Science Officer 2.0

Advanced Chemical Risk Assessment and Analysis

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National Trainers’ Exchange

OAI, Inc.

National Institute of Environmental Health Sciences

02 to 04May2023

Indianapolis, Indiana

National Trainers' Exchange

Advanced Chemical Risk Assessment and Analysis Objectives

- Define the concept of a Risk Based Response
- Review a Risk Based Response model (APIE)
- Review NFPA Chapter 38: Competencies for Hazardous Materials/WMD Technicians with an Advanced Chemical Risk Assessment and Analysis Specialty
- Review the training module to achieve compliance with NFPA Chapter 38
- Use CAMEO Chemicals as a resource for compliance
- Discuss and utilize the Advanced Chemical Risk Assessment and Analysis Document

Agenda

- NFPA 470, Chapter 38: **A risk-based process**
  - Analyzing the Incident
  - Planning the Response
- Science Officer Role
  - Chemical and the Container
  - **Risk Assessment and Analysis (new)**
- Advanced Chemical Risk Assessment and Analysis Worksheet
  - aka Tactical Response Documentation
- Tabletop scenarios

Risk versus Hazard

- **Hazard**: a substance that may cause harm due to one or more inherent characteristics such as flammability, corrosivity, toxicity, radioactivity, reactivity, etc.
- **Risk**: the potential, likelihood or probability that a hazardous material may cause harm to life, property or the environment.

- **Risk = Hazard X Exposure (vulnerability)**

Analysis at a fire is your 360° survey where you look for special risks

- Type of building construction
- Contents of the building (chemicals, gas cylinders, etc.)
- Exposures
- Stage of the fire (incipient, free burning, smoldering)
- Color of the smoke
- Need for rescue

- Your **Plan** (tactical response) is based on your analysis
  - Involves a risk assessment
- What are some risk factors at a hazmat scene?

Factors influencing risk at a hazmat scene…

- Physical state (solid, liquid, gas)
- Vapor pressure
- Flash point
- Quantity (spilled and remaining in container)
- Container and stressor(s) on the container (GEBMO)
- Concentration of the chemical
- Functional groups and chemical structure
- Reactivity/Stability of the chemical
- Toxicity (LD_{50} and LC_{50}) (PEL, TLV, IDLH, PAC)
- Location (vulnerability analysis)
- Expertise and training of responders

NFPA 470 (2022) combined…

- NFPA 472: Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents
  - Chapter 21 Advanced Chemical Risk Assessment and Analysis Specialty
- NFPA 473: Standard for Competencies for EMS Personnel Responding to Hazardous Materials/Weapons of Mass Destruction Incidents
- NFPA 1072: Standard for Hazardous Materials/Weapons of Mass Destruction Emergency Response Personnel Professional Qualifications

What is a

Risk Based Process

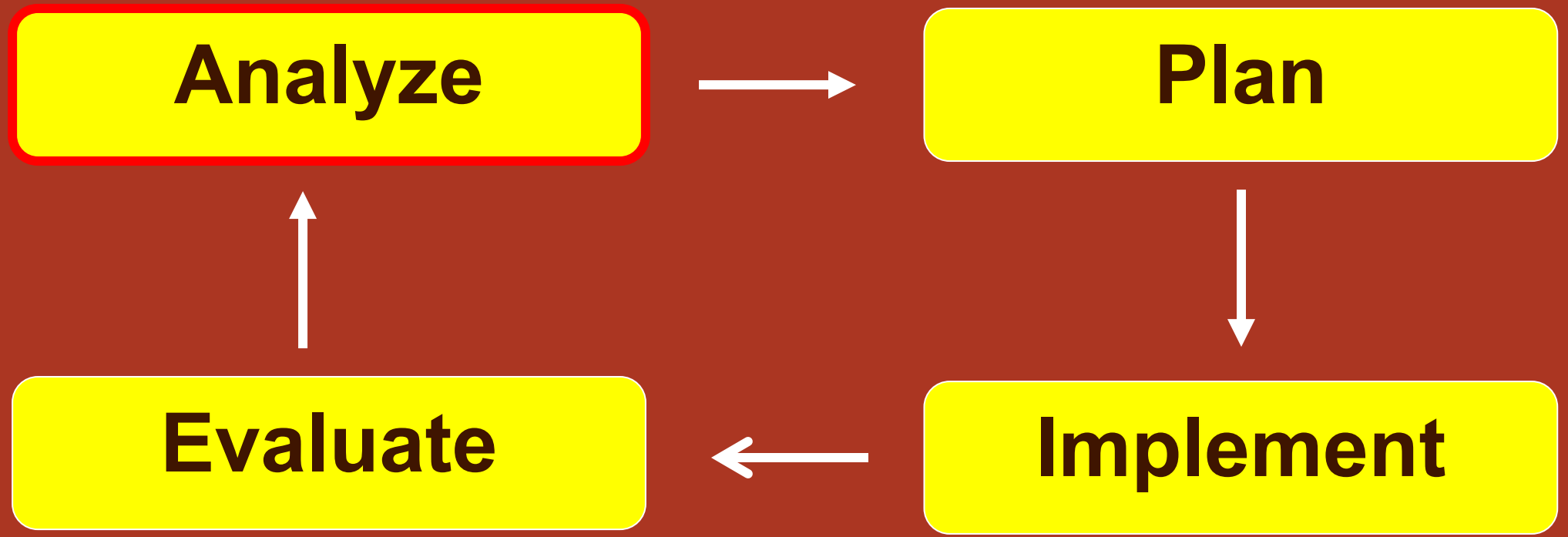
Compliant with NFPA 470?

NFPA Risk Based Response Definition

- NFPA 470 3.3.75: Systematic process, based on the facts, science and circumstances of the incident, by which responders analyze a problem involving hazardous materials/weapons of mass destruction, (WMD), to assess the hazards and consequences, develop an incident action plan (IAP), and evaluate the effectiveness of the plan.

Risk Based Response Process

- **APIE** contains four basic problem-solving elements for a risk-based response process
- APIE is a process to provide information to the IC



Science Officer Risk Assessment* (aka "Size up" or Analysis)

- Hazardous material (chemical) involved
  - Physical and Chemical Properties
- Type of container and integrity
  - **Thermal, Mechanical and Chemical Stress**
  - General Hazardous Materials Behavior Model©
- Environment or location of incident
  - Vulnerability analysis
- Resources and capabilities of responders
  - Training and Equipment

- G.G. Noll, M.S. Hildebrand and J. Yvorra, Managing the Incident, 4th Ed., 2014, page 142.

Hazardous Materials Incidents follow A Linear Sequence of Events

General Hazardous Materials Behavior Model
By Ludwig Benner

General Hazardous Materials Behavior Model (GEBMO)*

Event Sequence					
Stress	**Breach**	**Release**	**Engulf**	**Contact**	**Harm**
Identify Stress	Predict Breach	Predict Release	Predict Dispersion Pattern	Predict Length of Exposure	Predict Harm
Thermal Mechanical Chemical	Disintegration Runaway linear cracking Closures open up Punctures Splits or Tears	Detonation Violent rupture Rapid relief Spill or leak	Hemisphere Cloud Plume Cone Stream Pool Irregular	Short term Medium term Long term	**Physical** Thermal Mechanical **Health** Poisonous Corrosive Asphyxiation Radiation Etiologic

* Adapted from Ludwig Benner's Hazardous Materials Emergencies, copyright 1978

Additional information required to conduct a risk assessment per NFPA 470 (2022), Chapter 38

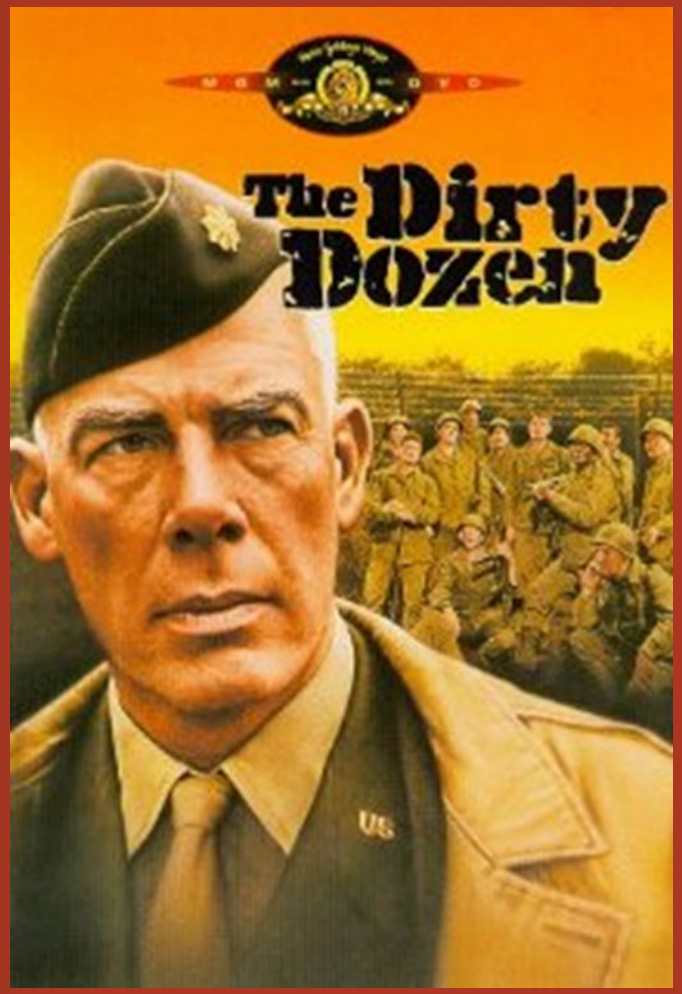
- NFPA 470 (2022), Chapter 38
- “Competencies for Hazardous Materials Technicians with an Advanced Chemical Risk Assessment and Analysis Specialty”
  - 38.1.1.1 “Hazardous Materials Technicians with an advanced chemical risk assessment and analysis specialty shall be competent at the technician level and assigned to implement advanced chemical risk assessment and analysis operations at hazardous materials/WMD incidents.

NFPA 470 (2022), 38.2 Competencies Analyzing the Incident

- 38.2.1 Include chemical and physical properties in decision making*
- 38.2.2 Impact of select terms on the risk assessment process
- 38.2.3 Significance of various salts on analysis process
- 38.2.4 Significance of various hydrocarbons on analysis process
- 38.2.5 Significance of inorganic nonsalts on analysis process
- 38.2.6 Significance of hydrocarbon derivatives on analysis process

- * See Advanced Chemical Risk Assessment and Analysis worksheet

38.2.1 Include chemical and physical properties in decision making



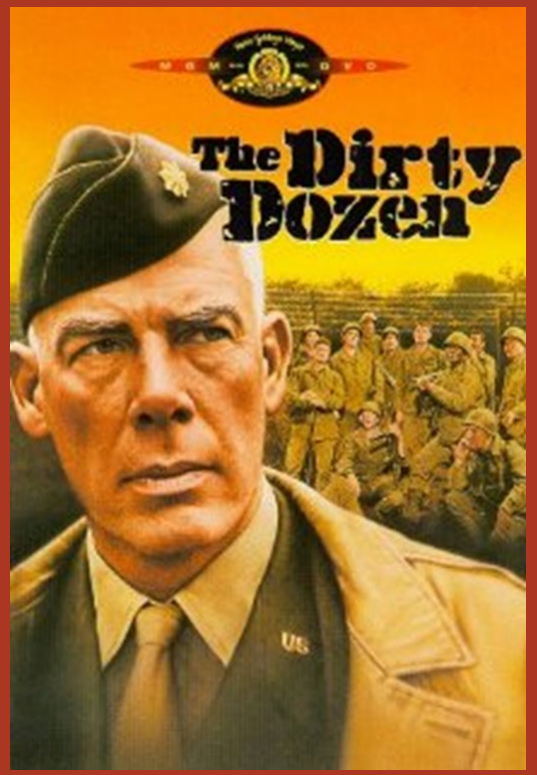
“HazMat Dirty Dozen”

There are 12 critical physical and chemical properties that are crucial to understanding basic hazardous materials behavior.

Physical and chemical properties are integral in the development of an overall strategy and specific mitigation tactics.

Physical Properties

1. Physical State (Solid, Liquid/Vapor, Gas)
2. Melting point and Boiling point
3. Expansion ratio
4. Specific gravity
5. Solubility in water
6. Vapor pressure
7. Vapor density

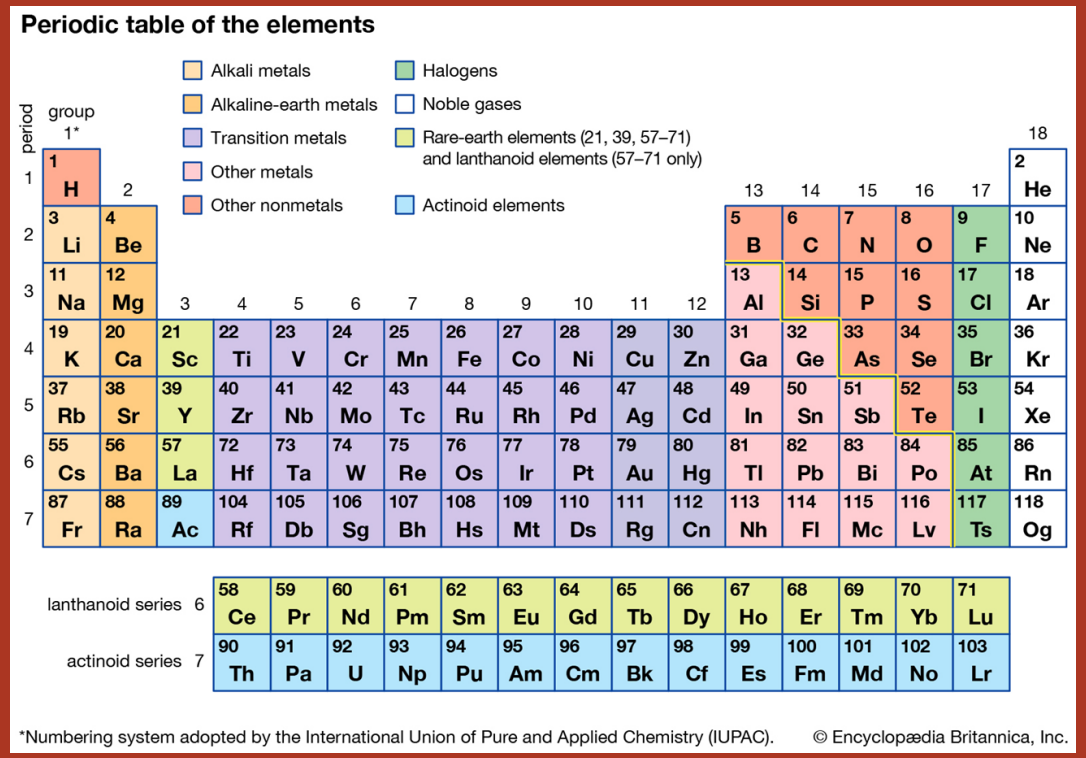


Chemical Properties

8. Flammable range (LEL/UEL)
9. Flash point
10. Ionization potential (Ionization energy)
11. pH (corrosivity)
12. Toxicity (LD_{50}, LC_{50}, , PEL, TLV, IDLH, PAC)

38.2.2 Impact of the following terms on the risk assessment

- States of matter
- Periodic table (HazMat IQ)
- Metals and nonmetals
- Transition metals
- Metalloids
- Electropositive and electronegative
- Noble gases
- Alkali metals
- Alkaline earth metals
- Organic and inorganic



38.2.3 Significance of various salts on analysis process

- Binary salt and binary oxide (NaCl, MgO, TiO_2, $CaCl_2$)
- Hydroxide* (NaOH, KOH)
- Peroxide* (H_2O_2, RO-OR')
- Cyanide (NaCN, KCN)
- Oxy-salt (NaOCl, Na_3PO_4, $Ca(OCl)_2$, KNO_3)
- Ammonium salt (NH_4Cl, NH_4NO_3,)

* See CAMEO Chemicals for definition and significance of terms

38.2.4 Significance of various hydrocarbons on analysis process

- Aromatic* (benzene, toluene)
- Aliphatic* (propane, hexane)
- Saturated* (carbon-carbon single bonds)
- Unsaturated* (carbon-carbon double and triple bonds)

* See CAMEO Chemicals for definition and significance of terms

38.2.5 Significance of inorganic nonsalts on analysis process

- Binary non-salts (PCl_3, NI_3, SCl_6)
- Binary acids (HF, HCl, HBr, HI)
- Oxyacids (H_2SO_4, HNO_3, $HClO_4$, H_3PO_4)
- Peroxides* (Na_2O_2, sodium percarbonate)
- Bases (alkalis)* (lithium, sodium, potassium, rubidium, cesium)

* See CAMEO Chemicals for definition and significance of terms

38.2.6 Significance of hydrocarbon derivatives on the analysis process

- Alcohols*
- Amines*
- Carboxylic acids*
- Esters*
- Aldehydes*
- Ketones*
- Ethers*
- Nitrogen-based compounds (nitrates, nitrites, etc.)*
- Halogenated hydrocarbons*
- Organic peroxides*
- Nitriles*
- Thiols and mercaptans*
- Isocyanates*
- Carbamates*

* See CAMEO Chemicals for definition and significance of terms

NFPA 470 (2018), 38.3 Competencies Planning the Response

- 38.3.1 Significance of specific reactivity terms on analysis process*
- 38.3.2 Describe heat transfer process for a cryogenic liquid*
- 38.3.3 Describe specific chemical reaction types*
- 38.3.4 Describe the use of IP for detection and monitoring strategy*
- 38.3.5 Describe the risks associated with the 4 categories of oxidizers and risks associated with specific listed oxidizers*

- * See CAMEO Chemicals and/or handouts for definitions and significance of terms

38.3.1 Significance of specific reactivity terms on analysis process*

- Chemical reaction
- Disassociation
- Exothermic*
- Endothermic*
- Ionic/Covalent bonds
- Molecular weight*
- Oxidation and Reduction*
- Oxidation potential
- Partition coefficient
- Persistence
- Pyrophoric*
- Water reactive*
- Air reactive*
- Aerosols*
- Critical temperature
- Critical pressure
- Cryogenic*

* See CAMEO Chemicals for definition and significance of terms

38.3.2 Describe heat transfer process for a cryogenic liquid*

- Involves a process of heat transfer between a solid material and contact with a cryogenic liquid
- Relevant for the design of:
  - Heat exchangers
  - Cryogenic fluid storage (Liquid N_2, O_2 , Ar, LNG)
  - Superconducting magnets
  - Low temperature instrumentation
- Emergency responders should be concerned about:
  - Extremely low temperature of the liquid
  - Large expansion ratio for liquid to gas vaporization
  - Oxygen displacement
  - Flammability

38.3.3 Describe specific chemical reaction types*

- Oxidation and reduction* (exothermic, endothermic, color change, precipitate formation, gas evolution)
- Decomposition (gas evolution, exothermic)
- Replacement reactions (gas evolution, precipitate)
- Neutralization* (acids and bases, exothermic)
- Polymerization* (state of matter change, usually exothermic, require a catalyst, inhibitor to prevent)

* See CAMEO Chemicals for definition and significance of terms

Evidence of a Chemical Reaction

Emergency responders should be concerned about:

- Exotherm
- Color change
- Precipitate formation
- Change in state of matter
- Gas evolution
  - Toxic
  - Flammable
  - Nontoxic
  - Corrosive

Single Replacement (Displacement) Reaction

- An element, aluminum, copper, chlorine, and a compound react so that the free element replaces or displaces an element in the compound.
- Evidence of a chemical reaction:
  - Gas evolution
  - Exotherm
  - Precipitate formation
  - Color change
- $Mg + 2HCl \longrightarrow MgCl_2 + H_2$ (gas)

Double Replacement (Displacement) Reaction

- An exchange of the positively charged ions (metal ions) occurs in two compounds.
- Evidence of reaction
  - Gas evolution
  - Exotherm
  - Color change
  - Precipitate formation
- $CaS + 2HCl \longrightarrow CaCl_2 + H_2S$ (gas)
- $Na_2SO4 + BaCl_2 \longrightarrow 2NaCl + BaSO_4$ (ppt)

Decomposition Reaction

- A relatively complex substance is broken down into several simpler substances.
- Evidence of a chemical reaction:
  - Gas evolution
  - Color change
  - Precipitate formation
  - Exotherm
- $2H_2O_2 \longrightarrow 2H_2O$ (liquid) + O_2 (gas) + heat
- $KClO_4 \longrightarrow KCl + 2O_2$ (gas)

Neutralization Reaction

- The reaction of an acid and a base to afford a pH close to 7.
- Evidence of a chemical reaction:
  - Strong exotherm
  - Gas evolution
  - Precipitate formation
  - Color change (may be due to added pH indicating reagent)
- $H_2SO_4 + Na_2CO_3 \longrightarrow Na_2SO_4 + CO_2$ (gas) + heat

Polymerization Reaction

- A chemical process where monomers (single unit) form chemical bonds to produce polymers (many units). An analogy is a chain where each link is a monomer and the chain is the polymer.
- Evidence of reaction
  - Exotherm
  - State of matter change
  - Volume decrease
- Styrene monomer (liquid) $\longrightarrow$ Poly(styrene) (solid)

Chemical reaction types exercise

- Work with the instructor and observe reactions between various chemicals in each chemical reaction category.
- Record your observations for each reaction
  - Exothermic
  - Gas evolution
  - Precipitate formation
  - Color change
- Discuss how each reaction might influence the course of mitigation of hazardous materials release

38.3.4 Describe the use of IP for detection and monitoring strategy*

- The energy required to "ionize" or remove an electron from an atom.
- The ions can be measured by a photoionization detector (PID), which measures the relative concentration of ionized compounds.
- The ionization potential identifies the minimum energy level of the PID lamp that is required to ionize an atom or molecule.

* See CAMEO Chemicals for definition and significance of terms

38.3.5 Describe the risks associated with the 4 categories of oxidizers

- NFPA 400 (2019) Hazardous Materials Code
- 3.3.73* **Oxidizer**. Any solid or liquid material that readily yields oxygen or oxidizing gas or that readily reacts to promote or initiate combustion of combustible materials that can, under some circumstances, undergo a vigorous self-sustained decomposition due to contamination or heat exposure.

- **3.3.73.1 Class 1**. An oxidizer that does not moderately increase the burning rate of combustible materials with which it comes into contact or a solid oxidizer classified as Class 1 when tested in accordance with the test protocol set forth in Section G.1.
- **3.3.73.2 Class 2**. An oxidizer that causes a moderate increase in the burning rate of combustible materials with which it comes into contact or a solid oxidizer classified as Class 2 when tested in accordance with the test protocol set forth in Section G.1.
- **3.3.73.3 Class 3**. An oxidizer that causes a severe increase in the burning rate of combustible materials with which it comes into contact or a solid oxidizer classified as Class 3 when tested in accordance with the test protocol set forth in Section G.1.
- **3.3.73.4. Class 4**. An oxidizer that can undergo an explosive reaction due to contamination or exposure to thermal or physical shock and that causes a severe increase in the burning rate of combustible materials with which it comes into contact.

Relative Strengths of Oxidizing Agents

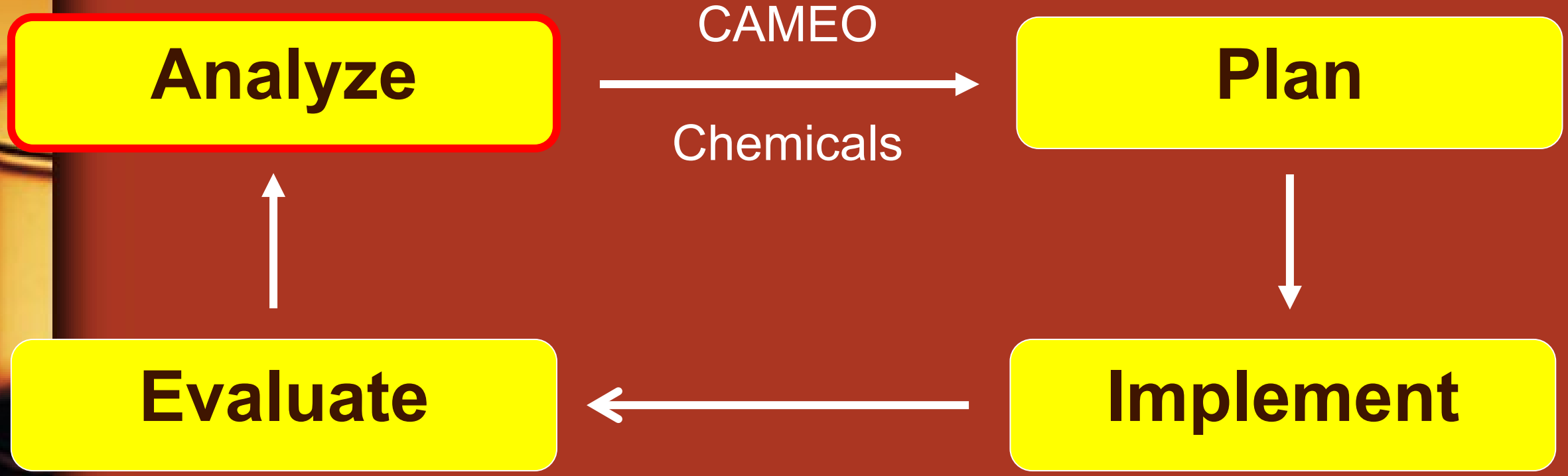
- Fluorine
- Ozone
- Hydrogen peroxide
- Hypochlorous acid
- Metallic chlorates
- Metallic permanganates
- Metallic dichromates
- Nitric acid (concentrated)
- Chlorine
- Sulfuric acid (concentrated)
- Oxygen
- Bromine
- Iron (III) compounds
- Iodine

Chemistry of Hazardous Materials, 2nd Edition, 1990, pg. 333, Eugene Meyer

NFPA 470 (2022), Chapter 38 Example

- Added categories of chemicals that had similar structure, functional groups, similar properties and similar risks and require the hazardous materials technician to explain their significance in the analysis process.
- For example, in NFPA 470, 38.2.4, “the hazardous materials technician with an advanced risk assessment and analysis specialty shall describe the following hydrocarbons and their isomers and explain their significance in the analysis process.”
- Example: NFPA 470, 38.2.4 (4) unsaturated hydrocarbons
- **Where does one locate this information?**

Advanced Chemical Risk Assessment and Analysis



CAMEO Chemicals Example

Significance of Unsaturated Hydrocarbons in the Analysis Process

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Database of Hazardous Materials

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Search

Find response information for thousands of hazardous materials, including fire and explosion hazards, health hazards, firefighting techniques, cleanup procedures, protective clothing, and chemical properties.

MyChemicals

Build a list of chemicals. For example, substances involved in an incident response (such as a train derailment) or chemicals stored in your community.

Reactivity

See what hazards might occur if chemicals in your MyChemicals collection are mixed together.

Get started by finding a substance of interest with a search.

Learn more by checking the help for background information, a glossary of terms, and guidance on using this database.

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Search

Enter a chemical name or identification number to begin searching for datasheets.

How does this search work?

Name *(not case sensitive)*
propylene ×
Search Name

CAS Number *(with or without dashes)*
Search CAS Number

UN/NA Number *(4-digit number)*
Search UN/NA Number

Other ways to find chemicals

Advanced Search Browse

Search for propylene

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Search Results

Name contains **propylene** matched 89 datasheets

1 - 20 of **89** results < Prev Next > Page **1** of **5** Go to page: Go

PROPYLENE
Propylene is a colorless gas with a faint petroleum like odor. It is shipped as a liquefied gas ...
DOT Hazard Label: Flammable Gas **Flash Point:** -162 ° F **Lower Explosive Limit (LEL):** 2 % **PAC-3:** 17000 ppm
CAS Number: 115-07-1
UN/NA Number: 1077
This chemical is also known as:
- **PROPYLENE**
- 1-**PROPYLENE**

View Datasheet Add to MyChemicals

UN/NA 1075
Response Guide 115: Gases - Flammable (Including Refrigerated Liquids)
Hazard Class: 2.1 - Flammable gas
Matching ERG or 49CFR proper shipping names:
- **Propylene**

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PROPYLENE

Chemical Identifiers | Hazards | Response Recommendations | Physical Properties | Regulatory Information | Alternate Chemical Names

Chemical Identifiers

What is this information?

CAS Number
115-07-1

UN/NA Number
1077

DOT Hazard Label
Flammable Gas

USCG CHRIS Code
PPL

NIOSH Pocket Guide
none

International Chem Safety Card
PROPYLENE

NFPA 704

NFPA 704 numbering system is a measure of risk

Diamond	Hazard	Value	Description
	Health	1	Can cause significant irritation.
	Flammability	4	Burns readily. Rapidly or completely vaporizes at atmospheric pressure and normal ambient temperature.
	Instability	1	Normally stable but can become unstable at elevated temperatures and pressures

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Hazards

What is this information?

Reactivity Alerts

Highly Flammable

Air & Water Reactions

Highly flammable.

Fire Hazard

Behavior in Fire: Containers may explode. Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. (USCG, 1999)

Health Hazard

Moderate concentration in air causes dizziness, drowsiness, and unconsciousness. Contact with liquefied propylene will cause ``freezing burn.'' (USCG, 1999)

Reactivity Profile

During an experiment to produce lactic acid by oxidizing PROPYLENE with nitrogen peroxide, a violent explosion occurred. These mixtures (olefins and nitrogen peroxide) form extremely unstable nitrosates or nitrosites (Comp. Rend. 116:756 1893). Contact of very cold liquid propylene with water may result in vigorous or violent boiling of the product and extremely rapid vaporization due to the large temperature differences involved. If the water is hot, there is the possibility that a liquid "superheat" explosion may occur. Pressures may build to dangerous levels if liquid propylene contacts water in a closed container.

Belongs to the Following Reactive Group(s)

- Hydrocarbons, Aliphatic Unsaturated

Synopsis of hazards and risks for this functional group

Potentially Incompatible Absorbents

Use caution: Liquids with this reactive group classification have been known to react with the absorbent listed below. More info about absorbents, including situations to watch out for...

- Dirt/Earth

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Reactive Group Datasheet

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Hydrocarbons, Aliphatic Unsaturated

What are reactive groups?

Reactive groups are categories of chemicals that typically react in similar ways because they are similar in their chemical structure. Each substance with a chemical datasheet has been assigned to one or more reactive groups, and CAMEO Chemicals uses the reactive group assignments to make its reactivity predictions. More info about reactivity predictions...

If you can't find a chemical in the database--but you know what reactive group it belongs in--you can add the reactive group to MyChemicals instead in order to see the reactivity predictions.

There are 476 chemical datasheets assigned to this reactive group.

Description

Flammability

The lightest-molecular-weight substances in this group are highly flammable and pose significant vapor cloud explosion hazards (examples are ethylene and propylene). All are combustible.

Reactivity

Unsaturated aliphatic hydrocarbons are generally much more reactive than alkanes, which are saturated aliphatic hydrocarbons. Strong oxidizers may react vigorously with them. Reducing agents can react exothermically to release gaseous hydrogen gas. In the presence of various catalysts (such as acids) or initiators, compounds in this class can undergo very exothermic addition polymerization reactions. Many of these compounds undergo autoxidation upon exposure to the air to form explosive peroxides (this process generally occurs slowly). These peroxide and polyperoxide substances are usually extremely unstable and prone to detonation. The peroxidation of butadiene has been involved in several serious industrial explosion accidents

chemicals: 0
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Predict Reactivity

Description

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Toxicity

Unsaturated aliphatic hydrocarbons have low toxicity, but act as asphyxiants.

Other Characteristics

Unsaturated aliphatic hydrocarbons are characterized by straight or branched carbon chains containing at least one double or triple bond between the carbon atoms. They are also known as alkenes or olefins (for compounds containing a C-C double bond) and alkynes (for compounds containing a C-C triple bond). Their physical state at room conditions changes with increasing molecular weight from gaseous to waxy solid. They are used in making rubber and plastics and in organic synthesis.

Examples

Butene, pentene, acetylene, amylene, cycloheptatriene, cycloheptane, cyclohexane, cyclooctadiene, isobutylene, dipentene, ethylene, hexene, isohexene, isoprene, methyl pentadiene.

Reactivity Documentation

Use the links below to find out how this reactive group interacts with any of the reactive groups in the database.

The predicted hazards and gas byproducts for each reactive group pair will be displayed, as well as documentation and references that were used to make the reactivity predictions.

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Use the links below to find out how this reactive group interacts with any of the reactive groups in the database.

The predicted hazards and gas byproducts for each reactive group pair will be displayed, as well as documentation and references that were used to make the reactivity predictions.

Mix **Hydrocarbons, Aliphatic Unsaturated** with:

- Acetals, Ketals, Hemiacetals, and Hemiketals
- Acids, Carboxylic
- Acids, Strong Non-oxidizing
- Acids, Strong Oxidizing
- Acids, Weak
- Acrylates and Acrylic Acids
- Acyl Halides, Sulfonyl Halides, and Chloroformates
- Alcohols and Polyols
- Aldehydes
- Alkynes, with Acetylenic Hydrogen
- Alkynes, with No Acetylenic Hydrogen
- Amides and Imides
- Amines, Aromatic
- Amines, Phosphines, and Pyridines
- Anhydrides
- Aryl Halides
- Azo, Diazo, Azido, Hydrazine, and Azide Compounds
- Bases, Strong
- Bases, Weak
- Carbamates
- Carbonate Salts
- Chlorosilanes
- Conjugated Dienes
- Cyanides, Inorganic
- Diazonium Salts
- Epoxides
- Esters, Sulfate Esters, Phosphate Esters, Thiophosphate Esters, and Borate Esters
- Ethers
- Fluoride Salts, Soluble
- Fluorinated Organic Compounds

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Reactivity Documentation

Hydrocarbons, Aliphatic Unsaturated

mixed with

Acids, Strong Oxidizing

Summary

- **Flammable:** Reaction products may be flammable
- **Generates gas:** Reaction liberates gaseous products and may cause pressurization
- **Generates heat:** Exothermic reaction at ambient temperatures (releases heat)
- **Intense or explosive reaction:** Reaction may be particularly intense, violent, or explosive
- **Toxic:** Reaction products may be toxic
- **May produce the following gases:**
  - Carbon Dioxide
  - Nitrogen Oxides

Details

Hazard Predictions

- **Flammable:** Reaction products may be flammable
- **Generates gas:** Reaction liberates gaseous products and may cause pressurization
- **Generates heat:** Exothermic reaction at ambient temperatures (releases heat)
- **Intense or explosive reaction:** Reaction may be particularly intense, violent, or explosive
- **Toxic:** Reaction products may be toxic

Phenylacetylene explodes on contact with perchloric acid. This can even occur at cryogenic temperatures if a dilutant is not present (Martheard, J.P. et al. 1982. Tetrahedron Letters 23:3484.).

Acetylene reacts violently or explosively with most oxidants (Urben, P.G. 1995. Bretherick's Handbook of Reactive Chemical Hazards, 5th Edition. Oxford: Butterworth-Heinemann. pp. 265.).

Cyclopentadiene reacts explosively with HNO3 or concentrated H2SO4 (Wilson, P.J. et al. 1944. Chemical Reviews 38:8.).

Aliphatic unsaturated hydrocarbons are very susceptible to oxidation by strong oxidizing acids, which can result in heat generation and fire (Rich, G. A., 1993, Dangerous Chemical Reactions, Gulf Publishing Co., Houston, TX, p. 249).

Addition of mineral acids to alkenes can result in exothermic alkene-addition reactions, forming alkyl sulfates in the case of sulfuric acid (Rich, G. A., 1993, Dangerous Chemical Reactions, Gulf Publishing Co., Houston, TX, p. 242).

Strong oxidizing acids, such as sulfuric acid, perchloric acid, or nitric acid, can catalyze exothermic alkene-hydration reactions, which produce alcohols (Loudon, Marc. 2002. Organic Chemistry. 4th ed. New York: Oxford University Press. p. 152).

Strong oxidizing acids can initiate the exothermic polymerization of olefins. These reactions can be violent (Rich, G. A., 1993, Dangerous Chemical Reactions, Gulf Publishing Co., Houston, TX, p. 251).

Acetylene and HNO3 react to liberate toxic NOx and inert CO2 gases (Copenhaver, J. W. and Bigelow M. H. Acetylene and Carbon Monoxide Chemistry. New York: Reinhold Publishing Co, 1949, pp. 23).

Dienes and alkynes form hypergolic (spontaneously explosive) mixtures with HNO3 (Andrussow, L. 1961. Chim. Ind. (Paris) 86:542).

Potential Gas Byproducts

- Carbon Dioxide (CO2)
- Nitrogen Oxides (NOx)

Search CAMEO Chemicals

Using

MyChemicals for Reactive Groups

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Predict Reactivity

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Database of Hazardous Materials

Search

Find response information for thousands of hazardous materials, including fire and explosion hazards, health hazards, firefighting techniques, cleanup procedures, protective clothing, and chemical properties.

MyChemicals

Choose "My Chemicals"

Build a list of chemicals. For example, substances involved in an incident response (such as a train derailment) or chemicals stored in your community.

Reactivity

See what hazards might occur if chemicals in your MyChemicals collection are mixed together.

Get started by finding a substance of interest with a search.

Learn more by checking the help for background information, a glossary of terms, and guidance on using this database.

CAMEO Chemicals version 2.7.1

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MyChemicals

MyChemicals Collection

The MyChemicals collection is empty.

Add Water | Add Reactive Group

Click "Add Reactive Group"

Accidentally removed a chemical? Retrieve it here.

Use MyChemicals to...

- Create a temporary collection of chemicals, which you can also save for later reference. More info on saving MyChemicals collections...
- View predicted reactivity between the chemicals in the collection. More info on viewing reactivity predictions...
- Print reports for all the chemicals in the collection. More info on printing reports...

Getting Started

There are 3 ways to add items to your MyChemicals collection:

- To add a specific chemical, run a search and then click Add to MyChemicals on the chemical datasheet.
- To add water or a reactive group, either click on the buttons on the top of this page or click Add to MyChemicals on a reactive group datasheet. More info on reactive groups...
- To use a MyChemicals collection that you previously saved to your computer, click Import.

Import

Load complete

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Predict Reactivity

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Browse Reactive Group Datasheets

Reactive groups are categories of chemicals that typically react in similar ways because they are similar in their chemical structure. For purposes of predicting reactivity between mixed chemicals, each substance in CAMEO Chemicals has been assigned to one or more reactive groups, based on the known chemistry of that substance.

If you can't find a chemical in the database--but you know what reactive group it belongs in--you can add the reactive group to MyChemicals instead in order to see the reactivity predictions.

There are 68 reactive group datasheets in CAMEO Chemicals:

- Acetals, Ketals, Hemiacetals, and Hemiketals
- Acids, Carboxylic
- Acids, Strong Non-oxidizing
- Acids, Strong Oxidizing
- Acids, Weak
- Acrylates and Acrylic Acids
- Acyl Halides, Sulfonyl Halides, and Chloroformates
- Alcohols and Polyols
- Aldehydes
- Alkynes, with Acetylenic Hydrogen
- Alkynes, with No Acetylenic Hydrogen
- Amides and Imides
- Amines, Aromatic
- Amines, Phosphines, and Pyridines
- Anhydrides
- Aryl Halides
- Azo, Diazo, Azido, Hydrazine, and Azide Compounds
- Bases, Strong
- Bases, Weak
- Carbamates
- Carbonate Salts

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Reactive Group Datasheet

Add to MyChemicals | Print Friendly Page

Carbamates

What are reactive groups?

Reactive groups are categories of chemicals that typically react in similar ways because they are similar in their chemical structure. Each substance with a chemical datasheet has been assigned to one or more reactive groups, and CAMEO Chemicals uses the reactive group assignments to make its reactivity predictions. More info about reactivity predictions...

If you can't find a chemical in the database--but you know what reactive group it belongs in--you can add the reactive group to MyChemicals instead in order to see the reactivity predictions.

There are 59 chemical datasheets assigned to this reactive group.

Description

Flammability

Compounds in this group are high-boiling liquids or solids. They are generally nonflammable, but are combustible. Combustion products include noxious NOx and carbon monoxide.

Reactivity

Materials in this group are chemically similar to, but more reactive than amides. Like amides they form polymers such as polyurethane resins. Carbamates are incompatible with strong acids and bases, and especially incompatible with strong reducing agents such as hydrides. Flammable gaseous hydrogen is produced by the combination of active metals or nitrides with carbamates. Strongly oxidizing acids, peroxides, and hydroperoxides are incompatible with carbamates.

Description

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Toxicity

Many carbamates are used as pesticides. These materials can be extremely toxic. They act by blocking the function of cholinesterase, an enzyme that is essential to the transmission of nerve impulses. Oral exposure is the principal concern. Absorption through the skin is slow, but dermal exposure must still be avoided because of the high toxicity.

Other Characteristics

Compounds in this group are derivatives of carbamic acid (NH2COOH). The urethanes are alkyl carbamates, that is, esters of carbamic acid.

Examples

Carbamic acid, ammonium carbamate, bendiocarb, carbaryl, oxamyl, propoxur, urethane.

Reactivity Documentation

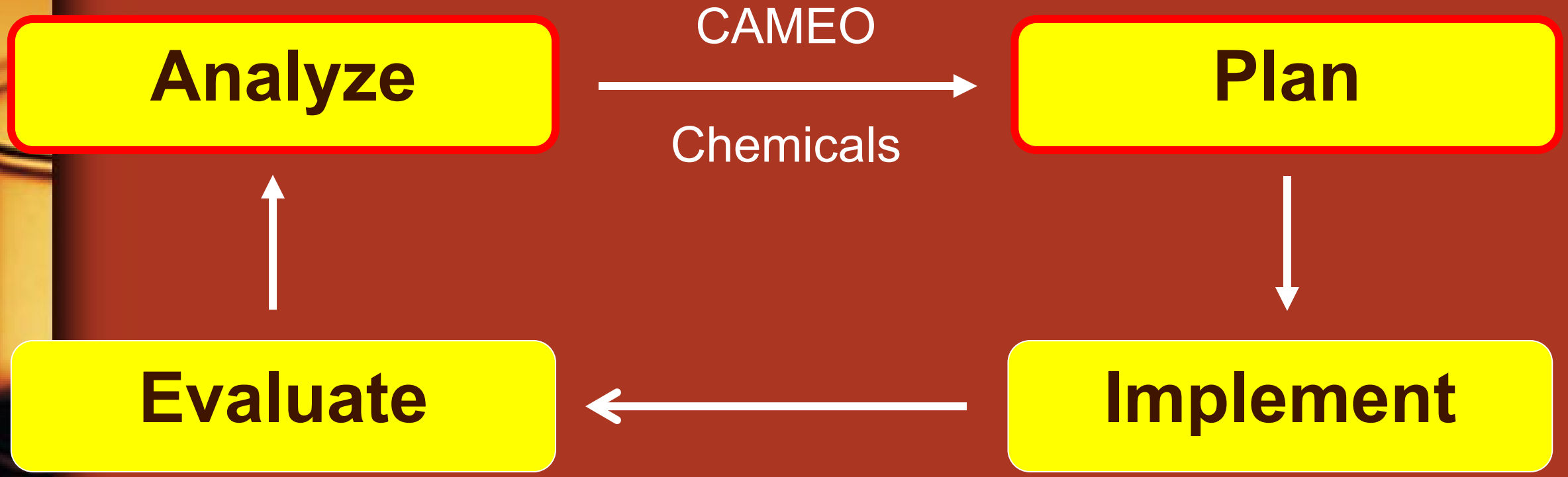
Use the links below to find out how this reactive group interacts with any of the reactive groups in the database.

The predicted hazards and gas byproducts for each reactive group pair will be displayed, as well as documentation and references that were used to make the reactivity predictions.

Mix **Carbamates** with:

- Acetals, Ketals, Hemiacetals, and Hemiketals

Advanced Chemical Risk Assessment and Analysis
38.3 Planning the Response



38.3.1 Significance of specific reactivity terms on analysis process* (Example)

- Chemical reaction
- Disassociation
- Exothermic*
- Endothermic*
- Ionic/Covalent bonds
- Molecular weight*
- Oxidation and Reduction*
- Oxidation potential
- Partition coefficient
- Persistence
- **Pyrophoric***
- Water reactive*
- Air reactive*
- Aerosols*
- Critical temperature
- Critical pressure
- Cryogenic*

* See CAMEO Chemicals for definition and significance of terms

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Search Results

Name contains **diethylzinc** matched 2 datasheets

1 - 2 of **2** results < Prev Next > Page **1** of **1** Go to page: Go

DIETHYLZINC
Diethylzinc is a pyrophoric liquid with a garlic-like odor. It is stable when it is shipped in s...
DOT Hazard Label: Spontaneously Combustible, Dangerous When Wet **PAC-3:** 1600 ppm
CAS Number: 557-20-0
UN/NA Number: 1366
This chemical is also known as:
- **DIETHYLZINC**

View Datasheet Add to MyChemicals

UN/NA 1366
Response Guide 135: Substances - Spontaneously Combustible
Hazard Class:
Matching ERG or 49CFR proper shipping names:
- **Diethylzinc**

View Datasheet

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DIETHYLZINC

Chemical Identifiers | Hazards | Response Recommendations | Physical Properties | Regulatory Information | Alternate Chemical Names

Chemical Identifiers

What is this information?

CAS Number
557-20-0

UN/NA Number
1366

DOT Hazard Label
Spontaneously Combustible
Dangerous When Wet

USCG CHRIS Code
DEZ

NIOSH Pocket Guide
none

International Chem Safety Card
none

NFPA 704

Diamond	Hazard	Value	Description
	Health	3	Can cause serious or permanent injury.
	Flammability	4	Burns readily. Rapidly or completely vaporizes at atmospheric pressure and normal ambient temperature.

Load complete

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Hazards

What is this information?

Click on What is this information?

Reactivity Alerts

- Strong Reducing Agent
- Water-Reactive
- Pyrophoric

Air & Water Reactions

Highly flammable. Ignites in air with a blue flame giving off a peculiar garlic-like odor, [Merck, 11th ed., 1989]. Diethyl zinc is spontaneously flammable in air, [Douda(1966)]. Reacts violently with water to form flammable ethane gas, [Brauer(1965)].

Fire Hazard

Special Hazards of Combustion Products: Yields zinc oxide fumes when burning; can cause ``metal fume fever'' (see 5.2)

Behavior in Fire: Reacts spontaneously with air or oxygen, and violently with water, evolving flammable ethane gas. Contact with water applied to adjacent fires will intensify the fire. (USCG, 1999)

Health Hazard

Inhalation of mist or vapor causes immediate irritation of nose and throat; excessive or prolonged inhalation of fumes from ignition or decomposition may cause ``metal fume fever'' (sore throat, headache, fever, chills, nausea, vomiting, muscular aches, perspiration, constricting sensation in lungs, weakness, sometimes prostration); symptoms usually last 12-24 hrs., with complete recovery in 24-48 hrs. Eyes are immediately and severely irritated on contact with liquid, vapor, or dilute solution; without thorough irrigation, cornea may be permanently damaged. Moisture in skin combines with chemical to cause thermal and acid burns; tissue may be scarred without prompt treatment. Ingestion is unlikely but would cause immediate burns at site of contact; pain, nausea, vomiting, cramps, and diarrhea may follow; if untreated, tissue may become ulcerated. (USCG, 1999)

Reactivity Profile

DIETHYLZINC is pyrophoric in air, it ignites instantaneously. It reacts explosively with alcohols (methanol, ethanol), bromine, chlorine or liquefied sulfur dioxide [Houben-Weyl, 1973, 13.2a, p. 855, 757, 709]. Reaction with water, nitro compounds, arsenic trichloride, phosphorus trichloride is violent [Bretherick, 5th ed., 1995, p. 587].

Load complete

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DIETHYLZINC Help

Hazards

What is this information?

The Hazard fields include special hazard alerts, air and water reactions, fire hazards, health hazards, a reactivity profile, and details about reactive groups assignments and potentially incompatible absorbents. The information in CAMEO Chemicals comes from a variety of data sources.

Reactivity Alerts

- Strong Reducing Agent
- Water-Reactive
- Pyrophoric

Air & Water Reactions

Highly flammable. Ignites in air with a blue flame giving off a peculiar garlic-like odor, [Merck, 11th ed., 1989]. Diethyl zinc is spontaneously flammable in air, [Douda(1966)]. Reacts violently with water to form flammable ethane gas, [Brauer(1965)].

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Reactivity Profile

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Reactivity Alerts

The following *reactivity* alerts are shown on **chemical datasheets** in the Hazards section, when applicable:

Reactivity Alert	Definition
Air-Reactive	Likely to react rapidly or violently with dry air or moist air. May generate *toxic* and *corrosive fumes* upon exposure to air, or may catch fire.
Decomposes at Elevated Temperatures (<120 deg. C)	Materials that are unstable and can readily decompose—that is, break down into simpler chemical components—under rather mild conditions (where the temperature is less than 120°C [248°F]). The decomposition byproducts may be hazardous. Many of these materials may be stored under refrigeration to stabilize them.
Explosive	A material synthesized or mixed deliberately to allow the very rapid release of chemical energy. Also, a chemical substance that is intrinsically unstable and liable to detonate under conditions that might reasonably be encountered. See topic on **Could it burn or explode?**
Highly Flammable	Substances having a *flash point* of less than 100°F (and mixtures that include those substances). See topic on **Could it burn or explode?**
Known Catalytic Activity	Substances that have been known to act as catalysts. A *catalyst* is a substance that increases the rate of a chemical *reaction* by reducing the reaction's activation energy;

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	reaction—a situation called thermal runaway. The products of polymerization reactions are generally less *reactive* than the starting materials.
Pyrophoric	Substances that ignite instantly upon exposure to oxygen (air). Generally, these materials are stored in solvents or *inert* atmospheres to prevent exposure to air. Many pyrophoric materials are also *water-reactive*, and can produce heat and hazardous gases when they come into contact with water or humid air. See topic on **Would it react with water?**
Radioactive Material	Spontaneously and continuously emitting ions or ionizing *radiation*. Radioactivity is not a chemical property, but a hazard that exists in addition to the chemical properties of a material.
Strong Oxidizing Agent	Oxidizing agents gain electrons from other substances and are themselves thereby chemically reduced. Strong oxidizing agents accept electrons particularly well from a large range of other substances. The ensuing *oxidation-reduction* reactions may be vigorous or violent, and may release new substances that may take part in additional reactions. Strong oxidizing agents should be kept well separated from strong reducing agents. In some cases, the presence of a strong *oxidizing agent* can greatly increase the severity of a fire.
Strong Reducing Agent	Reducing agents give up electrons to other substances. They are themselves thereby oxidized. Strong reducing agents donate electrons particularly well to a large range of other substances. The ensuing oxidation-reduction reactions may be vigorous or violent and may generate new substances that take part in further reactions.

Load complete

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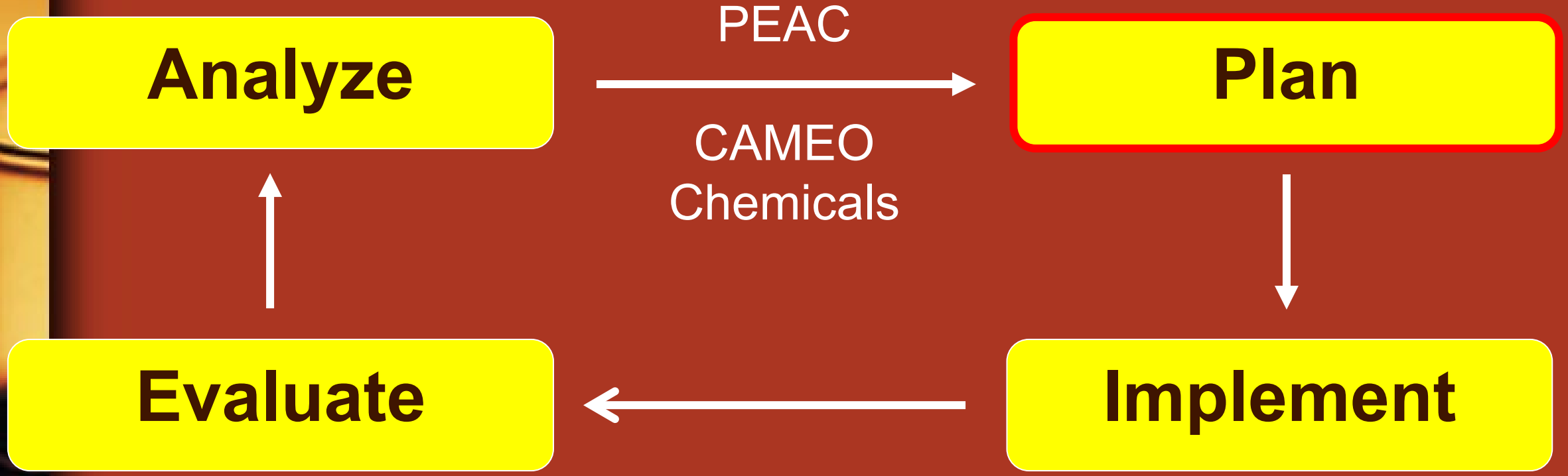
Advanced Chemical Risk Assessment and Analysis



Planning: Minimize Chemical Exposure to People, Property and the Environment

- Personal protective equipment
- Air monitoring
- Decontamination
- Shelter-in-Place
- Evacuation
- Water fog
- Foam blanket
- Neutralization
- Degradation
- Dilution
- Sterilization
- Robotics and Artificial Intelligence

Summary

- Use a Risk based process to (APIE):
  - **Analyze** hazards posed by the hazardous material(s)
  - Predict the potential for exposure to the hazardous material
  - **Analyze** stressor(s) on the container
  - Using the GEBMO, predict the outcome of the event
- Using facts, science and circumstances of the event, be prepared to make recommendations to the IC to develop a **Plan** for strategy and tactics to mitigate the hazardous materials event

Document everything you do!

Advanced Chemical Risk Assessment and Analysis Documentation

T. O. Murdock and V. Pellegrin

Section 1: Identification	
Chemical name	
Chemical Abstracts Service Number	
UN ID Number (XXXX)	
DOT ERG Guide Number (XXX)	
DOT ERG initial evacuate in all directions	**75' 150' 330' other =**
DOT ERG initial downwind evacuation	

Section 2: Physical Properties (list resources)		
Physical State (at 70°)	Solid Liquid Gas	
Specific gravity (Sp. Gr.)		
Vapor density (VD) Relative Gas Density (RGasD)		$VD_{(calc)}$ = MW/29 =
Boiling point (BP)		
Melting point (FRZ or MP)		
Vapor pressure (VP)		
Water solubility (Sol)		
Section 3: Chemical Properties (list resources)		

Questions?

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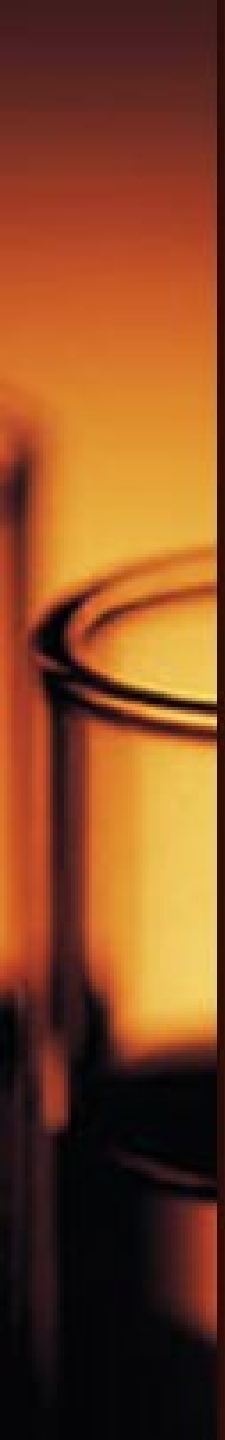
Hazardous Materials Response and Chemical Assessment Training
tomdimurdock@gmail.com
763-208-5581 (home)
612-715-2361 (cell)

Tabletop Exercises

- Each group will receive a package of information
  - Description of the incident
  - Photos of the incident
  - Name of the chemical(s)
  - CAMEO Chemicals, NIOSH Pocket Guide data sheet and/or SDS
  - CAMEO Chemicals functional group report
  - Advanced Chemical Risk Assessment and Analysis Worksheet
- Complete the worksheet and report your Analysis and Plan to the class

Tabletop Scenarios

- **Nitric acid 70%**
- Hydrochloric acid
- Propylene glycol
- Sodium hydroxide solution (~35%)
- Gasoline
- Sulfuric acid and Sodium chloride
- Xylenes
- Ferric chloride solution



Broken 70% Nitric Acid Containers on the Freeway

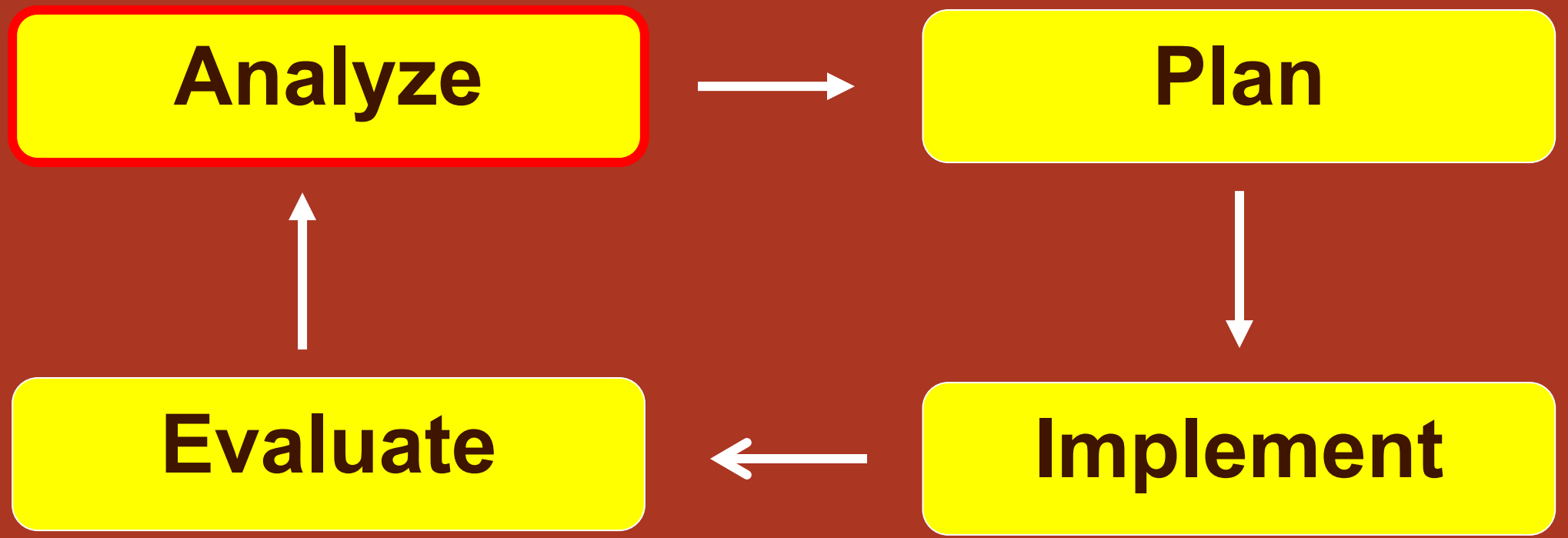
CASCADE TOWNSHIP (Grand Rapids, MI)– (14Jul2009) A call about a smoking box on M-6 near the Thornapple River has a lane blocked as hazardous materials crews clean up some nitric acid that spilled on the roadway, according to state police.

Police say the call came in about 8 a.m. about debris and glass on the road and when road crews arrived, they saw the box that had fallen off a truck was "fogging."

Four broken one gallon glass containers of 70% nitric acid

Risk Based Response

- A process to provide information to the IC
- **APIE** is a common risk-based response process



Nitric acid	Formula: HNO_3	CAS#: 7697-37-2	RTECS#: QU5775000	IDLH: 25 ppm
Conversion: 1 ppm = 2.58 mg/m^3	**DOT:** 2032 157 (fuming); 2031 157 (other than red fuming)			

Synonyms/Trade Names: Aqua fortis, Engravers acid, Hydrogen nitrate, Red fuming nitric acid (RFNA), White fuming nitric acid (WFNA)

Exposure Limits:
NIOSH REL: TWA 2 ppm (5 mg/m^3)
ST 4 ppm (10 mg/m^3)
OSHA PEL†: TWA 2 ppm (5 mg/m^3)

Measurement Methods (see Table 1):
NIOSH 7903
OSHA ID165SG

Physical Description: Colorless, yellow, or red, fuming liquid with an acrid, suffocating odor.
[**Note:** Often used in an aqueous solution. Fuming nitric acid is concentrated nitric acid that contains dissolved nitrogen dioxide.]

Chemical & Physical Properties:
MW: 63.0
BP: 181°F
Sol: Miscible
Fl.P: NA
IP: 11.95 eV
Sp.Gr(77°F): 1.50
VP: 48 mmHg
FRZ: -44°F
UEL: NA
LEL: NA
Noncombustible Liquid, but increases the flammability of combustible materials.

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: N.R.
Provide: Eyewash (pH<2.5)
Quick drench (pH<2.5)

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
25 ppm: Sa:Cf*/CcrFS¿/GmFS¿/ScbaF/SaF
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFS¿/ScbaE

Incompatibilities and Reactivities: Combustible materials, metallic powders, hydrogen sulfide, carbides, alcohols
[**Note:** Reacts with water to produce heat. Corrosive to metals.]

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Ing, Con
SY: Irrit eyes, skin, muc memb; delayed pulm edema, pneu, bron; dental erosion
TO: Eyes, skin, resp sys, teeth

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

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NITRIC ACID, OTHER THAN RED FUMING

Chemical Identifiers | Hazards | Response Recommendations | Physical Properties | Regulatory Information | Alternate Chemical Names

Chemical Identifiers

What is this information?

CAS Number
7697-37-2

UN/NA Number
2031

DOT Hazard Label
Corrosive
Oxidizer

USCG CHRIS Code
none

NIOSH Pocket Guide
Nitric acid

International Chem Safety Card
NITRIC ACID

NFPA 704

Diamond	Hazard	Value	Description
	Health	4	Can be lethal.
	Flammability	0	Will not burn under typical fire conditions.
	Instability	0	Normally stable, even under fire conditions.
	Special	OX	Possesses oxidizing properties.

(NFPA, 2010)

Hazards

What is this information?

Reactivity Alerts

- Strong Oxidizing Agent
- Known Catalytic Activity
- Water-Reactive

Air & Water Reactions

Fumes in air. Fully soluble in water with the release of heat. Reacts violently with water with the production of heat, fumes, and spattering.

Fire Hazard

Excerpt from ERG Guide 157 [Substances - Toxic and/or Corrosive (Non-Combustible / Water-Sensitive)]:

Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes. For UN1796, UN1826, UN2031 at high concentrations and for UN2032, these may act as oxidizers, also consult ERG Guide 140. Vapors may accumulate in confined areas (basement, tanks, hopper/tank cars, etc.). Substance may react with water (some violently), releasing corrosive and/or toxic gases and runoff. Contact with metals may evolve flammable hydrogen gas. Containers may explode when heated or if contaminated with water. (ERG, 2016)

Health Hazard

Excerpt from ERG Guide 157 [Substances - Toxic and/or Corrosive (Non-Combustible / Water-Sensitive)]:

TOXIC; inhalation, ingestion or contact (skin, eyes) with vapors, dusts or substance may cause severe injury, burns or death. Reaction with water or moist air may release toxic, corrosive or flammable gases. Reaction with water may generate much heat that will increase the concentration of fumes in the air. Fire will produce irritating, corrosive and/or toxic gases. Runoff from fire control or dilution water may be corrosive and/or toxic and cause pollution. (ERG, 2016)

Reactivity Profile

NITRIC ACID ignites upon contact with alcohols, amines, ammonia, beryllium alkyls, boranes, dicyanogen, hydrazines, hydrocarbons, hydrogen, nitroalkanes, powdered metals, silanes, or thiols [Bretherick 1979. p.174]. The reaction of finely divided antimony and nitric acid can be violent [Pascal 10:504. 1931-34]. Bromine pentafluoride reacts violently with strong nitric acid and strong sulfuric acid [Meller 2. Supp. 1:172. 1956]. Fuming nitric acid reacts with hydrogen selenide with incandescence [Berichte 2:658]. Fuming nitric

react with water (some violently), releasing corrosive and/or toxic gases and runoff. Contact with metals may evolve flammable hydrogen gas. Containers may explode when heated or if contaminated with water. (ERG, 2016)

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Excerpt from ERG Guide 157 [Substances - Toxic and/or Corrosive (Non-Combustible / Water-Sensitive)]:

TOXIC; inhalation, ingestion or contact (skin, eyes) with vapors, dusts or substance may cause severe injury, burns or death. Reaction with water or moist air may release toxic, corrosive or flammable gases. Reaction with water may generate much heat that will increase the concentration of fumes in the air. Fire will produce irritating, corrosive and/or toxic gases. Runoff from fire control or dilution water may be corrosive and/or toxic and cause pollution. (ERG, 2016)

Reactivity Profile

NITRIC ACID ignites upon contact with alcohols, amines, ammonia, beryllium alkyls, boranes, dicyanogen, hydrazines, hydrocarbons, hydrogen, nitroalkanes, powdered metals, silanes, or thiols [Bretherick 1979. p.174]. The reaction of finely divided antimony and nitric acid can be violent [Pascal 10:504. 1931-34]. Bromine pentafluoride reacts violently with strong nitric acid and strong sulfuric acid [Mellor 2, Supp. 1:172. 1956]. Fuming nitric acid reacts with hydrogen selenide with incandescence [Berichte 3:658]. Fuming nitric acid reacts with hydrogen sulfide with incandescence [Berichte 3:658]. A mixture of finely divided magnesium and nitric acid is explosive [Pieters 1957. p. 28]. Nitric acid oxidizes magnesium phosphide with incandescence [Mellor 8:842. 1946-47]. Experiments show that mixtures of over 50% nitric acid by weight in acetic anhydride may act as detonating explosives [BCISC 42:2. 1971]. An etching agent of equal portions of acetone, nitric acid, and 75% acetic acid exploded four hours after it was prepared and placed in a closed bottle. This is similar to a formulation for the preparation of tetranitromethane a sensitive explosive [Chem. Eng. News 38: 56. 1960]. Phosphine is violently decomposed by concentrated nitric acid, and flame is produced. Warm fuming nitric acid, dropped in a container of phosphine gas produces an explosion [Edin. Roy. Soc. 13:88. 1835]. An explosion occurs when nitric acid is brought into contact with phosphorus trichloride [Comp. Rend. 28:86]. The exothermic nitration of phthalic acid or phthalic anhydride by fuming nitric acid-sulfuric acid may give mixtures of the potentially explosive phthaloyl nitrates or nitrites or their nitro derivatives [Chem. & Ind. 20:790. 1972]. The reaction of sodium azide and strong nitric acid is energetic [Mellor 8, Supp 2:315. 1967]. Nitric acid can react with uranium with explosive violence [Katz and Rabinowitch 1951]. Reacts violently with water with the production of heat, fumes, and spattering.

Belongs to the Following Reactive Group(s)

- Acids, Strong Oxidizing

Potentially Incompatible Absorbents

Use caution: Liquids with this reactive group classification have been known to react with the absorbents listed below. More info about absorbents, including situations to watch out for...

- Cellulose-Based Absorbents
- Expanded Polymeric Absorbents

CAMEO Chemicals

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Search Chemicals
New Search
Modify Search
Search Results

MyChemicals
chemicals: 0
View MyChemicals
Predict Reactivity

Reactive Group Datasheet

Add to MyChemicals | Print Friendly Page

Acids, Strong Oxidizing

What are reactive groups?

Reactive groups are categories of chemicals that typically react in similar ways because they are similar in their chemical structure. Each substance with a chemical datasheet has been assigned to one or more reactive groups, and CAMEO Chemicals uses the reactive group assignments to make its reactivity predictions. More info about reactivity predictions...

If you can't find a chemical in the database--but you know what reactive group it belongs in--you can add the reactive group to MyChemicals instead in order to see the reactivity predictions.

There are 52 chemical datasheets assigned to this reactive group.

Description

Flammability

Materials in this group are generally nonflammable. They may accelerate the combustion of other materials by providing oxygen to the combustion site, that is, by serving as oxidizing agents.

Reactivity

Materials in this group are generally soluble in water with the release of hydrogen ions. The resulting solutions have pHs of 1 or near 1. Materials in this group react with chemical bases (for example: amines and inorganic hydroxides) to form salts. These neutralization reactions occur as the base accepts hydrogen ions that the acid donates. Neutralizations can generate dangerously large amounts of heat in small spaces. The dissolution of acids in water or the dilution of their concentrated solutions with water may generate significant heat. The addition of water to acids often generates sufficient heat in the small region of mixing to boil some of the water explosively. The resulting "bumping" spatters acid widely. These materials have significant ability as oxidizing agents, but that ability varies (for example, nitric acid is a stronger oxidizing agent than sulfuric acid and most

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Toxicity

Corrosive to tissue. Acid fumes irritate sensitive tissues (such as the eyes and respiratory system) especially severely.

Other Characteristics

Acids have a sour taste; they turn blue litmus red. Strong acids completely dissociate in water to H+ ions and extremely weak conjugate base anions. Oxidizing acids dissociate to give anions that do act as oxidants. They possess a pKa value below -2, or a pH value less than 2.

Examples

Sulfuric acid, nitric acid, perchloric acid, chlorosulfonic acid, chloric acid, nitrosulfuric acid, selenic acid.

Reactivity Documentation

Physical Properties

What is this information?

Chemical Formula: HNO3

Flash Point: data unavailable

Lower Explosive Limit (LEL): data unavailable

Upper Explosive Limit (UEL): data unavailable

Autoignition Temperature: data unavailable

Melting Point: -44 ° F (NIOSH, 2016)

Vapor Pressure: 48 mm Hg (NIOSH, 2016)

Vapor Density (Relative to Air): data unavailable

Specific Gravity: 1.5 at 77 ° F (NIOSH, 2016)

Boiling Point: 181 ° F at 760 mm Hg (NIOSH, 2016)

Molecular Weight: 63 (NIOSH, 2016)

Water Solubility: Miscible (NIOSH, 2016)

Ionization Potential: 11.95 eV (NIOSH, 2016)

IDLH: 25 ppm (NIOSH, 2016)

CAMEO Chemicals

File Navigate Sharing Help

ALOHA CAMEO

NITRIC ACID, OTHER THAN RED FUMI... Help

AEGLs (Acute Exposure Guideline Levels)

Final AEGLs for Nitric Acid (7697-37-2)

Exposure Period	AEGL-1	AEGL-2	AEGL-3
10 minutes	0.16 ppm	43 ppm	170 ppm
30 minutes	0.16 ppm	30 ppm	120 ppm
60 minutes	0.16 ppm	24 ppm	92 ppm
4 hours	0.16 ppm	6 ppm	23 ppm
8 hours	0.16 ppm	3 ppm	11 ppm

(NAC/NRC, 2017)

ERPGs (Emergency Response Planning Guidelines)

Chemical	ERPG-1	ERPG-2	ERPG-3
Nitric Acid WFNA (7697-37-2)	1 ppm ✪	10 ppm	78 ppm

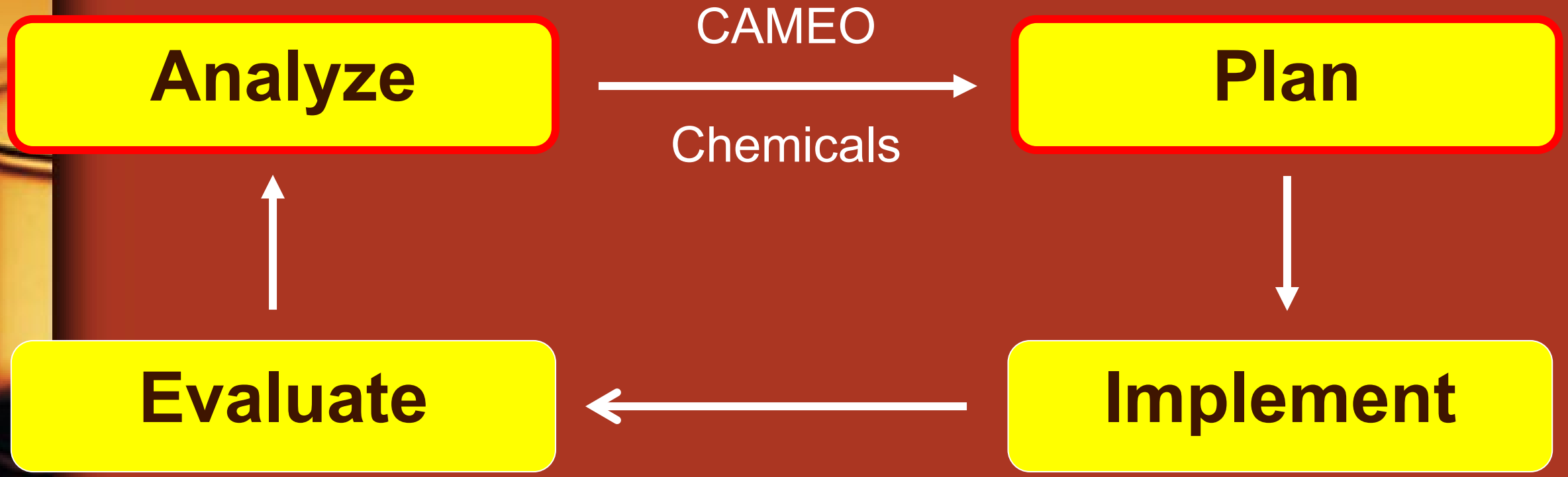
✪ indicates that odor should be detectable near ERPG-1.
(AIHA, 2016)

PACs (Protective Action Criteria)

Chemical	PAC-1	PAC-2	PAC-3
Nitric acid (7697-37-2)	0.16 ppm	24 ppm	92 ppm

(DOE, 2016)

Advanced Chemical Risk Assessment and Analysis
38.3 Planning the Response



Documentation

Advanced Chemical Risk Assessment and Analysis Documentation

T. O. Murdock and V. Pellegrin

Section 1: Identification	
Chemical name	
Chemical Abstracts Service Number	
UN ID Number (XXXX)	
DOT ERG Guide Number (XXX)	
DOT ERG initial evacuate in all directions	**75'** **150'** **330'** **other =**
DOT ERG initial downwind evacuation	

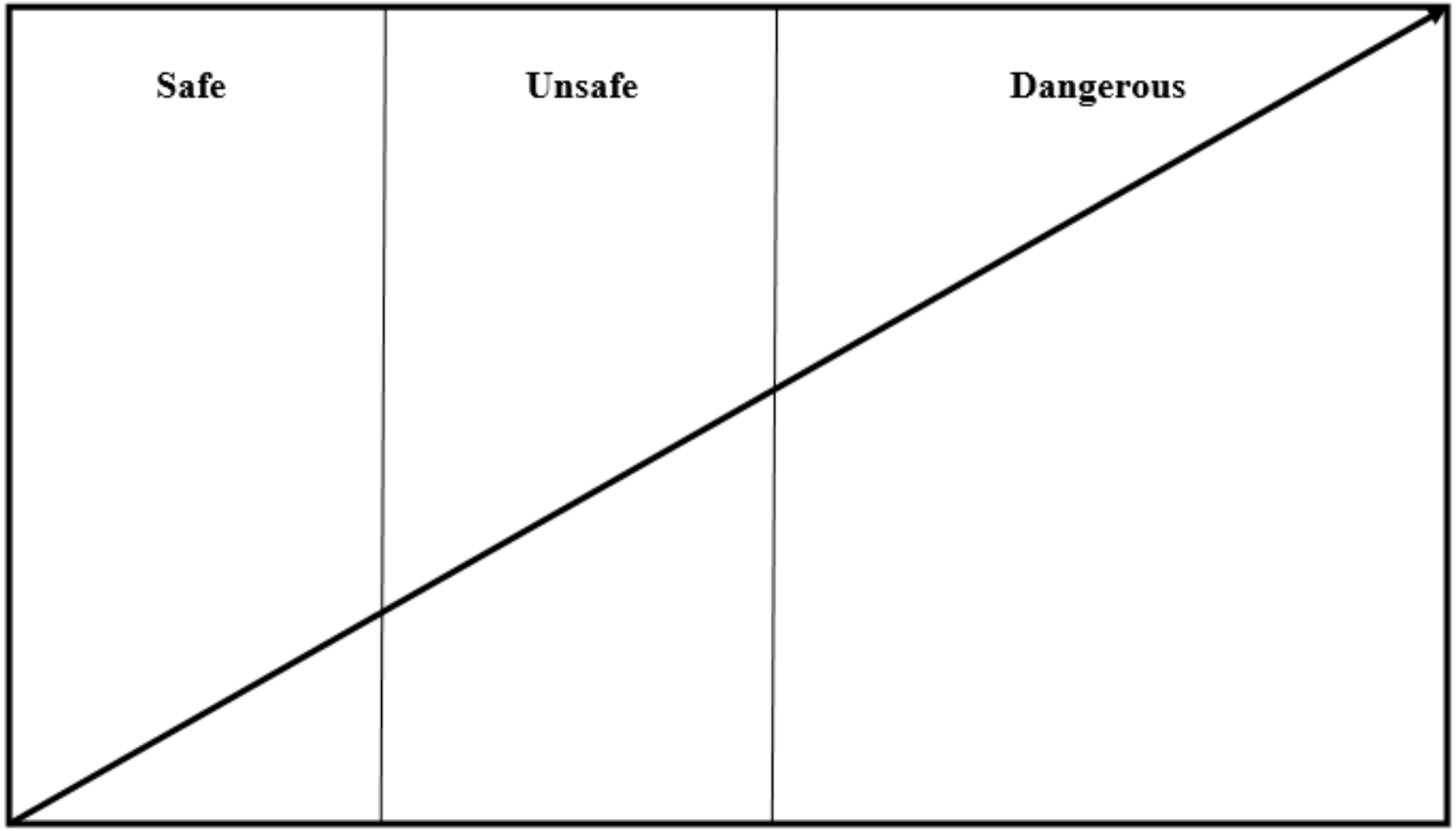
Section 2: Physical Properties (list resources)		
Physical State (at 70°)	Solid Liquid Gas	
Specific gravity (Sp. Gr.)		
Vapor density (VD) Relative Gas Density (RGasD)		$VD_{(calc)}$ = MW/29 =
Boiling point (BP)		
Melting point (FRZ or MP)		
Vapor pressure (VP)		
Water solubility (Sol)		
Section 3: Chemical Properties (list resources)		

Section 1: Identification	
Chemical name	70% Nitric acid
Chemical Abstracts Service Number	7697-37-2
UN ID Number (XXXX)	2031
DOT ERG Guide Number (XXX)	157
DOT ERG initial evacuate in all directions	**75' 150' 330' other = 100'**
DOT ERG initial downwind evacuation	Red fuming sm. spill: 0.1 mile downwind

Section 2: Physical Properties (list resources)		
Physical State (at 70°)	Solid Liquid Gas	
Specific gravity (Sp. Gr.)	1.5 @ 77F	
Vapor density (VD) Relative Gas Density (RGasD)		$VD_{(calc)}$ = MW/29 = 2.17
Boiling point (BP)	181 F	
Melting point (FRZ or MP)	-44 F	
Vapor pressure (VP)	44 mm Hg @ 68 F	
Water solubility (Sol)	Miscible	
Section 3: Chemical Properties (list resources)		
Flash point (Fl. P.)	NA	
Lower explosive limit (LEL) Correction Factor (CF)	NA	
Upper explosive limit (UEL)	NA	
pH	1	
Ionization Potential (IP) Correction Factor (CF)	11.95 eV	

Section 4: Hazard Assessment (circle all hazards that apply)						
Flammable	Cryogenic	Radioactive	Corrosive	Etiological	Toxic	Reactive
Oxidizer	Explosive	Pressure	Mechanical	Electrical	Noise	Surfaces
Other hazard(s)						

Section 5: Poison Line (Mike Callan) **CHEMICAL: ___Nitric acid_____**



PAC-1= 0.16 ppm
PEL= 2 ppm

PAC-2= 24 ppm
IDLH = 25 ppm

PAC-3= 92 ppm
LEL (ppm) = NA

Section 6: General Hazardous Materials Behavior Model (GEBMO)*

(*Adapted from Ludwig Benner's Hazardous Materials Emergencies, copyright 1978)
Highlight or circle the predicted sequence of events based on observed stressors on the container.

Event Sequence					
Stress	**Breach**	**Release**	**Engulf**	**Contact**	**Harm**
Identify stress	Predict breach	Predict release	Predict dispersion pattern	Predict length of exposure	Predict harm
Thermal Mechanical Chemical	Disintegration Runaway linear cracking Closures open up Punctures Splits or Tears	Detonation Violent rupture Rapid relief Spill or leak	Hemisphere Cloud Plume Cone Stream Pool Irregular	Short term Medium term Long term	**PHYSICAL** Thermal Mechanical **HEALTH** Poisonous Corrosive Asphyxiation Radiation Etiological

Section 7: NFPA 472, Chapter 21.2.3 to 21.2.6 requires that an advanced chemical risk assessment and analysis be conducted to categorize chemicals by chemical structure and functional and/or reactive groups and explain the significance in the analysis process. CAMEO Chemicals defines reactive groups as categories of chemicals that typically react in similar ways because they are similar in their chemical structure. Each substance with a chemical datasheet has been assigned to one or more reactive groups, and CAMEO Chemicals uses the reactive group assignments to assess the risk of exposure to **Flammability**, **Reactivity**, **Toxicity** and to make its reactivity predictions.

To access the Reactive Group datasheet in CAMEO Chemicals, scroll down to the **Hazards** section. Near the end of this section under **Belongs to the Following Reactive Group(s)**, find the list of the reactive groups to which the chemical belongs. Click on the highlighted reactive groups for additional information. Print, summarize or copy and paste the CAMEO Chemicals information in the following table.

Flammability
Materials in this group are generally nonflammable. They may accelerate the combustion of other materials by providing oxygen to the combustion site, that is, by serving as oxidizing agents.
Reactivity
Materials in this group are generally soluble in water with the release of hydrogen ions. The resulting solutions have pHs of 1 or near 1. Materials in this group react with chemical bases (for example: amines and inorganic hydroxides) to form salts. These neutralization reactions occur as the base accepts hydrogen ions that the acid donates. Neutralizations can generate dangerously large amounts of heat in small spaces. The dissolution of acids in water or the dilution of their concentrated solutions with water may generate significant heat. The addition of water to acids often generates sufficient heat in the small region of mixing to boil some of the water explosively. The resulting "bumping" spatters acid widely. These materials have significant ability as oxidizing agents, but that ability varies (for example, nitric acid is a stronger oxidizing agent than sulfuric acid and most sulfonic acids). They can react with active metals, including iron and aluminum, and also many less active metals, to dissolve the metal and liberate hydrogen and/or toxic gases. The subsequent stability of the corrosion products (possibly nitrates) should be considered. Like other acids, materials in this group can initiate polymerization in certain classes of organic compounds. Their reactions with cyanide salts and compounds release gaseous hydrogen cyanide. Flammable and/or toxic gases are also often generated by their reactions with dithiocarbamates, isocyanates, mercaptans, nitrides, nitriles, sulfides, and weak or strong reducing agents. Additional gas-generating reactions occur with sulfites, nitrites, thiosulfates (to give H2S and SO3), dithionites (SO2), and even carbonates: the carbon dioxide gas from the last is non-toxic but the heat and spattering from the reaction can be troublesome. Acids often catalyze (increase the rate of) chemical reactions.
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Corrosive to tissue. Acid fumes irritate sensitive tissues (such as the eyes and respiratory system) especially severely.
Other characteristics
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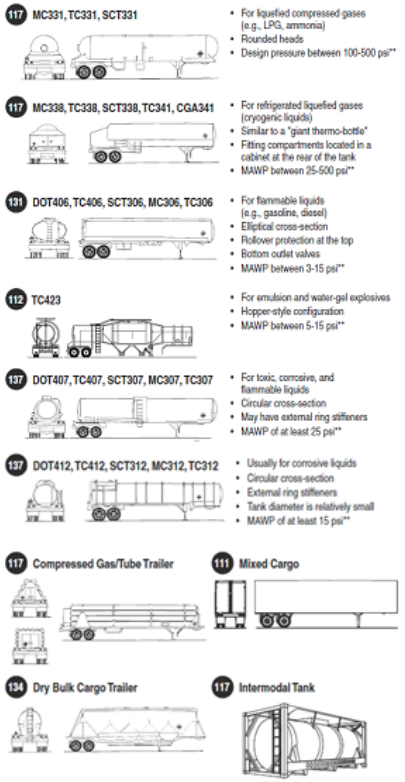
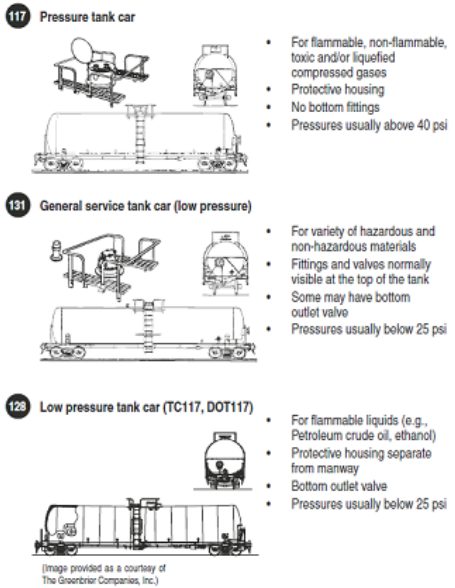
Examples
Sulfuric acid, nitric acid, perchloric acid, chlorosulfonic acid, chloric acid, nitrosulfuric acid, selenic acid.

Section 8: Container Identification (circle appropriate trailer)

2016 DOT ERG Road Trailer Identification Chart



Section 9: 2016 DOT ERG Railcar Identification Chart



Section 10: Portable Containers (select all that apply, estimate volume in gallons)		
Drum	**Cylinder**	**Miscellaneous**
Steel	Liquefied compressed gas	Bag
Stainless steel	Compressed gas	Bottle/Jar
Plastic	Cryogenic	Carboy
Fiber	Other	Fiber box
Other	Other	Tote
Estimate volume	**4L (1 gallon)**	

Section 11: Fixed Container (select all that apply, estimate volume in gallons)			
Atmospheric Pressure	**Low Pressure**	**High Pressure**	**Ultra-high Pressure**
Fixed/cone roof	Dome	Horizontal	Tube bank
Floating roof	Bulk tank	Sphere	Reactor
Internal floater	Other	Reactor	Other
Retrofit floater	Other	Bulk tank	Other
Bulk tank	Other	Other	Other
Estimated volume			

Section 12: Health Hazard Summary (list resources)	
Route of Entry	**Signs and Symptoms**
Inhalation	Delayed pulmonary edema, bronchitis, pneumonitis
Absorption	Irritating to the eyes, skin and mucous membranes, dental erosion (NIOSH)
Injection	
Ingestion	

Section 13: Public Protective Action Criteria (circle best choices)		
Attribute	**Shelter**	**Evacuation**
Infiltration	Tight housing	Leaky housing
Plume direction	Short	Long
Time of day	Night	Day
Population density	High	Low
Road conditions	Poor	Good
Population mobility	Immobile	Mobile
Traffic flow	Constrained	Unconstrained
Public perception of shelter-in-place	Good	Poor
Toxicity (LD_{50}, LC_{50}, IDLH)	High	Low

Section 14: Decontamination Method and Solutions	
Dry (gases, vapors, high VP liquids, low tox compounds)	
Decontamination Solution	
Water soluble or miscible	Water
Insoluble or slightly soluble	Soap and water
Pathogens	bleach solution or 10:1 dilution of bleach solution
Acidic compounds (pH < 6)	5% sodium carbonate or 5% sodium bicarbonate solution
Basic compounds (pH > 8)	5% citric acid or 5% monosodium phosphate solution
Equipment only	Isopropanol, Acetone, Toluene
Other decontamination solution	
Assess decon efficacy by:	pH paper

Section 15: Entry Team Personal Protective Equipment		
Function	**Name**	**Chemical Protective Clothing (material breakthrough time – minutes)**
Entry Team 1		
Entry Team 2		
Back-up Team 1		
Back-up Team 2		

Section 16: Decontamination Stations and Personal Protective Equipment		
Station Number	**Decontamination Station (check all that apply)**	**PPE (suit material breakthrough time – minutes)**
1	**Tool drop**	Self decon
2	**Gross wash**	Self decon
3	**Scrub and Rinse**	
4	**Wash and Rinse**	
5	**Outer boot and glove removal**	
6	**Suit removal**	
7	**Respirator removal**	
8	**Medical evaluation**	

Section 17: Exposure Monitoring (select all applicable monitoring methods)	
Test	**Results/Observations (record background)**
Radiation	
20/20 Kit (biological)	
Explosive Kit	
pH (volatile)	Wet and dry pH paper
Flammable (% LEL)	
Hydrogen sulfide (ppm)	Negative cross sensitivity to nitrogen dioxide
Carbon monoxide (ppm)	
% Oxygen	
Chlorine (ppm)	
Ammonia (ppm)	
Other sensor	
Other sensor	
PID (ppm)	For nitrogen dioxide (IP = 9.75 eV) CF = 16
M8 Paper	
pH (non-volatile)	pH paper
Other test paper	
Other test paper	
Detector tube	
Detector tube	
Other	

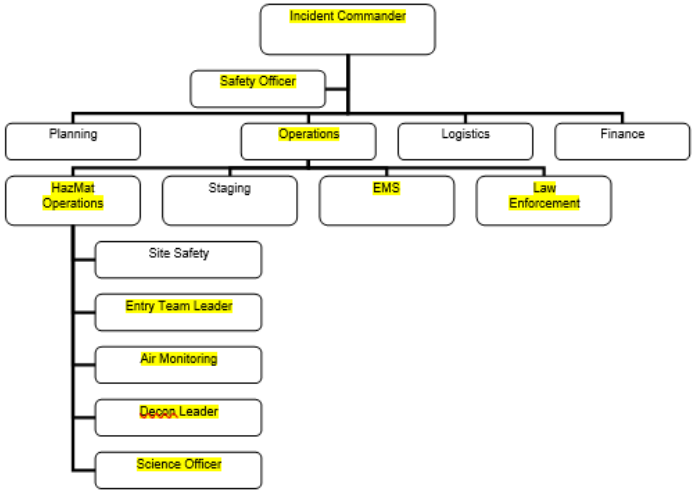
Section 18: Proposed Action Plan	
Absorption	
Ventilate	
Chlorine Kit Type	
Dike/Dam/Divert/Retention	
Dilution	
Vapor Dispersion/Vapor Suppression	
Foam (type)	
Neutralize (neutralization chemical)	Sodium carbonate, sodium bicarbonate, trisodium citrate
Plug and/or Patch	
Rescue	
Other	

Section 19: Weather Conditions			
Temperature	81 F	Barometric pressure	
Precipitation	none	Wind speed	8 mph
Humidity		Wind direction	NW
Visibility	unlimited	Other	

Section 20: Pre-Entry Medical Exam				
Name				
Pulse				
Blood pressure				
Respiratory rate				
Respiratory quality				
Temperature				

Section 21: Post-Entry Medical Exam				
Name				
Pulse				
Blood pressure				
Respiratory rate				
Respiratory quality				
Temperature				

Section 22: Site Control Personnel (Incident Management System)




+ ACID SPILL
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SPILL OF NITRIC ACID CLOSES HIGHWAY LANE
M-6 & I-96 IN KENT COUNTY
ACID SPILL
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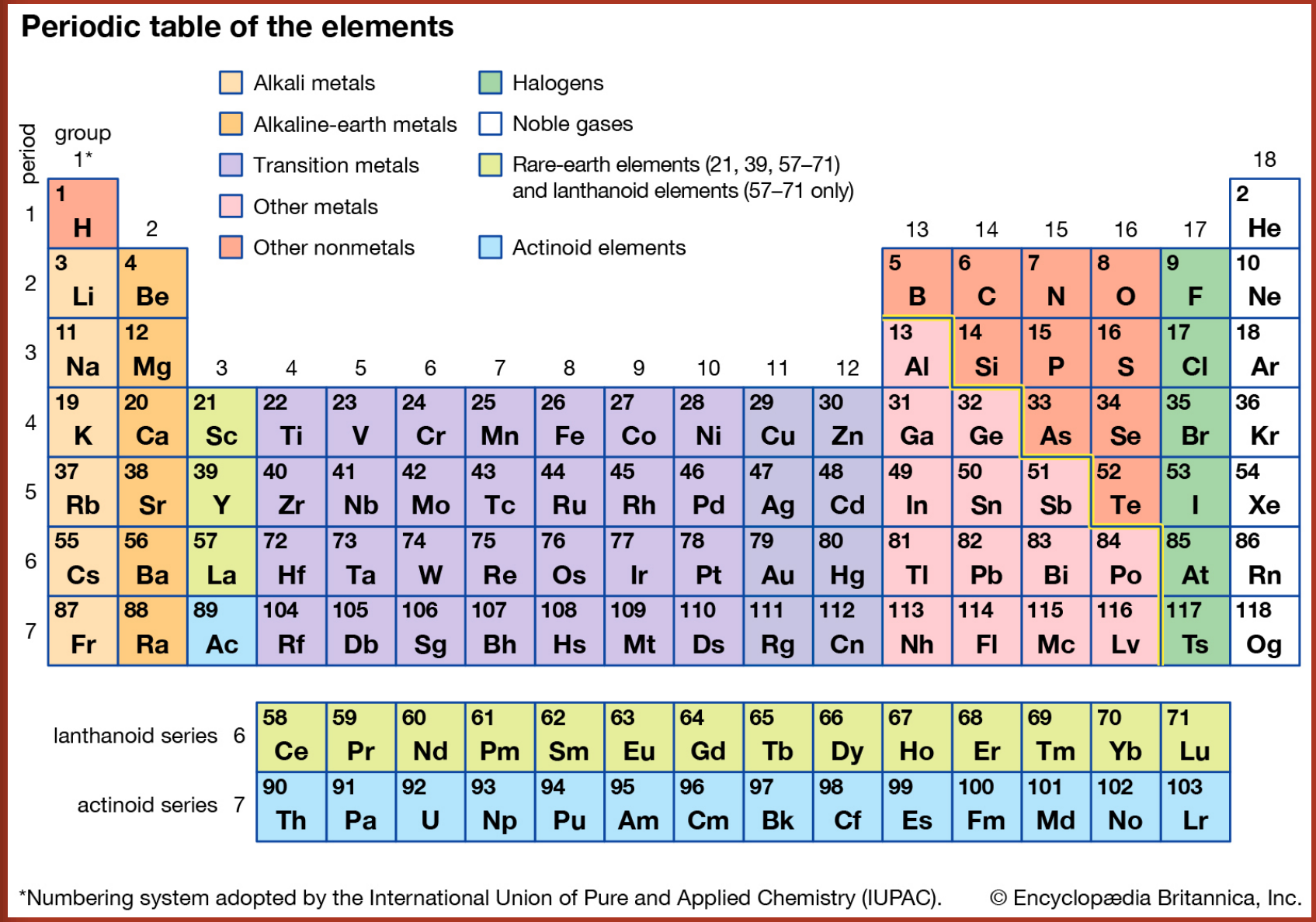
Hazardous Materials Technician

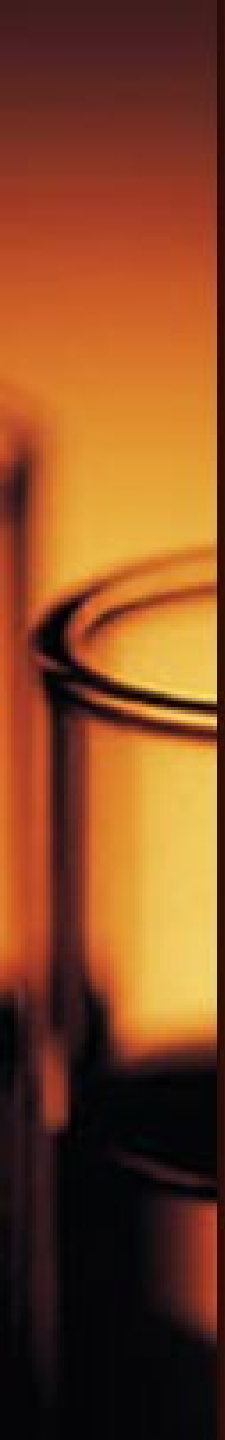
The *APIE* response model contains four basic problem-solving elements.

1. Analyze the incident
2. Plan the initial response
3. Implement the response
4. Evaluate progress

21.2.2 Impact of the periodic table on risk assessment process



HazMat IQ



What are some factors that influence risk at a hazmat scene?