observe**.
5. **Have at least 2 routes** - preferably roads – upwind direction.

Rig Safety

Well bores can emit many types of gases.

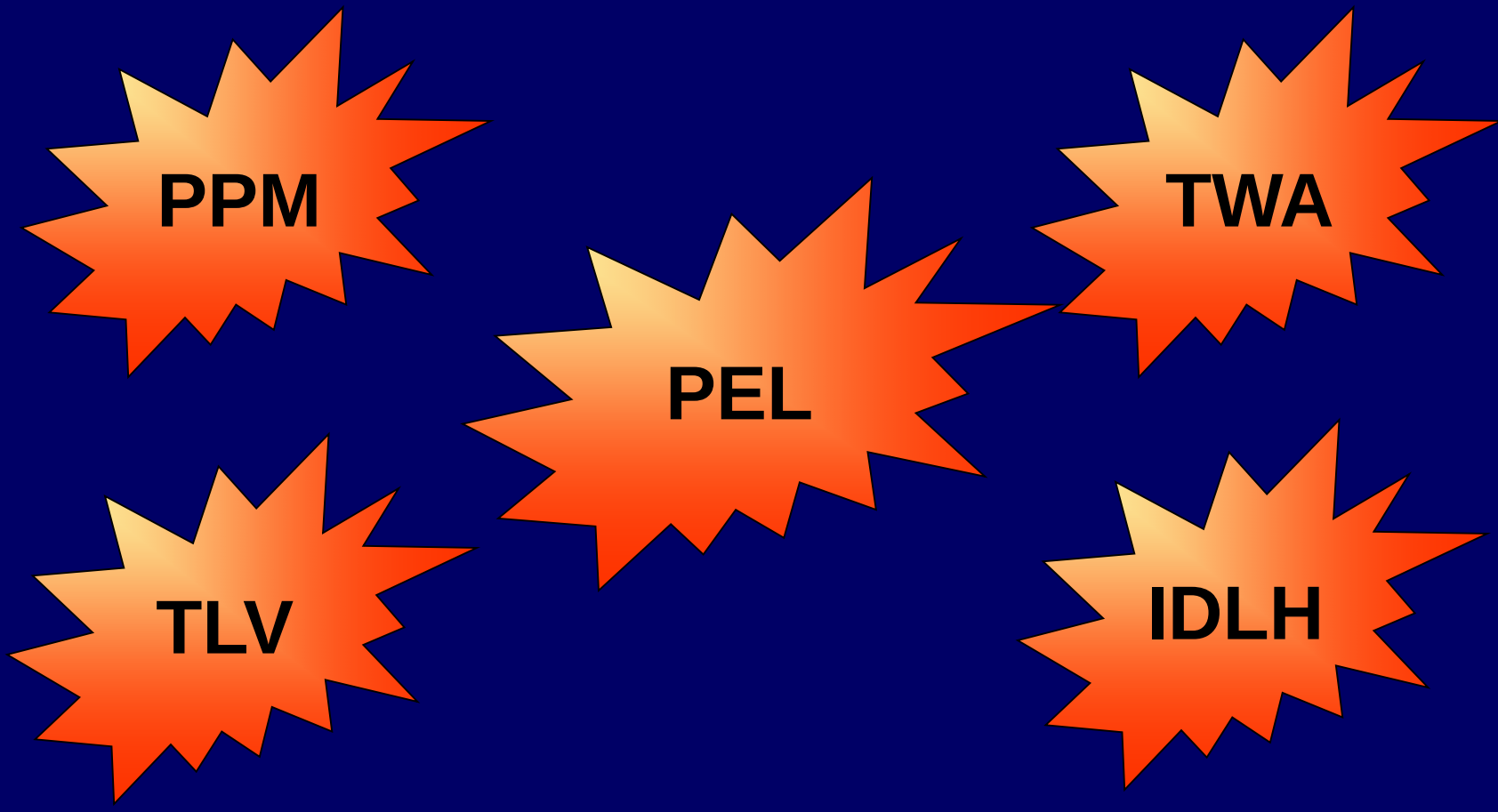
- Methane
- Ethane
- CO_2
- H_2S

Always be wind conscious.

Be familiar with the use of SCBA.

You can NOT hold your breath long enough to survive or to make a rescue.

CONCENTRATION LEVELS



- Safe Vs. Unsafe
- Only guidelines
- Never assume
- Respect - not fear
- Referenced - PPM

REMEMBER! Susceptibility varies between individuals.

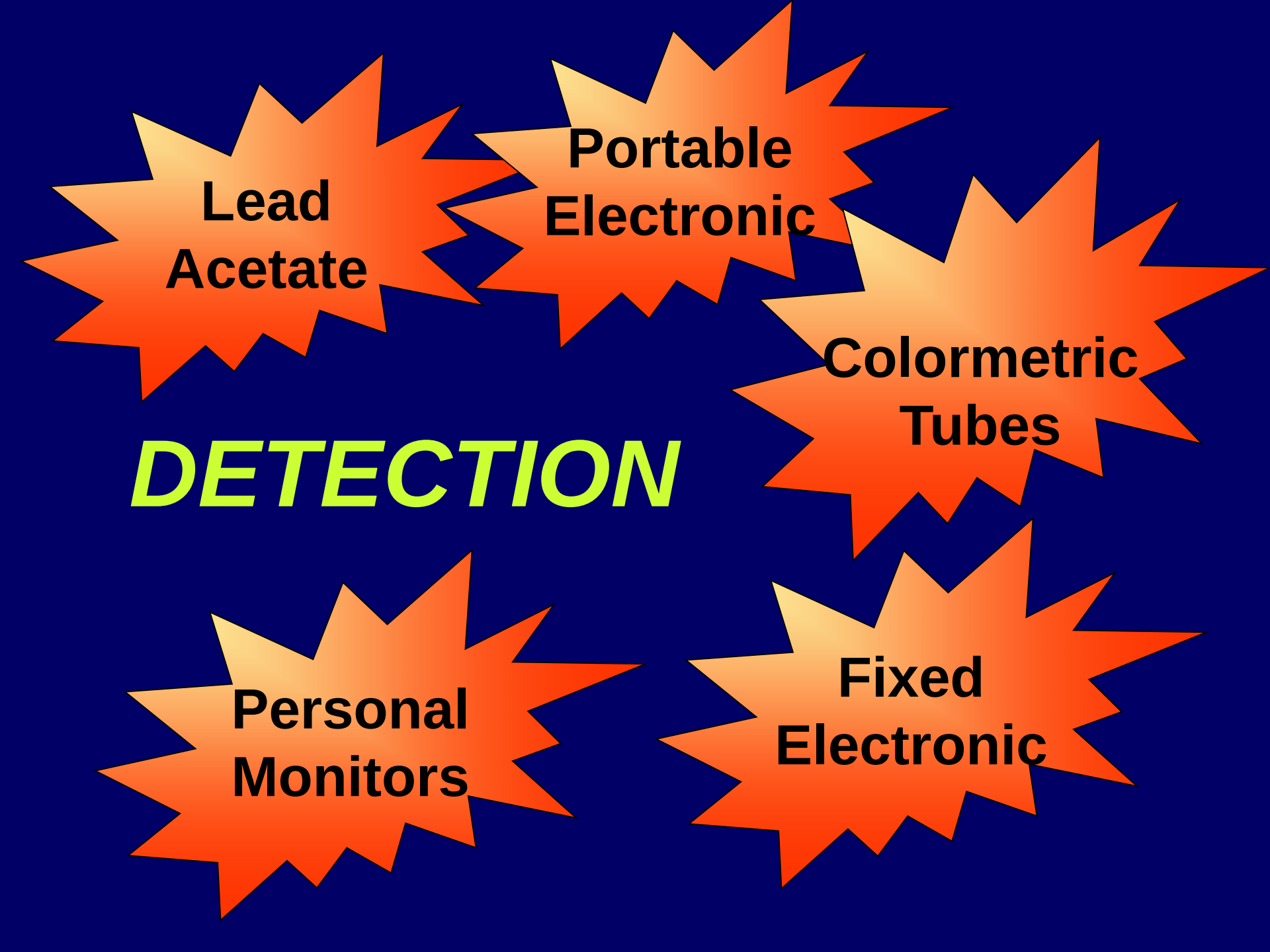
REFERENCE!

Air contains 21 % O2

- 1% H2S = 10,000 PPM
- 2% H2s = 20,000 PPM

These are lethal concentrations.

H2S IDLH = **500 ppm**


Lead Acetate
Portable Electronic
Colormetric Tubes
DETECTION
Personal Monitors
Fixed Electronic

DETECTION:
ESSENTIAL TO AN EFFECTIVE PROGRAM.

- Detection:
  - Smell
  - Monitors

4 Level Meter

- **Detection Devices:**
  - Lead Acetate
    - No alarms
  - Tubes
    - Accuracy
  - Portable electronic
    - Battery
    - Cost
  - Fixed electronic
    - Battery
    - Cost
    - Numerous locations
    - 24 hr. protection

Training

Signs

Wind Conscious

PRECAUTIONS

PPE

Buddy System

Communication

You can work safely in an H2S environment, provided:

- Informed
- PPE
- First-Aid Equipment
- Signs
- Testing
- Working in pairs
- Ventilation
- Wind conscious
- Low lying areas
- Escape routes
- Emergency phone numbers
- Communication
- Calibration

RESCUE- FIRST AID

RESCUE:

- Natural Reaction
- PPE
- Rescue Procedures
  - Hold breath
  - Put on SCBA
  - Evacuate upwind/crosswind

FIRST - AID:

- Administer First-aid until help arrives or
- Until victim can be transported to medical facility.
- Know symptoms:
  - Inhalation poisoning
  - Eye contact
  - Skin contact

NOTE: Respiratory Equipment required in areas having greater than 10 PPM. And again.....

- Use adequate ventilation
- Wind socks
- Avoid low lying areas
- Know escape routes
- Phone numbers
- Maintain communications

- **INHALATION:**
  - Get to fresh air
    - If not breathing- use rescue breathing
    - Remove contaminated clothing
    - Transport to E.M. facility
- **EYE CONTACT:**
  - Flush eyes for 15 min.
  - Do not use pressurized hose
  - Apply cool compresses
  - Transport to E.M. facility or physician

SKIN CONTACT:

- Perspiration & H2S- sulfuric acid
- Thoroughly wash skin
- Discomfort or irritation- transport to E.M. facility or physician.

RESPIRATORY

APR

SAR

SCBA

REGULATION

- 29 CFR 1910.134- requires protection
- Use & maintenance
- Company policy/responsibility
  - Provide respirator as necessary to protect health & ensure safety.
  - Provide respirator that are applicable & suitable for purpose intended.
  - Be responsible for effective respiratory program.

EMPLOYEE RESPONSIBILITY

- Use respiratory protection provided.
- Be familiar with it’s use.
- Protect from damage.
- Keep it well maintained.
- Report damage or malfunction.

HAZARDS

- O2 deficiency **<19.5% O2**
- Toxic gases & vapors
- Particulates in the air
- Combination of the above

IDLH

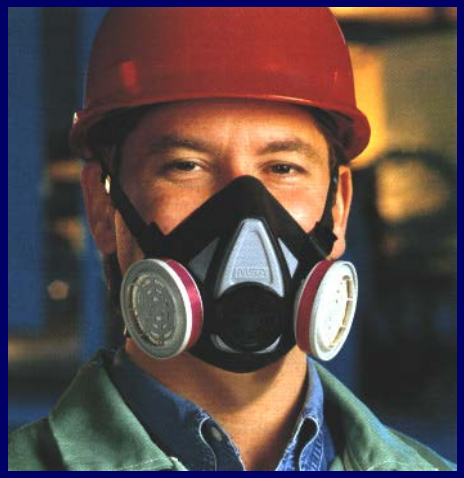
A condition from which an unprotected worker cannot escape without suffering permanent damage to his life or health.

Hydrogen Sulfide exposures @ or > 500 ppm is considered IDLH.

Even lower concentrations will kill you dependant on time of exposure and other variables.

Go to page 22 of manual - Toxicity of various gases.

CLASSES OF RESPIRATORS



Air Purifying (APR)

Self-contained breathing apparatus (SCBA)

Air-line respirators

AIR PURIFYING RESPIRATORS (APR)

- Removes harmful agents from the air
  - Dusts
  - Fumes
  - Mists
  - Smoke
- Does not supply O2

AIR SUPPLIED RESPIRATORS (SAR)

- **Self-Contained Breathing Apparatus (SCBA)**
  - Portable
  - Rated- 30 - 45 - 60 minutes
- **Air line SAR -** Supplied by stationary cascade cylinder system.
- **Combination SCBA & SAR**
  - Air Supplied by Stationary Source
  - Separate cylinder on back

Respiratory Emergencies

- Emergencies:
  - when normal breathing stops.

Causes

- Electrocution
- Drowning
- Shock
- Heart disease
- Strangulation
- Disease or injury
- Poisoning by drugs
- Asphyxiation
- Explosion
- Crushed chest

PERSONAL PROTECTIVE EQUIPMENT

PPE REDUCES CHANCE OF INJURY

- CATAGORIES OF PPE
  - All the time:
    - Hard Hat
    - Safety Glasses
    - Safety Toe Boots
    - Shirt-long sleeve
    - Gloves
  - Specific Task
    - Glove
    - Goggle/face shield
    - Ear plugs
    - Respirators

Summary

- Follow all safety procedures and precautions and be alert to exposure signs such as:
  - Detecting a rotten egg smell
  - Eye, nose, and throat irritation
  - Headache
  - Dizziness
  - Nausea
  - Breathing difficulties
- If any of these signs are noticed:
  - Get to Fresh Air Immediately!