Risk Assessment Techniques

24/0. Original Label: Review manufacturer’s labels.
25/0. Safety Data Sheet: Mandated information distributed for each hazardous substance with detailed information on risks, handling, exposure controls, and first aid.
27/0. Survey Meter: Measures various forms of contamination in the laboratory environment.
10/Ts. Test Strip: Used to test for presence of peroxides or other unwanted materials in solutions.
25/W. What If: Questions used in risk analysis to identify weaknesses in planning or design.
33/Bt. Bowls: Method of visualizing risk using diagram outlining threats, preventative measures, outcomes and consequences.
7/Ci. Checklist: Hazard mitigation through use of checklist to avoid oversights and uncontrolled consequences.

Method to identify potential hazards

75/Cl. Checklist: Used to test for presence of peroxides or other unwanted materials in solutions.
87/Environmental Hazard: Environmental hazards such as hydrogen with non-flammable alternatives such as helium.

Used to test for presence of peroxides or other unwanted materials in solutions.

Survey Meter:
Extra level of protection against airborne chemicals.
Transparent shields guard against airborne chemicals.
Prevents pinch-point injuries in laboratory.

Downdraft Table:
Location or hazard.

Aqueous Substitute:
Removes hazard through design and eliminates need for hazard.
Change design to eliminate hazardous alternative.

Non-Flammable Gas:
Non-hazardous, they utilized unsafe work practices.

System provides cooling without the use of toxic powdered substitutes.

Physical Hazards

47/Tp. Temperature: Extremely high or low temperatures.
12/Pt. Pressure: High-pressure hazards including those associated with gas cylinders and dewars.
20/Vs. Voltage: Electrical hazards.
38/Pi. Pinch Point: Risk of body part, hair, clothing or jewelry being caught between moving objects.
56/Tt. Trip Risk: Cords, tubing, wires and other objects located in foot traffic areas; unmarked stairs or uneven flooring.
88/Sa. Sharpes: Needles, glass and other materials that can penetrate the skin or eyes.

Behavioral Hazards

21/Uc. Unlabeled Chemicals: Improper or missing labels leading to misidentification of substances.
39/Hs. Poor Housekeeping: Dirty or disorganized workspaces.
22/Ea. Eating and Drinking: Storing or ingesting food or drink in the lab.
30/Ca. Chemical Exposure: Exposing skin or eyes.
40/Pm. Pipetting by Mouth: Storing or ingesting food or drink in the lab.
108/Freeze: Vials, bottles, and tubes are stored in freezers.

Safety Martyrs

89/Fm. Fluorine Martyrs: Several 19th century chemists died or were severely injured trying to isolate fluorine.
Chemical Health and Safety.

Table of the Elements of Safety

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The Hierarchy of Controls is a hazard prevention and mitigation system organized along a scale from most comprehensive (hazard removal and replacement) to protection from unavoidable hazards. The hierarchy lays out a system whereby inherently safer systems are implemented before moving to higher-risk solutions.

Elimination: Eliminate hazards during the design or development stage by finding safer ways to achieve project goals.

Substitution: Replace the hazard with something safer.

Engineering: Isolate the hazard from the people.

Administrative: Change the way people work with procedures limiting the amount and duration of exposure.

Personal Protective Equipment (PPE): Protect the worker with personal protective equipment.

Administrative Controls

- 13/Work Scheduling: Scheduling contributes to workers safety.
- 21/Training: Comprehensive training is critical.
- 49/Lock-out Tag-out: Procedure to ensure equipment in properly shut off and not to be started up again prior to the completion of maintenance or repair work.
- 81/Cb. Control Banding: Grouping hazards by control measure, handling procedure or characteristic.
- 113/Rs. Segregate Chemicals: Separate chemicals by hazard class to avoid storing or mixing incompatible chemicals.
- 82/Sf, Standard Operating Procedure: A written set of mandatory instructions for how to safely work with hazardous materials or operations.
- 114/Po. Policies: Policies governing proper lab procedures, access and monitoring are essential to any safety operation.

Personal Protective Equipment

- 57/Sf. Tyvec Suits: Head-to-toe covering for clean rooms and other environments where outside contamination must be prevented.
- 14/Ps. Face Shield: Covers face and neck to offer maximum splash protection. Often used in combination with splash goggles to provide extra level of protection.
- 32/Lp. Long Pants: Pants covering the entire leg to the ankle. Avoid synthetic fibers, which can melt if ignited.
- 56/Lc. Lab Coat: Long-sleeved coat covering skin and clothing. Sometimes made of chemical-resistant or flame-retardant material (e.g. Nomex).
- 33/Ct. Closed-Toe Shoes: Shoes worn in the lab must completely cover the foot and should be made of a non-porous material.
- 51/Api. Apron: When worn with lab coat, chemical-resistant aprons and smocks provide an extra layer of protection.
- 83/Gl. Gloves: Various types offer range of protection from disposable nitrile to chemically-resistant neoprene and silver coated, synthetic fibers, which can melt if ignited.
- 55/Ap. Aroma: When worn with lab coat, chemical-resistant aprons and smocks provide an extra layer of protection.
- 115/Rs. Respirator: Tight-fitting respirators are used when engineering controls are insufficient to negate inhalation hazard. Respirators require fitting and testing for individual users to ensure protection.
- 52/Gg. Goggles: Tight-fitting eye wear for protection from splash hazards.
- 84/Sg. Safety Glasses: Lighter-fitting protective eye ware for protection from particulates, flying debris, or minor splashes.
- 116/Uv. UV Protection: Eyewear and skin covering to prevent damage from ultraviolet rays.

Response Plans

- 6/LI Lessons Learned: Following any incident or near-miss, analyze the root causes and share lessons learned to avoid similar incidents.
- 7/A. Amalgam Powder: For cleaning mercury spills. Mix with water and solidsides the spilled mercury into a scappable mass.
- 15/Fs. Fire Extinguisher: With proper training, appropriate for fighting small, incipient stage fires.
- 8/Ca. Calcium Gluconate: Gel used in first aid treatment for exposure to hydrofluoric acid.
- 16/Ph. Polyethylene Glycol: Substance used in first aid treatment for exposure to phenol.
- 34/Ew. Eye Wash: Flush with water is the primary first aid for chemical exposure exposure to chemicals.
- 9/Sk. Skin Kit: Used for response to various types of spills.
- 17/Fa. First Aid Kit: Keep on hand for treatment of minor injuries.

Prepare: Surveys indicate any injury, no matter how small.

35/Rp. Response Plan: Emergency response protocols, including emergency contact numbers and instructions for specific scenarios.

53/Cb. Control Banding: Must be located within 100 feet or 10 seconds from any chemical use area.

Green Chemistry

- 83/Ch. Chemical Substitutions: Substitute safer materials for polluting or toxic materials whenever possible.
- 117/C. Cold Storage: Updating refrigerators, clearing door seals and filters, periodic defrosting, disposing of unneeded materials and consolidation of chemicals and reagents are all ways to reduce cold storage energy costs.
- 2/Cs. Close Sash: Close the sash on a fume hood when not in use to reduce electricity consumption in the lab.
- 10/M. Mercury Free: Eliminate use of mercury in experiments whenever possible to avoid the need to dispose of this hazardous metal.
- 18/Rp. Reduce Quantity: Reduce the amount of materials and resources used.
- 36/Mw. Minimize Waste: Find alternatives to disposal such as sharing, redistribution and recycling.
- 54/Cc. Water Conservation: Conserve water by using flow-reducing valves, reducing rinse cycles and running dishwashers only when they are full.
- 86/Ms. Microscale: Scaling down experiments saves time and resources, reduces storage needs and promotes safety in the lab.

Green Chemistry

Safety Heroes

- 57/Ps. Pinto the Elder: Ancient Roman philosopher described the use of loose-fitting animal bladder skins to protect workers in mines from lead oxide dust, the first recorded instance of use of a protective device to reduce exposure to airborne contaminants.
- 58/Ls. Leonardo da Vinci: Credited with the idea for an air-purifying respirator made of wet woven cloth, designed to protect sailors from a weapon utilizing toxic dust.
- 59/Pc. Paracelsus: Swiss physician, alchemist, and astrologer, father of toxicology. Credited with the adage, “the dose makes the poison.”
- 60/Pd. Powell Johnson: African-American inventor received “eye protector” patent in 1880 for use of furnace men, puddlers, furnace, and others exposed to glare of strong light.
- 61/N. D. Malott: First chief of surgery at Johns Hopkins Hospital, invented rubber surgical gloves in order to prevent medical staff from developing dermatitis from surgical chemicals.
- 62/Ah. Alice Hamilton: Physician and scientist, expert in field of industrial health and considered the founder of industrial hygiene.
- 63/Rc. Rachel Carson: Ecologist who lead the American Conference of Governmental Industrial Hygienists committee that produced the Threshold Limit Values (TLVs).
- 65/Gs. Glenn Seaborg: Nobel Prize-winning chemist and American Chemical Society president. The ACS Division of Chemical Health and Safety was founded with his support.
- 66/Jh. James Hodgson: US Secretary of Labor helped shape the Occupational Safety and Health Act of 1970, established the Occupational Safety and Health Administration (OSHA) to administer the Act.
- 67/Tj. Jan A. Young: Chemistry educator and one of the founders of the modern discipline of chemical health and safety, authoring and revising the original versions of several seminal lab safety publications.
- 68/Mh. Howard Fawcett: Co-organizer and first chair of the ACS Division of Chemical Health and Safety (CHAS), published four influential books and numerous papers on safety. In his honor, the CHAS Award was renamed the Howard F. Fawcett Chemical Health and Safety Award in 1998.

R.A.M.P. is an acronym developed by Robert H. Hill Jr. and David C. Finster to help researchers, educators and students remember the four key elements of laboratory safety: Recognize, Assess, Minimize and Prepare.

- Recognize common laboratory hazards. Do this by identifying hazards and understanding why they are dangerous.
- Assess the risks before, during and after an experiment. Assessing risk includes evaluating how you might be exposed to the hazard and what the probable results of that exposure would be.
- Minimize: Limit your risk of exposure utilizing substitution, personal protective equipment, proper disposal practices and other control measures.
- Prepare for emergencies should they occur. Have an emergency response plan and the proper safety equipment in place. Practice emergency drills and use of equipment.