SAND2008-6905P

Chemical SAFETY AND SECURITY TRAINING

Workshop

Kuala Lumpur, Malaysia

28-29 October 2008

SAND No. 2008-??
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,
for the United States Department of Energy's National Nuclear Security Administration
under contract DE-AC04-94AL85000.

Sandia National Laboratories

United States, Regulations, Recommendations, Standards and Guidelines

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1936 Walsh-Healy Act

The First US Safety Law

Required companies providing goods to the US government to provide a safe and health workplace

1970 Occupational Safety and Health Act

established OSHA and NIOSH to:

- **formulate work standards**
- **do safety research**

OSHA

NIOSH

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US Safety Related Regulations and Standards

- **OSHA-Occupational Safety and Health Administration**
- **EPA-Environmental Protection Agency**
- **DOT-Department of Transportation**
- **FDA-Food and Drug Administration**

US Safety Research and Recommendations

- **NIOSH-National Institute of Occupational Safety and Health**
- **NIH-National Institutes of Health**
- **CDC-Centers for Disease Control and Prevention**

NIOSH National Institute for Occupational Safety and Health

CDC Centers for Disease Control and Prevention

National Institutes of Health

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Chemical Safety and Security Training

Voluntary Industry Standards

- **ACGIH/TLV®-American Conference of Governmental Industrial Hygienists/Threshold Limit Values®**
- **NFPA-National Fire Protection Association**
- **ANSI-American National Standards Institute**

Voluntary Industry Standards: Continued

- CGA - Compressed Gas Association
- ASHRAE-American Society of Heating, Refrigeration, and Air Conditioning Engineers
- IME-Institute of Makers of Explosives
- ASME-American Society of Mechanical Engineers

Important OSHA Chemical Safety Regulations

OSHA General Industry Standard

29CFR1910

OSHA is part of DOL

29 = Department of Labor

CFR = Code of Federal Regulations

1910 = The General Industry Standard

General Duty Clause 5(a)(1)

States that employers "shall furnish to each of his employees … a place … free of recognized hazards … causing … or likely to cause death or serious physical harm"

OSHA Chemical Safety Regulations: Continued

29CFR1910.1904

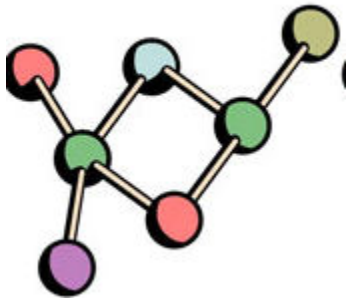
Recording and Reporting of Occupational Injuries and Illnesses

- **requires and specifies what must be reported, when, how, by whom and to whom**
- **also establishes confidentiality**

OSHA Chemical Safety Regulations: Continued

29CFR1910.1001-1048

suffix, .1001 establishes a specific standard



Specific Substance Standards

- **e.g., lead, asbestos, formaldehyde, specific carcinogens, benzene, arsenic, vinyl chloride, ethylene oxide**

OSHA Permissible Exposure Limits (PELs)

• asbestos	0.1 fiber/cm^3
• lead	0.05 mg/m^3
• formaldehyde	0.075 ppm
• benezine	1.0 ppm
• vinyl chloride	1.0 ppm
• ethylene oxide	<0.1 ppm
• arsenic	0.01 mg/m^3 (inorganic)
	0.5 mg/m3 (organic)

OSHA Chemical Safety Regulations: Continued

29CFR1910.1200

Hazard Communication Standard (1989)

– **evaluates hazards of chemicals and communicates information to workers by a hazard communication programs that includes labeling, material safety data sheets and training.**

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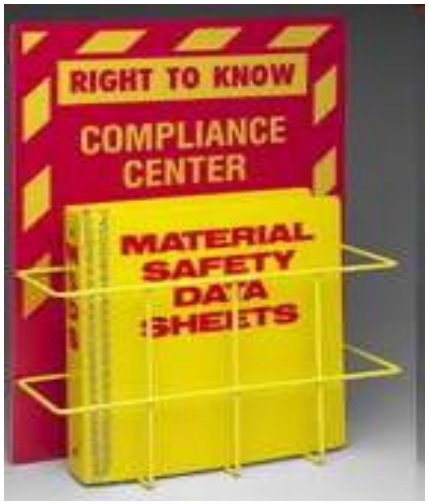
OSHA MSDSs

MSDS is described in the Hazard Communication Standard

- Content is specified ***but not*** the format.
- ***Therefore***, MSDS's may differ dramatically in appearance by manufacturer
- But they present the required data.



ANSI (GHS/REACH*) Standardized 16 Part MSDS Format

- Identification
- Hazard(s) identification
- Composition/information on ingredients
- First-aid measures
- Fire-fighting measures
- Accidental release measures
- Handling and storage
- Exposure controls/personal protection
- Physical and chemical properties
- Stability and reactivity
- Toxicological information
- Ecological information
- Disposal considerations
- Transport information
- Regulatory information
- Other information

(*More details in GHS/REACH presentation)

OSHA Chemical Safety Regulations: Continued

29CFR1910.1450

Occupational Exposure to Toxic Substances in Laboratories
(The Laboratory Standard, 1990)

- **specifies requirements needed to control exposure to chemicals in non-manufacturing and non-production laboratories**

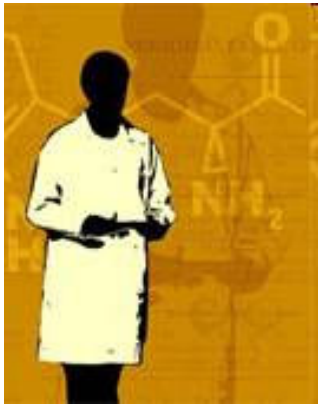
- **establishes need for Chemical Hygiene Officer and Chemical Hygiene Plan**

Definitions

- *Laboratory* **- a facility where small quantities of hazardous chemicals are used on a non-production basis**
- *Use-* **handling such chemicals as follows:**
  - **multiple chemical procedures or chemicals used**
  - **chemical manipulations can be performed by one person**
  - **procedures involved are not part of a production or manufacturing process**
  - **protective laboratory practices and equipment are available and used to minimize exposure**

Chemical Hygiene Officer

- an employee designated by the employer
- qualified by training and experience
- to provide technical guidance in development and implementation of the Chemical Hygiene Plan



Chemical Hygiene Plan

- Procedures/methods to:
  - protect employees
  - keep exposures below PEL/TLV
- Control measures
  - engineering control
    - selection, and use of lab hoods
  - PPE
- Chemical procurement
  - MSDS's
- Training
- Specify operations requiring approval
- SOP's as required
- Medical surveillance
- Waste management
- OSHA regulation appendix A should be considered
- Available to each employee
- Annual review and update

OSHA Chemical Safety Regulations: Continued

29CFR1910.1030

Occupational Exposure to Blood Borne Pathogens (1992)

– **controls exposure to potentially infectious material, can apply to biochemical and biomedical samples**

OSHA Chemical Safety Regulations: Continued

29CFR1910.120

Hazardous Waste Operations and Emergency Response (HAZWOPER, 1987)

- **regulates/controls potentially exposure of workers during clean-up of hazardous substances and waste**
- **requires health and safety plan that includes methods of worker protection**

Environmental Protection Agency (EPA) Chemical Safety Regulations

40CFR100

40 Pertains to the EPA

Clear Air Act (1963)

– **establishes criteria for control, emission and exposure to hazardous substances in the air**

EPA Chemical Safety Regulations: Continued

40CFR50

Clean Water Act (1972)

– **controls releases to water of high amounts of toxic substances, regulates water pollution to ensure safe standards for human exposure**

EPA Chemical Safety Regulations: Continued

40CFR240

Resource Conservation and Recovery Act (RCRA, 1976)

- **regulates disposal of hazardous and non-hazardous waste from the** *"cradle to the grave"*

RCRA Regulates and Defines Waste

- generation, transport, storage, treatment, disposal, tracking, record keeping and facilities

- conserving energy and natural resources, recycling, and reducing the amount of waste generated

- defines hazardous waste as:
  ignitable, corrosive, reactive, toxic

RCRA Waste Characteristics

- **Ignitability** - can create fires that are spontaneously combustible, or have a flash point < 60 ℃, e.g., waste oils, used solvents
- **Corrosivity** - acids or bases (pH </= 2, or >/= 12.5) capable of corroding metal containers, e.g., storage tanks, drums, and barrels, (battery acid)
- **Reactivity** - unstable under "normal" conditions; can cause explosions, toxic fumes, vapors when heated, compressed, or mixed with water, e.g., lithium-sulfur batteries and explosives
- **Toxicity** - harmful or fatal when ingested or absorbed (e.g., contain mercury, lead) or when land disposed, contaminated liquid may leach out and pollute ground water

EPA Chemical Safety Regulations: Continued

40CFR240-271

Comprehensive Environmental Response Compensation and Liability Act (CERLA, Superfund, 1980, Sara 1986)

- **established requirements for hazardous waste sites;**
- **provided for liability of persons responsible for releases of hazardous waste; and**
- **provided for cleanup when no responsible party could be identified.**

Department of Transportation (DOT)
Chemical Safety Regulations

49CFR173

General Requirement for Shipping and Packaging*

(*More details in Safe Chemical Transport Presentation)

DOT Chemical Safety Regulations: Continued

49CFR172

Hazardous Materials Table

- **includes chemical specific communication requirements, emergency response information**

DOT Chemical Safety Regulations: Continued

49CFR177

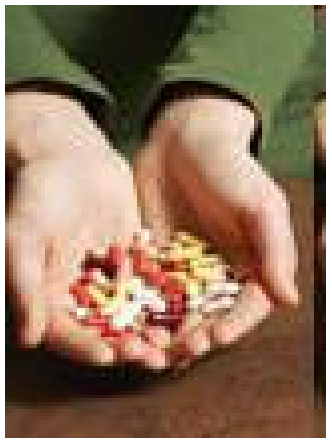
Requirements for Transport on Public Highways*

(*More details in Safe Chemical Transport Presentation)

Other US Chemical Safety Regulations e.g., Food & Drug Administration (FDA)

21CFR1300

Requirements for Controlled Substances
(restricted drugs)



- **e.g., heroin, pentobarbital, anabolic steroids , diazepam, chloral hydrate, hallucinogens, etc.**
- **lock & key, strict inventory control**

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Most Recent US Regulations

Department of Homeland Security (DHS):

Chemical Facility Anti-Terrorism Standards (CFATS, 2007)

- allows the DHS to regulate chemical installations (re: handout/CD)

European Union/United Nation Chemical Safety Regulations

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REACH

Registration, Evaluation, Authorisation of Chemicals

2007 EU regulation; replaces 40 existing acts to create a single system for all chemicals

- requires authorization to use, manufacture and import
- to track and manage chemical risks and provide safety information
- proposes to integrate REACH with GHS
- creates European Chemical Agency (ECHA, Helsinki, Finland

REACH

Life of the chemical from Cradle-to-the-Grave

Manufacturing

Importing

Marketing

Use

Waste stream

REACH

- Comprehensive legislation to ensure European authorities know and condone what chemicals are used as they enter the EU supply train
- Objective-is to protect human health and the environment by recognizing and classifying hazardous chemicals so they are handled safely
- REACH & GHS are not equivalent or optional but separate legislation with parallel requirements

REACH

- The responsibility for proving whether a chemical is hazardous or non-hazardous chemicals is on the manufacturer and supplier not the government
- The responsibility also includes documentation, tests, classification, risk exposure, labeling, safety data sheets
- ECHA will store the information in the International Uniform Chemical information Database (IUCLID)

REACH

Four Steps

1. Registration
2. Evaluation
3. Authorization
4. Restriction

ECHA maintains database

REACH: Registration

Importers and manufacturers of substances in quantities over 1 ton/yr must register their substance with ECHA

Registration began June 2007

December 1, 2010

>=1000 tons per year

- **carcinogenic, mutagenic, or reproductive toxin >= 1 ton per year**
- **substances classified as dangerous for aquatic environment >= 100 tons per year**

June 1, 2013

- **manufactured or imported at 100-1000 tons per year**

June 1, 2018

- **manufactured or imported at 1-100 tons per year**

REACH: Evaluation

Authorities will review registration and request further information or testing to determine the impact of the substance on human health and the environment

Decides next steps:

-- action for authorization

-- align classification & label

-- other action

REACH: Authorization

Decisions on what substances require an authorization or restriction are carried out for substances that pose the most concern, such as carcinogens and mutagens

Three steps:

- SVHC (Substances of Very High Concern)
  - carcinogenic, mutagenic and reprotoxic substances, persistent, bio-accumulative and toxic
- Prioritize
- Authorization provided

REACH: Restriction

- **Limit uses**
  - **Where no viable alternative exists, a research and development plan to derive a suitable alternative is developed**

- **Ban substance**
  - **where there is an unacceptable risk to human health and the environment.**

REACH: Concern

A potential concern may be creating country specific safety data sheets and labels that are compatible with the GHS proposal

REACH: Resources

About REACH:
http://reach.jrc.it/about_reach_en.htm

REACH Help:
http://echa.europa.eu/reach/helpdesk_en.htm

About ECHA: http://ec.europa.eu/echa

http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm

Globally Harmonized System

for Classification and Labeling of Chemicals (GHS)

International UN standardization for classification, safety data sheet format, and labeling of chemicals using pictograms, signal words, and hazard warnings

US OSHA is reviewing GHS for adoption

GHS

- United Nations proposed system to internationally standardize chemical communication
- Countries will adopt on their own timeframe
- 2008 - UN goal for world-wide implementation

GHS Implementation

Intergovernmental Forum on Chemical Safety (IFCS)- adopted GHS implementation goal of 2008. The US participates and agreed to work toward this goal

Japan, Korea, New Zealand – various stages of adopting & implemented GHS

European Union – 2010 deadline for GHS substance classification

Canada – Assessing how to adopt and implement GHS

United States – Assessing impact of GHS, plans to adopt GHS by 2009. DOT expects to have changes in place by 2009

GHS Benefits

- Uniform Communication
- Better Safety

- Improved International Trade
- Lower cost

GHS Changes

MSDS now named: “SDS” (Safety Data Sheet)

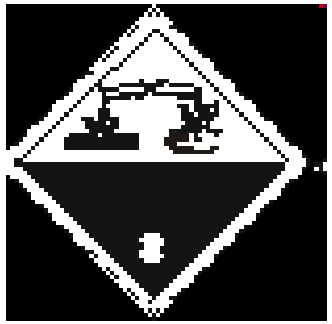
Labels will be standardized with:

- signal words
- hazard statements
- precautionary statements
- pictograms
- elimination of US, Canadian and EU labels

GHS Labeling

Information required on a GHS label:

- **Pictograms**
- **Signal words**
- **Hazard statements**
- **Precautionary statements and pictograms**
- **Product identifier**
- **Supplier information**



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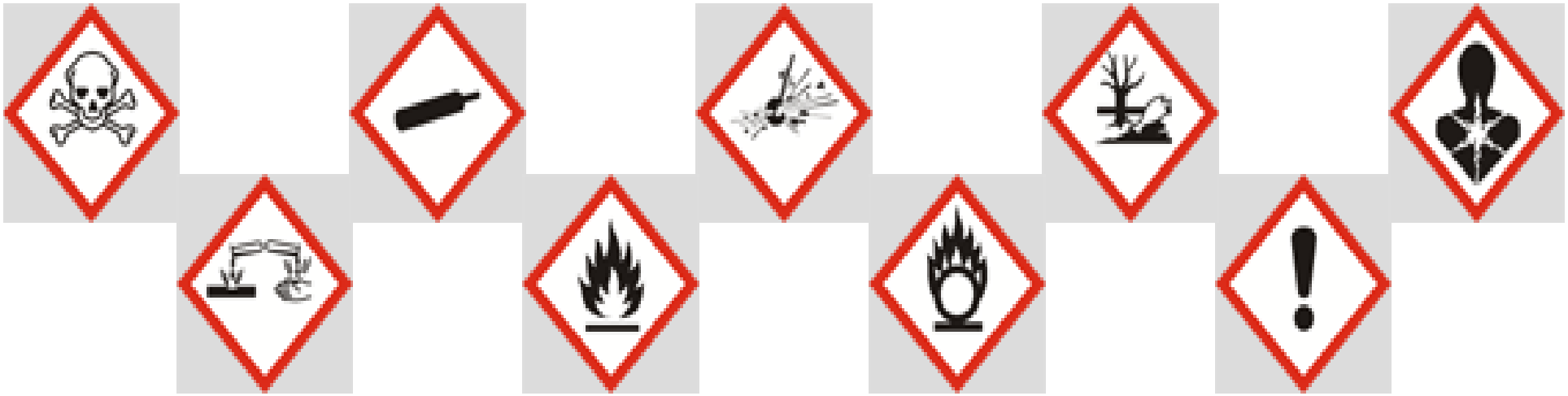
Changes to (M)SDS

GHS name: Safety Data Sheet (SDS)

- Format:
  - 16 sections required in specified order (as per ANSI MSDS format in US Regulations presentation)
- Reclassification:
  - (MSDS) Health & Physical Hazards
  - (SDS) Environmental Hazards
- Building Block Approach
  - each country can select portions of GHS to adopt
  - Not every country will require all categories or all hazards

Examples of GHS Pictograms



Differences between REACH and GHS

- REACH and GHS have different scopes but there are many links between the two regulations
- REACH aims to produces information on hazards, risks, and risk management
- GHS aims to harmonize classification and labeling of materials
- GHS is a UN recommendation which applies across countries, including the EU

Differences between REACH and GHS

- REACH intends to replace current EU classification criteria with GHS. REACH has provisions for safety data sheets based on GHS.
- GHS intends to apply classification and labeling beginning December 1, 2010, when the new GHS regulation will be available.
- Substances will be phased in the first 3.5 years. Mixtures will be given an additional 4.5 years for reclassification.

Globally Harmonized System

Resources

http://www.unece.org/trans/danger/publi/ghs/ghs_rev02/02files_e.html

http://www.unece.org/trans/danger/publi/ghs/presentation_e.html

http://www.osha.gov/SLTC/hazardcommunications/global.html

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Controlling Hazards:

Personal Protective Equipment (PPE) and Safety Equipment Performance Specifications

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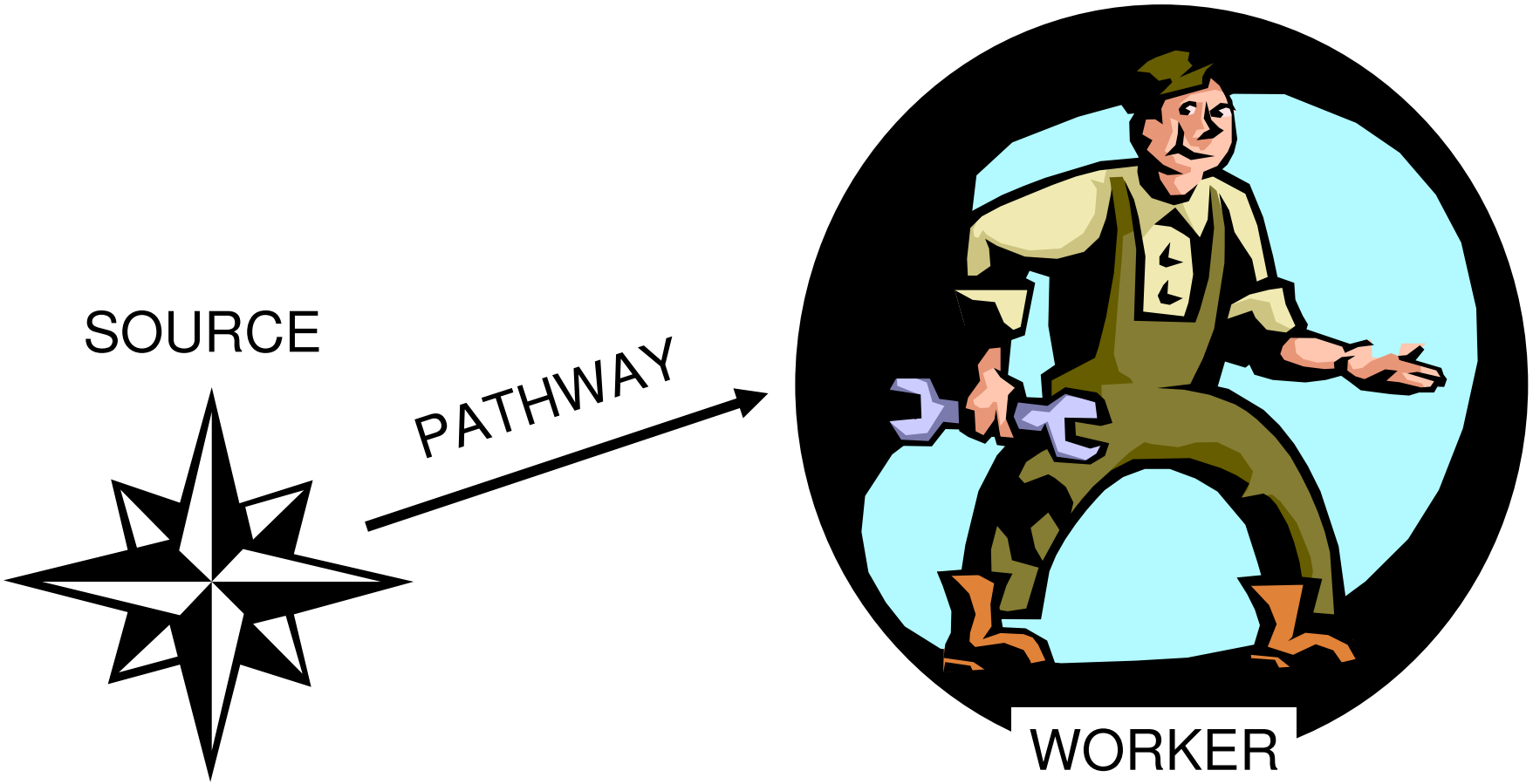
Worker Protection



Personal Protective Equipment (PPE)

- **Always a last resort, but may be necessary if:**
  - **engineering controls inadequate or being installed**
  - **administrative controls don't do the job**
  - **emergency response or spill cleanup**
  - **supplement other control techniques if can't achieve required level**
- **Depends upon human behavior**
  - **proper selection, fit and comfort issues**
- **Hazard is still present with PPE …**

US/OSHA PPE Regulations

- Eye and face protection
  - 29 CFR 1910.133
- Respiratory protection
  - 29 CFR 1910.134
- Head protection
  - 29 CFR 1910.135
- Foot protection
  - 29 CFR 1910.136
- Hand protection
  - 29 CFR 1910.138
- Hearing Protection
  - 29 CFR 1910.95

www.cdc.gov/nasd/menu/topic/ppe.html

www.osha.gov/SLTC/personalprotectiveequipment/index.html

www.osha.gov/Publications/osha3151.pdf

Training and Qualification

Employees should be trained to know:

- **When PPE is necessary?**
- **What PPE is necessary?**
- **How to properly don, doff, adjust and wear PPE**
- **Limitations of PPE**
- **Proper care, storage, maintenance, useful life, and disposal of PPE**

www.free-training.com/osha/ppe/ppemenu.htm

Training and Qualification

Retraining is necessary when:

- **Change in the process**
- **Change in type of PPE used**
- **Inadequate employee knowledge or use of PPE**
  - **retrain to reinforce understanding or skill**

Personal Protective Clothing (PPE)

- evaluate task, select appropriate type and train to use it properly
  - lab coats, gowns, aprons
  - safety glasses (with side shields), goggles, face shields
  - gloves
- remove PPE before leaving the lab

Protective Equipment Works

"It's a hot day, why wear a lab coat?"

An experiment reacted unexpectedly and a flammable solvent from a hood splashed out and landed on the bottom of the lab coat

Eye and Face Protection

- Thousands blinded each year from work-related eye injuries
- Nearly *three out of five* workers are injured while failing to wear eye and face protection

Eye & Face Protection

- safety glasses
- goggles
- face shield

Eye and Face Protection

Eye protection shields eyes by:

- **Primary protection:**
  - **safety glasses with side shields protect from flying objects**
  - **goggles prevent objects from entering under or around the eyewear**
- **Secondary protection:**
  - **face shields**
    - **combine with safety glasses or goggles**
    - **do not protect from impact hazards**

Hazard Assessment

Hazard Type	Hazard Source	Common Associated Tasks
Impact	**Flying objects such as large chips, fragments, particles, sand, and dirt**	**Chipping, grinding, machining, masonry work, wood working, sawing, drilling, riveting, sanding…**
Heat	**Anything emitting extreme heat**	**Furnace operations, pouring, casting, hot dipping, welding …**
Chemicals	**Splash, fumes, vapors, and irritating mists**	**Acid and chemical handling, degreasing, plating, and working with blood or OPIMs**
Dust	**Harmful dust**	**Woodworking, buffing, and general dusty conditions**
Optical Radiation	**Radiant energy, glare, and intense light**	**Welding, torch-cutting, brazing, soldering, and laser work**

Biohazards

Use caution *anytime* you are working with blood or other bodily fluids

Contaminated blood or bodily fluids may result in transmission through the eyes

Eye and Face Protection

Optical Hazards

- welding helmets are secondary protection to shield from UV, heat, and impact

- exposure to laser beams requires suitable laser safety goggles with:
  - Protection for the ***specific wavelength***

Eye and Face Protection Requirements

- Eye and face protection should comply with the American National Standards Institute:
  - ANSI Z87.1-1989

- Ensure employees who wear prescription lenses or contact lenses:
  - use safety eyewear that incorporates the prescription
  - use eye protection that can be worn over prescription lenses

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Additional Considerations

- **provide adequate protection against the specific hazards**
- **safe design and construction for the work to be performed**
- **comfortable**
- **don't interfere with the wearer's movements**
- **durable**
- **capable of being disinfected**
- **easily cleaned**
- **distinctly marked to indicate they are approved eye protection**

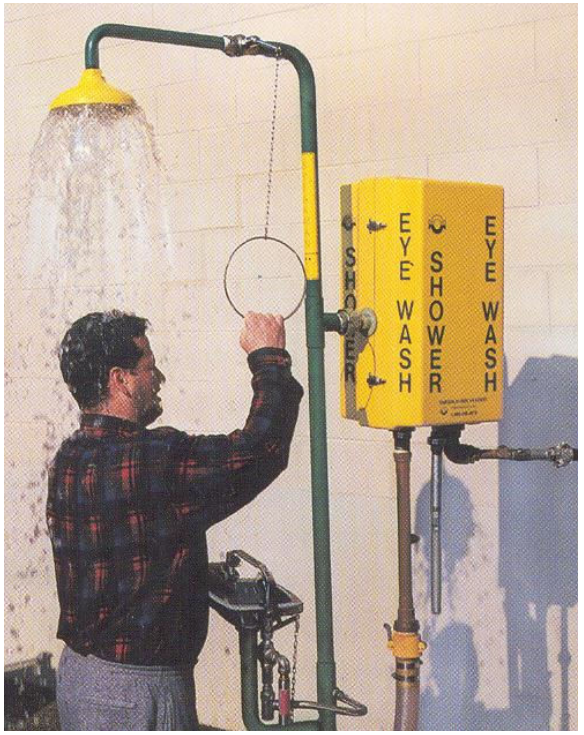
Worker satisfaction – include in selection process

Eyewash and Showers

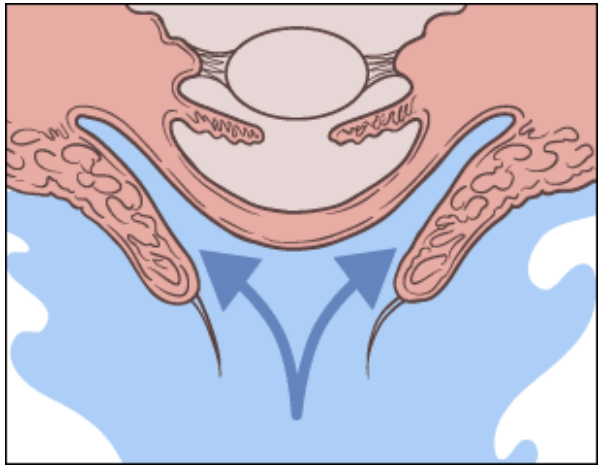
- US regulations
  - 29 CFR 1910.151(c)
  - ANSI Z358.1-2004
- types
  - eyewash
  - shower
  - drench hose
- concerns
  - drainage
  - freezing
  - contaminated water

Eyewash and Showers

- Know their locations
- Maintenance and testing program
- Concerns
  - drainage
  - freezing
  - contaminated water



Eye & Face Protection



- Eye wash stations
  - minimum 0.4 to 3.5 gal/min
    - flush for 15 minutes
  - provide flow for both eyes
    - hold eyes open
    - tepid, pH match eye (preferred)
  - easily accessible locations
    - 33 to 45 inches from floor
    - 6 inches from wall
  - test weekly
    - portable: clean/refill (6 mo – 2 yrs)
  - various types

ANSI Z358.1
NC DOL Guide:
www.dol.state.nc.us/osha/etta/indguide/ig28.pdf

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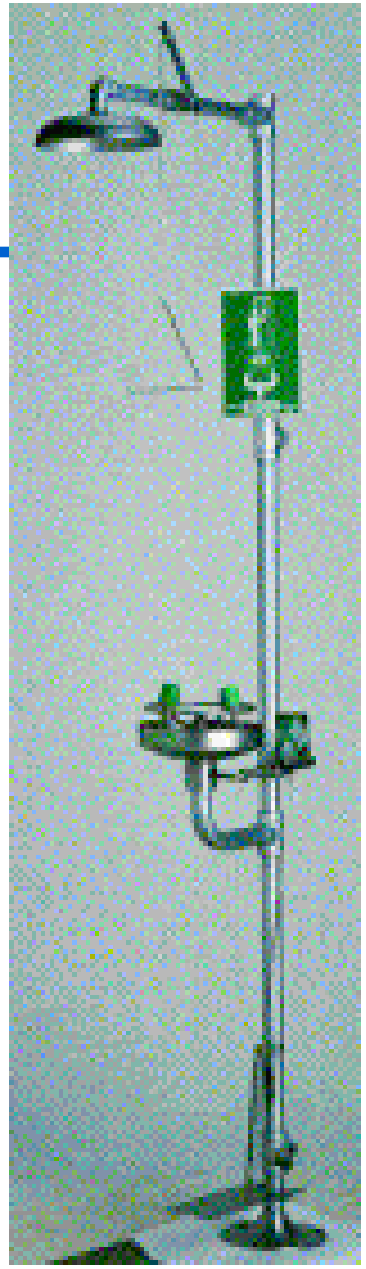
Safety Showers

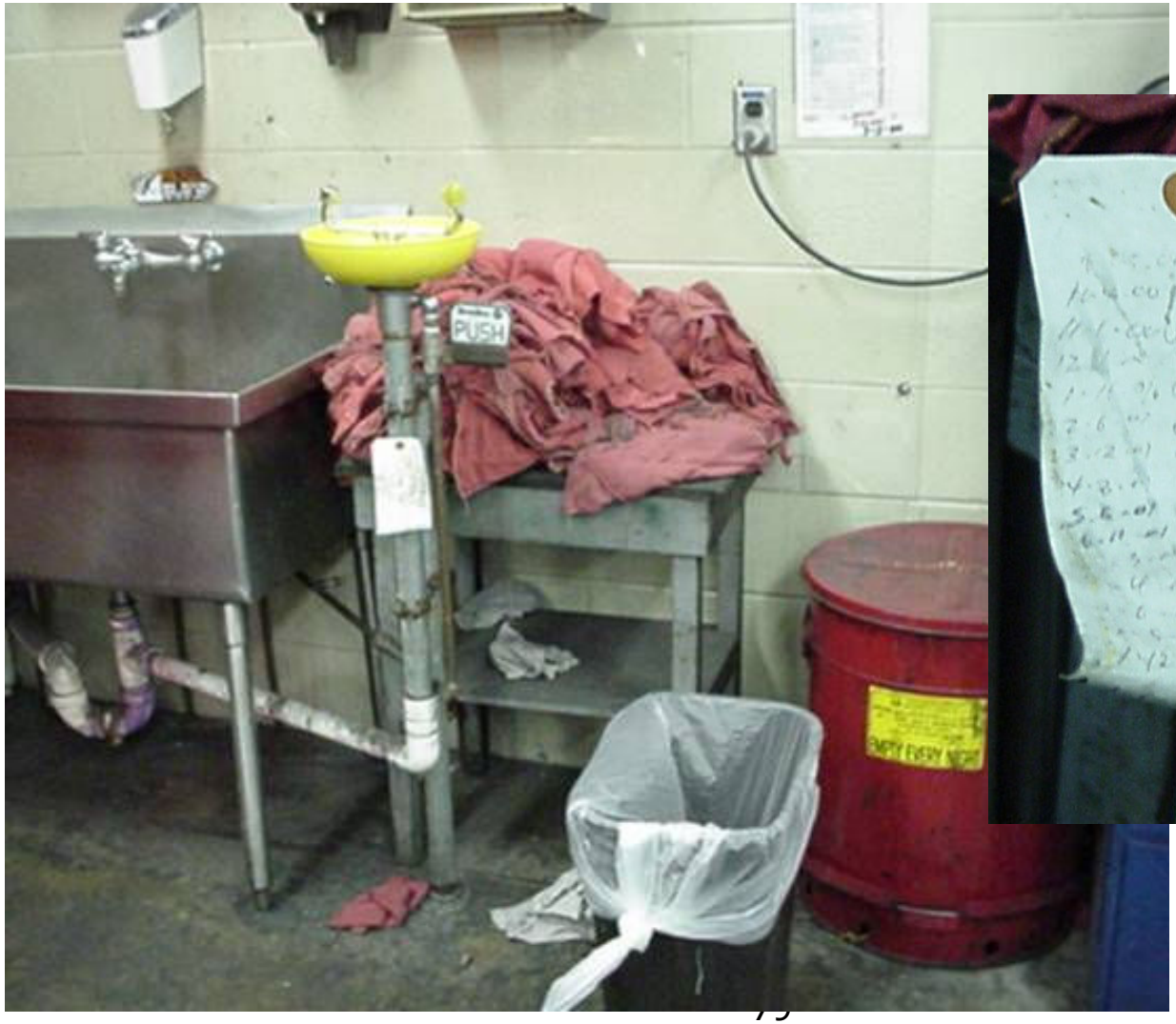
- within 55 feet or 10 seconds
  - Normal walking = 3.8 mph
- test monthly
- pull within reach (highly visible)
  - 82 to 96 inches high
  - deliver 20 inch column @ 60” above floor
- 20 - 30 gal/min (tepid: 60 to 100 °F)
- drains
- blankets/modesty curtains
- avoid or protect electrical outlets
- ANSI Z358.1-2004

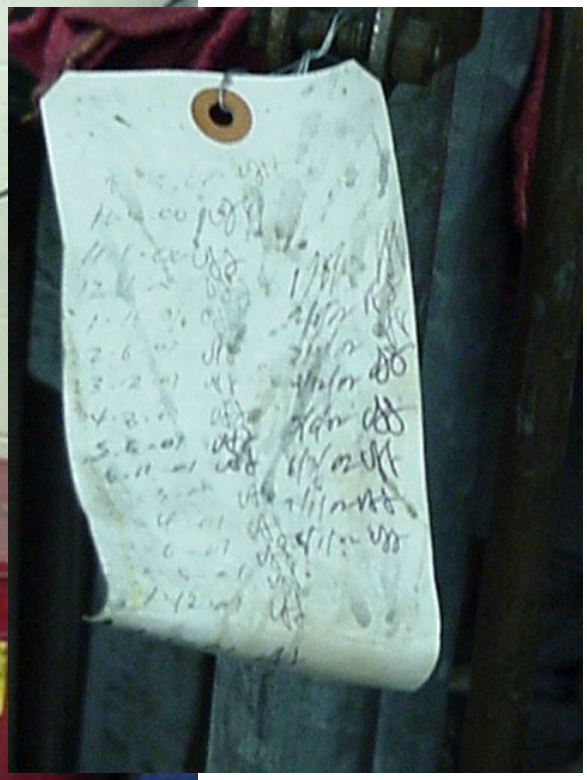


Blocked Eyewash & Safety Shower

Dirty Eyewash Station

Poorly Maintained Eye Wash Station





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Hand Protection

- Glove considerations
  - type
    - dexterity required
    - chemical & physical
      - material
    - **strength**
    - exposure time
      - breakthrough time
    - size, comfort, reusable/disposable
  - manufacturer selection charts

Glove Selection

- **Considerations:**
  - chemicals (splashes vs immersion)
  - thermal (extreme heat/cold)
  - abrasion; cuts; snags; splinters; punctures
  - grip: oily, wet, dry
  - comfort, fit, size
  - ergonomics

Chemical Protective Gloves/Clothing

- **Permeation** ("silent killer")
  - **Substances pass through intact material on a molecular level**
- **Penetration**
  - **Substances pass through seams, zippers, stitches, pinholes, or damaged material**
- **Degradation**
  - **Substance damages material making it less resist or resulting in physical breakdown**
- **Contamination**
  - **Substances transferred inside material (improper doffing or decontamination)**

Chemical Protection Ratings

permeation rate (PR)	permeation breakthrough (PB)	permeation degradation rate (DR)
E- Excellent; permeation rate of less than 0.9 mg/cm^2/min	>Greater than (time - minutes)	E - Excellent; fluid has very little degrading effect.
VG - Very Good; permeation rate of less than 9 mg/cm^2/min	< Less than (time - minutes)	G - Good; fluid has minor degrading effect.
G - Good; permeation rate of less than 90 mg/cm^2/min		F - Fair; fluid has moderate degrading effect.
F - Fair; permeation rate of less than 900 mg/cm^2/min		P - Poor; fluid has pronounced degrading effect.
P - Poor; permeation rate of less than 9000 mg/cm^2/min		NR - Fluid is not recommended with this material.
NR - Not recommended; permeation rate greater than 9000 mg/cm^2/min		† Not tested, but breakthrough time > 480 min DR expected to be Good to Excellent
		†† Not tested, but expected to be Good to Excellent based on similar tested materials

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http://www.hazmat.msu.edu:591/glove_guide/

Chemical SAFETY AND SECURITY TRAINING

Gloves

- It's important to have the *right glove* for the job and know *how long* it will last

- Glove Charts:
  - Consider several glove manufacturer's data before final selection
  - www.bestglove.com/site/chemrest/

The first square in each column for each glove type is color coded. This is an easy-to-read indication of how we rate this type of glove in relation to its applicability for each chemical listed. The color represents an overall rating for both degradation and permeation. The letter in each square is for Degradation alone…

- GREEN: The glove is very well suited for application with that chemical.
- YELLOW: The glove is suitable for that application under careful control of its use.
- RED: Avoid use of the glove with this chemical.







CHEMICAL	LAMINATE FILM BARRIER			NITRILE SOL-VEX			UNSUPPORTED NEOPRENE 29-865			SUPPORTED POLYVINYL ALCOHOL PVA			POLYVINYL CHLORIDE (Vinyl) SNORKEL			NATURAL RUBBER CANNERS AND HANDLERS*			NEOPRENE/ NATURAL RUBBER BLEND CHEMI-PRO*		
	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate
1. Acetaldehyde	■	380	E	P	—	—	E	10	F	NR	—	—	NR	—	—	E	7	F	E	10	F
2. Acetic Acid	■	150	—	G	270	—	E	60	—	NR	—	—	F	180	—	E	110	—	E	260	—
3. Acetone	▲	>480	E	NR	—	—	E	10	F	P	—	—	NR	—	—	E	10	F	G	10	G
4. Acetonitrile	▲	>480	E	F	30	F	E	20	G	■	150	G	NR	—	—	E	4	VG	E	10	VG
5. Acrylic Acid	—	—	—	G	120	—	E	390	—	NR	—	—	NR	—	—	E	80	—	E	65	—
6. Acrylonitrile	E	>480	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7. Allyl Alcohol	▲	>480	E	F	140	F	E	140	VG	P	—	—	P	60	G	E	>10	VG	E	20	VG
8. Ammonia Gas	■	19	E	▲	>480	—	▲	>480	—	—	—	—	■	6	VG	—	—	—	■	27	VG
9. Ammonium Fluoride, 40%	—	—	—	E	>360	—	E	>480	—	NR	—	—	E	>360	—	E	>360	—	E	>360	—
10. Ammonium Hydroxide	E	30	—	E	>360	—	E	250	—	NR	—	—	E	240	—	E	90	—	E	240	—
11. Amyl Acetate	▲	>480	E	E	60	G	NR	—	—	G	>360	E	P	—	—	NR	—	—	P	—	—
12. Amyl Alcohol	—	—	—	E	30	E	E	290	VG	G	180	G	G	12	E	E	25	VG	E	45	VG
13. Aniline	▲	>480	E	NR	—	—	E	100	P	F	>360	E	F	180	VG	E	25	VG	E	50	G
14. Aqua Regia	—	—	—	F	>360	—	G	>480	—	NR	—	—	G	120	—	NR	—	—	G	180	—
15. Benzaldehyde	▲	>480	E	NR	—	—	NR	—	—	G	>360	E	NR	—	—	G	10	VG	G	25	F
16. Benzene, Benzol	▲	>480	E	P	—	—	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—
17. Benzotrichloride	—	—	—	E	>480	E	NR	—	—	—	—	—	—	—	—	NR	—	—	NR	—	—
18. Benzotrifluoride	—	—	—	E	170	G	F	—	—	E	—	—	G	<10	F	P	50	G	—	—	—
19. Bromine Water	—	—	—	E	>480	E	E	>480	E	—	—	—	—	—	—	—	—	—	—	—	—
20. 1-Bromopropane	▲	>480	E	■	23	F	■	<10	P	▲	>480	E	■	<10	F	■	<10	P	■	<10	P

Types of Gloves

Polyethylene/Ethylene-vinyl Alcohol {"Silver Shield®"}

- resists permeation and breakthrough with chemicals
- uses: aromatics, esters, ketones, and chlorines

Butyl

- highest permeation resistance to gas or water vapors
- uses: ketones (MEK, acetone) and esters (amyl acetate, ethyl acetate)

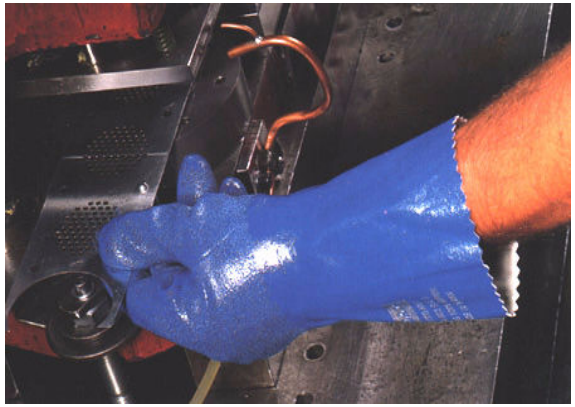
Types of Gloves

Viton®

- highly resistant to permeation by chlorinated and aromatic solvents
- can be used with water/water based solvents

Nitrile (acrylonitrile-butadiene rubber)

- good replacement for latex
- protects against acids, bases, oils, aliphatic hydrocarbon solvents and esters, grease, fats
- resists cuts, snags, punctures and abrasions



Types of Gloves

PVC

- protects against acids, caustics, oils, fats, petroleum hydrocarbons
- resists alcohols, glycols
- useful for:
  - 10% citric acid; cyclohexane, ethylene glycol, formaldehyde, formic acid, glycerine, 10% HCl
- ***not*** useful for aromatics, aldehydes and ketones

What is latex allergy?

- natural rubber latex is from the rubber tree *Hevea brasiliensis*
- the major route of occupational exposure is absorption of latex protein through the skin
- allergens in or on gloves can be transferred to the person's tissue

Latex Allergies

- Symptoms may occur within minutes of exposure or may take several hours depending on the individual
  - skin redness
  - hives
  - itching
  - respiratory Symptoms
    - runny Nose
    - itchy Eyes
    - scratchy Throat
    - asthma

Latex Allergies

- **to prevent latex allergies consider:**
  - **using non-latex gloves**
  - **if you choose latex gloves, use the powder-free version**
  - **when using gloves, do not use oil-based hand cream or lotions (cause glove deterioration)**
  - **recognize the symptoms of latex allergy**
  - **always wash hands after removing gloves**

www.cdc.gov/niosh/latexfs.html
www.osha-slc.gov/SLTC/latexallergy/index.html
http://www.nursingworld.org/osh/latex.htm

Proper steps for removing gloves

1

2

3

4

5

6

Respiratory Protection Program

- written program
- administered by Safety Office
- medical clearance
  - respiratory Protection Questionnaire
  - *no beards*
- fit testing
- respirator selection
  - air monitoring
- training (annual refresher)

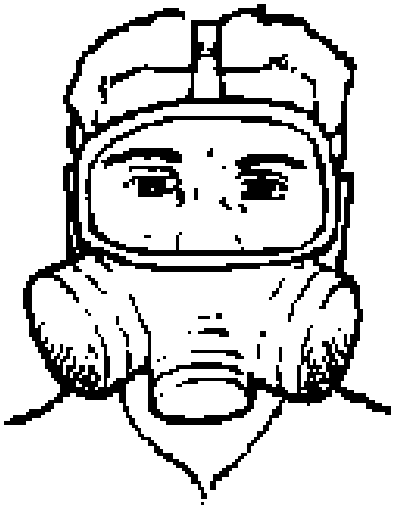
Respiratory Protection Standards

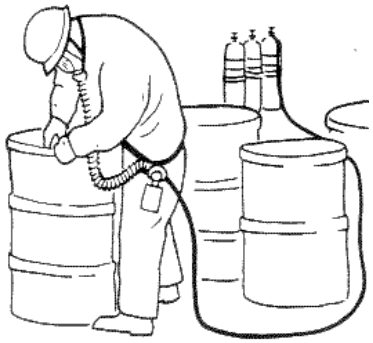
- **29 CFR 1910.134**
  - **OSHA Respiratory Protection Standard**
  - **New OSHA Assigned Protection Factors**
- **ANSI Z88.2–1992**
  - **ANSI Voluntary Consensus Standard**

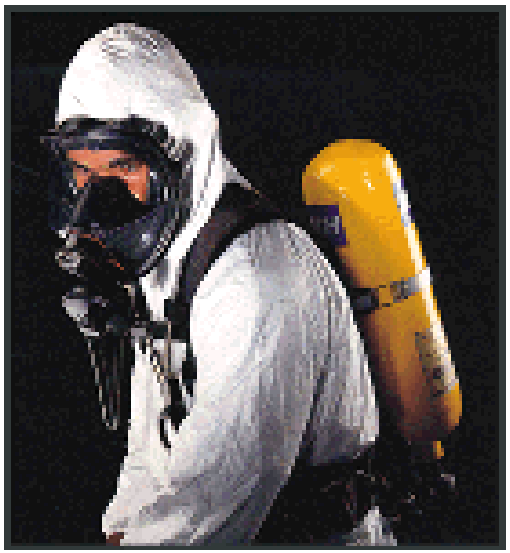
Conduct an Exposure Assessment:
www.osha.gov/SLTC/etools/respiratory/haz_expose/haz_expose.html

Types of Respirators

- Air Purifying (APR)
  - half Face
  - full Face
  - PAPR
- Air Supply
  - air line
  - SCBA







Air Purifying Respirators

- ***Must have at least 19.5% oxygen***
  - *Never* **use in O_2 deficient atmospheres**
- ***Only filters the air***

  particulate filters
    - **removes aerosols**

  chemical cartridges or canisters
    - **remove gases and vapors**
- **Concentrations must not exceed limitations of filter/cartridge**
- **PAPR (Powered Air Purifying Respirator)**
  - **uses a blower to force air through an air purifying element**

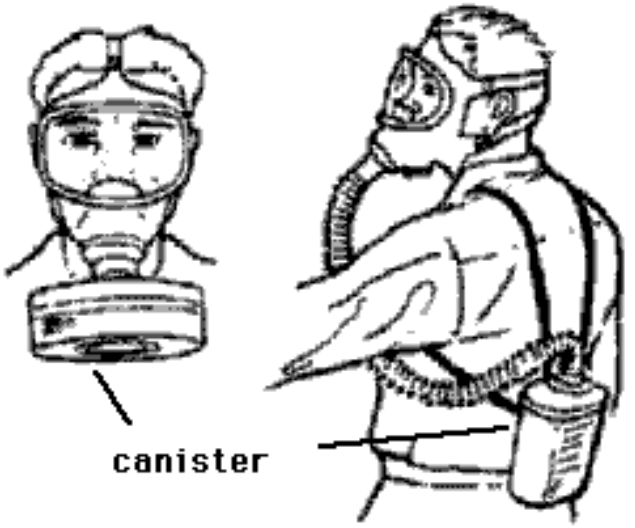
APR Chemical Cartridge Selection

- specific gases or vapors
- NIOSH or MSHA approval
- adequate warning properties
- end of service life

- mechanisms
  - adsorption
  - absorption
  - chemical reaction

- breakthrough times

- *proper maintenance and storage*



Cartridge Selection

Cartridge	Description
	Organic Vapor
	Organic Vapor and acid gases
	Ammonia, methylamine and P100 any particulates filter 99.97% minimum filter efficiency

End of Service Life Indicators

- **There are very few NIOSH-approved ESLI's:**
  - **ammonia**
  - **carbon monoxide**
  - **ethylene oxide**
  - **hydrogen chloride**
  - **hydrogen fluoride**
  - **hydrogen sulfide**
  - **mercury**
  - **sulfur dioxide**
  - **toluene-2,4-diisocyanate**
  - **vinyl chloride**

Assigned Protection Factors

- Level of workplace respiratory protection that a respirator or class of respirators is expected to provide
- Each specific *type* of respirator has an Assigned Protection Factor (APF)
- Select respirator based on the exposure limit of a contaminant and the level in the workplace

Maximum Use Concentration (MUC)

= APF x Exposure Limit (TLV or PEL)

New Assigned Protection Factors

Type of Respirator	Quarter Mask	Half Face Mask	Full Facepiece	Helmet/ Hood	Loose-Fitting Facepiece
Air-Purifying	5	10	50	-	-
PAPR	-	50	1,000	25/1,000	25
Supplied-Air or Airline – Demand – Continuous flow – Pressure Demand	- - -	10 50 50	50 1,000 1,000	- 25/1000 -	- 25 -
SCBA – Demand – Pressure Demand	- -	10 -	50 10,000	50 10,000	- -

Assigned Protection Factors

- **workplace air sampling indicates the exposure to benzene is 30 ppm. OEL is 1 ppm. What respirator should you choose?**

Maximum Use Concentration (MUC) = APF x PEL
Quarter Mask: MUC = 1 ppm x 5 = 5 ppm
Half Face Mask: MUC = 1 ppm x 10 = 10 ppm
PAPR (LFF): MUC = 1 ppm x 25 = 25 ppm
Full Face Respirator: MUC = 1 ppm x 50 = 50 ppm

Dust Masks *vs.* Hospital Masks

High Efficiency Particulate Air Filter (HEPA) Respirator

Fit Testing

- **Qualitative**
  - **irritant smoke (stannic chloride)**
  - **isoamyl acetate (banana oil)**
  - **saccharin**
  - **bitrex**
  - *employees should perform a user seal check each time they put on a tight-fitting respirator*
- **Quantitative**
  - **portacount**

Qualitative Fit Test

- **pass/fail fit test**
  - **assess the adequacy of respirator fit**
  - **relies on the individual's response to a test agent**

Qualitative Fit Test

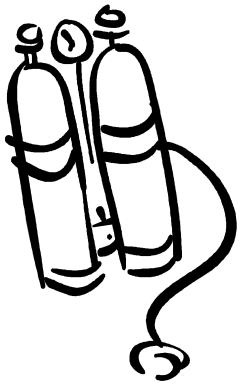
Positive / Negative pressure fit test

Supplied Air

- Supplies breathing air to employee
- Examples
  - SCBA
  - airline
- Grade D Air
- Limitations

Breathing air quality and use

- Compressed breathing air must be at least Type 1 - Grade D [ANSI/CGA G-7.1-1989]:
  - oxygen content = 19.5 - 23.5%
  - hydrocarbon (condensed) = 5 mg/m^3 or less
  - CO 10 ppm or less
  - CO_2 of 1,000 ppm or less
  - lack of noticeable odor
- Compressors equipped with in-line air-purifying sorbent beds and filters



Breathing air quality and use

- non-oil lubricated compressors
  - CO levels in the breathing air 10 ppm
- oil-lubricated compressors
  - high-temperature or CO alarm, or both
  - if only high-temperature alarm, the air supply must be monitored to prevent CO levels from exceeding 10 ppm

Maintenance and storage procedures

- Disposable filtering facepiece:
  - dispose after use
- Half-mask:
  - write expiration date (current date + 30) making sure to keep entire label legible
  - discard cartridges based on expiration date, end-of-service life indicator or calculated service life
  - clean
  - dry
  - place in sealable bag (write your name on bag)
  - contact Safety Office for repairs

Maintenance and storage procedures

- **Exclusive use by an employee:**
  - **clean and disinfect as often as necessary to be maintained in a sanitary condition**
  - **discard cartridges based on expiration date, end-of-service life indicator or calculated service life**
- **Respirators issued to more than one employee or maintained for emergency use:**
  - **clean and disinfect before worn by different individuals or after each use**
- **Respirators used in fit testing and training:**
  - **clean and disinfect after each use**
- **All respirators *must* be stored in clean, dry bags**

Hazards Requiring Body Protection

- *hazardous chemicals*
- potentially infectious materials
- intense heat
- splashes of hot metals and hot liquids

Body protection for emergency response

- **Full suits**
  - **Class A**
  - **Class B**
  - **Class C**
  - **Class D**

Level A Protective Suits

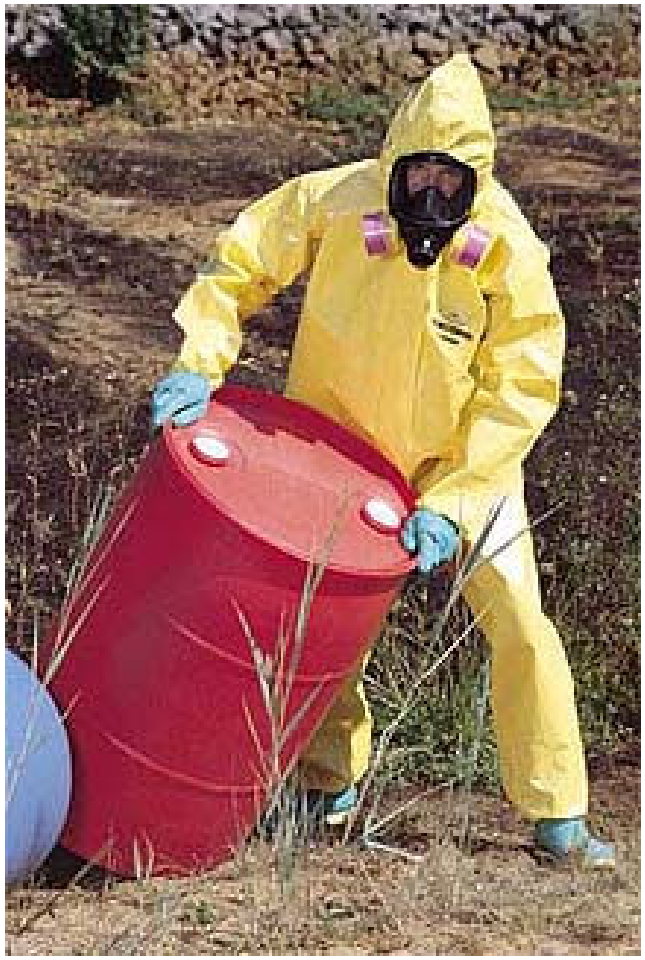
- potential exposure to unknown
  - greatest level of skin, respiratory, and eye protection
  - positive-pressure, full face-piece self contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA
  - totally encapsulated (air-tight) chemical and vapor protective suit
  - inner and outer chemical-resistant gloves, and boots

Level B Protective Suits

- **Atmospheric vapors or gas levels** not **sufficient to warrant level A protection**
- **Highest level of respiratory protection, with lesser level of skin protection**
  - **positive-pressure, full face-piece self contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA**
  - **hooded chemical resistant clothing or coveralls (non-totally-encapsulating suit), inner and outer chemical-resistant gloves, and boots**

Level C Protective Suits

- **Concentration or contaminant known**
- **Full-face air purifying respirator permitted with a lesser skin protection**
- **Inner and outer chemical-resistant gloves, hard hat, escape mask, disposable chemical-resistant outer boots**
  - ***difference between Level C and level B is respiratory protection***



Level D Protective Suits

- **Minimum protection**
- ***No* respiratory or skin protection**
- **Used only if no known or suspected airborne contaminants present**
- **May include gloves, coveralls, safety glasses, face shield, and chemical-resistant, steel-toe boots or shoes**

Any Questions?