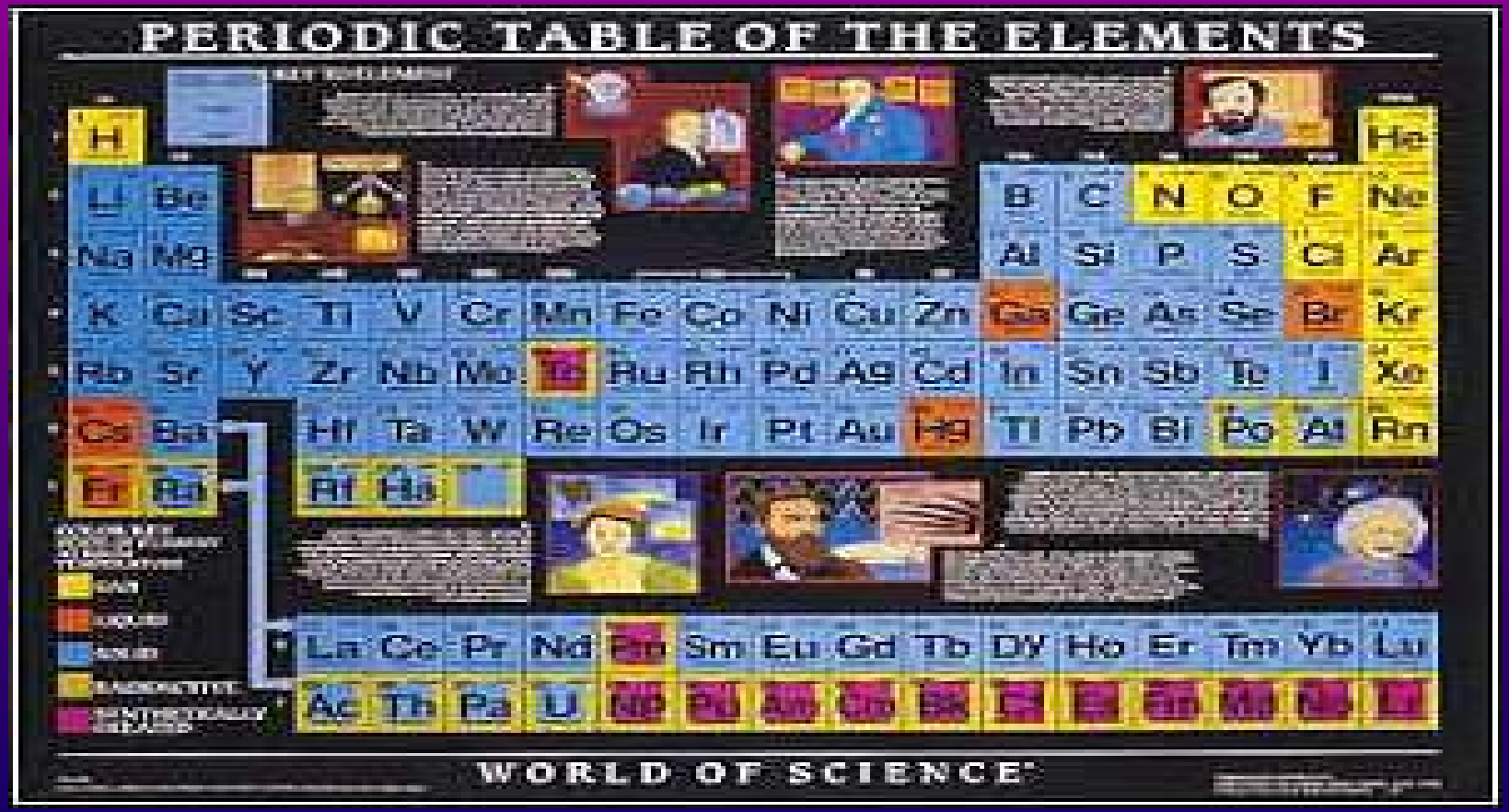
Meth Chemistry and the NIOSH Guide



METH CHEMICAL	NIOSH PAGE
Acetone	3
Ammonia	15
Coleman Fuel	246
Ethyl Alcohol	132
Ethyl Ether	140

Steps in the Production of Meth

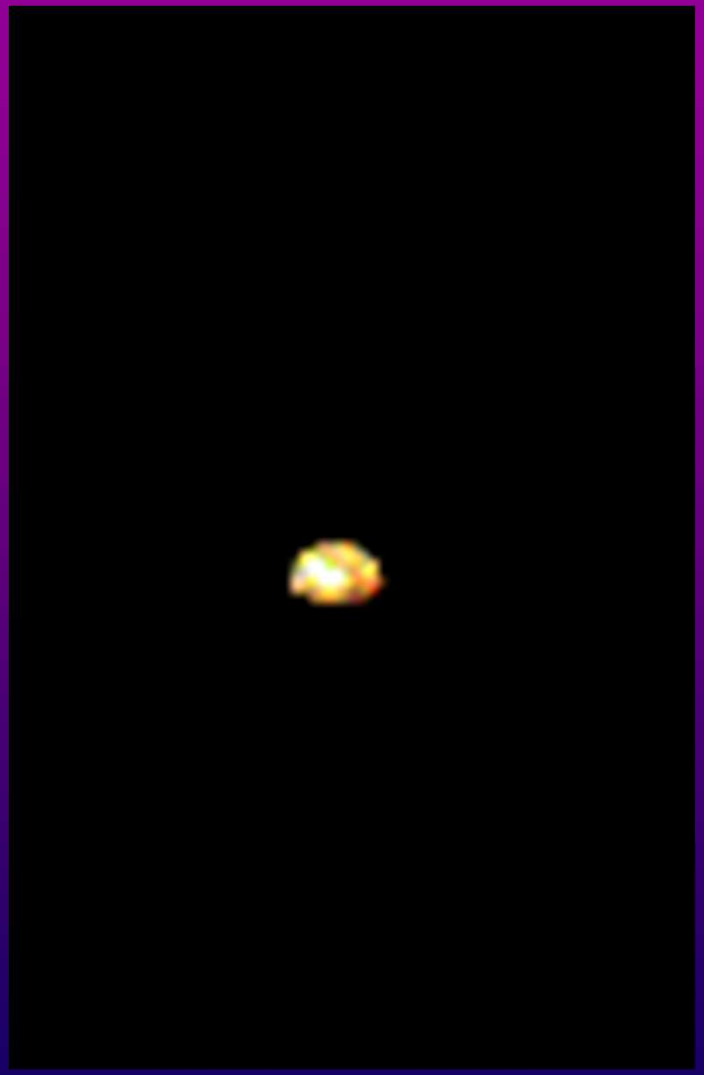
Nazi	Extraction	Cook	No pH Balance	Add Solvent	Salt-Out HCl bulbed thru meth oil
	Dissolve in Heat (methanol), Hydrocarbon, Or Solvents. **Then Filter**	Ephedrine + Lithium + Liquified ammonia = **Meth Oil**	Already a Base	Add solvent (coleman fuel or freon)	Salt + sulfuric Acid(liquid fire) = HCI gas[gas gen]
HI/Red P	Extraction	Cook	pH Balance	Add Solvent	Salt-Out HCl bulbed thru meth oil
	Dissolve in Heat (methanol), Hydrocarbon, Or Solvents. **Then Filter**	Ephedrine + I_2 crystals + Red Phosphorous + water = **Meth Oil**	Add NaOH or Lye(draino) to get base solution	Add solvent (coleman fuel or freon)	Salt + sulfuric Acid(liquid fire) = HCI gas[gas gen]

Objectives

- Identify basic properties of atoms / elements
- Associate general hazards with chemical families
- Classify compounds as organic or inorganic
- Identify and associate material in the NIOSH guide with chemicals found at meth labs
- Associate specific hazards with chemicals found at Meth labs

Introduction

- All compounds have chemical and physical properties which will determine their behavior in their environment
- All forms of matter, solids, liquids and gasses, are found at meth labs
- Understanding the chemical hazard and the physical property of the chemical enables you to protect yourself from it
- Chemistry is the study of the behavior of matter



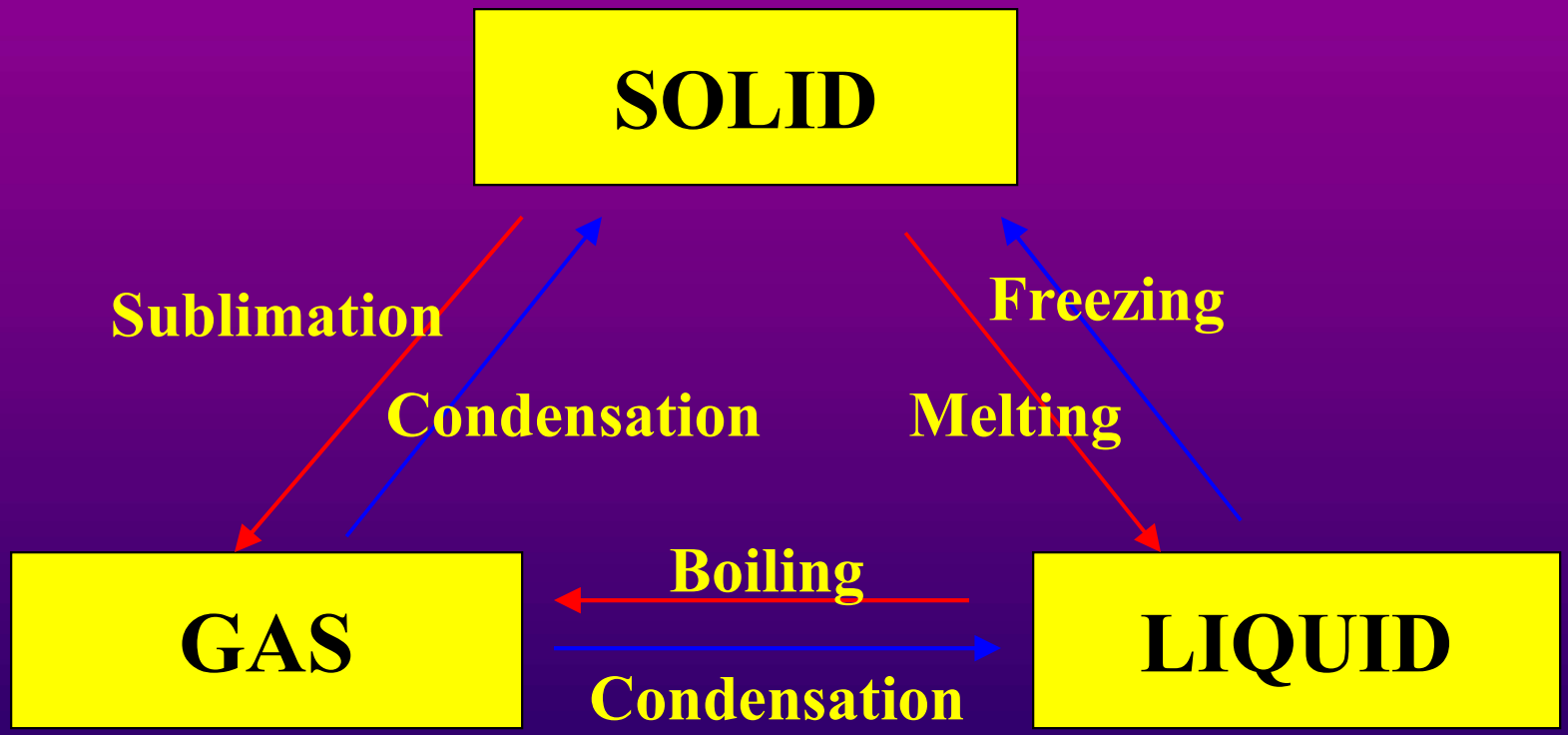
States of Matter

- **Solids**
  - Non-volitile
  - Fixed volume and shape
  - Non-compressible
- **Examples**
  - Red Phosphorous
  - Salt
  - Iodine

- **Liquids**
  - Fixed volume, but not a fixed shape
  - Volatile
- **Examples**
  - Ether
  - Sulfuric Acid
  - Gasoline
  - Mercury

- **Gases**
  - No fixed volume or shape
  - Compressible
- **Examples**
  - Ammonia
  - Phospine
  - Hydrogen Chloride
  - Methylamine

Effect of Temperature



*Red arrow indicates an increase in temperature
*Blue arrow indicates a decrease in temperature

Meth Chemical Building Blocks

Atoms

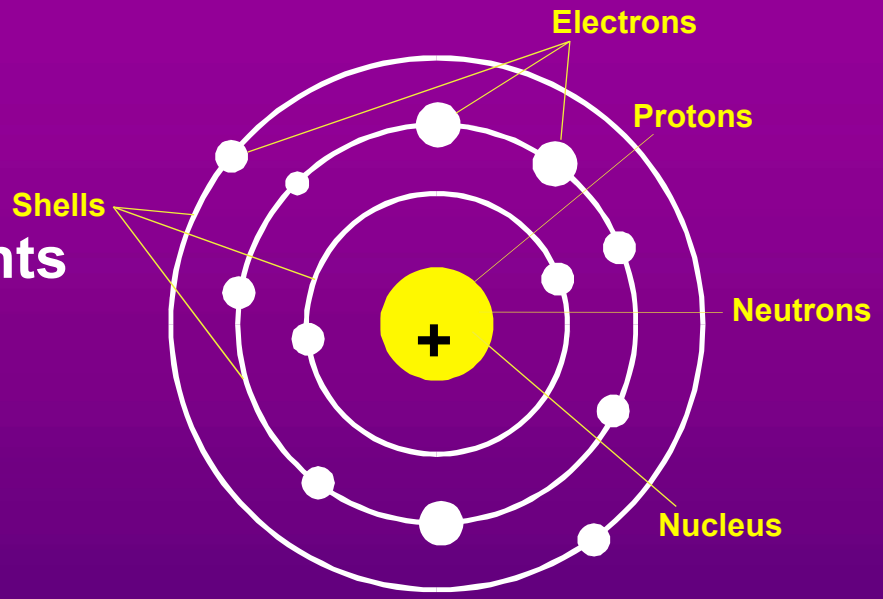
Elements

Molecules

Compounds

Mixtures

Parts of an Atom



Atom – Smallest individual components of elements

Atoms strive to be neutral

Nucleus - center of the atom

Protons - positively charged particles in the nucleus

Neutrons - neutrally charged particles in the nucleus

Outer Shell

Electrons - negatively charged particles orbiting the nucleus

Elements

- 118 Basic Elements
- Smallest indivisible constituent of a mixture
- Cannot be further separated**
- Arranged on the Periodic Chart

The Periodic Table

metals

non-metals

noble gases

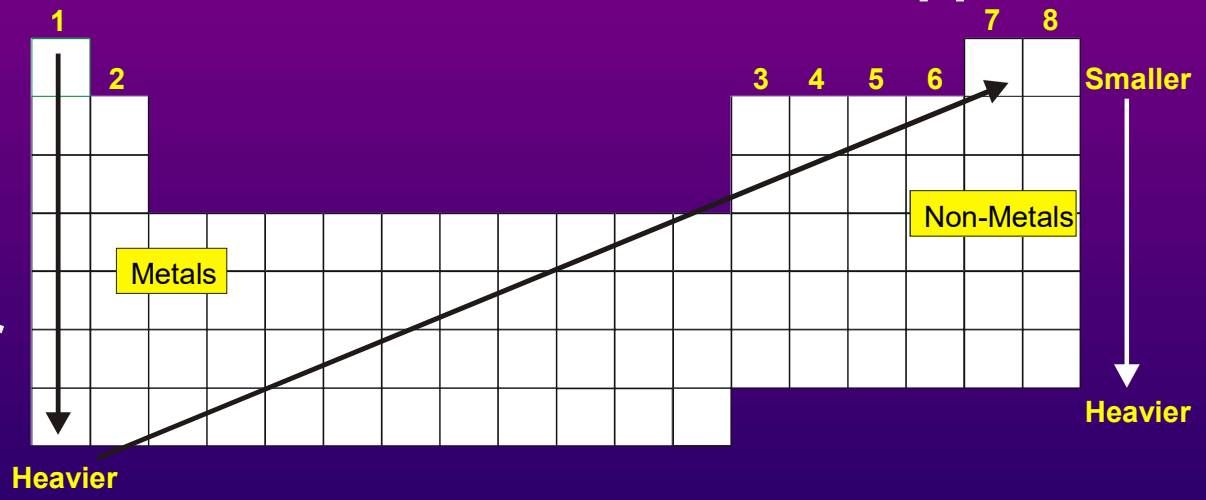
1 H 1.008																	2 He 4.0026
3 Li 6.941	4 Be 9.012											5 B 10.811	6 C 12.0107	7 N 14.00	8 O 15.9994	9 F 18.9984	10 Ne 20.1797
11 Na 22.9897	12 Mg 24.3050											13 Al 26.9815	14 Si 28.0855	15 P 30.9737	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.9559	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938	26 Fe 55.845	27 Co 58.9332	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.921	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9058	40 Zr 91.224	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.905	46 Pd 106.42	47 Ag 107.868	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.904	54 Xe 131.29
55 Cs 132.905	56 Ba 137.327	57 La 138.90	72 Hf 178.49	73 Ta 180.947	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.966	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)									

58 Ce 140.116	59 Pr 140.90765	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.964	64 Gd 157.25	65 Tb 158.92534	66 Dy 162.50	67 Ho 164.93032	68 Er 167.26	69 Tm 168.93421	70 Yb 173.04	71 Lu 174.967
90 Th 232.0381	91 Pa 231.03588	92 U 238.0289	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

The Periodic Table

The size and weight of the atoms can be determined by their relative position on the table.

- **The largest elements, and most reactive metals, are toward the bottom left**
- **Smallest, and most reactive non-metals, are near the upper right**
- **Similarly, lighter elements are found toward the top of the table and heavier elements are located near the bottom**

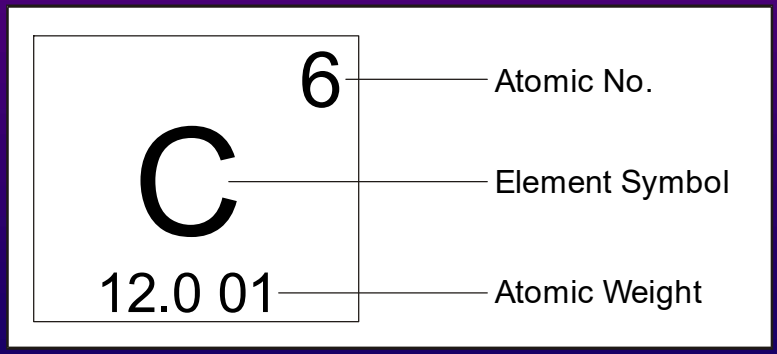


Element Properties

Atomic number - the number of protons in the nucleus

Atomic weight - is the total mass of the atom it is the sum of the protons and neutrons in the nucleus

Elements are chemically stable when there are 8 electrons in the outer shell



Molecules and Compounds

- Smallest indivisible components of a compound
- Molecules consist of multiple atoms
- Molecules may include atoms of one or more elements

- Smallest easily divisible component of a mixture
- Displays consistent properties (flammable, toxic, reactive etc…)

Basic Classes of Compounds

Organics

- Contains Carbon and Hydrogen
- Natural or Synthetic
- Flammable and toxic
- Solid, liquid or gas
- Don't conduct electricity

Inorganics

- Don't contain Carbon
- Natural or synthetic
- Usually doesn't burn
- Often toxic
- Usually water soluble
- Often conduct electricity

Mixtures and Formulas

- Solution that is easily separated
- Monogeneous Vs. Heterogeneous
- Properties vary depending on ratios of constituents
- Examples
  - Gasoline
  - Coleman Fuel

- Chemical formulas describe the ratio of atoms in a molecule
- Subscripts denote relative abundance
- Examples
  - CH_3OH (Methyl Alcohol)
  - HCl (Hydrogen Chloride)

Inorganics

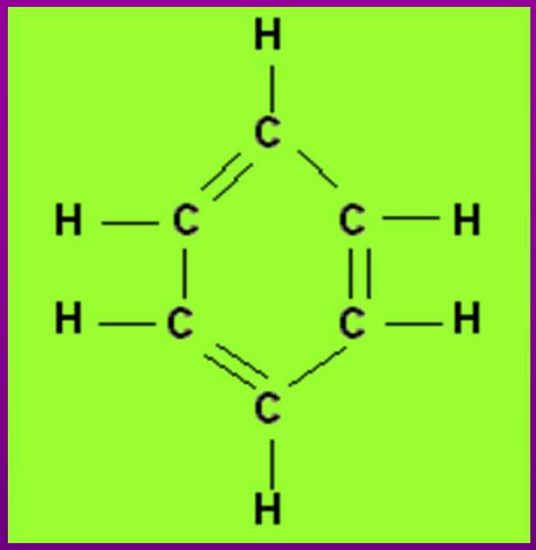
Chemical compounds that do NOT contain carbon and hydrogen in their structure.

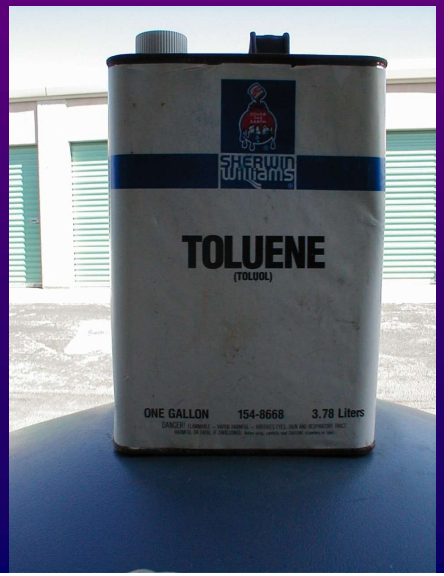
Organics

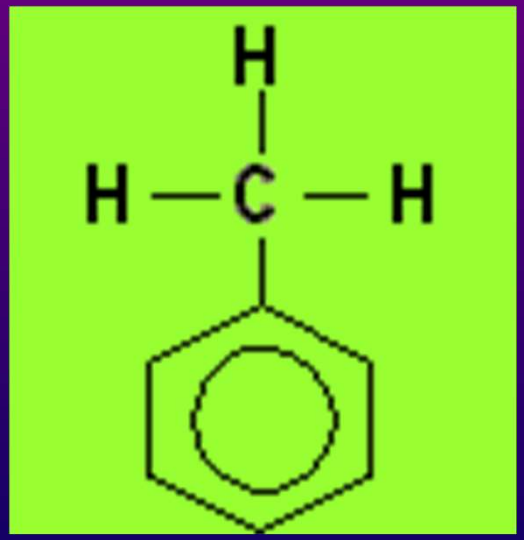
Chemical compounds that DO contain carbon and hydrogen in their atomic structure.

Aromatic Hydrocarbons

Distinct group of hydrocarbons with very different structures than other hydocarbon groups.







Aromatic Hydrocarbons

Benzene Ring:

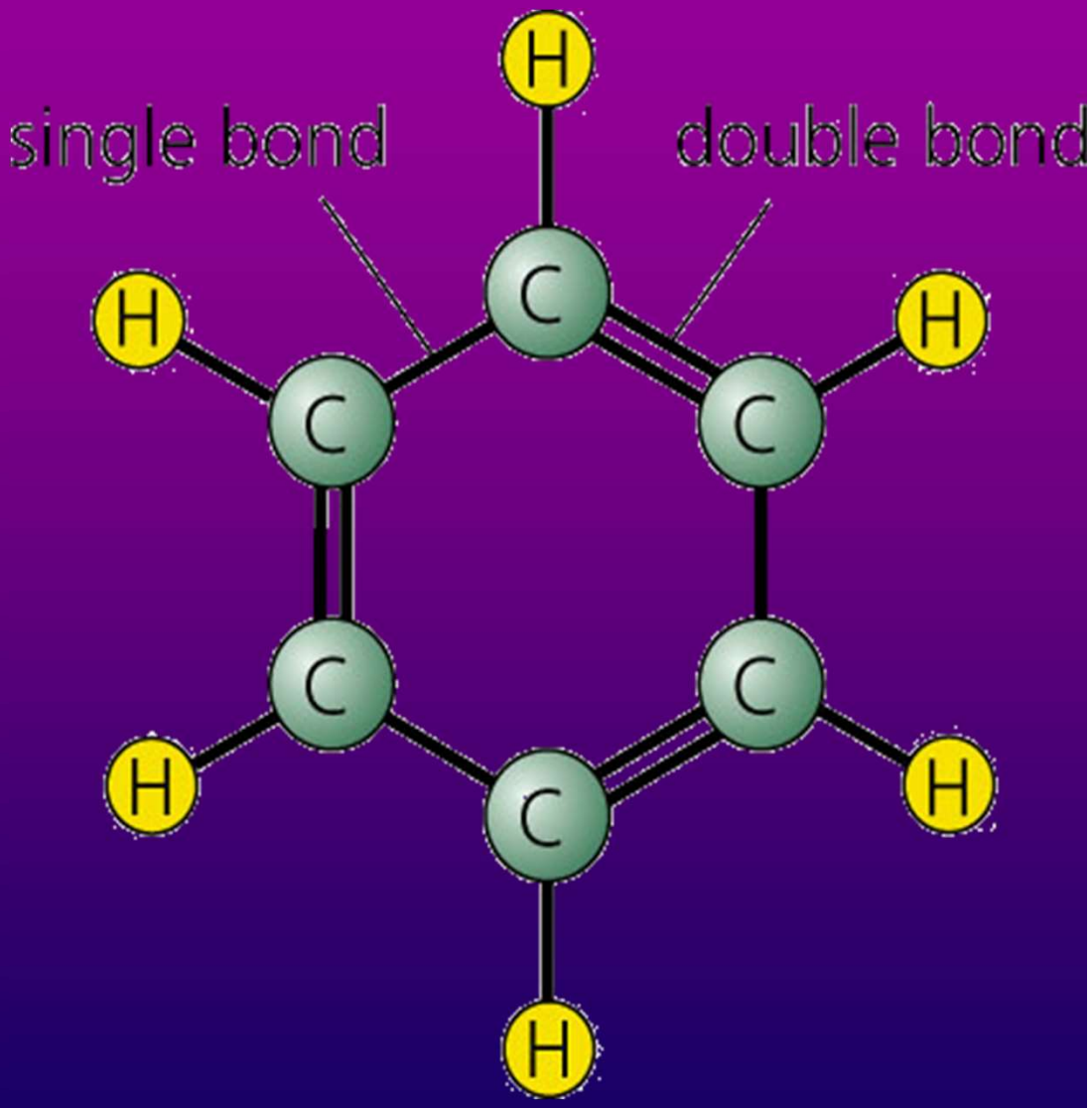
Backbone of aromatic hydrocarbons - very stable.

Examples:

Benzene

Toluene

Xylene



Resource Conservation and Recovery Act (RCRA)

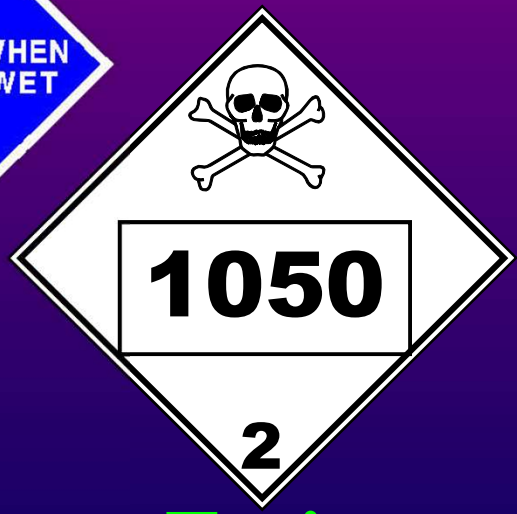
Categories of Hazardous Materials/Wastes

Flammable

(Ignitable)

Reactive

Corrosive



Toxic

Flammable

- Liquid with a flash point of 140°F (60°C)
- Not a liquid and capable under normal conditions of causing fire through friction, adsorption of moisture or spontaneous chemical changes, and when ignited, burn vigorously and persistently; or
- Ignitable compressed gases and oxidizers, as identified by DOT (49 CFR 173)

Flammable

Organics

- Coleman Fuel
- Propane
- Methyl Alcohol
- Ethyl Alcohol
- Isopropyl Alcohol
- Ether
- Acetone

Inorganics

- Phosphine
- Ammonia
- Hydrogen

Corrosives

ACIDS

Hydriodic Acid (HI)

Hydrochloric Acid (HCl)

Hydrogen Chloride Gas (HCl)

Sulfuric Acid (H_2SO_4)

Nitric Acid (HNO_3)

Acetic Acid (CH_3COOH)

BASES

- **Sodium Chloride (NaCl)**
- **Ammonium Hydroxide (NH_4OH)**
- **Anhydrous Ammonia (NH_3)**
- **Calcium Hydroxide ($Ca(OH)_2$**

Corrosive Reactions

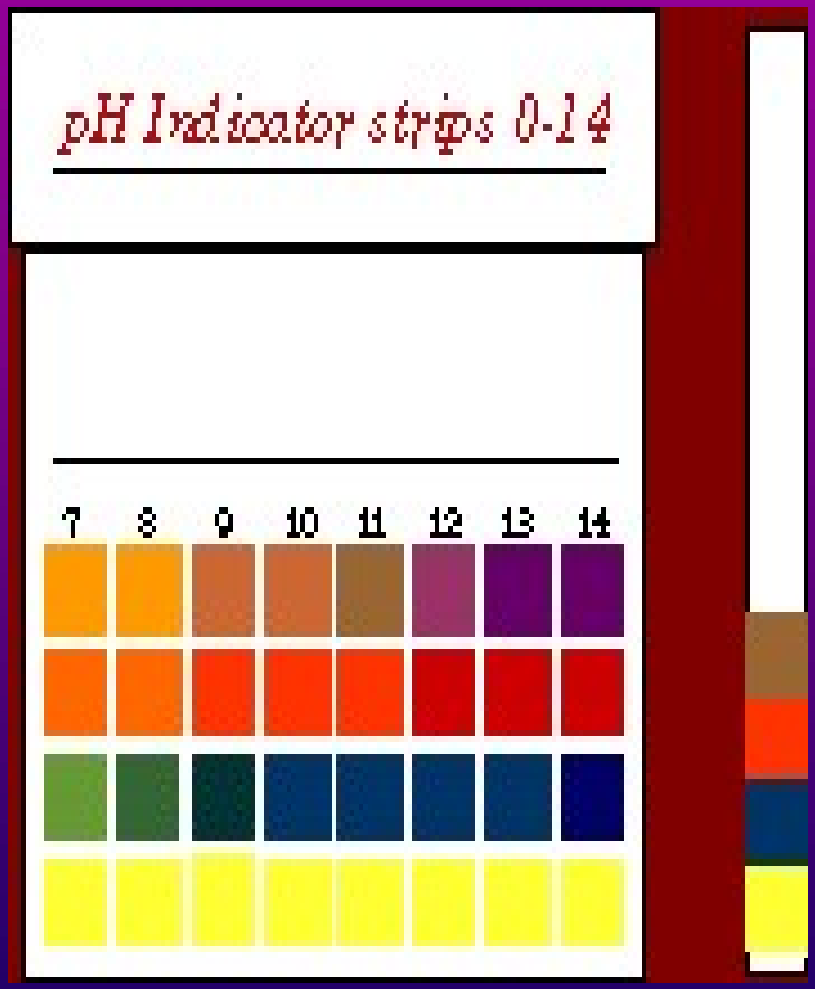
- Acids typically corrode metals producing flammable hydrogen gas
- Acids and bases destroy human tissue
- Acids react with bases to produce heat and gases

pH of Common Items

	14.0	Sodium Hydroxide
CAUSTIC	**12.5**	**RCRA haz. waste**
BASIC	12.0	Household ammonia
ALKALINE	10.0	Detergents and Baking Soda
	8.0	Seawater
	7.4	Blood
NEUTRAL	7.0	Pure water
	6.0	Rain
	4.0	Beer
	3.0	Orange juice, vinegar, wine, acid rain
ACIDIC	**2.0**	**RCRA haz. waste**/lemon juice, stomach acid
	1.0	Strong acids, HCl
	0.0	Very acidic

WHAT IS pH?

- Measure of acid or base concentration
- An acid with a pH of 1 is 10 times more concentrated than an acid with a pH of 2
- A base with a pH of 14 is 10 times more concentrated than a base with a pH of 13



Relation of pH with dilution

- **Dilution of 1 gallon of a solution of pH=3 to pH=7 would require 10 000 gallons of water**
  - pH 3 to pH 4: 10 gallons
  - pH 4 to pH 5: 100 gallons
  - pH 5 to pH 6: 1000 gallons
  - pH 6 to pH 7: 10 000 gallons
- **NOT A PRACTICAL SOLUTION**

CORROSIVE CONCENTRATION TERMINOLOGY

A. ANHYDROUS, GLACIAL, FUMING
(NO WATER)

B. CONCENTRATION → 35%-98%
(WATER SOLUTION)

C. DILUTE → 10% OR LESS

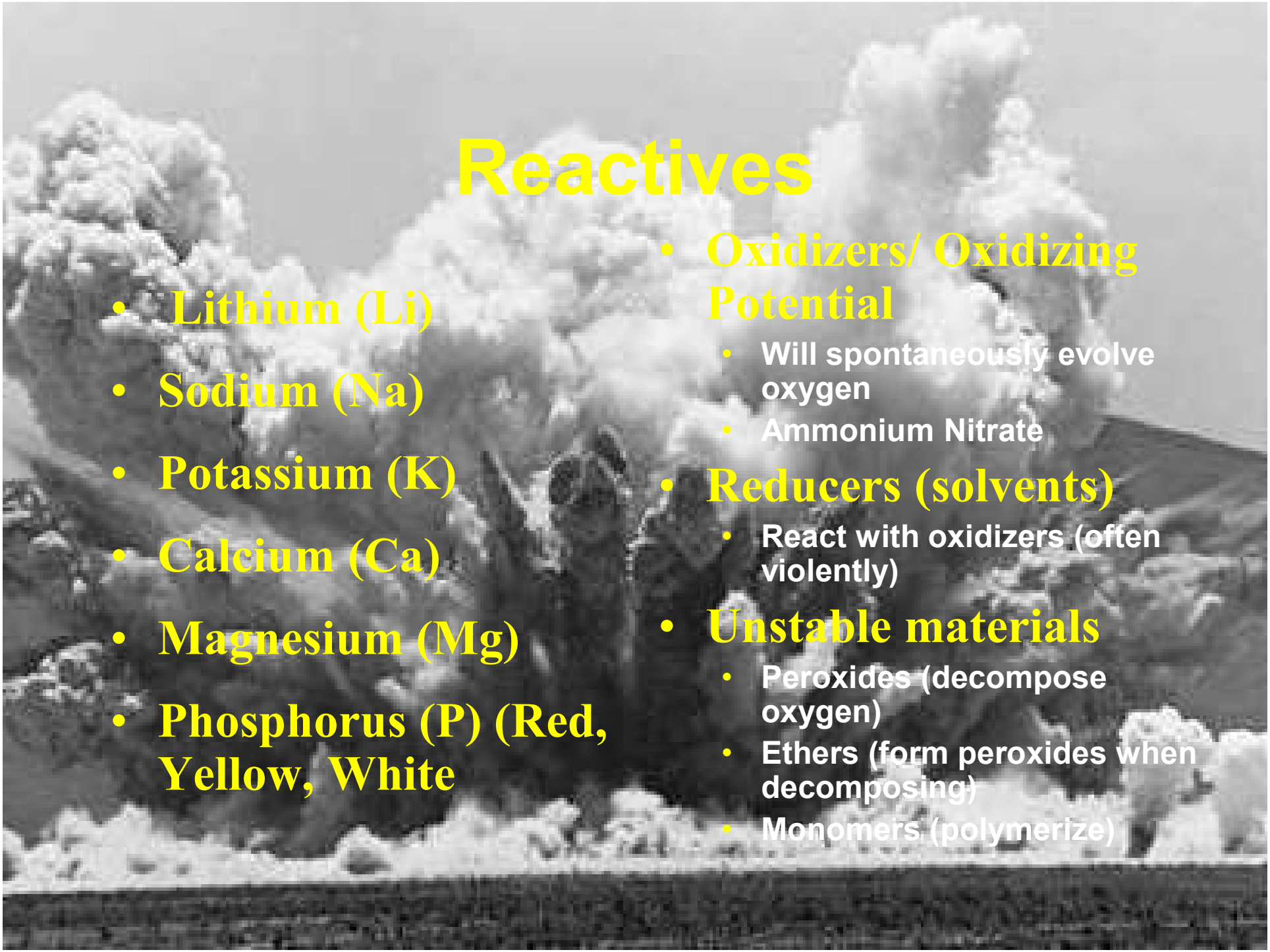
If spill or release is outside, the acid or base becomes more concentrated as the water evaporates.

HAZWOPER for Clandestine Meth Lab Law Enforcement

Please complete day one evaluation

REACTIVES

- Normally unstable-reacts violently
- Mixes with water to form toxic or flammable gases
- Capable of detonation at STP or if heated in confinement
- Contains cyanide or sulfide and generates toxic gases, vapors, or corrosive fumes



Reactives

- Lithium (Li)
- Sodium (Na)
- Potassium (K)
- Calcium (Ca)
- Magnesium (Mg)
- Phosphorus (P) (Red, Yellow, White

- Oxidizers/ Oxidizing Potential
  - Will spontaneously evolve oxygen
  - Ammonium Nitrate
- Reducers (solvents)
  - React with oxidizers (often violently)
- Unstable materials
  - Peroxides (decompose oxygen)
  - Ethers (form peroxides when decomposing)
  - Monomers (polymerize)

Toxic

- Iodine (I)
- Ephedrine (HCl or Sulfate salts)
- Psuedo-ephedrine
- Phosgene ($COCl_2$)
- Phosphine (PH_3)

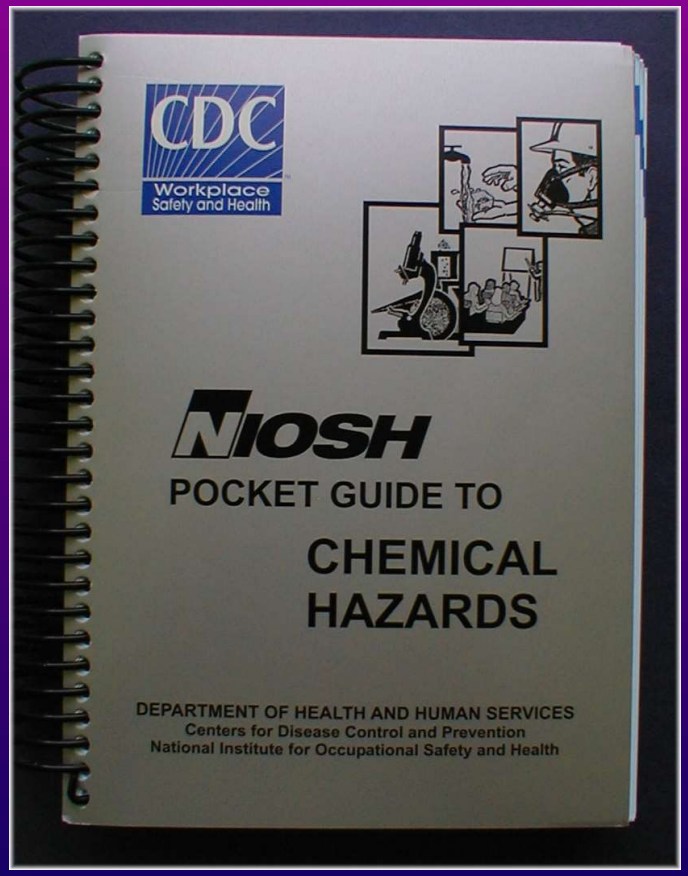
Poisonous: chemicals that are highly toxic to humans and animals

Who is the sign for? The tank or the cars?

NIOSH Guide Introduction

September 2005 Edition

- **How To (Front)**
- **Tables 1 – 6 (Front)**
- **Appendices A – G (Back)**
- **Indices - CAS, DOT, Synonym and Trade Names (Back)**



Ammonia (1)

Formula: (2) NH_3

CAS#: (3) 7664-41-7

RTECS: (4) BO0875000

IDLH: (5) 300 ppm

Conversion: 1 ppm = 0.70 mg/m^3 (6)

DOT: 1005 125 (anhydrous); 2672 154 (10-35% solution); 2073 125 (>35-50% solution); 1005 125 (.50% solution (7)

Synonyms/Trade Names: Anhydrous ammonia, Aqua ammonia, Aqueous ammonia (8)
[**Note:** Often used in an aqueous solution.]

Exposure Limits: (9)
NIOSH REL: TWA 25 ppm(18 mg/m^3)
ST 35 ppm (27mg/m^3)
OSHA PEL†: TWA 50 ppm (35 mg/m^3)

Measurement Methods (see Table 1): (10)
NIOSH 3800, 6015,6016
OSHA ID 188

Physical Description: Colorless gas with a pungent, suffocating odor. (11)
[**Note**: Shipped as a liquefied compressed gas. Easily liquefied under pressure.]

Chemical & Physical Properties: (12)
MW: 17.0
BP: -28° F
Sol: 34%
FL.P: NA (Gas)
IP: 10.18ev
RGasD: 0.60
VP:
UEL: 28%
LEL: 15%
[**Note:** Although NH_3 does not meet the DOT definition of a Flammable Gas (for labeling purposes), it should be treated as one.]

Box #

Personal Protection/Sanitation (see Table 2): (13)
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When Contam (solution)
Remove: When wet or contam (solution)
Change: N.R.
Provide: Eyewash (>10%)
Quick drench (>10%)

Respirator Recommendations (see Tables 3 & 4): (14)
NIOSH
250 ppm: CcrS*/Sa*
300 ppm: Sa:Cf*/PaprS*/CcrFS/ GmFW/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids, halogens, salts of silver & zinc (15)
[**Note:** Corrosive to copper & galvanized surfaces.]

Exposure Routes, Symptoms, Target Organs (see Table 5): (16)
ER: Inh, Ing (solution), Con (solution/liquid)
SY: Irrit eyes, nose, Throat; dysp, wheez, chest pain; pulm Edema; pink frothy sputum; skin burns, vesic; liquid: frostbite
TO: Eyes, skin, resp sys

First Aid (see Table 6): (17)
Eye: Irr immed (solution/liquid)
Skin: Water flush immed (solution/liquid)
Breath: Resp support
Swallow: Medical attention immed (solution)

Ammonia

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NH_3	7664-41-7	BO0875000	300 ppm

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TO: Eyes, skin, resp sys

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Eye: Irr immed (solution/liquid)
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Breath: Resp support
Swallow: Medical attention immed (solution)

Boxes 1,2,3,4,6, & 7

- **Chemical Name**
- **Structure / formula**
- **CAS Number**
- **RTECS Number**
- **DOT ID Number and ERG Guide Number**
- **See Ammonia**
  - Note different DOT #'s, depending on concentration
- **Chemical, Synonyms and Trade Name Index**
  - If you can't find a chemical name under column 1, look in the synonym and trade name index
- **Conversion factors**
  - convert ppm to mg/m3, for air monitoring
- **See Methyl Ethyl Ketone**

2008

EMERGENCY RESPONSE GUIDEBOOK

How To Use This Guidebook
(White page 1)

- Identify the material
- Look up the 3-digit Guide Number
  - **ID Number Index (Yellow pages)**
  - **Name Index (Blue pages)**
  - **Explosives List (p. 1)**
  - **Table of Placards (p. 16-17)**
  - **If no info available, use Guide # 111**
- "P" suffix - may violently polymerize
- Highlighted - Look in Green pages

ID Number Index (Yellow pages)

ID No.	Guide No.	Name of Material
2599	126	Chlorotrifluoromethane and Trifluoromethane azeotropic mixture with approximately 60% Chlorotrifluoromethane
2599	126	Refrigerant gas R-13 and Refrigerant gas R-23 azeotropic mixture with 60% Refrigerant gas R-13
2599	126	Refrigerant gas R-23 and Refrigerant gas R-13 azeotropic mixture with 60% Refrigerant gas R-13
2599	126	Refrigerant gas R-503 (azeotropic mixture of Refrigerant gas R-13 and Refrigerant gas R-23 with approximately 60% Refrigerant gas R-13)
2599	126	Trifluoromethane and Chlorotrifluoromethane azeotropic mixture with approximately 60% Chlorotrifluoromethane
2600	119	Carbon monoxide and Hydrogen mixture
2600	119	Carbon monoxide and Hydrogen mixture, compressed
2600	119	Hydrogen and Carbon monoxide mixture
2600	119	Hydrogen and Carbon monoxide mixture, compressed
2601	115	Cyclobutane
2602	126	Dichlorodifluoromethane and
2602	126	Refrigerant gas R-12 and Refrigerant gas R-152a azeotropic mixture with 74% Refrigerant gas R-12
2602	126	Refrigerant gas R-152a and Refrigerant gas R-12 azeotropic mixture with 74% Refrigerant gas R-12
2602	126	Refrigerant gas R-500 (azeotropic mixture of Refrigerant gas R-12 and Refrigerant gas R-152a with approximately 74% Refrigerant gas R-12)
2603	131	Cycloheptatriene
2604	132	Boron trifluoride diethyl etherate
2605	155	Methoxymethyl isocyanate
2606	155	Methyl orthosilicate
2607	129P	Acrolein dimer, stabilized
2608	129	Nitropropanes
2609	156	Triallyl borate
2610	132	Triallylamine
2611	131	Propylene chlorohydrin
2612	127	Methyl propyl ether
2614	129	Methallyl alcohol
2615	127	Ethyl propyl ether
2616	129	Triisopropyl borate
2617	129	Methylcyclohexanols
2618	130P	Vinyltoluenes, inhibited
2619	132	Benzyldimethylamine

Numbered Guide (Orange pages)

GUIDE 130 **FLAMMABLE LIQUIDS (NON-POLAR/WATER-IMMISCIBLE/NOXIOUS)** NAERG96

POTENTIAL HAZARDS

FIRE OR EXPLOSION

- **HIGHLY FLAMMABLE: Will be easily ignited by heat, sparks or flames.**
- Vapors may form explosive mixtures with air.
- Vapors may travel to source of ignition and flash back.
- Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks).
- Vapor explosion hazard indoors, outdoors or in sewers.
- Some may polymerize (P) explosively when heated or involved in a fire.
- Runoff to sewer may create fire or explosion hazard.
- Containers may explode when heated.
- Many liquids are lighter than water.

HEALTH

- May cause toxic effects if inhaled or absorbed through skin.
- Inhalation or contact with material may irritate or burn skin and eyes.
- Fire will produce irritating, corrosive and/or toxic gases.
- Vapors may cause dizziness or suffocation.
- Runoff from fire control or dilution water may cause pollution.

PUBLIC SAFETY

- **CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- Isolate spill or leak area immediately for at least 50 to 100 meters (160 to 330 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Keep out of low areas.
- Ventilate closed spaces before entering.

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Structural firefighters' protective clothing will only provide limited protection.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 300 meters (1000 feet).

Fire

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

NAERG96 **FLAMMABLE LIQUIDS (NON-POLAR/WATER-IMMISCIBLE/NOXIOUS)** **GUIDE 130**

EMERGENCY RESPONSE

FIRE

CAUTION: All these products have a very low flash point: Use of water spray when fighting fire may be inefficient.

Small Fires

- Dry chemical, CO_2, water spray or regular foam.

Large Fires

- Water spray, fog or regular foam.
- **Do not use straight streams.**
- Move containers from fire area if you can do it without risk.

Fire involving Tanks or Car/Trailer Loads

- Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Cool containers with flooding quantities of water until well after fire is out.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from the ends of tanks.
- For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

SPILL OR LEAK

- ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area).
- All equipment used when handling the product must be grounded.
- Do not touch or walk through spilled material.
- Stop leak if you can do it without risk.
- Prevent entry into waterways, sewers, basements or confined areas.
- A vapor suppressing foam may be used to reduce vapors.
- Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.
- Use clean non-sparking tools to collect absorbed material.

Large Spills • Dike far ahead of liquid spill for later disposal.

- Water spray may reduce vapor; but may not prevent ignition in closed spaces.

FIRST AID

- Move victim to fresh air. • Call emergency medical care.
- Apply artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Wash skin with soap and water.
- Keep victim warm and quiet.
- Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

Name Index (Blue pages)

Name of Material	Guide No.	ID No.
p-Nitrosodiethylaniline	135	——
p-Nitrosodimethylaniline	135	1369
Nitrostarch, wet, with not less than 30% alcohol or solvent	113	1337
Nitrostarch, wetted with not less than 20% water	113	1337
Nitrostarch, wetted with not less than 30% solvent	113	1337
Nitrosyl chloride	125	1069
Nitrosylsulfuric acid	157	2308
Nitrosylsulphuric acid	157	2308
Nitrotoluenes	152	1664
Nitrotoluenes, liquid	152	1664
Nitrotoluenes, solid	152	1664
Nitrotoluidines (mono)	153	2660
Nitrous oxide	122	1070
tert-Octyl mercaptan	131	3023
Octyltrichlorosilane	156	1801
Oil, n.o.s., flash point not less than 93°C (200°F)	171	9277
Oil, petroleum, n.o.s.	128	1270
Oil gas	119	1071
Oil gas, compressed	119	1071
Oleum	137	1831
Oleum, with less than 30% free Sulfur trioxide	137	1831
Oleum, with less than 30% free Sulphur trioxide	137	1831
Oleum, with not less than 30% free Sulfur trioxide	137	1831
Oleum, with not less than 30% free Sulphur trioxide	137	1831
Organic peroxide, liquid, n.o.s.	146	9183

XXXX

Numbered Guide (Orange pages)

POTENTIAL HAZARDS

HEALTH

- TOXIC; inhalation, ingestion or contact (skin, eyes) with vapors, dusts or substance may cause severe injury, burns, or death.
- Fire will produce irritating, corrosive and/or toxic gases.
- Reaction with water may generate much heat which will increase the concentration of fumes in the air.
- Contact with molten substance may cause severe burns to skin and eyes.
- Runoff from fire control or dilution water may cause pollution.

FIRE OR EXPLOSION

- Some of these materials may burn, but none ignite readily.
- May ignite combustibles (wood, paper, oil, clothing, etc.).
- Substance will react with water (some violently), releasing corrosive and/or toxic gases.
- Flammable/toxic gases may accumulate in confined areas (basement, tanks, hopper/tank cars etc.).
- Contact with metals may evolve flammable hydrogen gas.
- Containers may explode when heated or if contaminated with water.
- Substance may be transported in a molten form.

PUBLIC SAFETY

- **CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- Isolate spill or leak area immediately for at least 50 to 100 meters (160 to 330 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Keep out of low areas.
- Ventilate enclosed areas.

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing which is specifically recommended by the manufacturer.
- Structural firefighters' protective clothing is recommended for fire situations ONLY; it is not effective in spill situations.

EVACUATION

Spill

- See the Table of Initial Isolation and Protective Action Distances for highlighted substances. For non-highlighted substances, increase, in the downwind direction, as necessary, the isolation distance shown under "PUBLIC SAFETY".

Fire

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

EMERGENCY RESPONSE

FIRE

- **When material is not involved in fire: do not use water on material itself.**

Small Fires

- Dry chemical or CO_2.
- Move containers from fire area if you can do it without risk.

Large Fires

- Flood fire area with large quantities of water, while knocking down vapors with water fog. If insufficient water supply: knock down vapors only.

Fire involving Tanks or Car/Trailer Loads

- Cool containers with flooding quantities of water until well after fire is out.
- Do not get water inside containers.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from the ends of tanks.

SPILL OR LEAK

- Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire.
- Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.
- Stop leak if you can do it without risk.
- Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container.
- Keep combustibles (wood, paper, oil, etc.) away from spilled material.

Small Spills • Cover with DRY earth, DRY sand, or other non-combustible material followed with plastic sheet to minimize spreading or contact with rain.

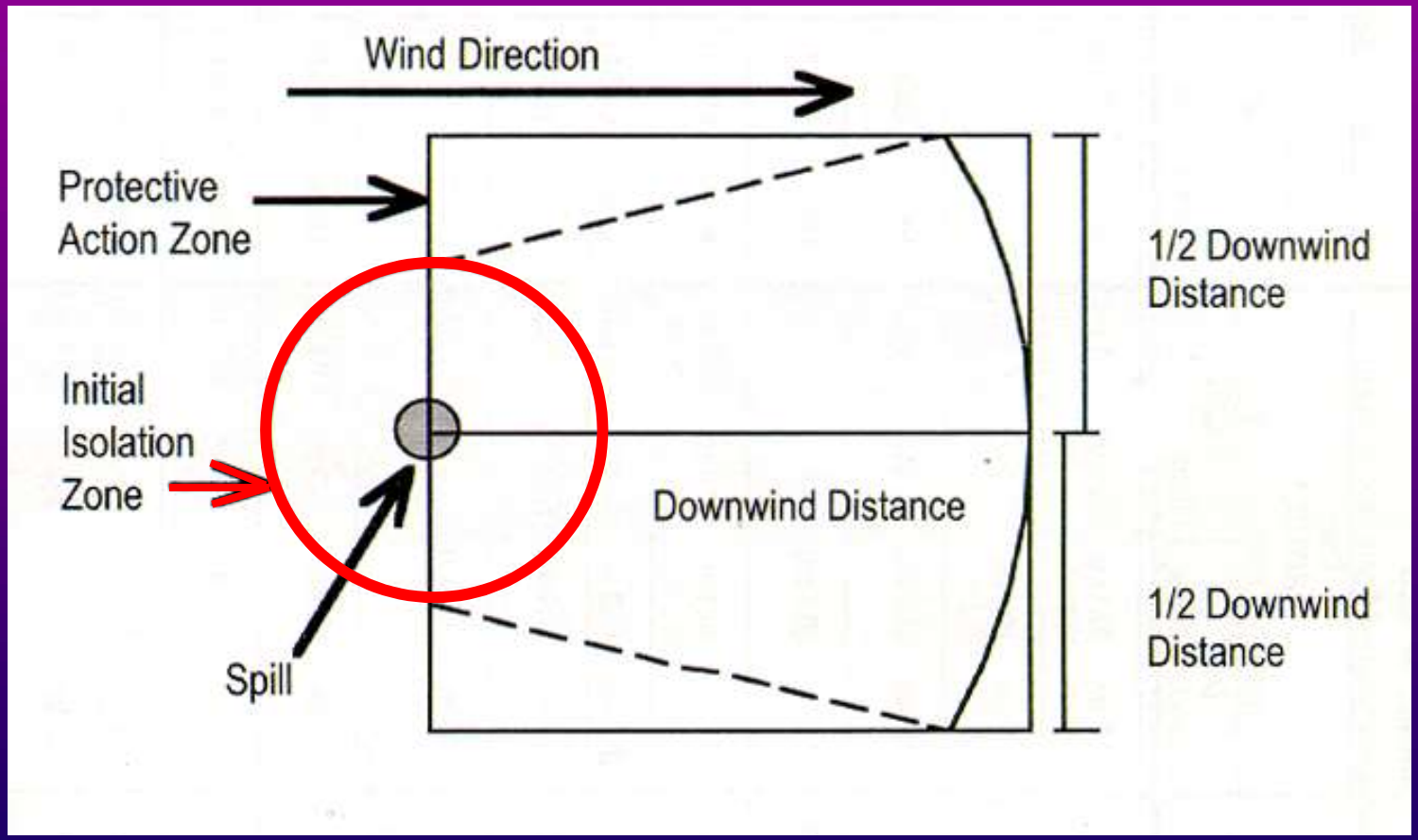
- Use clean non-sparking tools to collect material and place it into loosely covered plastic containers for later disposal.
- Prevent entry into waterways, sewers, basements or confined areas.

FIRST AID

- Move victim to fresh air. • Call emergency medical care.
- Apply artificial respiration if victim is not breathing.
- **Do not use mouth-to-mouth method if victim ingested or inhaled the substance; induce artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device.**
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- For minor skin contact, avoid spreading material on unaffected skin.
- Removal of solidified molten material from skin requires medical assistance.
- Keep victim warm and quiet.
- Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

Initial Isolation vs. Protective Action

(Green pages 316-317)



Isolation & Protection Distances (Green pages)

TABLE OF INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES

ID No.	NAME OF MATERIAL	SMALL SPILLS (From a small package or small leak from a large package) First ISOLATE in all Directions Meters	(Feet)	Then PROTECT persons Downwind during- DAY Kilometers	(Miles)	NIGHT Kilometers	(Miles)	LARGE SPILLS (From a large package or from many small packages) First ISOLATE in all Directions Meters	(Feet)	Then PROTECT persons Downwind during- DAY Kilometers	(Miles)	NIGHT Kilometers	(Miles)
1834	Sulphuryl chloride (when spilled in water)	30 m	(100 ft)	0.2 km	(0.1 mi)	0.2 km	(0.1 mi)	125 m	(400 ft)	1.1 km	(0.7 mi)	2.4 km	(1.5 mi)
1836	Thionyl chloride (when spilled on land)	30 m	(100 ft)	0.2 km	(0.1 mi)	0.5 km	(0.3 mi)	60 m	(200 ft)	0.5 km	(0.3 mi)	1.1 km	(0.7 mi)
1836	Thionyl chloride (when spilled in water)	30 m	(100 ft)	0.2 km	(0.1 mi)	1.0 km	(0.6 mi)	335 m	(1100 ft)	3.2 km	(2.0 mi)	7.1 km	(4.4 mi)
1838	Titanium tetrachloride (when spilled on land)	30 m	(100 ft)	[illegible]	[illegible]	[illegible]	[illegible]	30 m	(100 ft)	0.3 km	(0.2 mi)	0.8 km	(0.5 mi)
1838	Titanium tetrachloride (when spilled in water)	30 m	(100 ft)	[illegible]	[illegible]	[illegible]	[illegible]	125 m	(400 ft)	1.1 km	(0.7 mi)	2.9 km	(1.8 mi)
1859 1859	Silicon tetrafluoride Silicon tetrafluoride, compressed	30 m	(100 ft)	0.2 km	(0.1 mi)	0.5 km	(0.3 mi)	60 m	(200 ft)	0.5 km	(0.3 mi)	1.6 km	(1.0 mi)
1892	ED (when used as a weapon)	30 m	(100 ft)	0.3 km	(0.2 mi)	0.8 km	(0.5 mi)	125 m	(400 ft)	1.3 km	(0.8 mi)	2.6 km	(1.6 mi)
1892	Ethyldichloroarsine	30 m	(100 ft)	0.2 km	(0.1 mi)	0.3 km	(0.2 mi)	60 m	(200 ft)	0.5 km	(0.3 mi)	1.0 km	(0.6 mi)
1898	Acetyl iodide (when spilled in water)	30 m	(100 ft)	0.2 km	(0.1 mi)	0.2 km	(0.1 mi)	60 m	(200 ft)	0.6 km	(0.4 mi)	1.6 km	(1.0 mi)
1911 1911	Diborane Diborane, compressed	30 m	(100 ft)	0.2 km	(0.1 mi)	0.3 km	(0.2 mi)	95 m	(300 ft)	1.0 km	(0.6 mi)	2.7 km	(1.7 mi)
1923 1923 1923	Calcium dithionite (when spilled in water) Calcium hydrosulfite (when spilled in water) Calcium hydrosulphite (when spilled in water)	30 m	(100 ft)	0.2 km	(0.1 mi)	0.2 km	(0.1 mi)	30 m	(100 ft)	0.3 km	(0.2 mi)	1.1 km	(0.7 mi)

What's This?

Water-Reactive Materials
(Green pages 360-363)

TABLE OF WATER-REACTIVE MATERIALS WHICH PRODUCE TOXIC GASES

Materials Which Produce Large Amounts of Toxic-by-Inhalation (TIH) Gas(es) ***When Spilled in Water***

ID No.	Guide No.	Name of Material	TIH Gas(es) Produced	
1834	137	Sulfuryl chloride	HCl	SO_3
1834	137	Sulphuryl chloride	HCl	SO_3
1836	137	Thionyl chloride	HCl	SO_2
1838	137	Titanium tetrachloride	HCl	
1898	156	Acetyl iodide	HI	
1923	135	Calcium dithionite	H_2S	SO_2
1923	135	Calcium hydrosulfite	H_2S	SO_2
1923	135	Calcium hydrosulphite	H_2S	SO_2
1939	137	Phosphorus oxybromide	HBr	
1939	137	Phosphorus oxybromide, solid	HBr	
2004	135	Magnesium diamide	NH_3	
2011	139	Magnesium phosphide	PH_3	
2012	139	Potassium phosphide	PH_3	
2013	139	Strontium phosphide	PH_3	
2442	156	Trichloroacetyl chloride	HCl	

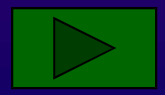
Boxes 1,2,3,4,6, & 7

- **Chemical Name**
- **Structure / formula**
- **CAS Number**
- **RTECS Number**
- **DOT ID Number and ERG Guide Number**
- **See Ammonia**
  - Note different DOT #'s, depending on concentration

- **Chemical, Synonyms and Trade Names Index**
  - If you can't find a chemical name under column 1, look in the synonym and trade name index
- **Conversion factors**
  - convert ppm to mg/m3, for air monitoring
- **See Methyl Ethyl Ketone**

Box 9: Exposure Limits

- **Lists NIOSH limits first, then OSHA limits**
- **NIOSH REL: TWA for up to a 10-hr workday during a 40-hr workweek**
- **Notations for additional exposure limits:**
  - ST (Short Term Exposure Limit): 15-min TWA that should not be exceeded during a workday (Toluene)
  - C (Ceiling): Not to be exceeded at any time (HCl)
  - Ca: Potential occupational carcinogen (Benzene)
  - [skin]: Potential for skin absorption, prevent skin exposure (Methyl Alcohol)



Exposure Limits (continued)

- **OSHA PEL: TWA concentrations that must not be exceeded during any 8-hr workshift of a 40-hr workweek**
- **Notations for additional exposure limits:**
  - ST, Ca, [skin]: same as NIOSH
  - C: same as NIOSH, plus:
    - **[15-min] - Ceiling as a 15-min TWA**
    - **[5-min max peak] - 5-min TWA above the normal ceiling that may be reached over a specified period**
- **See Gasoline for Ca**

Box 5: IDLH

- **Immediately Dangerous to Life and Health**
  - Concentration at which a worker whose respiratory protection failed should be able to escape without permanent health effects, based on a 30-minute exposure
  - Must have SCBA to enter IDLH atmosphere
- **Ca - carcinogen, followed by IDLH in brackets**
- **[10% LEL] - IDLH was based on the flammability hazard, rather than toxicological data (Ethyl Ether, Acetone)**
- **N.D. - Not determined**

METH LAB CHEMICAL HAZARD ASSESSMENT EXERCISE

Box 12: Chemical and Physical Description

- **Describes the appearance, odor and physical state of the chemical at normal conditions (STP = 68 degrees F)**
- **[ ] - shipped as a liquefied compressed gas or used as a pesticide (Hydrogen Chloride)**

What if you respond to an incident and the temperature of the compound is greater or less than 68 degrees F? (Ether, Sulfuric Acid)

Physical and Chemical Properties

MW-Molecular Weight

BP-Boiling Point

Sol-Solubility in Water

Fl.P.-Flash Point

I.P.-Ionization Potential

Sp.Gr.-Specific Gravity

VP-Vapor Pressure

MLT-Melting Point (solids)

FRZ-Freezing Point (liq/gas)

UEL-Upper Explosive Limit

LEL-Lower Explosive Limit

RGasD-Relative Density of gases (relative to air)

Chemical and Physical Properties

- **MW - Molecular Weight**
  - **MW of Air is 29**
- **IP - Ionization Potential**
  - **Lowest energy level at which a molecule of the substance may be ionized**
  - **We'll discuss the IP when we cover the PID air monitoring instrument**

Chemical and Physical Properties

- **Sol – Solubility***
  - The percentage of a material (by weight) that will dissolve in water at STP (68 ^{O}F, 1 atm)
  - Solubility provided for solids, liquids and gases
  - Miscible means the material is "mixable" or will completely go into solution
- **Sp. Gr - Specific Gravity**
  - Weight of a chemical in comparison to an equal volume of water

$$\text{Sp.Gr.} = \frac{\text{Weight of a gallon of substance}}{\text{Weight of a gallon of water}}$$

Solubility Terms

Degree of Solubility in Distilled Water at 50° F	Percentage
Negligible	< 0.1
Slight	0.1-1
Moderate	1-10
Appreciable	> 10
Complete/Miscible	In all proportions

Look up Ammonia

Chemical and Physical Properties

- Sol – Solubility*
  - The percentage of a material (by weight) that will dissolve in water at STP (68 ^{O}F, 1 atm)
  - Solubility provided for solids, liquids and gases
  - Miscible means the material is “mixable” or will completely go into solution
- **Sp. Gr - Specific Gravity***
  - **Weight of a chemical in comparison to an equal volume of water**

$$\text{Sp.Gr.} = \frac{\text{Weight of a gallon of substance}}{\text{Weight of a gallon of water}}$$

Specific Gravity of liquids:

< 1 Insoluble materials will float in (or on) water .....

> 1 Insoluble materials will sink in water .....

Soluble/Miscible materials will mix with water .....

Chemical and Physical Properties

- **RGasD - Relative Gas Density / Vapor Density**
  - The weight of a vapor or gas compared to the weight of an equal volume of air (Air is equal to "1")
  - Provided for gases only
  - **Where will Ammonia, Hydrogen Chloride and Phosphine be?**

RGasD =

$$\frac{\text{Molecular Weight of a Substance}}{\text{Molecular Weight of Air}} = \frac{\text{Molecular Weight of a Substance}}{29}$$

8 Lighter Than Air Gases

- Hydrogen 0.07
- Ammonia 0.589
- Helium 0.42
- Acetylene 0.969
- Methane 0.553
- Illuminating gases < 1.00
- Carbon monoxide 0.969
- Ethylene 0.98

VP - Vapor Pressure

- **Indication of the ability of a substance to evaporate (liquid to gas or vapor)**
- **Evaporation rate increases with an increase in temperature**
- **The larger the value, the more volatile the substance**
- **The pressure exerted by a saturated vapor above its own liquid in a closed container**

Vapor Pressure

- **High vapor pressure => high inhalation hazard**
  Normal atmospheric pressure: 760 mm Hg
- **Examples of vapor pressures:**
  - **Water: 25 mm Hg - slow evaporation**
  - **Acetone: 270 mm Hg - fast evaporation**
  - **Sulfuric acid: 0.01 mm Hg - almost no evaporation**
  - **Ammonia: 8.5 atm (atmospheres) - exists as gas**

↓ BP = ↑ VP = ↑ volatility = ↑ flammability

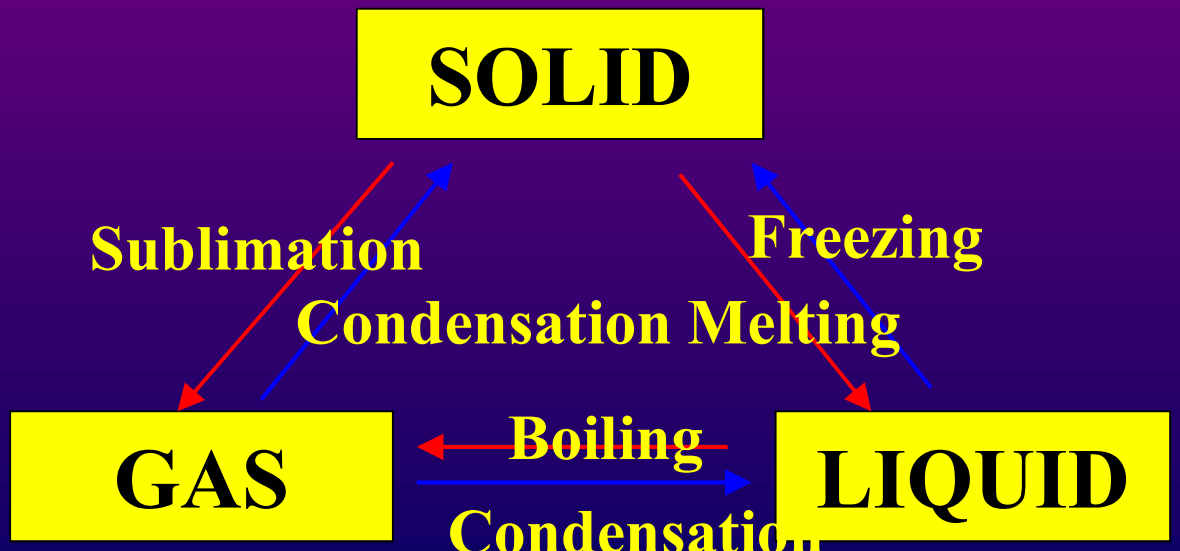
↑ BP = ↓ VP = ↓ volatility = ↓ flammability

Vapor Pressure Guidelines

Vapor Pressure	Hazard	Distance Vapors Travel
0-10 mmHg	Little concern	< 1 foot above liquid
> 100 mmHg	Inhalation concern	> 3-4 feet above liquid (breathing zone)

Chemical and Physical Properties

- **FRZ - Freezing Point**
  - Temperature at which a liquid or gas begins to change to a solid
- **MLT - Melting Point**
  - Temperature at which a solid begins to change to a liquid
- **BP - Boiling Point**
  - in ^{O}F at 1 atmosphere (760 mmHg)



Chemical and Physical Properties

- **Flammability (below Sp.Gr. or RGasD)**
  - Determined for most solids and gases
  - Liquids are classified following OSHA criteria (see page xiv)
- **Fl. P - Flash Point**
  - The temperature at which the liquid phase gives off enough vapor to flash when exposed to an external ignition source

Flammable Range

- **LEL - Lower Explosive Limit**
  - The minimum concentration of a vapor in air that will produce a flash of fire when an ignition source is present
- **UEL – Upper Explosive Limit**
  - The maximum concentration of a vapor in air that will produce a flash of fire when an ignition source is present

Flammable Range

- **LEL - Lower Explosive Limit**
  - The minimum concentration of a vapor in air that will produce a flash of fire when an ignition source is present
- **UEL – Upper Explosive Limit**
  - The maximum concentration of a vapor in air that will produce a flash of fire when an ignition source is present

Flammable Range

Concentration of vapor in air

Chemical	Flash Point	LEL	UEL
Gasoline	-45 oF	1.4%	7.6%
Methyl Alcohol	52 oF	6%	36%
Acetylene	NA	2%	100%

- State of Matter:
- Hazard Class:
- Vapor Pressure:
- Specific Gravity:
- Flash Point:
- LEL:
- UEL:
- Corrosively:

Modified Toyota Pick-up

METH LAB CHEMICAL HAZARD ASSESSMENT EXERCISE

Box 15: Incompatibilities
Box 10: Measurement Method

- **Box 15**
  - Lists important hazardous incompatibilities or reactivities of each substance
- **Box 10**
  - Describes the suggested sampling and analysis method for the substance

Possible Incompatibility Reactions

- **Chemical Interactions / Reactivity**
  - Chemicals interacting to form new substances
  - May be violent / explosive
  - May require some energy input to start the reaction
  - “Unstable” materials generally very reactive
  - “Instability” refers to the substance being in an energetically unfavorable state
  - “Inert” materials generally unreactive
- **Water-reactives & air-reactives**

Box 13: Personal Protection and Sanitation

- Summary of recommended practices for each substance
- Supplement general safe work practices (i.e. no eating, drinking or smoking)

Box 14: Respirator Selection

- Lists maximum use concentrations (MUC) for various types of respiratory protection
- Must use SCBA or Supplied Air at or above IDLH
- See Table 4 for codes

Boxes 16 & 17: Health Hazards

- **Route**
  - Lists important routes of entry & if there is a skin/eye contact hazard
- **Symptoms**
  - Lists potential symptoms
- **First Aid**
  - List procedures for eye & skin contact, inhalation and ingestion
- **Target Organs**
  - Lists organs affected by exposure

Steps in the Production of Meth

Nazi	Extraction	Cook	No pH Balance	Add Solvent	Salt-Out HCl bulbed thru meth oil
	Dissolve in Heat (methanol), Hydrocarbon, Or Solvents. **Then Filter**	Ephedrine + Lithium + ammonia = **Meth Oil**	Already a Base	Add solvent (coleman fuel or freon)	Salt + sulfuric Acid(liquid fire) = HCI gas[gas gen]
HI/Red P	Extraction	Cook	pH Balance	Add Solvent	Salt-Out HCl bulbed thru meth oil
	Dissolve in Heat (methanol), Hydrocarbon, Or Solvents. **Then Filter**	Ephedrine + I_2 crystals + water = **Meth Oil**	Add NaOH or Lye(draino) to get base solution	Add solvent (coleman fuel or freon)	Salt + sulfuric Acid(liquid fire) = HCI gas[gas gen]

Photo by Vincent Laforet / The New York Times