Safe Laboratory Practices

agenda

01

Safety

02

Hazard & Risk

03

Chemical Safety

04

Chemical Exposure / Toxicity

05

Compatibility & Storage

06

Chemical Handling

07

Avantor's Guide

08

Disposal & Inventory Management

Safety is crucial in all that we do……

Safety

- ✓ The condition of being protected from or unlikely to cause danger, risk, or injury.
- ✓ Safety is the state of being safe, the condition of being protected from harm or other non-desirable outcomes.
- ✓ Safety can also refer to the control of recognized hazards in order to achieve an acceptable level of risk.
- ✓ Eliminating all risk, if even possible, would be extremely difficult and very expensive. A safe situation is one where risks of injury or property damage are low and manageable
- ✓ In order to ensure safety in the workplace, information about the identities and hazards of the equipment / instruments / chemicals, etc. must be available and understandable to workers.


work safety
workplace hazards
health
employee
protection
work environment
safety procedures
safety regulations
occupational stress
accident
injury
hardhat
inspector
construction
working conditions
long working hours
heavy metals
chemicals
fumes
biological agents
safety glasses
occupational hearing loss
burns
workplace violence
electrocution
gloves
helmet
lawsuit
machinery
allergens
safety glasses
workplace hazards

Safety

OSHA's Hazard Communication Standard (HCS) requires the development and dissemination of all the relevant about the identities and hazards :

- Chemical manufacturers and importers are required to evaluate the hazards of the chemicals they produce or import, and prepare labels and safety data sheets to convey the hazard information to their downstream customers;

- All employers with hazardous chemicals in their workplaces must have labels and safety data sheets for their exposed workers, and train them to handle the chemicals appropriately. The training for employees must also include information on the hazards of the chemicals in their work area and the measures to be used to protect themselves.

Chemical Safety

Q: Are you at risk because you work with chemicals?

A: Yes

Q: How much risk?

A: It Depends!

- **Chemical Safety -** Being secure from undergoing or causing hurt, injury, or loss when working with elements, chemical compounds, or mixtures of elements and/or compounds.
- **Chemical Hazards -** Elements, chemical compounds, or mixtures of elements and/or compounds which poses potential risk to safety or health.

3. Tanker blast due to leakage on road.mp4

Chemical Safety - Importance

- More than 30 million workers are potentially exposed to one or more chemical hazards.
- There are an estimated 650,000 existing hazardous chemical products,
- The hazards associated with these chemicals vary depending on their properties and mode of handling and usage.
- Inherent hazards are also associated with the reactions that are carried out with these chemicals and the equipment being used.
- The risks involved include serious injuries and adverse health effects.

- Prevention of mishaps requires a proactive approach in identifying hazards and putting control measures in place.

Hazard & Risk

- ✓ **Hazard** is any source of potential damage, harm or adverse health effects on something or someone.
  - ➢ *Harm* - physical injury or damage to health
  - ➢ *Hazard* - a potential source of harm to a worker

Types of Hazard

- Biological - Bacteria, viruses, insects, plants, birds, animals, and humans, etc.
- Chemical - Depends on the physical, chemical and toxic properties of the chemical.
- Ergonomic - Repetitive movements, improper set up of workstation, etc.
- Physical - Radiation, magnetic fields, pressure extremes (high pressure or vacuum), noise, etc.
- Psychosocial - Stress, violence, etc.
- Safety - Slipping/tripping hazards, inappropriate machine guarding, equipment malfunctions or breakdowns.

Probable Sources:

- ✓ Equipment & Instrument
- ✓ Electrical
- ✓ Cryogenics
- ✓ Fire
- ✓ Radiation
- ✓ Gas Cylinder
- ✓ Chemicals & Reagents
- ✓ Biological samples

Risk

Risk is the chance or probability that a person will be harmed or experience an adverse health effect if exposed to a hazard. It may also apply to situations with property or equipment loss, or harmful effects on the environment.

- *Risk* – the combination of the likelihood of the occurrence of a harm and the severity of that harm.
- *Likelihood* – the chance of something happening.

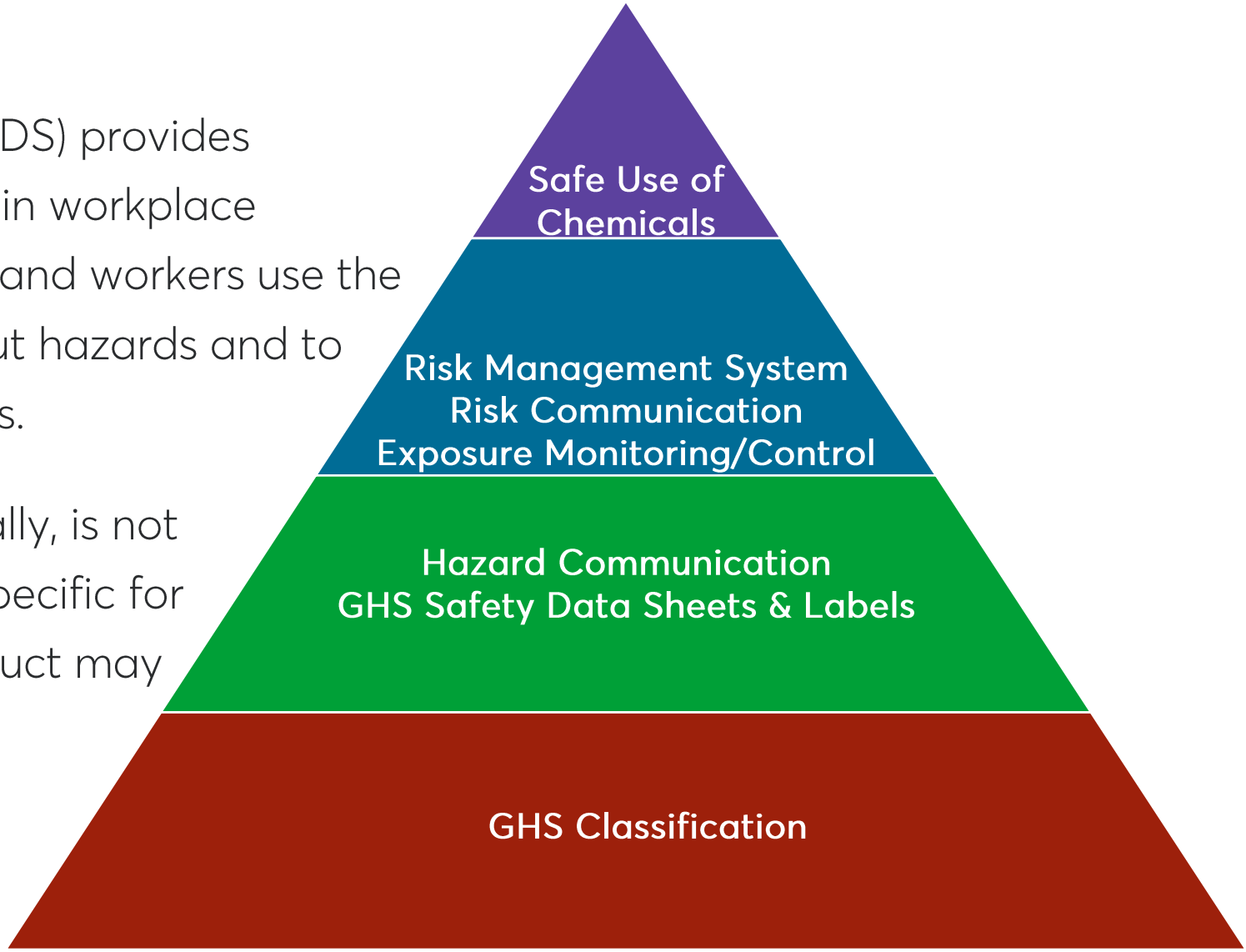
Note: In risk assessment terminology, the word "likelihood" is used to refer to the chance of something happening, whether defined, measured, or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically (e.g., a probability or a frequency over a given time period).

Risk Assessment

		Consequences				
		Insignificant (1) No injuries / minimal financial loss	**Minor (2)** First aid treatment / medium financial loss	**Moderate (3)** Medical treatment / high financial loss	**Major (4)** Hospitable / large financial loss	**Catastrophic (5)** Death / massive financial loss
Likelihood	**Almost Certain (5)** Often occurs / once a week	Moderate (5)	High (10)	High (15)	Catastrophic (20)	Catastrophic (25)
	Likely (4) Could easily happen / once a month	Moderate (4)	Moderate (8)	High (12)	Catastrophic (16)	Catastrophic (20)
	Possible (3) Could happen or known it to happen / once a year	Low (3)	Moderate (6)	Moderate (9)	High (12)	High (15)
	Unlikely (2) Hasn't happened yet but could / once every 10 years	Low (2)	Moderate (4)	Moderate (6)	Moderate (8)	High (10)
	Rare (1) Conceivable but only on extreme circumstances / once in 100 years	Low (1)	Low (2)	Low (3)	Moderate (4)	Moderate (5)

Safety Data Sheet

- The (Material) Safety Data Sheet (SDS) provides comprehensive information for use in workplace chemical management. Employers and workers use the SDS as sources of information about hazards and to obtain advice on safety precautions.
- The SDS is product related and, usually, is not able to provide information that is specific for any given workplace where the product may be used.



Safety Data Sheet

1. Identification of the substance or mixture and of the supplier
2. Hazards identification
3. Composition/information on ingredients
4. First aid measures
5. Firefighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls/personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other information including information on preparation and revision of the SDS

Adverse Health Effect

Any change in body function or the structures of cells that can lead to disease or health problems.

- Bodily injury
- Disease
- Change in the way the body functions, grows, or develops,
- Effects on a developing fetus (teratogenic effects, fetotoxic effects),
- Effects on children, grandchildren, etc. (inheritable genetic effects)
- Decrease in life span,
- Change in mental condition resulting from stress, traumatic experiences, exposure to solvents, etc.
- Effects on the ability to accommodate additional stress.

Chemical Safety

Chemical Safety - being secure from undergoing or causing hurt, injury, or loss when working with elements, chemical compounds, or mixtures of elements and/or compounds.

Chemical Hazards - elements, chemical compounds, or mixtures of elements and/or compounds which poses potential risk to safety or health.

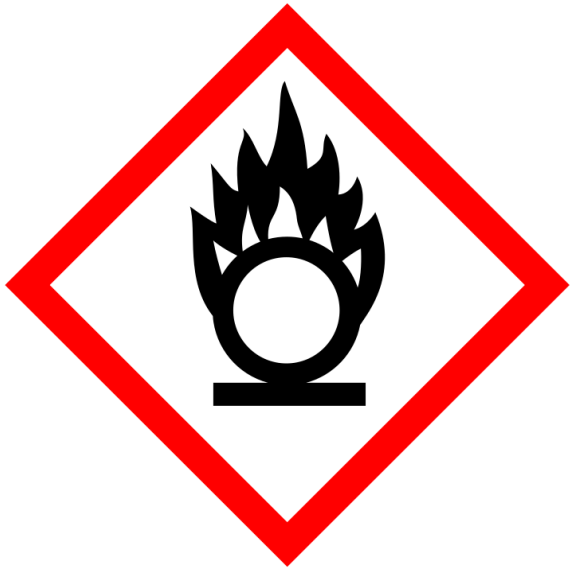
Physical Hazard	Health Hazard
Fire Hazards	Systemic Effects
Explosion Hazards	Target Organ Effects
Reactive Hazards	Other Health Effects

Corrosives

- Corrosive substances causes destructive burns on the tissue by chemical action at the site of contact.
- Corrosive effect can also occur in the respiratory tract in case of inhalation and in the gastrointestinal tract in case of ingestion.
- Sulfuric acid, nitric acid, Potassium hydroxide (caustic potash), Sodium hydroxide (caustic soda), Bromine and Phenol.

Oxidizers

- Oxidizers are chemicals which decompose readily under certain conditions to yield oxygen.
- They can cause a fire to burn violently.
- Oxidizers must not be stored with flammables.
- Hydrogen Peroxide, Nitric Acid, Perchloric Acid , Sulphuric Acid, Chlorates, Chromates, Nitrates, Peroxides, Permanganates, Picrates, etc.



Flammables & Combustibles

- Flammable substances are those that readily catch fire and burn in air.
- The vapors released from a flammable liquid are a common fire hazard in a laboratory.
- The degree of hazard associated with a flammable liquid depends on its flash point, flammability limit and ignition temperature.

Explosion Limits

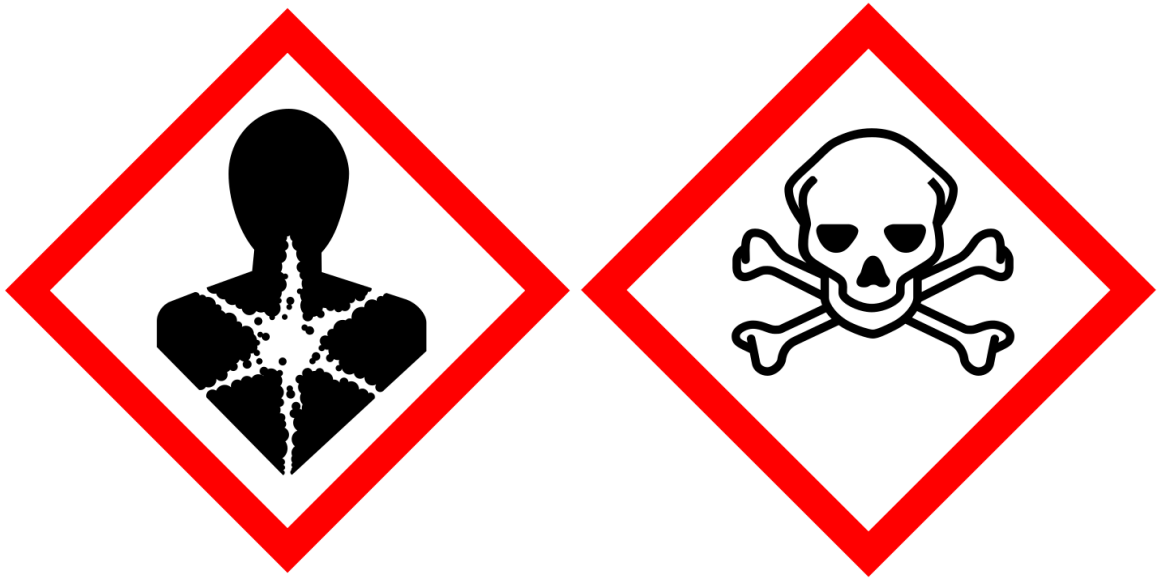
Below Lower Explosion Limit - Too little fuel to ignite
Above Upper Explosion Limit - Too much fuel to ignite

Potentially Explosive Chemicals

- Chemicals when subjected to heat, impact or friction, undergoes rapid chemical change, evolving large volumes of gases which cause sudden increase in pressure.
- Heat, light, mechanical shock and certain catalysts can initiate explosive reactions.
- Acetylides, Azides, Nitrogen Triiodide, Organic Nitrates, Nitro Compounds, Perchlorate Salts, Organic Peroxides, etc.
- Perchloric acid, if allowed to dry on wood or other combustibles, will explode and cause a fire on impact or friction.
- Picric acidand picratesare detonated by heat and impact.
- Ethers that have aged and dried to crystals are extremely unstable and potentially explosive.

Toxic Chemicals

- Toxic chemicals produce injurious or lethal effects upon contact with body cells due to their chemical properties.
- The toxic effects depend upon the extent of exposure and the inherent toxicity of a chemical.
- The extent of exposure is determined by the dose, duration and frequency of exposure and the route of exposure.
- Toxic effects of a chemical may occur after a single (acute) exposure or long term repeated (chronic) exposure.
- Examples of acute toxins are sodium-cyanide, sodium azide and dimethylmercury.
- Benzene is an example of a chronic toxin..



Toxic Chemicals

Highly Toxic Chemicals

- *LD(50) </= 50 mg/kg (oral) albino rats.*

  Sodium Cyanide 6.4 mg/kg

  2,4 – dinitrophenol 30 mg/kg
- *LD(50)) </= 200 mg/kg (contact) albino rabbits.*

  Nicotine 50 mg/kg
- *LC(50) in air </= 200 ppm (gas/vapor) or*

  LC(50) in air </= 2 mg/l (mist/ fume/dust) inhalation albino rats.

  Phosgene 3ppm

Toxic Chemicals

- *LD(50) >50 mg/kg </= 500 mg/kg (oral) rats.*

  Acrylamide 124 mg/kg

  Formaldehyde 100 mg/kg
- *LD(50)) >200 mg/kg </= 1,000 mg/kg (contact) rabbits.*

  Phenol 630 mg/kg
- *LC(50) in air >200 ppm </= 2,000 ppm (gas/vapor) or LC(50) in air >2 mg/l </= 20 mg/l (mist/ fume/dust) inhalation rats.*

  Hydrazine 570 ppm Hydrogen Sulfide 444 ppm

Target Organ Effect

- *Neurotoxins (nervous system)* - Mercury (metallic, inorganic and organic), Xylene, Carbon disulphide, n-Hexane, trichloroethylene.
- *Hematotoxins (blood)* - Carbon Monoxide, Nitrates Aromatic amine compounds.
- *Hepatotoxins (liver)* - Chloroform, Dinitrobenzene
- *Nephrotoxins (kidney)* - Cadmium, Mercury, Carbon Tetrachloride
- *Dermatotoxins (skin)* - Organic solvents

Carcinogens, Teratogens & Mutagens

Carcinogens

- Substances and exposures that can lead to cancer are called carcinogens.
- Substances labeled as carcinogens may have different levels of cancer-causing potential.
- IARC List (102 Known, 68 probable, 245 possible)
- NTP List (58 Known, 188 reasonably anticipated)

Teratogens

- Substances and exposures that can cause malformations of an embryo or fetus.
- Acetaldehyde, Acetonitrile, Heavy Metals, Dimethyl sulfoxide, Ethylene oxide, Formaldehyde, Ketamine, d-Limonene, Methylene chloride, Naphthalene, Nicotine, Phenol, PCBs, etc.

Mutagens

- Substances and exposures that can cause an increase in the rate of change in genes (subsections of the DNA of the body's cells).
- These mutations (changes) can be passed along as the cell reproduces, sometimes leading to defective cells or cancer.
- Sodium azide, UV Radiation, etc.

Pyrophorics

- The rapid oxidation of a pyrophoric chemical by oxygen or moisture in air causes the compound to ignite spontaneously.
- Butyl Lithium, Sodium Metal, etc.

Water Reactive Chemicals

- These chemicals react violently when they come in contact with moisture or water.
- Lithium, Sodium, Potassium, Aluminium bromide, Calcium oxide, Sulfur trioxide, phosphorus pentachloride.

Chemical Exposure / Toxicity

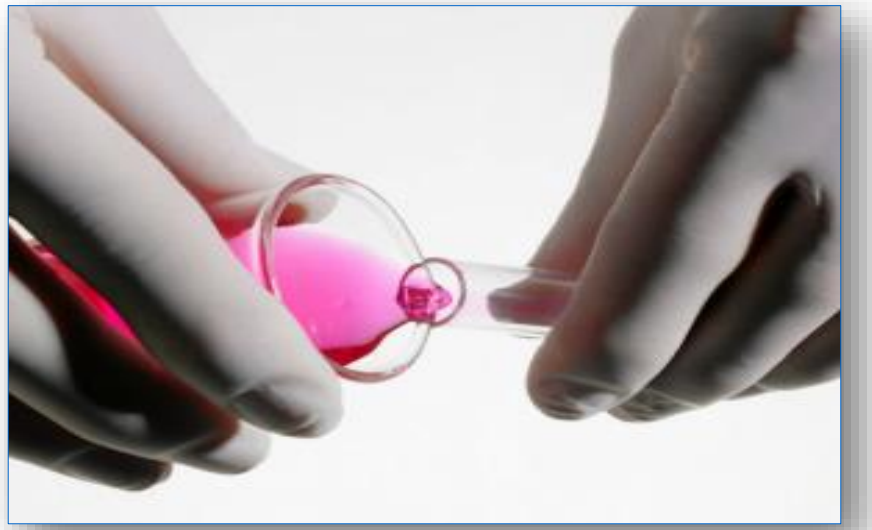
- Potential for experiencing adverse health effects from hazardous chemicals is dependent on the amount (dose or concentration) we are exposed to over the time we are exposed to it.

Dose x Exposure = Toxicity (Harm)

- TLV : Threshold Limit Value (TWA–an 8-hour Time-Weighted Average) is the concentration the average worker can be exposed during an 8-hour workday, day after day, without harmful effects.)
- STEL : "Short Term Exposure Limit" is the concentration the average worker can be exposed 15 minute period.
- IDLH : Immediately Dangerous to Life & Health is a level that poses an immediate threat to life or would interfere with an individual's ability to escape

Chemicals - Routes of Entry

- Inhalation
- Absorption through skin
- Ingestion



Chemical Compatibility & Storage

- Keep containers closed when not in use
- Keep away from ignition sources
- Label your chemicals.
- Keep emergency equipment such as fire extinguishers handy and in good working order.
- Don't store chemicals on the floor, window or platform ledges.
- Segregate incompatible chemicals.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Inorganic Acids																								
2	Organic acids	X																							
3	Caustics	X	X																						
4	Amines & Alkanolamines	X	X																						
5	Halogenated Compounds	X		X	X																				
6	Alcohols, Glycols & Glycol Ethers	X																							
7	Aldehydes	X	X	X	X		X																		
8	Ketone	X		X	X			X																	
9	Saturated Hydrocarbons																								
10	Aromatic Hydrocarbons	X																							
11	Olefins	X				X																			
12	Petrolum Oils																								
13	Esters	X		X	X																				
14	Monomers & Polymerizable Esters	X	X	X	X	X	X																		
15	Phenols			X	X			X							X										
16	Alkylene Oxides	X	X	X	X		X	X							X	X									
17	Cyanohydrins	X	X	X	X	X		X									X								
18	Nitriles	X	X	X	X												X								
19	Ammonia	X	X					X	X					X	X	X	X	X							
20	Halogens			X			X	X	X	X	X	X	X	X	X	X				X					
21	Ethers	X													X						X				
22	Phosphorus, Elemental	X	X	X																	X				
23	Sulfur, Molten									X	X	X	X				X								
24	Acid Anhydrides	X		X	X		X	X							X		X	X	X	X					

X Represents Unsafe Combinations

Represents Safe Combinations

Chemical Handling

- Bench tops must not be used as storage area to prevent clutter. Keep only chemical bottles that is for immediate use on bench tops.
- All chemical bottles must be tightly closed after use and must not be placed on edge of the bench or shelf from which they can fall.
- Chemical formulae or short forms must not be used for labeling chemical bottles.
- Use secondary containment when transporting chemicals.

Head Protection

- Helmets
- Bump Caps
- Accessories

European Standards
Standards
- EN397
- EN 812

Markings
- CE Mark
- Date of Manufacture
- Material & Properties

ABS
- ✓ These containers are designed for storing personal safety apparatus in work place
- ✓ Protection against dirt, dump & dampness
- ✓ Patented opening allows for quick removal of the PPE in case of emergency

Eye & Face Protection

- Spectacles & Goggles
- Face shields
- Welding

European Standards
- EN 166 specifications
- EN 167 Optical test methods
- EN168 Test methods other than optical

Frame marking
- Symbols
- Mechanical strengths symbols

Lens marking
- Radiation protection
- Optical quality
- Strength of the lens
- Warning

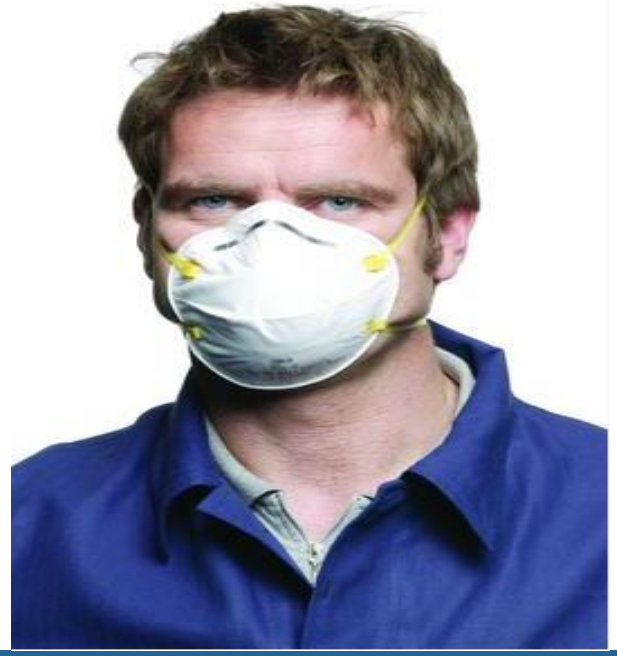
Hearing Protection

- Ear plugs
- Ear muffs

European Standards
- EN 352-2 – Ear plugs
- EN 352-1 – Ear muffs

Respiratory Protection

- Disposable mask
- Reusable mask
- Powered Air
- Detection & Monitoring



European Standards

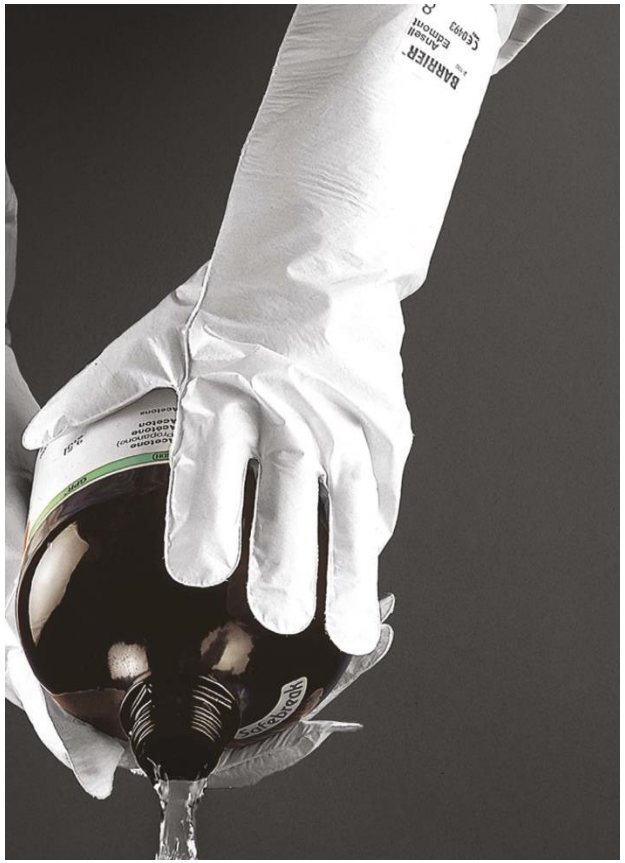
- EN 149:2001 + A1:2009
- EN 405
- EN140

✓ Respirators are tested to the relevant European standards & CE marked

✓ All respirators carry the CE mark plus the European standard performance category markings

Arm & Hand Protection

- Disposable gloves
- Nitrile, Latex
- Reusable gloves



European Standards

- EN 420 : General requirements for protective
- EN 374 (Parts 1-3) : Protective gloves against chemicals & microorganisms
- PPE are certified according to EU directive 89/686/EC

Foot Protection

- Sandals
- Safety Shoes
- Sterile Shoes

European Standards

- EN ISO 20345
- EN ISO 20345:2011
- EN ISO 20346

Body Protection

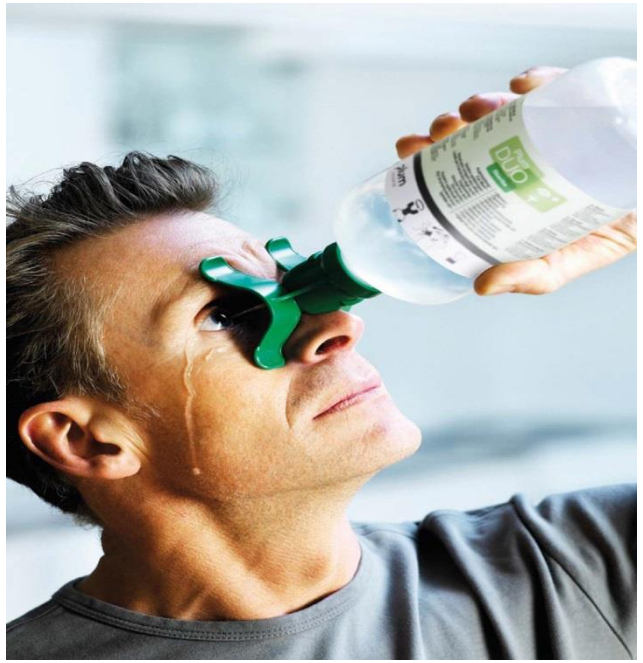
- Body protection
- Coveralls
- Sterile Coveralls with boots & Cap

Skin Protection

- Soap, Hand & Skin Cleansers
- Disinfecting Agents
- Skin Care & Skin Protection
- Accessories

First Aid

- First Aid Panels, Cabinets & Kits
- Personal Eye Wash
- Hand & Eye Wash Station



Safety Carriers & Containers

- Disposal containers
- Bio-hazard bags / containers
- Safety Storage Cabinets

Safety bottle carrier

The high tensile strength transport carriers are designed to ensure the safe transport of bottles containing acids , alkali & solvents. The small models can hold bottles with a capacity of 500ml or 1 L. The large carriers hold bottles with a volume of 2.5L or 4L

- Service temperature from -45 to +110C – steam sterilizable
- - handle specially shaped for carrying comfort

Safety Carriers & Containers

- Disposal containers
- Safety Transport Containers
- Storage Containers
- Sample Carriers

Liquid Handling Systems

- Pipette Controllers – 1ml – 100ml
- Micro-pipettes – Single & Multi, with fixed/variable volume
- Bottle-top dispensers – for acids, solvents.

Environmental Safety

- Warning Posts
- Wall Hooks for PPEs
- Disposal containers
- Bio-hazard bags / containers
- Safety Transport Containers
- Safety Storage Cabinets
- Air Filter Systems
- Absorbents - mats, rolls and socks for oil, water and chemical-based spills
- Spill response kit
- Emergency intervention kit

Avantot-VWR Safety Portfolio

- Head Protection
- Respiratory Protection
- Body Protection
- Environmental Safety
- Face Protection
- Hand & Arm Protection
- Foot Protection
- First Aid
- Hearing Protection
- Skin Protection

General Safety Practices

- Loose clothing should not be worn because it may dip into chemicals or fall into a flame and catch fire.
- Sandals and open-toed shoes do not protect your feet from broken glass or chemical splash, that is frequently found in the lab..
- Do not apply cosmetics, eat, or drink in the lab.
- Always ADD ACID to water.
- Work with volatile chemicals under a fume hood.
- Do not smell any chemicals directly.
- Do not pipet solutions by mouth. Use a rubber suction bulb or other device to fill a pipet.
- Wash your hands with soap and water before leaving.
- Tie Back Loose Hair (For Female).
- Remember that the lab is a place for serious work. Careless behavior may endanger yourself and your colleagues.

Inventory & Disposal

The inventory of stored chemicals must be examined periodically. Inventory checks helps in many ways:

- It ensures that chemicals are segregated according to their compatibility.
- Discarding expired chemicals and help to save space.
- Help to quickly locate the chemicals.
- Shelf llife of peroxides & other short expiry chemicals can be monitored.
- Help to identify bottles with worn out labels or those which are leaking.
- Maintain latest MSDS of all chemicals.
- Laboratories must maintain dedicated labeled carboys/cans for collecting spent chemicals
- Care must be taken to prevent mixing of incompatible chemicals while transferring spent chemicals.
- In case of Hazardous/Toxic chemicals, follow regulatory norms for disposable.

Chemical Spillage

The following actions must be taken in the event of a chemical spill.

- Evacuate non-essential personnel from the area.
- Ventilate the area by opening the windows.
- If the spilled material is flammable, extinguish all open flames. Do not operate electric switches near the spill.
- Avoid inhaling vapor from spilled material.
- Use personal protective equipment.
- Ensure that there is an exit near by.
- Use spill containment kits to clean up the spill.

Safety @ Avantor

- Focus On training.
- Leadership Involvement in EHS.
- JSA, PSSR for Non Routine & new jobs.
- Hazard Area Classification study.
- Implemented Process Safety Management.
- Arc Flash Study for electrical panels.
- Respiratory Qualitative Fit testing.
- PPE Hazard Assessment.
- Reward and Recognition.

NSC AWARD 2016

NSA AWARD 2015

OSH INDIA AWARD 2017

NSA AWARD 2013

STEP - 1

STEP - 2

STEP - 3


Thank
you