What we’ll cover...

Determine how to properly store typical Hazmats (laboratories excluded)

Help reduce the most common findings
Who this will help...

- HAZMAT Department Representatives, who have completed NPS HMC&M Training Successfully
- Federal, State and others who inspect hazmat storage areas
What we won’t cover...
Have you ever felt......

...Like everyone is beating down your door to inspect you?
Types of Hazards

- There are two kinds of hazards according to OSHA 29 CFR 1910.1200, HAZCOM Standard
  - Health
  - Physical
- Dukes of Hazzard

- When we store materials, we are primarily concerned with PHYSICAL HAZARD
Physical hazard means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

(29 CFR 1910.1200)
HAZMAT is stored by compatible PHYSICAL HAZARDS to avoid possible mixing that may cause:

- toxic gases to be released
- property damage
- violent reactions
- fire or explosions
- personal injury or death
Most folks just don’t know how to determine the physical hazard
PHYSICAL HAZARDS
Typical Physical Hazards

- Flammable
- Combustibles
- Corrosives
- Oxidizers
- Organic Peroxides
- Various Compressed Gases

LEARN TO RECOGNIZE THE HAZARD!
Flammable and Combustibles
Flammables & Combustibles

• Most common hazard
• Several agencies define and classify flammable & combustible liquids
  ✓ OSHA
  ✓ NFPA
  ✓ DOT
  ✓ EPA
Flammability is determined by measuring a substance's flash point.
Flammables & Combustibles are divided by class

- You must know the class of a material because there are storage quantity restrictions depending on the class
- (quantities later...)
## Flammables & Combustibles

### Classifications

<table>
<thead>
<tr>
<th>Classification</th>
<th>Term</th>
<th>Flash Point and Boiling Point</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class IA</td>
<td>Flammable</td>
<td>Below 73°F</td>
<td>Ether, Methane</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boils below 100°F</td>
<td></td>
</tr>
<tr>
<td>Class IB</td>
<td>Flammable</td>
<td>Below 73°F</td>
<td>Acetone, MEK, Toluene, Benzene, Methanol, Methanol, Ethanol, Gasoline</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boils above 100°F</td>
<td></td>
</tr>
<tr>
<td>Class IC</td>
<td>Flammable</td>
<td>Above 73°F</td>
<td>Liquid Propane</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boils below 100°F</td>
<td></td>
</tr>
<tr>
<td>Class II</td>
<td>Combustible</td>
<td>At or above 100°F</td>
<td>Diesel, JP-8, Hydrazine</td>
</tr>
<tr>
<td>Class IIIA</td>
<td>Combustible</td>
<td>At or above 140°F</td>
<td>JP-5</td>
</tr>
<tr>
<td>Class IIIB</td>
<td>Combustible</td>
<td>At or above 200°F</td>
<td>Hydraulic Fluid, Lube Oil</td>
</tr>
</tbody>
</table>
Flammables & Combustibles

Bottom Line:

- Any material having a flash point below 140 °F
  ≈ FLAMMABLE

- At or above 140 °F - 200°F
  ≈ COMBUSTIBLE
Recent changes made by DOT, accepted by OSHA & EPA, identifies Flammable material as any material with a Flash Point of 140°F or below.
Fire Triangle or Tetrahedron

- Oxygen - sustain combustion
- Heat (ignition source) - raise material to ignition temp
- Fuel or Combustible Material

≈ FIRE
(Known as a Chemical Reaction)
It’s the vapors stupid...it’s the vapors!
Corrosives
A corrosive material is a highly reactive substance that causes obvious damage to living tissue. Corrosives act either directly, by chemically destroying the part (oxidation), or indirectly by causing inflammation.

(29 CFR 1910.1200 Appendix A)
Both ends of the pH scale are Corrosive...

...but high and low pH’s are INCOMPATIBLE

also called Alkaline or Caustic
Corrosives

Gang Colors

You can look at their colors and know what they are...
...Not so with CORROSIVES!

Both acids and alkalines have the same Corrosive Label

You must know what type of Corrosive it is BEFORE storing!

Just because they have the same label does not mean they belong to the same Gang!
Typical Corrosives

BASE + ACID
Corrosive Liquid, Acidic, Inorganic, N.O.S. (contains chromic acid, hydrofluoric acid)
Oxidizers
Oxidizers are compounds which are capable of reacting with and oxidizing other materials (i.e., giving off oxygen).

Source: http://safety.science.tamu.edu/oxidizers.html
Oxidizers

- The primary hazard lies in their ability to act as an oxygen source, and thus to readily stimulate the combustion of organic materials.
Oxidizers

Oxidizer Precautions

- Caution – don’t mix with organics
- Segregate from flammables and combustibles
- Signage on locker
### Classification System for Oxidizing Materials

**Class 4**
- An oxidizing material that can undergo an explosive reaction when catalyzed or exposed to heat, shock or friction.
- Hydrogen Peroxide (>91% concentration)
- Ammonium Perchlorate

**Class 3**
- An oxidizing material that will cause a severe increase in the burning rate of combustible material with which it comes in contact or will undergo vigorous self-sustained decomposition when catalyzed or exposed to heat.
- Calcium Hypochlorite (>51% by weight)

**Class 2**
- An oxidizing material that will moderately increase the burning rate or which may cause spontaneous ignition of combustible material with which it comes in contact.
- Chromium Trioxide (Chromic acid)
- Potassium Permanganate

**Class 1**
- An oxidizing material whose primary hazard is that it may increase the burning rate of combustible material with which it comes in contact.
- Nitric Acid <70%
- Strontium Chlorate
Organic Peroxides
An organic peroxide is any organic (carbon-containing) compound having two oxygen atoms joined together (-O-O-). This chemical group is called a "peroxy" group.

Organic peroxides can be severe fire and explosion hazards.

- May also be toxic and corrosive
- Strong Oxidizing agents

Source: http://www.ccohs.ca/oshanswers/chemicals/organic/organic_peroxide.html
Organic Peroxides

- Primary hazard is that these hazmats have two of the three sides of the fire triangle: fuel (carbon) and $O_2$ in the same compound.

- Only need slight heat, friction, mechanical shock or contamination with incompatible materials to burn.

- Potential to form explosive peroxides if safe storage times are exceeded or if stored improperly.
Organic Peroxides

- Most common used by the Air Force: Methyl Ethyl Ketone Peroxide (MEKP)
  - Keep cool
  - Do not extend shelf life – dispose of when expired
  - Do Not Over Order
  - Disposal may be expensive
  - Look for alternatives
Compressed Gas
Compressed Gas

• Classifications
  • Flammable
  • Non-Flammable
  • Oxygen
  • Poison

• Types
  • Liquefied
  • Dissolved
  • Cryogenic

Compressed Gas Association is at http://www.cganet.com

- Available on-line
- NOT Free
Compressed Gas

- Just because a gas is non-flammable does not mean it is not hazardous
  - Nitrogen
  - Argon
  - Helium
  - Carbon dioxide
  - Liquid carbon dioxide
Oxygen

- Oxygen is an oxidizer!
  - Will accelerate burning of ignited materials
  - Will even make some materials burn violently in an oxygen-enriched atmosphere even if they do not under normal conditions

- Keep combustibles and ignition sources away from areas where oxygen is used or stored.
Compressed air is a potentially deadly non-flammable gas because:

- Under pressure it supports and will accelerate burning
- As little as 10 pounds per square inch (psi) of compressed air entering a cut or body opening can cause death
- NOTE: Substituting pure oxygen for compressed air in supplied-air respirators can cause explosions
Compressed Gas

Flammable Gas

- Highly flammable when mixed with air. Just a spark...
  - Hydrogen
  - Propane
  - Butane
  - Acetylene
Compressed Gas

Handling & Storage

- Marked with a color-coded, diamond-shaped label and a written warning label which includes the material's name, hazards and safety precautions

- Cylinders should be stored on end on a smooth floor. All cylinders should be chained or otherwise fastened firmly against a wall, post, or other solid object
Handling & Storage

- Empty cylinders must be stored apart from full cylinders.
- Group cylinders according to their hazard classification.
- Store fuel-gas cylinders at least 20 feet away from oxidizers.
- Storage should be set up away from heavy traffic.
- Never leave cylinders outside in direct sunlight or near other sources of heat.
Compressed Gas

Transporting/moving cylinders

Use a special dolly when moving cylinders that does not allow excessive movement, sudden or violent contacts to help prevent injury to yourself or damage to the cylinder.
Compressed Gas

Transporting/moving cylinders

- For short distance moving, a cylinder may be rolled on its bottom edge, but never dragged
- Cylinders should never be dropped or permitted to strike one another

NOTE: Do not use a forklift to move cylinders

Picture from www.slosipe.org/TRAIN/Mod33/pg6.htm
Compressed Gas

Valves & Caps

• Never force valve connections
• Always open a valve slowly and point it away from yourself and others
• NEVER use the valve or cover to move or lift the cylinder
• Check that all valves are closed before moving a cylinder
• Protective caps must be kept on valves when not in use
Compressed Gas

LP Gas Tanks (NFPA 58, page 58)

Public-Frequented Buildings:
- Max 200 lbs stored in one location

Non Public-Frequented Buildings:
- Max 735 lbs stored in one location
- 300 ft separation of storage areas on same floor

Outdoor Storage:
- At least 5 ft from any doorway or opening in a building frequented by the public with two means of egress
- At least 10 ft from any doorway or opening in a building or sections of a building with only one means of egress
- At least 20 ft from any vehicle service station fuel dispenser
Compressed Gas

Small Compressed Gas Containers

Do not store small compressed gas bottles in flammable lockers with other flammables


article by Dan Dresser, HQ AFSPC/CEVC

Store flammable aerosol cans on a dedicated shelf
So How do I determine the Physical Hazard of a material?
First: Read the Label

OSHA requires labels to communicate “appropriate hazard warnings”
First: Read the Label

What if the hazard isn’t on the label?
Second: Read the MSDS

- MSDSs unfortunately do not have a section that clearly states the Physical Hazard
- Dept. HM Reps. must be able to INTERPRET the data!
Interpreting MSDSs

- Fire Section
  - Flash Point
- Physical Properties Section
  - pH
- Handling and Storage
- Stability
  - Incompatibles
What is the Flash Point?

FLASH POINT (method): 435 deg F (COC)

FLAMMABLE LIMITS
LOWER EXPLOSION LIMIT: 0.9 %
UPPER EXPLOSION LIMIT: 7.0 %
FLAMMABILITY CLASS: None

EXTINGUISHING MEDIA: Foam, Dry Chemical, Carbon Dioxide (Fog)
### SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odor, Color, Grade</td>
<td>Clear viscous liquid, water white to pale straw color. Liquid</td>
</tr>
<tr>
<td>General Physical Form</td>
<td>Liquid</td>
</tr>
<tr>
<td>Autoignition temperature</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Flash Point</td>
<td>-6 °C [Test Method: Closed Cup]</td>
</tr>
<tr>
<td>Flammable Limits - LEL</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Flammable Limits - UEL</td>
<td>No Data Available</td>
</tr>
<tr>
<td>Boiling point</td>
<td>76 °C</td>
</tr>
<tr>
<td>Density</td>
<td>1.0 g/ml</td>
</tr>
<tr>
<td>Vapor Density</td>
<td>3.1 [Ref Std: AIR=1]</td>
</tr>
<tr>
<td>Vapor Pressure</td>
<td>73 mmHg [@ 20 °C]</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.0 [Ref Std: WATER=1]</td>
</tr>
<tr>
<td>pH</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Melting point</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

### Section IX - Physical and Chemical Properties:

- **pH:** 11.85 - 11.95
- **Specific Gravity:** 1.014 @ 25 °C
- **Solubility in Water:** 100%
- **Boiling Point:** 208°F
- **Appearance and Odor:** Pale yellow/Clear liquid, faint odor
- **Freezing Point:** 30°F (-1.1 °C)

### Section X - Stability and Reactivity:

- **Physical Hazards:** None suspected, identified or known.
- **Stability Status:** Stable
- **Hazardous Polymerization:** Will not occur
- **Physical Hazards:** None identified
- **Incompatibility:** Strong Acids; reactive metals; electrically energized equipment; any materials reactive with water.

Remember alkalines do not mix with acids!
Third: Other Markings HMIS® vs. NFPA

HMIS®

- National Paint and Coatings Association (NPCA)
- HMIS® is a registered mark of the NPCA
- HMIS® III changes NFPA
- National Fire Protection Association

HMIS® attempts to convey full health warning information to all employees while NFPA is meant primarily for fire fighters and other emergency responders.
NFPA & HMIS® Labeling

- Not found on all MSDSs
- Not a definitive source for the Physical Hazard...but still a clue

- HMIS® Label
- NFPA Label
Change from Protective Equipment to Physical Hazard
Physical Hazard
NFPA & HMIS Info on MSDSs

No consistent display of info
**Chemical Name:** Inorganic acids in water

**Product Use:** Tile and vinyl cleaner for pool and spa surfaces.

<table>
<thead>
<tr>
<th>Hazard Rating</th>
<th>Designation</th>
<th>Health</th>
<th>Fire</th>
<th>Reactivity</th>
<th>Personal Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Extreme</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>D</td>
</tr>
<tr>
<td>3</td>
<td>High</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Slight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Section II - Hazardous Ingredients**

<table>
<thead>
<tr>
<th>Material</th>
<th>% By Weight</th>
<th>CAS Nr</th>
<th>Exposure Limits</th>
<th>LD_{50} (Oral-Rat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfuric acid</td>
<td>15 – 25</td>
<td>7664-93-9</td>
<td>1 mg/m³</td>
<td>2218 mg/Kg</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>15 – 25</td>
<td>7647-01-0</td>
<td>5 ppm</td>
<td>900 mg/Kg</td>
</tr>
<tr>
<td>Phosphoric acid</td>
<td>7 - 15</td>
<td>7664382</td>
<td>3 mg/m³</td>
<td>1530 mg/Kg</td>
</tr>
</tbody>
</table>
Who you gonna call?

When you just need a little help or reassurance about a decision on how to store or handle HAZMATs

CALL YOUR DEPARTMENT HAZMAT REP OR THE NPS HMC&M
HMC&M Team

- Department HM Managers = 19 Trained and Competent HM Managers at NPS
- NPS HMC&M Program Manager/Coord.
- Environmental HW Manager
- Fire and Emergency Services
FLAMMABLE STORAGE LOCKERS
Flammable Storage Cabinets

2nd Most Findings
Cabinet & Material Limits

- Not more than 120 Gallons of Class I (A, B, or C), Class II, and Class IIIA liquids may be stored in a storage cabinet.

- The combined total of Class I (A, B, or C) and Class II liquids may not exceed 60 gallons per storage cabinet.
  - Increased number of smaller cabinets can be used but you may not exceed the gallons specified.

- Not more than three such cabinets (120 gallons each) may be located in a single fire area except in an industrial area.
Cabinets will be labeled with conspicuous lettering,

**FLAMMABLE**

**KEEP FIRE AWAY**

Wording is non-negotiable!
To Vent or not to Vent?

- If vented – vent to outdoors
- If not vented – leave bungs IN
- (inside storage lockers must have bungs IN)
Misc Locker Requirements

Construction requirements

• Door Must be Locked when not in use

• Retrofitting lockers
  - Must meet the specification requirements stated in AFOSH 91-501
  - Not recommended!

• 2 inch raised sill – Don’t Leave Shelf on bottom of locker
  - Common finding: Users leave bottom shelf on floor of locker negating the 2” raised sill

• Do NOT alter the locker by drilling holes such as to add additional security
RESOURCES
Incompatibility Charts

- Got One hanging on your wall?
- Great resource ....if you took it off the wall and actually used it!
Storage and Handling of Hazardous Materials

Joint regulation (AFJMAN 23-209) for storing hazardous materials. This manual contains technical know-how for storage of hazmats, intended for warehouse (HAZMART) personnel.

Excellent resource for understanding the physical hazards of hazmats and how to properly segregate them.
Chapter 22

FLAMMABLES AND COMBUSTIBLES

22.1. General Information. This chapter addresses key flammable and combustible liquids criteria, references other Air Force directives that cover specific aspects of flammable and combustible liquids storage, use, and handling, and implements pertinent portions of regulatory Occupational Safety and Health Administration (OSHA) Standard Title 29 Code of Federal Regulations (CFR) 1910.106, Flammable and
• 1910.110 - Storage and handling of liquefied petroleum gases
• 1910.111 - Storage and handling of anhydrous ammonia
• 1910.156 - Fuel handling and storage
• 1910.106 - Flammable and combustible materials
• 1910.176 - Handling materials – general
The Hazardous Chemical Data Manual is intended for use primarily by the On-Scene Coordinator (OSC) and by Regional Response Teams for devising, evaluating, and carrying out response plans. It includes a compatibility chart, a list of synonyms, and can be accessed at [http://www.chrismanual.com/Default.htm](http://www.chrismanual.com/Default.htm).
PICTURES
Housekeeping
Paper & Cardboard in Flam Cabinets
Be careful not to put a label over information on the container that makes it non-Hazcom compliant.
Open Tube – material spilling out
Improper Storage
Improper Cylinder Storage
Compressed Gas
Batteries in Food Frig
Leaking Packages - Outside
Sloppy – Poor Housekeeping
This isn’t Water!

Bottles says “DON’T DRINK” NEVER Ever Store HM in Food Containers! This includes Coffee Cans. No, Never, and No Again!
Incompatibles
Leaking Containers
Good Flammable Locker?
Good Job

Tag

Creative Labeling
Sloppy
Housekeeping
Batteries – poor storage
Mixed Corrosives
Shelf Life

June 1952!
Unlabeled Squirt Bottles
Mixed Storage
Indoor Storage
Indoor Storage
Unlabeled Containers
Consider the human element...
Meets regulation?
Things that make you go hmmmm...
Use storage you have...
Perfect?....
NOT
Cool!
Don’t forget Spill Prevention
Making the most of shelf life...
OMG!
ANY... BURNING... QUESTIONS?