Chemicals training

Milena Toselli – Consiglio Nazionale delle Ricerche

Good morning, my name is Milena Toselli and I am the safety and radiation protection manager for same CNR laboratories

My English is not fluent so I ask you to be patient

My intervention will be divided into four parts:

- a general overview of the chemical risk with attention to the duties,
- to what must be in a chemical laboratory including the collective protection devices and the personal protective equipment and their choice and to good laboratory practices
- then I want to go into the specific and illustrate the chemical risks related to a series of compounds as asked me
- and lastly I wanted to show you the layout of a laboratory that uses one of these particularly dangerous substances

Examples of legislation

- Regulatory requirements for organization and management of security:
  - Switzerland: MSSL directive (CFSL 6508 directive)
  - Europe: European directive 89/391 EEC on the safety and health of workers
  - United States: Occupational Safety & Health Administration Act
  - Italy: Legislative Decree 81/2008 (transposition of European legislation)

Here you will find the main references of Switzerland, Europe, USA and Italy on security laws.

MSSL is the abbreviation for "appeal to occupational physicians and other occupational safety specialists". However, this acronym indicates the creation of a security system applied to companies and therefore a systematic prevention strategy.

The **European directive 89/391** EEC on the safety and health of workers represented a fundamental step in the improvement of health and safety at work. It guarantees minimum health and safety requirements throughout Europe. The aim of this Directive is to introduce measures to encourage improvements in the safety and health of workers at work. It applies to all sectors of activity, both public and private.

It is of fundamental importance as well as of the basic safety and health. It contains principles concerning the prevention of risks, the assessment of risks, the elimination of risks and accident factors, the informing, consultation and training of workers.

The **Occupational Safety and Health Administration in the US** is an agency of the US Department of Labor.

In Italy the **decree 81/2008** comes from the European directive

Responsibility

- Parties responsible for the safety and health program must have authority and resources
- Employer and laboratory managers are involved in the implementation of occupational safety
- Program operations must be reviewed periodically to evaluate, identify deficiencies, and revise, as needed

Safety in the workplace provides a precise and defined hierarchy of tasks and responsibilities

At the top is the employer (for example in the case of the CNR this is identified in the director of the Institute).

However, the managers of the various laboratories, as well as the workers themselves, have responsibilities and consequently criminal penalties.

A key point is the identification and assessment of all risks and then the planning of the measures to ensure the improvement of safety levels over time.

From this point of view we will identify the risks related to the utilization of dangerous chemical agents and the measures necessary to keep the risks to a minimum.

Types of «hazard»

- **Materials used**: hazardous substances, hazardous biological agents, radioactive material, etc.
- **Equipment**: electric equipment, centrifuges, vacuum systems, high temperatures, etc.
- **Structures, furnishings, systems**: limited space, crowding, non-suitable gas distribution, unsuitable hoods, unsuitable surfaces
- **Training**: not adequate, presence of guests

In addition to the use chemicals, there are other types of hazard that we can find in a chemical laboratory:

The use of electrical equipment means that there is an electrical risk, if you use centrifuges must know that have specific procedures for use, etc.

Ergonomically designing a laboratory makes the spaces efficient that allow a good level of safety: working in a confined space or with a non-functional work equipment can affect safety levels, the work surfaces of a chemical laboratory must be such as to allow an effective cleaning as well as the surfaces of floors and walls must washable to allow cleaning in case of spills of chemicals

Chemical risk in the research laboratories

Danger due to the chemical-physical characteristics of the substances or chemical products used.

Safety of the person

(fire, explosion, corrosion)

Danger due to the toxicological characteristics of the substances or chemical products used

Health of the person

(acute or chronic effects)

As a first step you will have to identify the hazard chemicals and for each of them know the type of specific risk. In this way it will be possible to carry out a risk assessment and define the levels of risk linked to the use of the substance.

When defining and assessing the hazard of a chemical substance, it is necessary to divide into physical hazards such as the dangers of fire, explosion, corrosion, etc. Or the toxicological hazard that will affect the health of the operator with effects that may be acute or chronic.

Modality of action of chemical risk

in a sudden and brutal way

- **accident / injury**: fire, explosion, burn, intoxication, asphyxiation, etc.

after a certain exposure time

- **disease**: respiratory system (asthma, rhinitis), diseases of the skin and mucous membranes (irritation, ulceration, eczema, etc.), diseases of the nervous system (headaches, tremors, mental disorders, etc.), tumors (airway and digestive, etc.).

The modality of action related to the chemical risk that are represented by:

sudden and brutal action that generates an accident such as a fire, an explosion, a burn of the operator, an intoxication

Or the chemical risk can manifest itself after a certain exposure time generating a disease in the worker

Critical issues

- **a high number is used** (generally small quantities)
- **the presence of hazardous chemical agents is intrinsic to the type of activity** (it is not possible to eliminate or replace them)
- **health effects are not always fully known** (they are not all classified in according to GHS)
- **they can also be formed as secondary products from the most diverse reactions** (synthesis, decomposition, oxidation, cyclization, alkylation, etc.)

In a research laboratory, unlike industrial activities, one must know how to handle a series of critical issues that are typical, and I would say exclusive of these activities.
In particular, the use of a large number of chemicals with different hazard characteristics does not simplify the management of chemical risk even if the quantities are in use and in storage are very small compared to an industrial context.
Often the very activity of research and experimentation leads to the synthesis of chemical substances that have not yet been well studied and whose effects on human health are not known.

Critical issues

- **the methods used in research laboratories can not always be standardized**
- **the autonomy of the researcher in managing the experiment is not associated with choices of prevention and protection of risks** (the modification of the techniques and analytical methods used in real time, is a peculiarity of this work activity, for which the changes can also intervene during the analysis itself)
- **a high turnover of personnel** (precarious forms of work such as scholarships, research grants, occasional collaboration contracts that determine

The research activity is such that standard methods are not always used and, in the researcher's autonomy, it can be admissible to manage the experiment in real time.

Furthermore, the high turnover of personnel linked to flexible contracts means that constant training of personnel must be taken into account in order to meet this situation.

L'attività di ricerca è tale per cui non sempre si utilizzano metodiche standard e nell'ambito dell'autonomia del ricercatore può essere ammissibile gestire l'esperimento in tempo reale.

Inoltre l'elevato turn over del personale legato a contratti di tipo flessibile fa sì che si debba tener in conto la formazione continua a costante del personale stesso in modo da sopperire a questo inconveniente.

Type of accidents

Mixing of incompatible substances

- Incorrect transfer procedures
- Discharge of the material because it is not compatible with the substance used
- Breakage of the container (bottle, jerrycan, etc.).

N. B. the consequences of any contamination occurring in the laboratory, may concern both the person who works, both the working environment

Among the types of accidents related to the use of chemicals that must be taken into account when assessing the chemical risk we can identify:

Wrong preparation of diluted solutions where it is good practice to add the strong acid (or base) to the water and not vice versa

It is necessary to know the compatibility of the container with respect to the content: for example, hydrofluoric acid is incompatible with glass containers as it dissolves them, some mixtures generate heat (exothermic reaction) and therefore the container must be adequate, it is possible to generate gas during mixing, so it is important to open the containers with caution in order to avoid splashes

It is necessary to know how to behave in case of accidental breakage of the container and to know if it is necessary to use adequate containment adsorbent material in relation to the substance that was present

Biological damage

The biological damage induced by chemical agents depends on the characteristics of the agent itself

The biological damage induced by chemical agents is correlated to the methods of exposure

- inhalation
- ingestion
- contact

Resulting effects:

- Irritation of the respiratory system
- Respiratory allergies
- Irritation of skin and eyes
- Alterations of the Nervous System
- Alterations of liver or digestive function

The toxic materials enter in the body in many ways:

- By mouth: we think of contaminated fingers
- By breathing in gases, aerosol or fine powders
- By skin contact or damage or by absorption through the skin

Evaluation of chemical risk

What is needed:

- List of substances with quantities;
- Updated safety data sheets;
- Activities where use is envisaged;
- Workers involved in the exhibition;
- How to use;
- Duration of exposure;
- Prevention and protection measures adopted;
- Results of health surveillance.

Now that we have a general overview of what are the main critical issues that we must take into account when we make a chemical risk assessment related to our laboratory activity, we can move on to a more specific phase starting with a list of the information we need.

In detail we should know:

The substances used with the quantities, for each substance we should have the safety data sheets

The activities in which the use and the modalities of employment of these substances are previewed.

I will have to identify the workers involved in the exhibition and how to use the duration of the exposure.

Identify which prevention and protection measures the laboratory is already equipped with and, if necessary, provide further information.

In the research laboratories are used small amounts of hazardous chemicals: for this reason, the security management **classify laboratories at a low level of risk both for the health of operators and for safety**.

This classification is confirmed by levels of concentration of pollutants in the environment very low, also because it **works with dedicated suction systems and worn protection devices**

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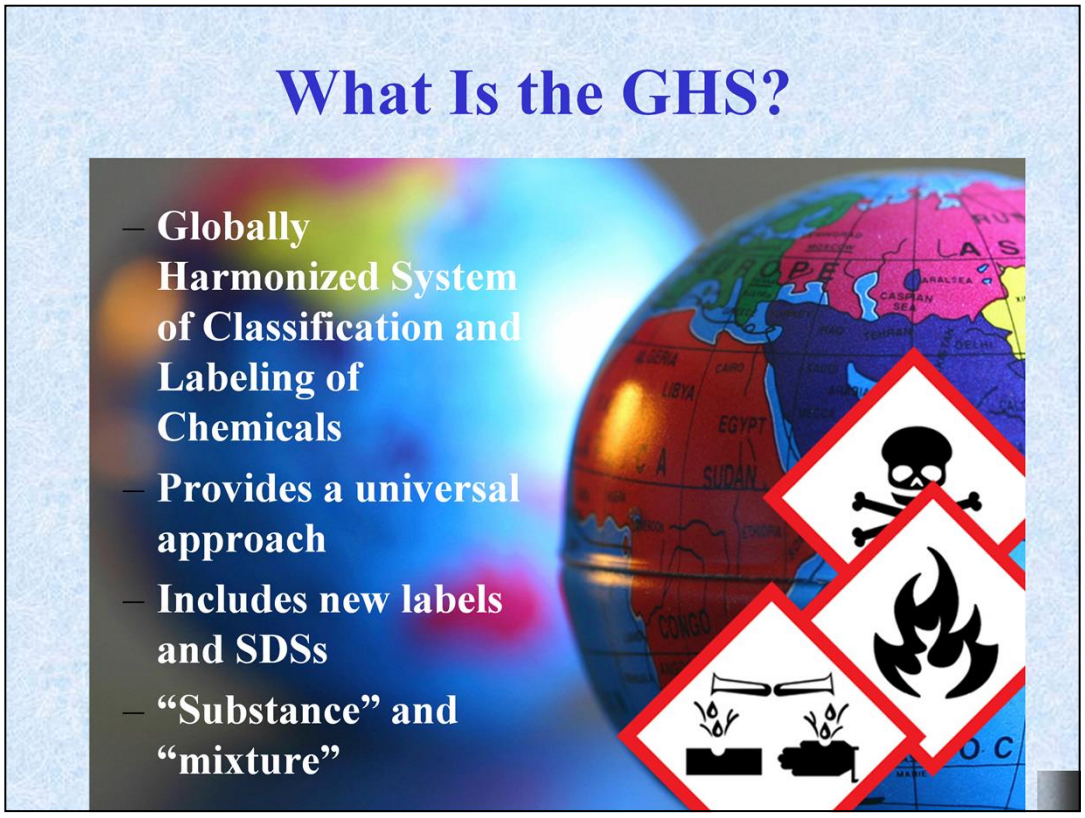


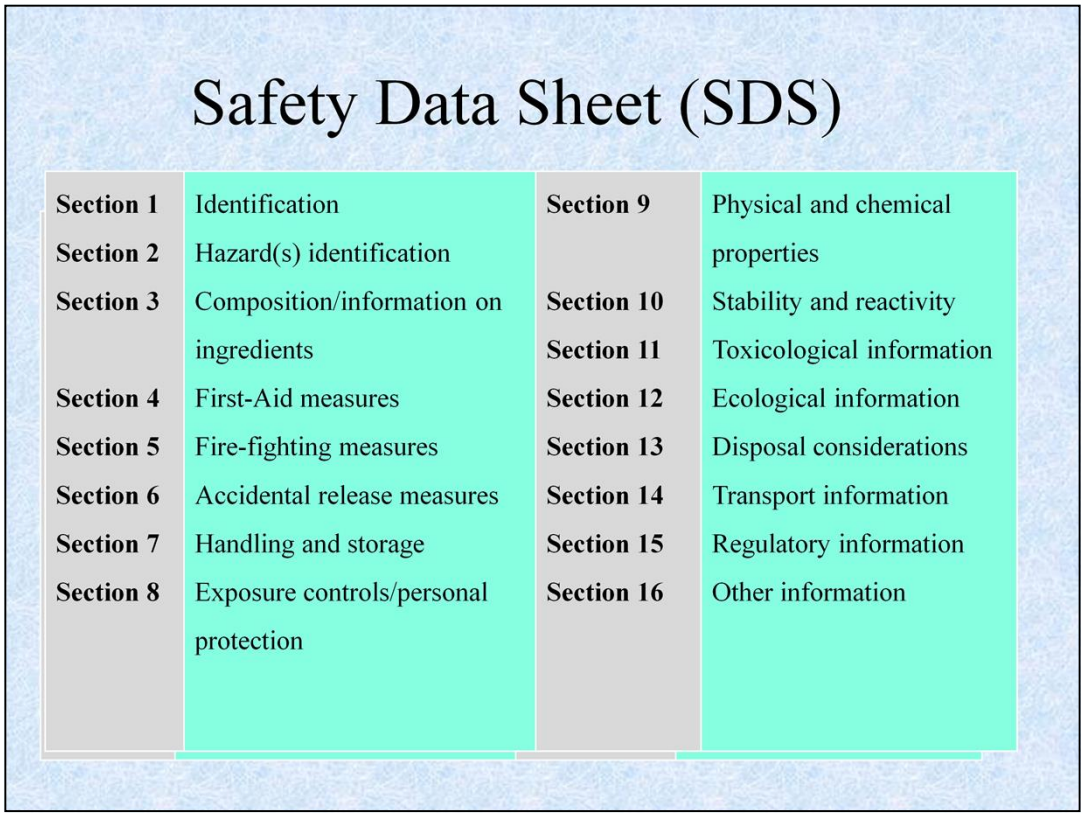
I need to clarify and talk to you about the GHS system first

We have two main ways to talk about the dangers of a substance: container labels and SDS (formerly MSDS). The safety data sheet is an essential part of basic workplace safety.

now because of the global economy, we have a system to standardize safety, health and environmental information on substances so that people around the world get the same information about the dangers. That system is called GHS.

The purpose of the GHS is to provide a universal approach to defining hazards, classifying substances, and communicating hazard information and protective measures to employers and employees throughout the world.

Under the GHS, a "substance" is defined as a chemical element and its compounds in the natural state or obtained by any production process, including any additive necessary to preserve the stability of the product (and any impurities deriving from the process used, but excluding any solvent that may be separated without affecting the stability of the substance or changing its composition). "Mixtures" are defined as mixtures or solutions composed of two or more substances in which they do not react.



The basic goal of hazard communication is to ensure that employers and employees are provided with adequate practical, reliable, and comprehensible information on the hazards in the use of chemical substance

the SDS is the principal tool to do this information

The sds have sixteen section, the main, for me, are:

The first section of the SDS identifies the chemical or mixture as well as the manufacturer or distributor. The most important information that you find in this section is:

- An emergency phone number for obtaining information about spills and other accidents 24 hours a day, 7 days a week.

Properly identifying a product and its recommended uses is an important part of working safely with the chemical. Information about the supplier and an emergency number is critical, especially in the event of an accident involving the product.

The second section of the SDS identifies hazards of the chemical or mixture. This section includes the following information.

- The hazard classification of the chemical or mixture and any national or regional information is provided. Hazard classifications include physical hazards such as flammable or reactive, health hazards such as toxic or cancer-causing, and environmental hazards such as hazards posed to an aquatic environment.
- It is important to identify the hazards of the substances you work with.

Information about chemical composition and ingredients is provided in **Section 3**. The

section provides information relevant to both substances and mixtures

In **Section 4**, you will find:

- A description of necessary first-aid measures categorized, to the different routes of exposure—inhalation, skin and eye contact, and ingestion;

- The most important symptoms and health effects, both acute and delayed; and

- The need for immediate medical attention and special treatment when required.

It's important to know proper first aid for exposures. Whether it's you or a co-worker who is exposed to a substance, quick, effective, on-the-spot treatment greatly increases the chance of a full recovery.

Section 5 contains information about fighting fires caused by the substance

Section 6 tells you what to do in the event of an accidental release.
For example:

- Personal precautions and personal protective equipment;

- Emergency precautions;

- Environmental procedures; *and*

- Methods and materials of containment and cleanup.

In Section 7 you'll learn about safe handling and storage requirements, including:

- Precautions for safe handling of the substance; *and*
- Conditions for safe storage, such as identifying incompatibilities and what substances need to be stored elsewhere.

- And so on….

HCS Pictograms and Hazards

Health Hazard	Flame	Exclamation Mark
		
• Carcinogen • Mutagenicity • Reproductive Toxicity • Respiratory Sensitizer • Target Organ Toxicity • Aspiration Toxicity	• Flammables • Pyrophorics • Self-Heating • Emits Flammable Gas • Self-Reactives • Organic Peroxides	• Irritant (skin and eye) • Skin Sensitizer • Acute Toxicity (harmful) • Narcotic Effects • Respiratory Tract Irritant • Hazardous to Ozone Layer (Non Mandatory)
Gas Cylinder	**Corrosion**	**Exploding Bomb**
		
• Gases under Pressure	• Skin Corrosion/ burns • Eye Damage • Corrosive to Metals	• Explosives • Self-Reactives • Organic Peroxides
Flame over Circle	**Environment (Non Mandatory)**	**Skull and Crossbones**
		
• Oxidizers	• Aquatic Toxicity	• Acute Toxicity (fatal or toxic)

There are nine pictograms under the GHS to convey the health, physical and environmental hazards.

The Hazard Communication Standard requires pictograms on labels to alert users of the chemical hazards to which they may be exposed. Each pictogram consists of a symbol on a white background framed within a red border and represents a distinct hazard(s). The pictogram on the label is determined by the chemical hazard classification

Know the chemicals - read the labels

- With synthetic phrases and clearly visible symbols
- Accurate, clear information and above all should not mislead those who read them

In addition to the safety data sheet, some information can be obtained from the labels directly placed on the containers.

Unlike the safety data sheet, the information we find on the labels is a first useful information especially for the purpose of manipulation in the laboratory.

In fact, on the labels we find the pictograms related to the hazard information, the danger phrases and the precautionary statements

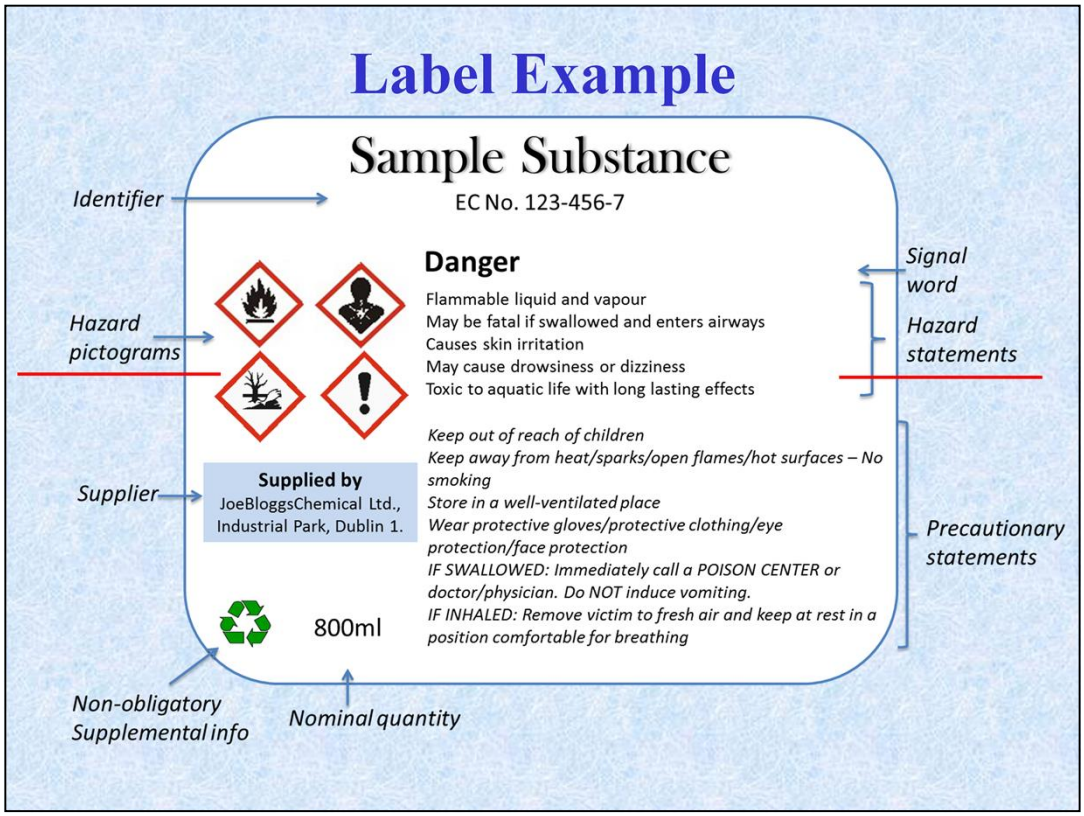
Not always there is more information on the toxicity of the substance and on actions, for example, to be implemented in case of fire or, for example, spillage.

Oltre alla scheda tecnica di sicurezza alcune informazioni le possiamo ricavare dalle etichette direttamente poste sui contenitori.

A differenza delle scheda di sicurezza, le informazioni che troviamo sulle etichette sono una prima informazione utile ai fini soprattutto della manipolazione in laboratorio.

Infatti sulle etichette troviamo i pittogrammi legati alle informazioni di pericolo, le frasi di pericolo e i consigli di prudenza

Quindi non si hanno informazioni più dettagliate sulla tossicità della sostanza e sulle azioni , ad esempio, da attuare in caso di incendio o, ad esempio, di sversamento



An example of label

Hazard statements - precautionary statements

At each Danger / Prudence Indication there is a unique alphanumeric code, consisting of a letter followed by three numbers:

letter H warning of hazard - letter P advice precautionary,

the first number indicates the type of Hazard or Precautionary,

the two following numbers correspond to the sequential order of the Hazard or the Precautionary

Example :

Hazard statement H	Precautionary statement P
H2.. - physical chemical hazards H3.. - health hazards H4.. - environmental hazard	P1.. - general character P2.. - prevention P3.. - reaction P4.. - storage P5.. - disposal

Another important parameter that introduced the GHS system is the classification of the indications of Hazard and the Precautionary statements. The indications of hazard are an alpha numeric code represented by the letter H followed by a series of numbers. Of these numbers the first has a very specific meaning that I always suggest to everyone to keep in mind, in fact if the first number is a 2 the substance will have a physical chemical hazard, if the first number is a 3 the substance will have an hazard characteristic for the health of the operator and finally if the first number is a 4 the substance will have a characteristic of hazard to the environment.

In this way it will be possible, remembering only 3 numbers, to have a quick information on the main hazard characteristics that the substance we are using.

Then, again as part of the harmonization of information, the GHS system provides a series of precautionary statements, there are 5, which are also represented by an alphanumeric code represented by the letter P followed by a series of numbers.

INDICATIONS FOR THE USE OF CHEMICAL SUBSTANCES

1. Choose the less hazardous
2. Use limited quantities
3. Keep them in their original packaging
4. Avoid mixing with other products
5. Inform workers about the characteristics and use of substances
6. Provide DPC collective protection devices
7. Provide personal protective equipment PPE.
8. Keep the dressing package available
9. Prepare operational protocols to be followed in case of emergency or accident

Here are the indications for the selection and use of chemical substances in the laboratory.

The priority will have to be on the choice of the less hazardous substances and then on the limitation of the use of the only quantities necessary for the activity:

When possible, the substances should be stored in their original packaging so as not to put in mistake the user,

if necessary you should prefer the choice of the minimum quantity in use but at the same time provide for labeling of the container of the withdrawn aliquot corresponding to the minimum safety requirements which are: substance name, hazard characteristics, concentration or title, any added substances, and if possible, pictograms of safety.

It is important to know the possible incompatibilities of the substances in use so as to avoid mixtures with other products that increase the danger of the system.

Among the fundamental preventive measures that must be provided for the correct use of chemical substances, a separate chapter I want to dedicate to collective protection devices and one to personal protection devices

Carcinogenic or mutagenic chemical agents

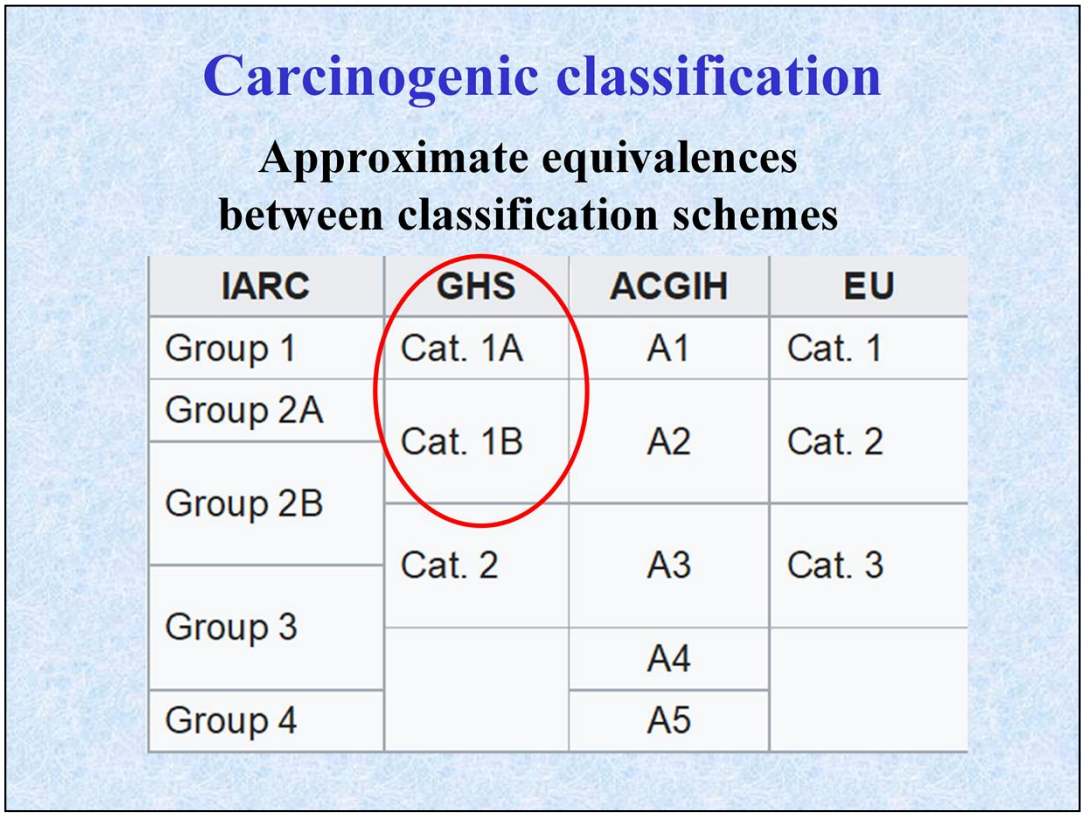
- They are chemical substances capable of altering the genetic material of a cell, making it able to develop a tumor following a more or less prolonged exposure over time
- Compared to other chemical agents, exposure makes a damage is significantly higher

They are chemical substances capable of altering the genetic material of a cell, making it able to develop a tumor following a more or less prolonged exposure over time

Compared to other chemical agents, exposure makes a damage is significantly higher

Sono sostanza chimiche in grado di alterare il materiale genetico di una cellula rendendola capace di sviluppare un tumore in seguito ad una esposizione più o meno prolungata nel tempo

Rispetto agli altri agenti chimici ad un'esposizione segue un danno significativamente più elevato



Many organization have a classification of possible carcinogens

The Globally Harmonized System of Classification and Labelling of Chemicals (GHS) classifies carcinogens into two categories, of which the first may be divided again into subcategories :

Category 1: known or presumed to have carcinogenic potential for humans

Category 1A: the assessment is based primarily on human evidence

Category 1B: the assessment is based primarily on animal evidence

Category 2: suspected human carcinogens

It is important to remember the reference pictogram and the hazard code H which is H350

Ecco un esempio di etichetta di una sostanza cancerogena: vedete sia il pittogramma che li codice di pericolo H350

Here is an example of a carcinogen label: see both the pictogram and the H350 hazard code

Mutagenic classification

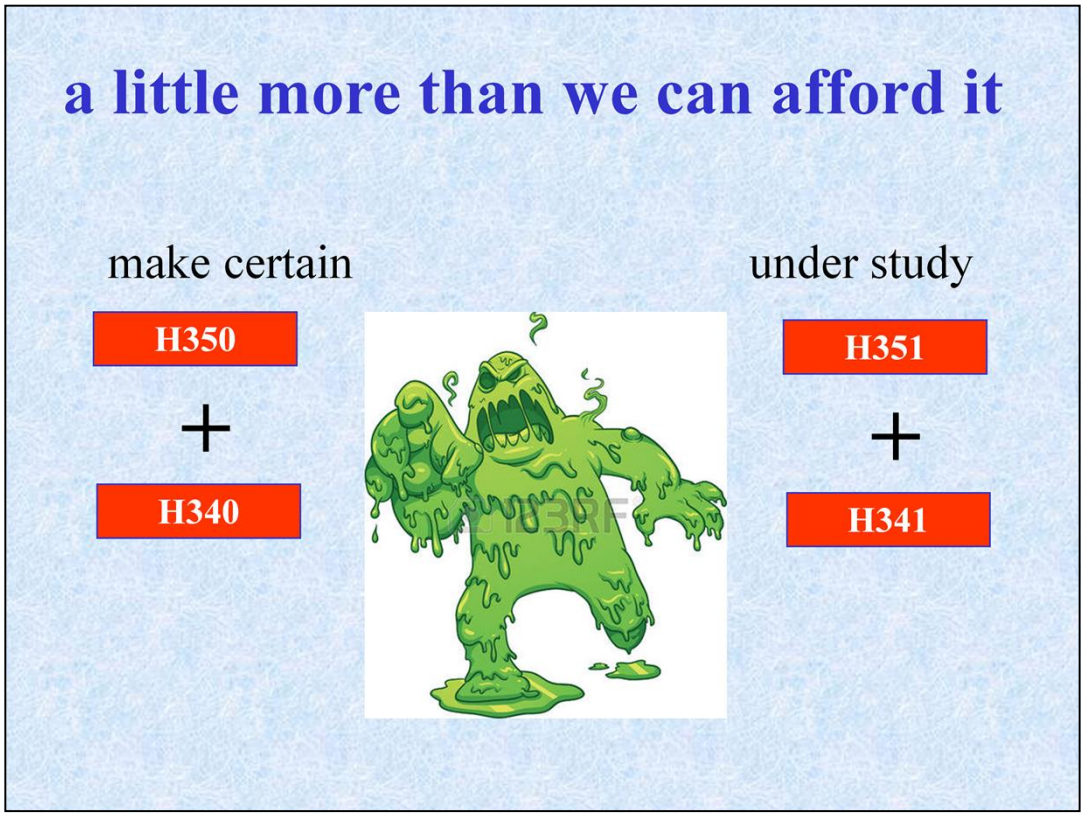
GHS	EU
Cat. 1A	Cat. 1
Cat. 1B	Cat. 2
Cat. 2	Cat. 3

label and safety data sheet

H340

Mutagens are those agents that cause mutations or alterations in the genetic material, thus damaging that encoded set of information that is present in every cell and that is responsible for the various biochemical processes and the transmission of inherited traits. Mutagens can act essentially in three ways: causing changes in the chemical composition of DNA, causing alterations in the physical re-arrangement of this macromolecule or causing the fusion or loss of entire chromosomes.

the classification distinguishes three different categories: to the first belong the substances definitely mutagenic to humans; to the second those which must be assimilated to human mutagens on the basis of studies conducted on animals; to the third belong those for which the studies have given worrying results, but not sufficient to register them in the second category.



Come avete visto dalla classificazione delle sostanze cancerogene noi le possiamo dividere in due macro gruppi: quelle che sono sicuramente cancerogene o mutagene e che sono classificate H350 o H340, poi c'è il gruppo delle sostanze cancerogene o mutagene per le quali ancora non c'è certezza che non siano tossiche perché sono ancora in fase di studio;

ecco io chiedo sempre ai colleghi ricercatori di considerare come cancerogeni tutte quelle sostanze che ancora sono in fase di studio così da tutelarci al massimo

As you have seen from the classification of carcinogens we can divide them into two macro groups: those that are certainly carcinogenic or mutagenic and that are classified H350 or H340, then there is the group of carcinogens or mutagens for which there is still no it is certain that they are not toxic because they are still under study;

here I always ask my fellow researchers to consider as carcinogenic all those substances that are still under study so as to protect us to the maximum

these substances are classified by the hazard code H351 for cacerogens and mutagenic substances with the code H341

Fume hoods

The fume hood has the purpose of preventing the diffusion of vapors and / or gases, reducing the risk of inhalation by the operator

The choice must be made based on the type of pollution that can be developed and on the basis of the environment in which the hood is placed

Almost all liquid chemicals must be managed under a hood

The fume hoods are protective devices that are designed to prevent the spread of vapors and /or gases, reducing the risk of inhalation by the operator

Keep in mind that chemical hoods are a very simple equipment to use, what makes the difference is the operator who uses them, the correct methods of use.

It is important to know the type of substance to be used and especially the physical state and toxicity

The physical state because the hood is a system that sucks the air outside its box so that, when the operator uses it, it is not affected by vapors or pollutants, while these are sucked out.

The other benchmark for substances that are used under the hood is the toxicity of the substance itself because technical standards that classify the chemical hoods on the velocity of aspiration of the frontal flow in relation to the TLV.

"threshold limit value" or TLV are the environmental concentrations of airborne chemical substances below which it is believed that most workers may be repeatedly exposed day after day, for a working life, without any negative effect on the health - TLV values for the various substances are published each year by the American Association of Industrial Hygienists (ACGIH)

Important: the chemical hoods are not suitable for the operator's protection deriving from the use of biological agents, in that case they need bioHazard hoods

When I must to use a fume hood

- When handling chemicals with **significant inhalation hazards** such as toxic gases, toxic chemical vapors, volatile radioactive material, and respirable toxic powders
- When carrying out experimental procedures with **strong exothermic reactions**
- When handling **chemicals with significant vapor pressure**
- When chemical vapors generated **could cause a fire hazard**
- When working with compounds that have an **offensive odor**

The fume hood must always be used when handling chemicals with **significant inhalation hazards** such as toxic gases, toxic chemical vapors, volatile radioactive material, and respirable toxic powders

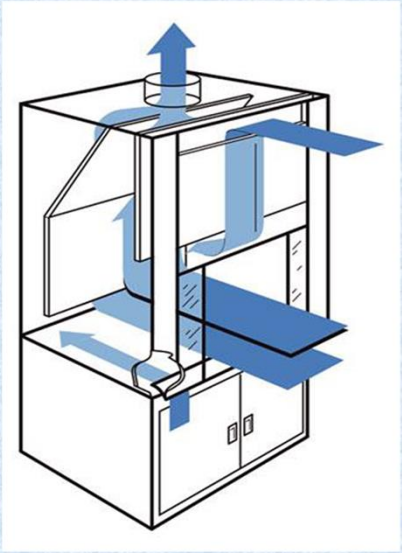
When carrying out experimental procedures with **strong exothermic reactions**

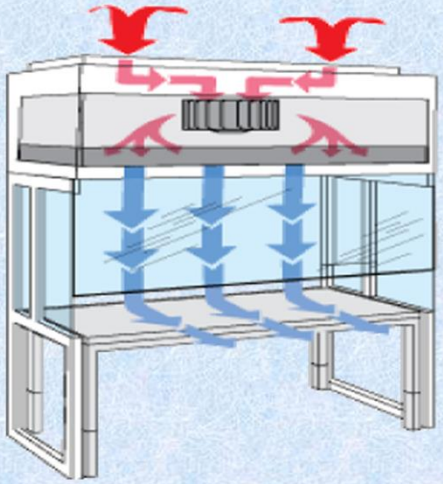
When handling **chemicals with significant vapor pressure**

When chemical vapors generated **could cause a fire hazard**

When working with compounds that have an **offensive odor**

Chemical fume hood and biological hood





The chemical hood and the biological hood are extremely different in concept and therefore it is important to recognize them and not to be mistaken in their use

The chemical hood, we said, serves to protect the operator and the air flow enters the hood and moves by dragging out any pollutants outwards.

The biological or laminar flow hood has a unidirectional air flow formed by threads of sterile air, parallel to each other, all moving at the same speed, generally of 0.5 m / sec, generating a homogeneous air flow, without turbulence . The threads of sterile air drag contaminants away from the working area and prevent vortex formation. The flow of air is sterile because it is filtered through HEPA filters.

A biological hood has the primary function of protecting the sample and the work surface from possible contamination.

Type of fume hoods

Hood channeled to the outside, also called conventional hood. This type of chemical hood is equipped with an external electric fan positioned at the end of the exhaust duct

Recirculating hood, also called unconventional hood. This type of chemical hood is equipped with an electric fan and a filtering unit.

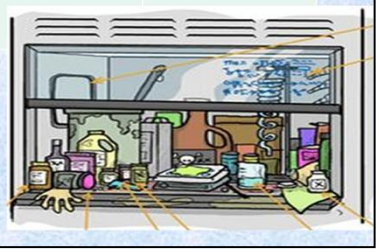
Another important distinction that we need to know concerning the chemical hoods involves the suction mode, or rather the connection to the suction system.
We can distinguish two types of chemical hoods: the hood that is directly connected to the outside: also called conventional hood. This type of chemical hood is equipped with an external electric fan positioned at the end of the exhaust duct so that the vapors are directly expelled to the outside. It is clear that this system is the best solution from the point of view of safety for operator protection. A small filtering system may be provided for before the emission of air expelled into the atmosphere if the substances are extremely toxic and / or the legislation foresees it.
There are also hoods that do not directly emit the vapors aspirated outside, but have a filter through which the air sucked passes before being introduced into the same work environment.

This system is simpler and more versatile, but it has limitations because the substances that will be used must be well defined and they must not have incompatibility with each other and with the filtering material, they also require a well-planned maintenance of filters.

Classification of chemical hoods

Activity	TLV (mg/Nm3)	Front opening height (cm)	Front speed (m/s)	SAMA
Negligible toxicity	> 300	40	0,4	C
Moderate toxicity	< 300	40	0,5	B
Toxic and / or moderately carcinogenic substances	< 50	40	0,7	A
High toxicity and / or carcinogenic substances	<1	GLOVE BOX		

Periodic flow controls should be done according to the UNI reference standards (UNI EN 14175 Standard)



The chemical hoods are classified in relation to the average velocity measured on the font light and this datum is related to the toxicity of the substances used expressed as TLV and it is possible to have up to 4 categories of hoods

In detail we must know that the front speed must be at least above 0.4 m / s (80 fpm), if less than this value the ability to protect us is zero, the ideal as front speed is 0.6 - 0.7 m / s (120 - 135 fpm), with this speed we can also think of using very toxic chemicals with a TLV <50 ppm

Le cappe chimiche vengono classificate in relazione alla velocità media misurata sulla luce fontale e questo dato viene messo in relazione con la tossicità delle sostanze utilizzate espressa come TLV ed è possibile avere fino a 4 categorie di cappe

Nel dettaglio dobbiamo sapere che la velocità frontale deve essere almeno superiore a 0,4 m/s (80 fpm) , se inferiore a questo valore la capacità di proteggerci è nulla, l'ideale come velocità frontale è 0,6 – 0,7 m/s (120 – 135 fpm), con velocità di questo tipo possiamo anche pensare di utilizzare sostanze chimiche molto tossiche con un TLV < 50 ppm

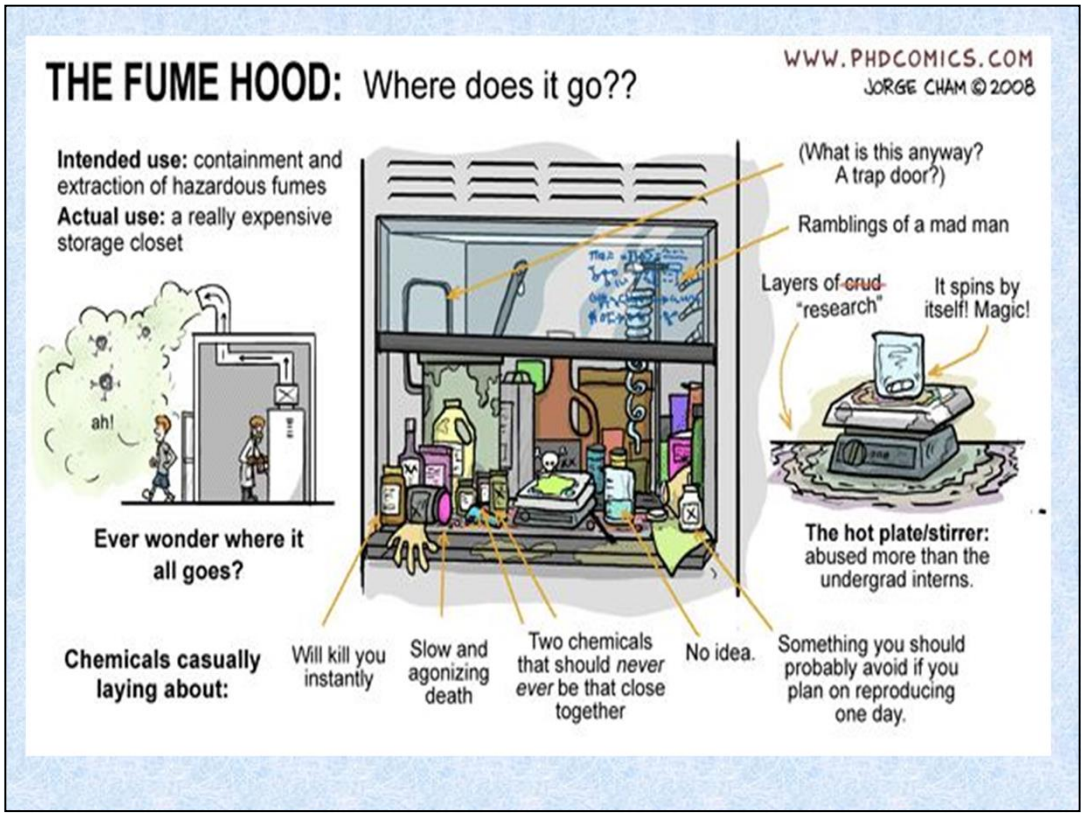
Rules to use of fume hoods

- operations with dangerous chemicals must be carried out under the hood
- always leave the hood in operation
- the hood must be positioned away from any source of air turbulence
- verify that the hood is operating
- lower the front screen at least about 40 cm from the worktop and in any case lowered as far as possible
- work standing or sitting upright, avoiding to lean over the working area with your head.
- do not use the hood as a deposit of substances
- the electrical devices introduced must be supplied from outside and must be certified as suitable for explosive atmospheres
- reduce to an absolute minimum the tools and materials present in the work area to minimize turbulence
- keep only the material strictly necessary for the experiment under the hood

(http://www.youtube.com/watch?v=q2Pp3wge2j8)

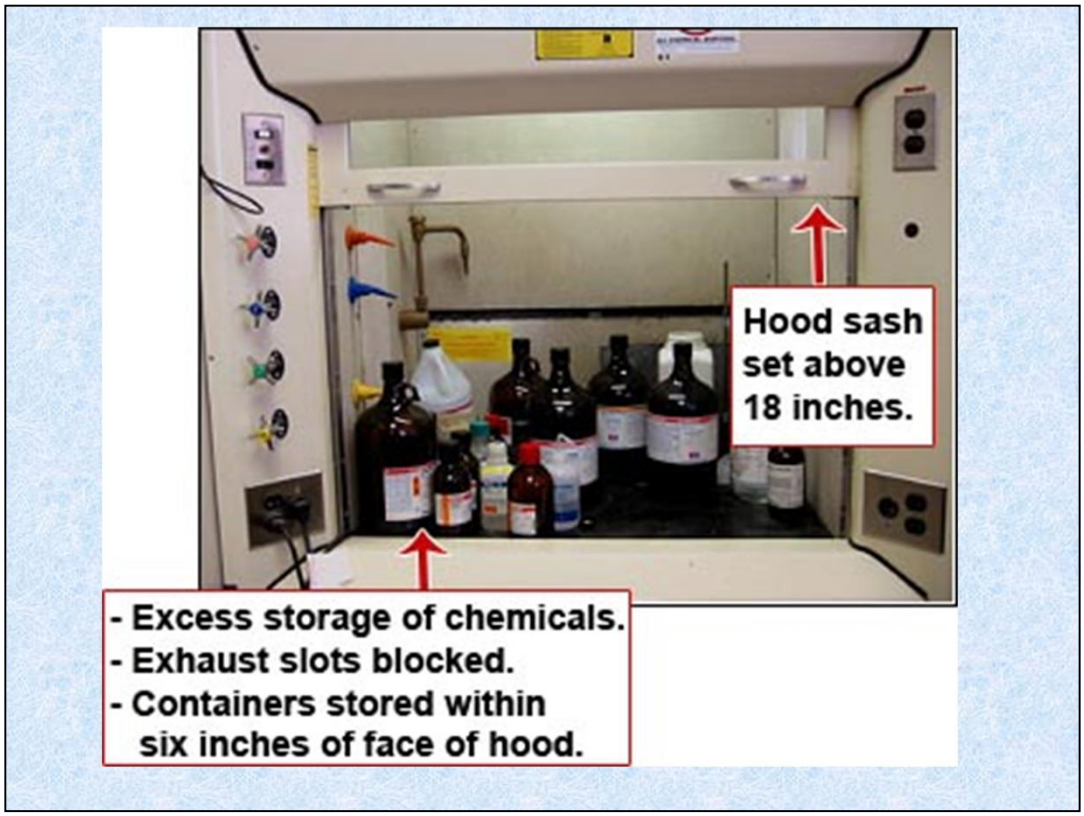
Here are the main ways to use the chemical hoods:
- operations with dangerous chemicals must be carried out in a hood
- the hood must always be in operation
- the hood must be positioned away from any source of air turbulence, the technical standard linked to the correct positioning of the hoods foresees that there is a minimum distance from windows, doors and any other possible opening that may affect the air inlet in the hood compartment
- before using a hood it is important to check that the hood is operating and that it draws air and this is done simply by using a small piece of paper by placing it at the opening and seeing if it is waving
- to work safely, it is necessary to lower the front screen at least about 40 cm from the worktop and, in any case, lowered as much as possible, the air speed is strongly influenced by the opening of the front screens
- you have to work standing upright and never sitting, it is forbidden to introduce the head inside the work area
- the hood must not be used as a deposit of substances or waste
- all the electrical equipment introduced must be supplied from outside and must be certified suitable for explosive atmospheres (ATEX)
it is important to reduce the tools and materials present in the work area to the minimum necessary to minimize turbulence and only keep the material strictly necessary for the experiment under the hood

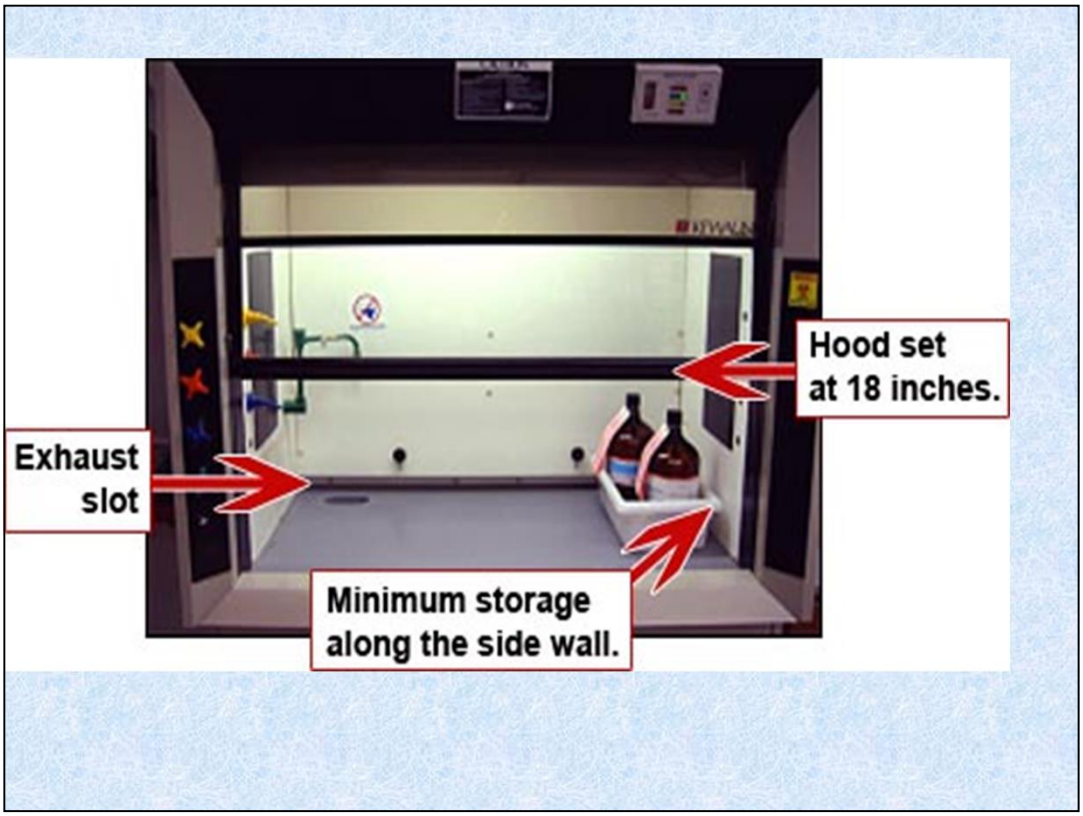
Below I wanted to show you some demonstrative photos

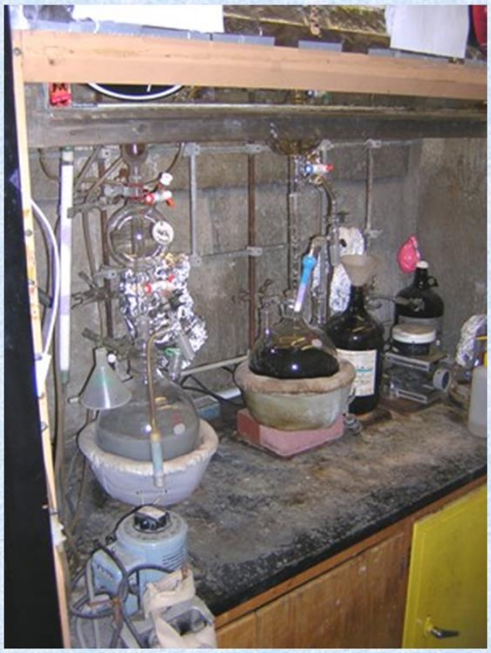


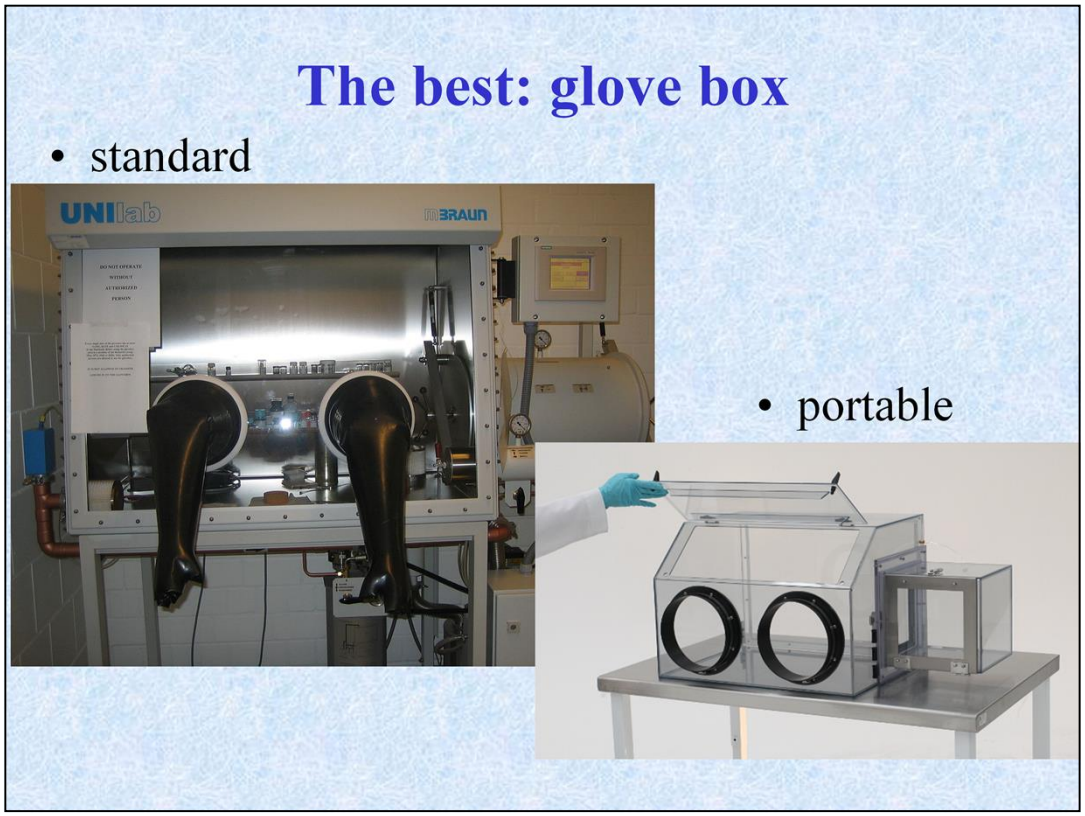
Questa vignetta mi piaceva e mi serve per introdurre le principali regole per un corretto utilizzo delle cappe chimiche

This sticker I liked and I need to introduce the main rules for the proper use of chemical hoods


Hood sash set above 18 inches.
- Excess storage of chemicals.
- Exhaust slots blocked.
- Containers stored within six inches of face of hood.


Hood set
at 18 inches.
Exhaust
slot
Minimum storage
along the side wall.





Surely if you have a glove box you can think of using any type of substance in complete safety without having to wear any personal protective equipment.

But I wanted to point out that, in addition to the classic glove boxes, there are commercially available glove boxes that can be purchased at a low price, also placed on a counter, depending on the needs can surround measuring instruments such as scales, equipment for the crushing of powders, the mixing of powders, in other words those conditions where particulate matter is handled, and which in this way I can contain with regard to volatility

Sicuramente se disponete di una glove box potete pensare di utilizzare in sicurezza qualunque tipo di sostanza in tutta sicurezza senza dover indossare nessun dispositivo di protezione individuale.

Volevo però segnalarvi che, oltre alle glove box classiche, esistono in commercio delle glove box più economiche che possono essere acquistate a poco prezzo, posizionate anche su un bancone, a seconda delle necessità possono circondare strumenti di misura (ad esempio come bilance, apparecchiature per la frantumazione di polveri, miscelazione di polveri, insomma quelle condizioni dove si manipolano sorattutto polveri e che in questo modo riesco a contenere per quanto riguarda la volatilità

Chemical safety cabinets

- Special safety cabinets, suitable for the type of hazard
- Keep in the lab quantities of flammable substances limited to use (external storage for larger quantities)
- Keep incompatible substances separate
- No chemical must be eliminated through the sewage system

Other important equipment that must be present in a laboratory, and should not be confused with a simple piece of furniture, are the safety cabinets for the storage of chemical substances. These, like the chemical hoods, can also be connected to the extraction system towards the outside or can be equipped with a filtering system.

The cabinets must not be positioned along escape routes, near emergency exits and in any case must be far from free flames (bunsen, stoves, etc.), and must not hinder the reaching of emergency devices (fire extinguishers, first aid, eyewash showers, etc.).

A segregation of simple but effective chemical products is to subdivide chemical agents according to their hazard classes and compatibility in: acids, bases, flammables and toxic

for the storage of flammable substances, fire safety cabinets must be used in accordance with the specifical technical standard

for the storage of toxic substances, safety cabinets with outward suction must be used that guarantee a high number of air changes now

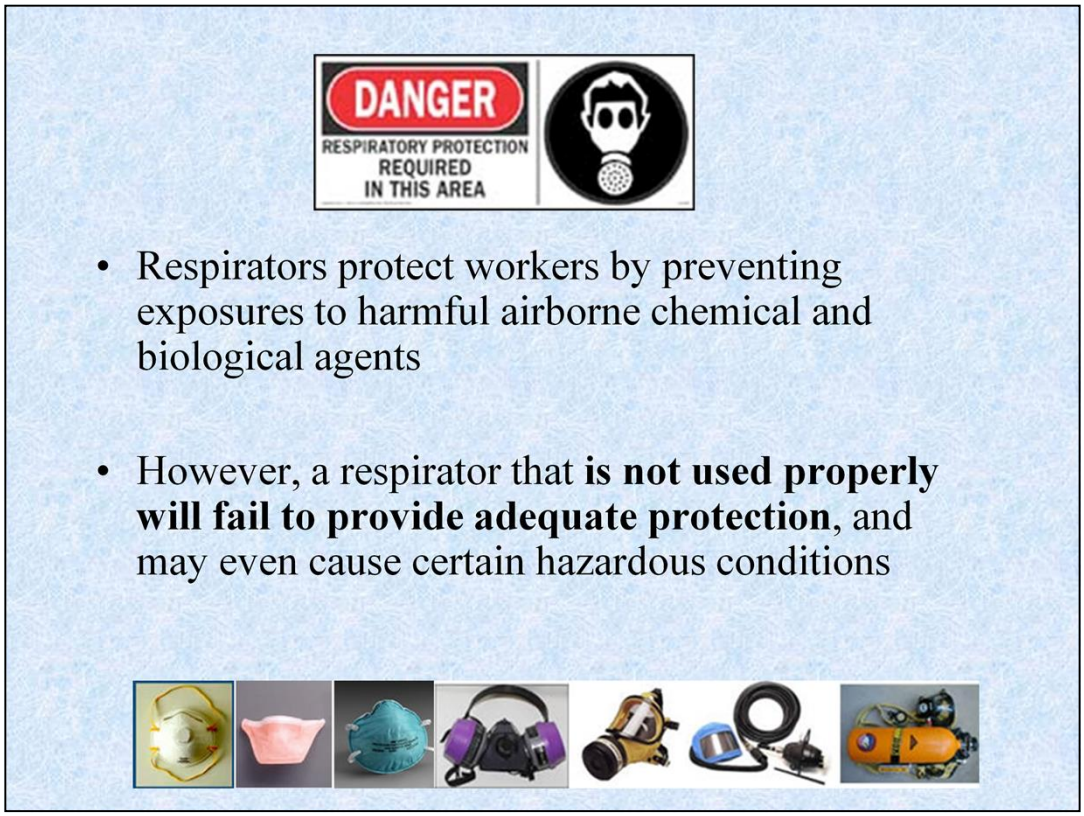
A list of the contained products must be placed at each cabinet, with relative indications of danger and update date of the list itself.

Chemical agents must be arranged in such a way that: corrosive, caustic and irritating agents are below eye level; in the lower shelves, place the largest containers and the most dangerous substances; the containers are not stacked one on top of the other and do not overload the shelf; any special indications indicated in the safety data sheet under the heading Manipulation and Storage including incompatibilities are observed.

Personal protective equipment

- Any equipment intended to be worn by the worker in order to protect him against risks
- Protect the head, eyes and / or face, hearing, respiratory tract, upper limbs, body, lower limbs and falls from a height
- They must be adequate to risks, to working conditions and to take into account the worker's ergonomic and health needs
- Well preserved and always effective

The term "personal protection equipment" (acronym PPE) refers to products that have the function of safeguarding the person who wears it from risks to health and safety
PPE must:
be adapted to the conditions at the workplace
be adequate to the risks to be prevented, without posing a greater risk for the worker
take into account the ergonomic needs and health of the worker
PPE are divided into three categories, depending on the type of risk, those that interest us and we are talking about are those of the first category, namely those that are easy to design and designed to protect users from minor damage.
It is the employer's duty to provide the most appropriate PPE for risks and working conditions, this choice is made based on the results of the risk assessment.
It is then the duty of the worker to keep them in an efficient manner



Respirators protect workers by preventing exposures to harmful airborne chemical and biological agents

However, a respirator that **is not used properly will fail to provide adequate protection**, and may even cause certain hazardous conditions

PPE to respiratory protection

- They are used to protect against potentially harmful aeriform substances:
  - disposable dust masks (face mask) - EN149 compliance rules
  - half-masks - EN140 compliance rules
  - full face masks - EN136 compliance rules
- The **filters** are then classified with a code (depending on the type), with a number (from 1 to 3 based on filtering power), and by color:
  - FFA antigas (1 ÷ 3)
  - dustproof FFP (1 ÷ 3)
  - Combined FFA (1 ÷ 3) P (1 ÷ 3)

Below I want to illustrate the basics of three types of DPI that are those that are definitely more used and necessary in a chemical laboratory

Start from PPE to protect the respiratory tract, serve to protect against potentially harmful aeriform substances (gases, powders, vapors) and to allow normal breathing

They are classified as follows:

filter - disposable dust masks (face mask) - European conformity standards: EN 149: 2001

half-masks - EN140 compliance rules

full face mask class with bayonet filter connection and visor according to EN136: 2001

Then there are the scuba divers, but I do not want to talk about it because I would open a chapter too big and in this area also useless

On the other hand, it is important to know the abbreviations linked to the filters: the filters are then classified with a code (depending on the type), with a number (from 1 to 3 depending on the filtering power), and with a color (based on the substance that filter), and are divided as follows:

antigas FFA (1 ÷ 3) (EN 14387) - Absorption with a chemical reaction in catalysis

dustproof FFP (1 ÷ 3) (EN 143)

combined FFA (1 ÷ 3) FFP (1 ÷ 3)

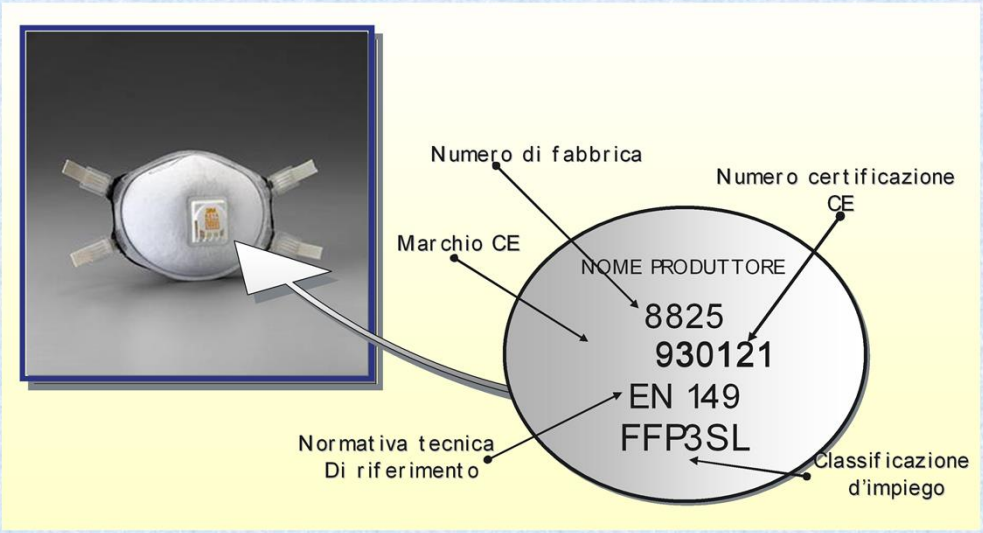
Example of Half mask with combined filter gas (low power) and dust (high power): A1P3

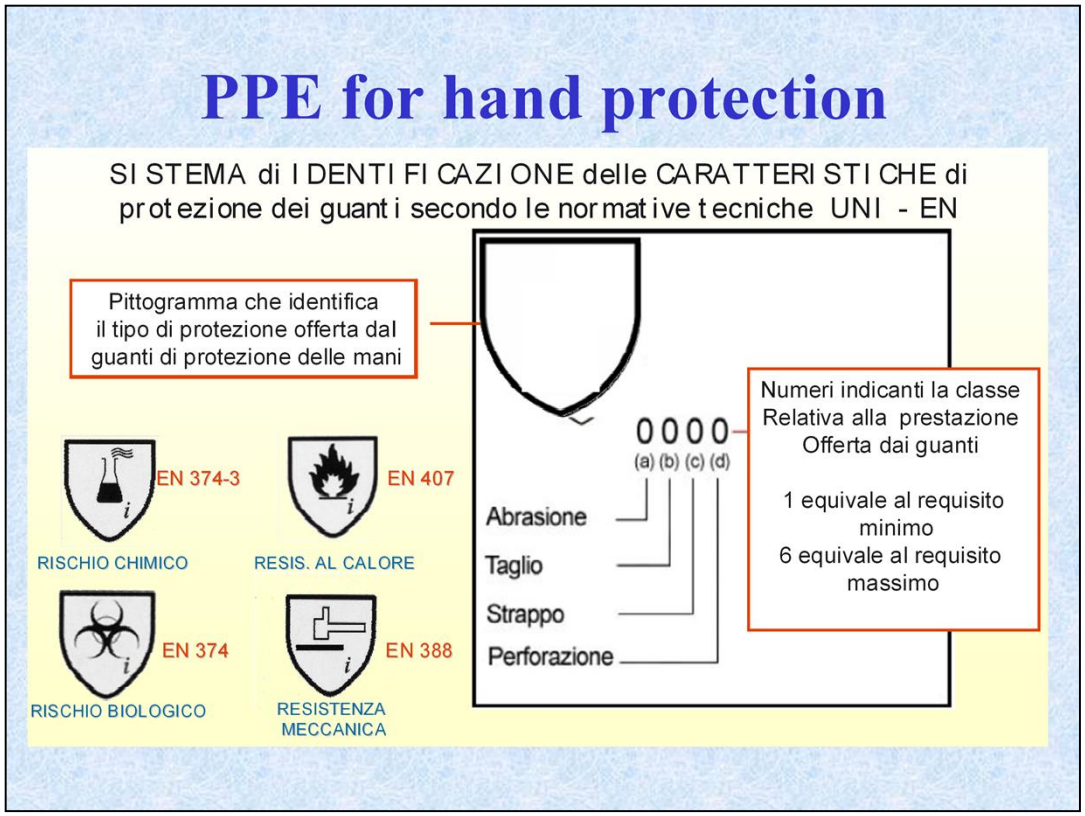
Face mask

half-mask

full face mask

HOW TO READ THE FILTERING FACIAL LABEL





The devices for the protection of the upper limbs concern in particular the hands, more exposed t

Gloves - EN420 compliance rules

Mechanical and electrostatic risks - EN388 conformity rules

Chemical and microbiological risks - EN374 compliance rules

Cold hazards - EN511 compliance rules

Heat and fire hazards - EN407 compliance rules

The gloves can be made in different materials:

Nitrile, vinyl, polyethylene or latex (to protect against the absorption of chemicals)

vinyl or neoprene rubber (to protect against corrosive chemical elements such as acids and / or al

leather, coated nylon (to protect against mechanical risks)

La resistenza chimica: la norma EN 374

Eye and Face Protection

Esempio di marcatura di occhiali (interno della bacchetta)

I EN 166 CE 3 F

I: identificazione del fabbricante
EN 166: norma di riferimento
CE: marcatura di conformità
3: campo di utilizzo
F: resistenza meccanica

Eyes are subject to various risks: splinters, hot or caustic or corrosive materials, radiation, which can lead to three types of injury: mechanical, optical and thermal. To protect these delicate organs we use PPE of the type:

Eyewear - EN166 compliance rules

Masks - EN166 compliance rules

Visors - EN166 compliance rules

Screens - EN166 compliance rules

possibly combined with:

Ultraviolet rays filters - EN170 compliance rules

Radiation damage differs according to the type of light emitted:

blue light: penetration of the retina;

infrared: corneal deformation;

ultraviolet: redness of the eyes.

Eye and Face Protection

Regular glasses or sunglasses are not appropriate SAFETY GLASSES

Hydrofluoric acid

In addition to being a highly corrosive liquid, hydrofluoric acid is also a powerful contact poison. Because of the ability of hydrofluoric acid to penetrate tissue, poisoning can occur readily through exposure of skin or eyes, or when inhaled. Symptoms of exposure to hydrofluoric acid may not be immediately evident, and this can provide false reassurance to victims, causing them to delay medical treatment.

HF interferes with nerve function, meaning that burns may not initially be painful. Symptoms of HF exposure include irritation of the eyes, skin, nose, and throat, eye and skin burns, rhinitis, bronchitis, pulmonary edema (fluid buildup in the lungs), and bone damage.

Once absorbed into blood through the skin, it reacts with blood calcium and may cause cardiac arrest. Burns with areas larger than one hundred and sixty square inches have the potential to cause serious systemic toxicity from interference with blood and tissue calcium levels.

In the body, hydrofluoric acid reacts with the biologically important ions Ca^{2+}.

We have the general documents «Do's and Don'ts Poster (EN, DE, ES, FR, IT, NL, PL, RU, SE, TR, UA)»

Calcium gel 2.5%

- antidote with priority 2 in fluoride intoxications
- not available on the market,

at least in Italy

Il miglior antidoto per le ustioni da acido fluoridrico consiste nell'uso del gel di gluoconato di calcio al 2,5%

Per la farmacopea italiana non è disponibile in commercio perché il gel non è stabile, viene prodotto dalle farmacie ospedaliere

The best antidote for hydrogen fluoride burns is the use of 2.5% calcium gluoconate gel

The calcium gluconate, a source of Ca^{2+} sequesters the fluoride ions. HF chemical burns can be treated with a water wash and 2.5% calcium gluconate gel or special rinsing solutions. However, because it is absorbed, medical treatment is necessary; rinsing off is not enough. Intra-arterial infusions of calcium chloride have also shown great effectiveness in treating burns.

For the Italian pharmacopoeia it is not available on the market because the gel is not stable, it is produced by hospital pharmacies

In a period of my life I produced the antidote in the laboratory for colleagues who used the HF

Strong acids

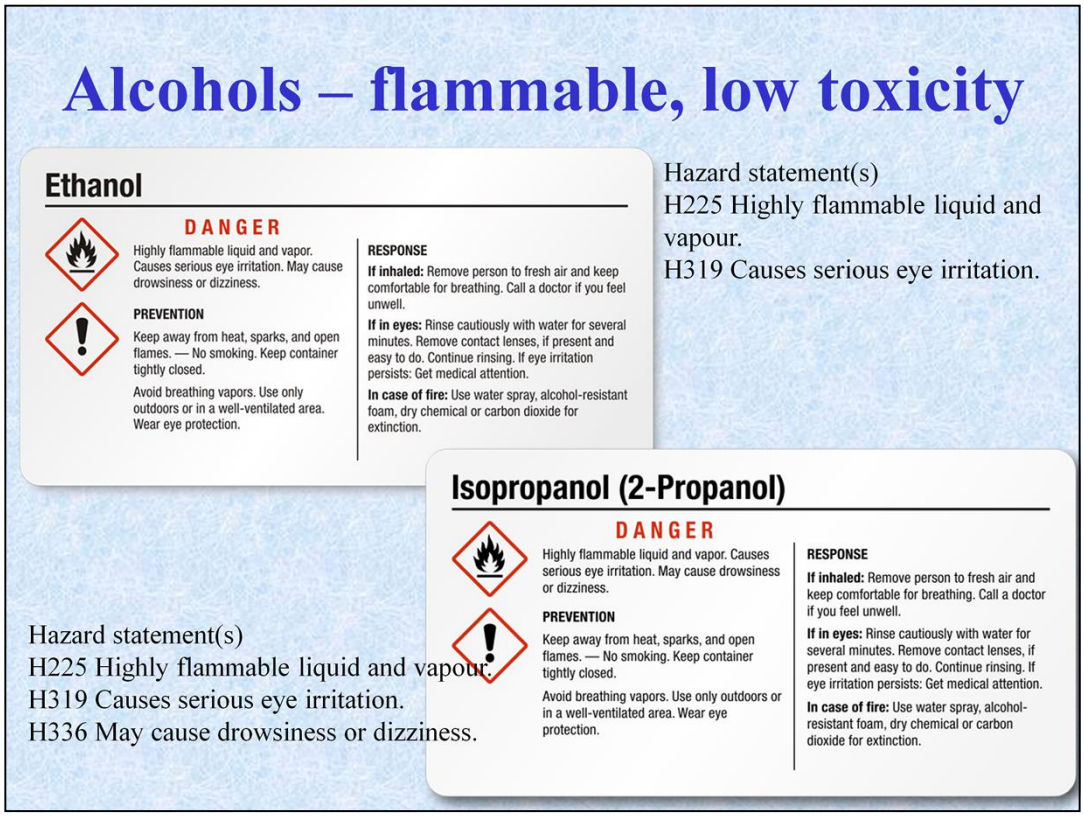
- Dilutions and rackings
  - Always add the acid to the water and not vice versa

This family of substances has not been indicated to me, but I want to point out to you the correct way to dilute a strong acid in water

This is because there is a proper way to perform the dilution and sometimes we forget it, very often nothing happens because the quantities involved are small but I want to point out this aspect because it is not underestimated and then because I often found myself with the doubt about the correct procedure to follow

Questa famiglia di sostanze non mi è stata indicata, ma voglio lo stesso segnalarvi la corretta modalità di diluizione di un acido forte in acqua

Questo perché esiste una corretta modalità di effettuare la diluzione e a volte ce ne dimentichiamo, molto spesso non succede nulla perché le quantità in gioco sono piccole ma voglio lo stesso puntualizzare quest'aspettp perché non vnga sottovalutato e poi perché anch'io spesso mi trovata con il dubbio sulla corretta procedura da seguire



Among the substances we are talking about today these are definitely the least dangerous and those that are most used.

Two things to keep in mind: the level of flammability of the substances themselves and their vapors, and their dangerousness in case of accidental contact with the eyes

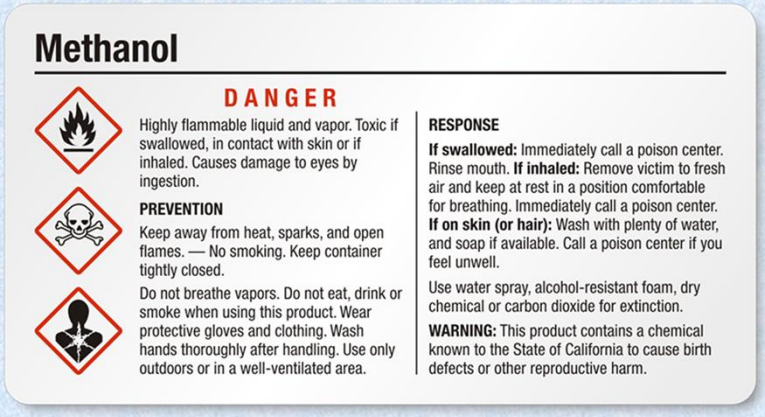
Therefore, if the use requires large quantities, the use must be done under a chemical hood and between the PPE you have to put the eye protection, in addition to gloves that must always be worn

Tra le sostanze di cui parliamo oggi queste sono decisamente le meno pericolose e quelle che maggiormente vengono utilizzate.

Due cose sono da tenere presente: il livello di infiammabilità delle sostanze stesse e dei loro vapori, e la loro pericolosità in caso di contatto accidentale con gli occhi

Pertanto se l'impiego prevede grandi quantità l'utilizzo si dovrà fare sotto cappa chimica e tra i DPI si dovranno mettere gli occhiai di protezione, oltre ai guanti che devono essere sempre indossati

Alcohols – flammable and/or toxic



Hazard statement(s)

H225 Highly flammable liquid and vapour.

H301 + H311 + H331 Toxic if swallowed, in contact with skin or if inhaled

H370 Causes damage to organs.

Tra gli alcoli usati che rientrano in questa famiglia: quella degli alcoli infiammabili e tossici il metanolo è quello più utilizzato

Oltre alla formazione di vapori infiammabili il metanolo è pericoloso perché tossico sia ingerito, che inalato che a contatto con la pelle.

Pertanto l'utilizzo del metanolo dovrà avvenire sempre sotto cappa e con guanti e occhiali come DPI

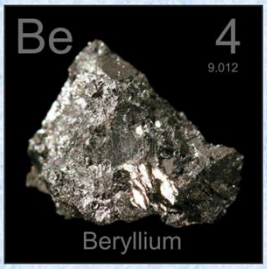
Among the alcohols used in this family: that of inflammable and toxic alcohols, methanol is the most widely used

In addition to the formation of flammable vapors, methanol is dangerous because it is swallowed, ingested and in contact with the skin.

Therefore the use of methanol must always take place under the hood and with gloves and glasses such as PPE

Beryllium and its compounds

- Be is highly toxic by inhalation
- It's **classified by IARC as a class 1 known human carcinogen**
- **Inhalation** of beryllium particles produces progressive pulmonary fibrosis and may lead to lung cancer
- Skin disease develops in workers overexposed to beryllium
- Hazard statement(s) for Be powder:



H301 Toxic if swallowed.

H315 Causes skin irritation.

H317 May cause an allergic skin reaction.

H319 Causes serious eye irritation.

H330 Fatal if inhaled.

H335 May cause respiratory irritation.

H350i May cause cancer by inhalation.

H372 Causes damage to organs through prolonged or repeated exposure.

There are a number of health concerns associated beryllium. These fall into two categories skin disorders and lung disease.

A skin rash can develop when there is contact with water soluble beryllium salts.

When very high concentrations of beryllium are inhaled for a short duration, pneumonia-like symptoms may occur.

Acute Beryllium Disease is treatable and is completely reversible.

Chronic Beryllium Disease, however, is not reversible. It can occur when small concentrations of beryllium have been inhaled over a certain time period. It can only occur if the individual has become sensitized to beryllium.

The beryllium alloys, and ceramic beryllia are not hazardous unless they are machined or used in a manner that creates a dust, fume, or mist.

Detergents

HALOGENS (Iodines or hypochlorites)

Poor residual activity, low toxicity, but may stain surfaces.

Effective at low concentrations for disinfecting clean, small objects.

QUATERNARY AMMONIUM COMPOUNDS

Limited effectiveness in soaps, detergents and hard water salts.

Non-irritating, non-corrosive and low toxicity.

Residual activity is limited by the amount of recontamination.

Good disinfectant for use on cleaned surfaces.

PHENOLICS (Single or Multiple)

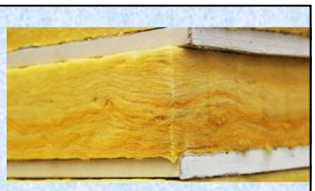
Low toxicity and low corrosiveness.

OXIDIZING AGENTS (Hydrogen peroxide, Potassium Permanganate)

Moderately corrosive, limited toxicity.

Detergents are powerful cleaning products that may contain strong acids, alkalis, or phosphates. Cationic detergents are often used as germ-killing cleansers (antiseptics) in hospitals. Anionic detergents are sometimes used to clean carpeting. Detergent poisoning occurs when someone swallows cationic or anionic detergents.

Fibreglass, rock wool



- Fiberglass
  - H315: Causes skin irritation.
  - H319: Causes serious eye irritation.
  - H335: May cause respiratory irritation.
- Rock wool
  - Classified as Non-Hazardous

At present rock wool seems to be the safest material available. the traditional forms of rock wool can be hard and dissolve with incredible ease in the lungs and is completely non-carcinogenic even in tests on the most intense animals.

The types of glass fiber we use also seem quite safe and, as with rock wool and organic substances, they have absolutely no history of causing lung cancer in people or animals from exposure even in the long term.

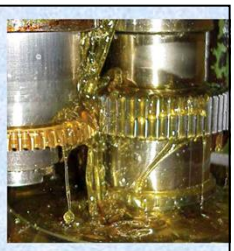
However, the typical glass fiber is much more abrasive than rock wool, and therefore at least in theory more capable of inducing lung irritation problems, particularly with high-level unprotected exposure.

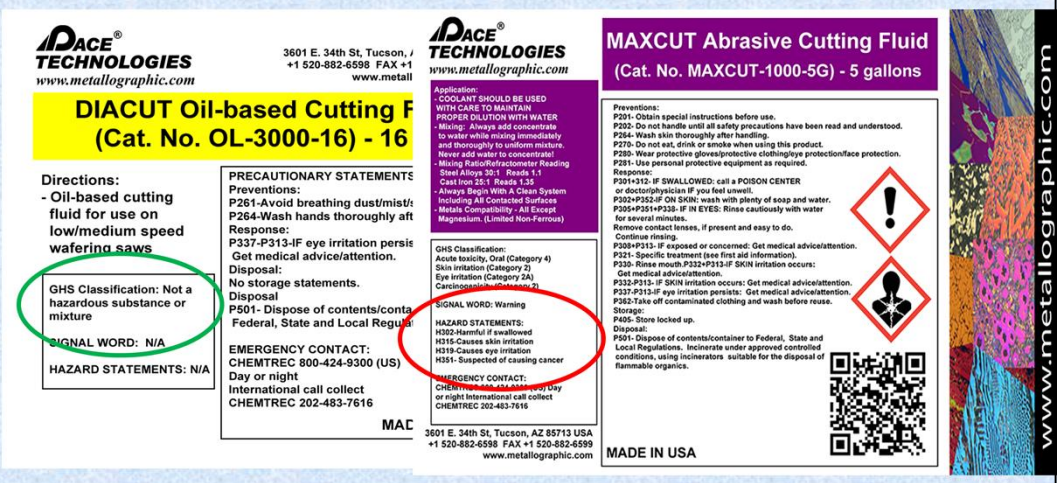
In fact, glass fibers are classified as irritating to skin, eyes and respiratory level

Whatever you choose, always wear a mask, gloves and protective clothing when handling any of these materials

Lubrificants and cutting oil

- Two examples:





The most of the cutting oils used for metalworking is inert, but it can be important the skin absorption if the pieces being processed are handled without appropriate PPE: you can have a direct contact with the oil when you clean the tool

In addition, the airborne oil mists that are formed due to the speed with which the tool works and the condensation of vapors generated by the high temperatures involved can also be a source of exposure.

Therefore, specific PPE for the hands and, if necessary, a mask to protect the airways are necessary.

In any case, the toxicity must always be verified through the safety data sheet and the product with the lowest toxicity should be chosen for the same performance

Questo gruppo di sostanze è troppo vasto per definire a priori un livello di tossicità

Sarà obbligatorio acquisire la scheda di sicurezza e sulla base di questa utilizzare i DPI indicati e effettuare le lavorazioni in sicurezza

This group of substances is too broad to define a level of toxicity a priori

It will be mandatory to acquire the safety data sheet and on the basis of this use the PPE indicated and carry out the work in safety

Epoxy resins

- epoxy resin 
  - H315 Provoca irritazione cutanea.
  - H317 Può provocare una reazione allergica cutanea.
  - H319 Provoca grave irritazione oculare

- catalyst / hardener  
  - H312 Nocivo per contatto con la pelle.
  - H314 Provoca gravi ustioni cutanee e gravi lesioni oculari.
  - H317 Può provocare una reazione allergica cutanea.

Epoxy resins are used for cold embedding: these resins polymerize at room temperature in 20 ÷ 30 min.

These resins, mixed with a catalyst (hardener), produce a viscous liquid that is poured into a mold containing the sample

The toxicity of epoxy resins is modest, in general processing is also carried out not under the hood with the use of gloves only

Le resine epossidiche si utilizzano per l'inglobatura a freddo: queste resine polimerizzano a temperatura ambiente in 20÷30 min.

Queste resine, miscelate con un catalizzatore (indurente), producono un liquido viscoso che è colato in uno stampo contenente il provino

La tossicità delle resine epossidiche è modesta, in genere la lavorazione avviene anche non sotto cappa con l'utilizzo dei soli guanti

Silica / Quartz

- Silica SiO_2
  - Silica, Silicic anhydride, Silicon dioxide amorphous,
  - Sostanza o miscela non pericolosa
- Silica SiO_2
  - Cristobalite, Quartz, Sand, Silica
  - H319 Causes serious eye irritation.
  - H335 May cause respiratory irritation.
  - H373 May cause damage to organs (Lungs) through prolonged or repeated exposure

Silica is a mineral (silicon dioxide = SiO2) that can be found in many forms, the most dangerous form of Silica for health, when inhaled, is crystalline.

The effects of silicon dust depend on the nature and size of the particles as well as the type of processing

Exposure limits exist in relation to the type of work: consider that silica is a raw material in the ceramic and terracotta tile industry, in tiles and bricks, and abrasive materials.

The use in a research laboratory of these products is such as not to be a problem for the small amounts

La silice è' un minerale (biossido di Silicio = SiO2) che si puo' presentare in molte forme, la forma di Silice piu' pericolosa per la salute, quando inalata, e' quella cristallina.

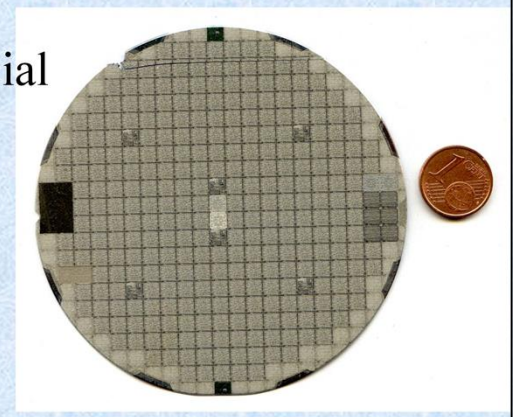
Gli effetti della polvere di silicio dipendono dalla natura e dimensioni delle particelle oltre che dal tipo di lavorazione

Esistono dei limiti di esposizione in relazione al tipo di lavoro: si pensi che la silice è una materia prima nell'industria delle piastrelle di ceramica e terracotta, delle tegole e dei mattoni, e materiali abrasivi.

L'utilizzo in un laboratorio di ricerca di questi prodotti è tale da non rappresentare un problema

Wafer di silica

- They are classified as non-hazardous
- They do not require special prevention measures



What I see in your labs are silicon wafers

These artifacts are not classified from the point of view of the danger also it must be said that those who use these artifacts in the white room and with a series of protective clothing of the sample but also guarantee the same operator

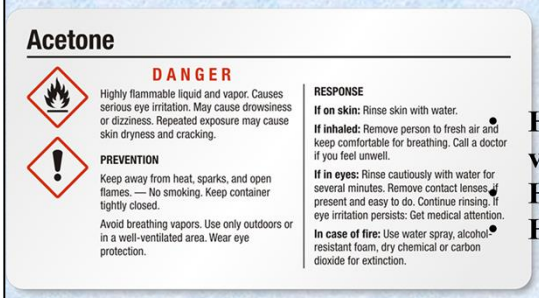
Quello che mi capita di vedere nei vostri laboratori sono i wafer di silicio

Questi manufatti non sono classificati dal punti di vista della pericolosità inoltre c'è da dire che chi utilizza questi manufatti lo fa in camera bianca e con una serie di indumenti di protezione del campione che però garantiscono anche lo stesso operatore

Hydrocarbon solvents

(toluene, xylene, acetone, white spirit)

- **H225 Highly flammable liquid and vapour.**
- **H304 May be fatal if swallowed and enters airways.**
- **H315 Causes skin irritation.**
- **H336 May cause drowsiness or dizziness.**
- **H361d Suspected of damaging the unborn child.**
- **H373 May cause damage to organs through prolonged or repeated exposure.**



H225 Highly flammable liquid and vapour.
H319 Causes serious eye irritation.
H336 May cause drowsiness or dizziness.

Organic compounds are those substances which have tetravalent carbon in their structure.

The way of penetration into the organism most frequently described for solvents in the workplace is the airway

Solvent absorption is based on the principle of passive diffusion of gases and vapors through the alveolar-capillary barrier

The modalities of the solvent-organism interaction are conditioned by two main variables:? 1. concentration? 2. exposition time.

However, many solvents can be absorbed through the skin,

The handling of these substances must be done strictly under the hood using gloves, it will be possible, but for substances with toxicity comparable to that of acetone, use also not under the hood but only if the quantities are modest and the environment is still ventilated, I generally refer to the cleaning of optics in laser laboratories or for cleaning small substrates

Thallium and its compounds

- Soft and malleable metal easily oxidizable
- Used in optics for its properties against infrared radiation
- It is used for the production of semiconductor materials
- As a dye in scintillator crystals for X and gamma radiation detection

- No longer used as rat poison

Thallium is the chemical element of atomic number 81. Its symbol is Tl.

It resembles tin, but darkens by oxidation when it is exposed to air.

It is a soft and malleable metal, which can also be cut by a knife. Exposed to the air, its shiny surface oxidizes assuming a gray-blue hue similar to that of lead. In the presence of water, instead, a layer of thallium hydride is formed.

Thallium sulfate, odorless and tasteless, is used as a poison for mice and ants. In many countries it has been banned because of its danger.

Among other uses we find:

the electrical conductivity of thallium sulphide changes with exposure to infrared light and this compound therefore finds use in some types of photocells;

the crystals of bromide and thallium iodide are used to produce optical parts for infrared light;

thallium oxide was used to produce glass with a high index of refraction;

together with sulfur, selenium and arsenic, it is used in the production of high-density glass with a low melting point (125-150 ° C);

treatment of ringworm and other skin infections;

green light emitter for metal halide lamps.

It is used for production:

of semiconductor materials;

as a scintillator crystal dopant for the detection of X-ray radiation and gamma radiation;

high density liquids for the separation of minerals;

201-Tl, radioactive, is used for diagnostic purposes in nuclear medicine, in particular in stress tests for patients suffering from coronary disorders.

It is also involved in research for the development of high-temperature super-conductive materials for applications such as nuclear magnetic resonance, magnetic propulsion, generation and transmission of electric current.

Il tallio è l'elemento chimico di numero atomico 81. Il suo simbolo è Tl.

Somiglia allo stagno, ma scurisce per ossidazione quando è esposto all'aria.

È un metallo tenero e malleabile, che può essere tagliato anche da un coltello. Esposto all'aria, la sua superficie lucente si ossida assumendo una tinta grigio-blu simile a quella del piombo. In presenza di acqua, si forma, invece, uno strato di idruro di tallio.

Il solfato di tallio, inodore e insapore, è usato come veleno per i topi e per le formiche. In molte nazioni è stato vietato per via della sua pericolosità.

Tra gli altri usi troviamo:

la conducibilità elettrica del solfuro di tallio cambia con l'esposizione alla luce infrarossa e tale composto trova pertanto uso in alcuni tipi di fotocellule;

i cristalli di bromuro e ioduro di tallio sono usati per produrre parti ottiche per luce infrarossa;

l'ossido di tallio è stato usato per produrre vetri ad alto indice di rifrazione;

insieme allo zolfo, al selenio e all'arsenico trova impiego nella realizzazione di vetri ad alta densità e basso punto di fusione (125-150 °C);

trattamento della tricofitosi ed altre infezioni della pelle;

emettitore di luce verde per lampade ad alogenuri metallici.

Si utilizza per la produzione:

di materiali semiconduttori;

come drogante di cristalli scintillatori per la rivelazione di radiazioni X e radiazione gamma;

di liquidi ad elevata densità per la separazione dei minerali;

201-Tl, radioattivo, è usato a fini diagnostici in medicina nucleare, in particolare nei test sotto sforzo per pazienti affetti da disturbi coronarici.

È inoltre coinvolto nelle ricerche per lo sviluppo di materiali super-conduttori ad alta temperatura per applicazioni quali la risonanza magnetica nucleare, la propulsione magnetica, la generazione e la trasmissione di corrente elettrica.

HAZARD SUMMARY:

- Thallium can affect you when breathed in and by passing through your skin; it can irritate and burn the skin and eyes.
- Prolonged contact can cause blurred vision and/or loss of vision, nail changes, skin rash and dryness, and hair loss.
- Thallium can damage the nervous system causing headache, weakness, irritability, pain, and "pins and needles" in the arms and legs.
- Repeated exposures can cause tremor, convulsions, hallucinations, coma and death.
- Thallium may damage the liver and kidneys.

The recommended airborne exposure limit is 0.1 mg/m^3 averaged over an 8-hour workshift. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

Thallium and its compounds are often highly toxic.

Thallium can affect you when breathed in and by passing through your skin.

Thallium can irritate and burn the skin and eyes.

Prolonged contact can cause blurred vision and/or loss of vision, nail changes, skin rash and dryness, and hair loss.

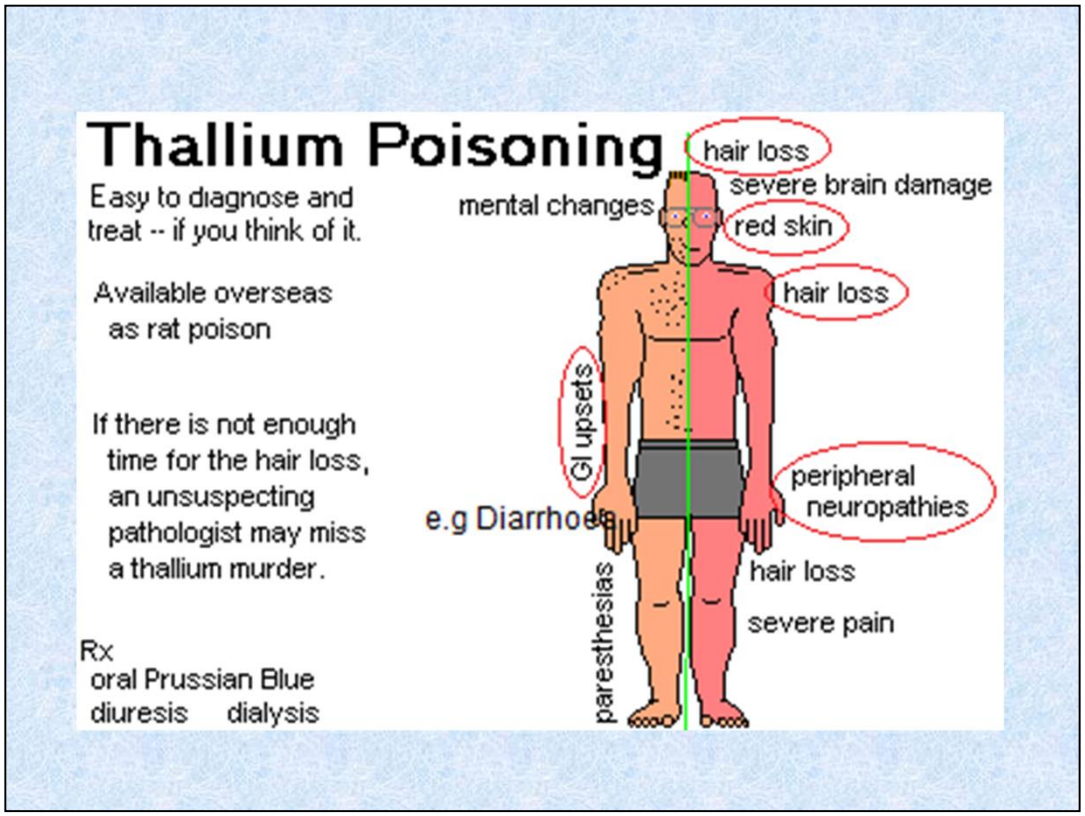
Exposure can cause fatigue, poor appetite, nausea, vomiting, metallic taste, insomnia, confusion and mood changes.

Thallium can damage the nervous system causing headache, weakness, irritability, pain, and "pins and needles" in the arms and legs.

Repeated exposures can cause tremor, convulsions, hallucinations, coma and death.

Thallium may damage the liver and kidneys.

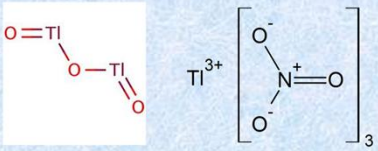
The recommended airborne exposure limit is 0.1 mg/m3 averaged over an 8-hour workshift. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.



The reason for thallium's high toxicity is that, when present in aqueous solution as the univalent thallium(I) ion (Tl^+), it exhibits some similarities with essential alkali metal cations, particularly potassium. It can enter the body via potassium uptake pathways. Other aspects of thallium's chemistry differ strongly from that of the alkali metals, such as its high affinity for sulfur ligands. Thus, this substitution disrupts many cellular processes (for instance, thallium may attack sulfur-containing proteins such as cysteine residues and ferredoxins).

Among the distinctive effects of thallium poisoning are hair loss (which led to its initial use as a depilatory before its toxicity was properly appreciated) and damage to peripheral nerves (victims may experience a sensation of walking on hot coals), although the loss of hair only generally occurs in low doses; in high doses the thallium kills before this can take effect. Thallium was once an effective murder weapon before its effects became understood and an antidote (Prussian blue) discovered. Indeed, thallium poisoning has been called the "poisoner's poison" since thallium is colorless, odorless and tasteless; its slow-acting, painful and wide-ranging symptoms are often suggestive of a host of other illnesses and conditions.

Thallium nitrate
Thallium oxide



Danger:

- H272 May intensify fire; oxidiser.
- H300 Fatal if swallowed.
- H300 + H330 Fatal if swallowed or if inhaled
- H330 Fatal if inhaled.
- H373 May cause damage to organs through prolonged or repeated exposure.
- H411 Toxic to aquatic life with long lasting effects.

- **Exposure controls:**
- **Appropriate engineering controls**
- Avoid contact with skin, eyes and clothing. **Personal protective equipment**
- Face shield and safety glasses
- Handle with gloves. erived from it.
- **Body Protection**
- Complete suit protecting against chemicals, The type of protective equipment must be selectedaccording to the concentration and amount of the dangerous substance at the specific workplace.
- **Respiratory protection**
- Where risk assessment shows air-purifying respirators are appropriate use a full-face particlerespirator
- **Control of environmental exposure**
- Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge intothe environment must be avoided.

Here is an part from the safety data sheet of thallium compounds

Exposure controls:

Appropriate technical controls

Avoid contact with skin, eyes and clothing. Personal protection equipment

Visor and safety glasses

Handle with gloves. From it.

Body protection

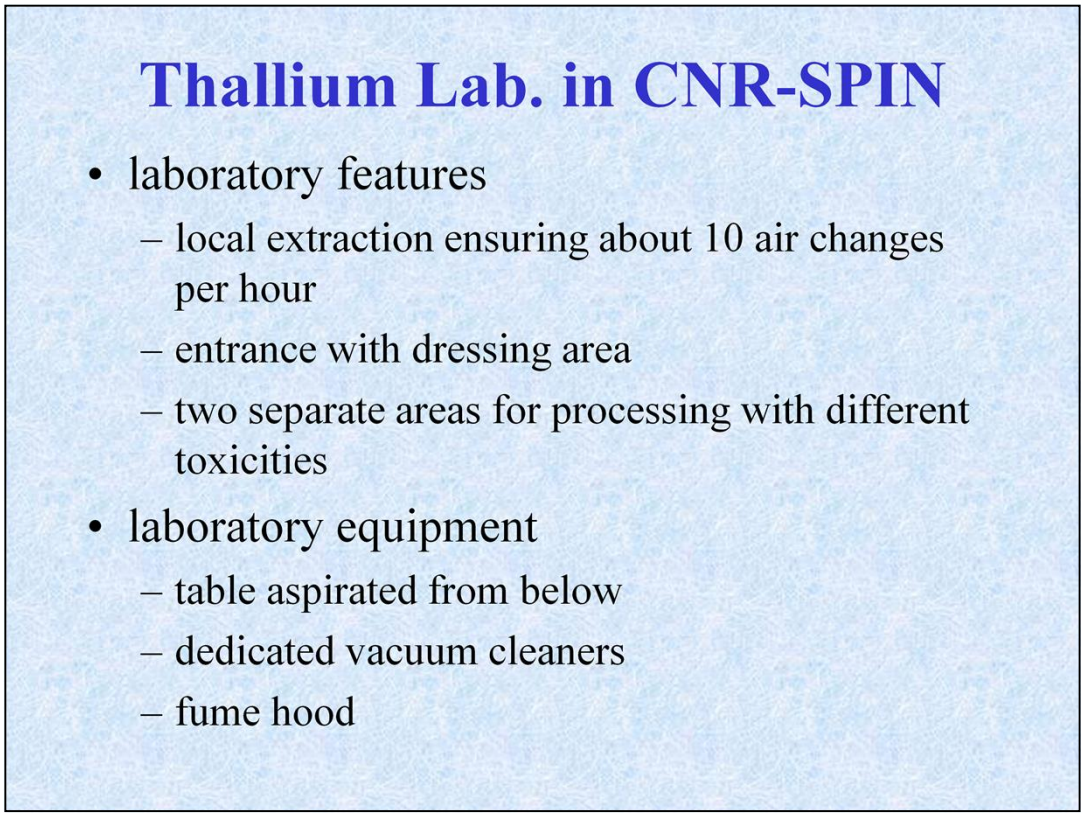
Complete chemical protection suit, the type of protective device must be selected based on the concentration and amount of the hazardous substance at the specific workplace.

Respiratory protection

Where risk assessment shows that air purifying respirators are appropriate, use a particular full face aspirator

Environmental exposure control

Prevent further losses or leaks if it is safe to do so. Do not let the product enter the drains. The discharge in the environment must be avoided.



a laboratory dedicated to the use of thallium is active at cnr spin.

this laboratory is equipped with specific equipment and strict access rules

in particular in the laboratory we have local extraction which guarantees about 10 changes of air per hour

entrance with locker room where workers wear specific PPE

two separate areas for processing with different toxicities

among the specific laboratory equipment we have

table aspirated from below

dedicated vacuum cleaners

and a chemical hood

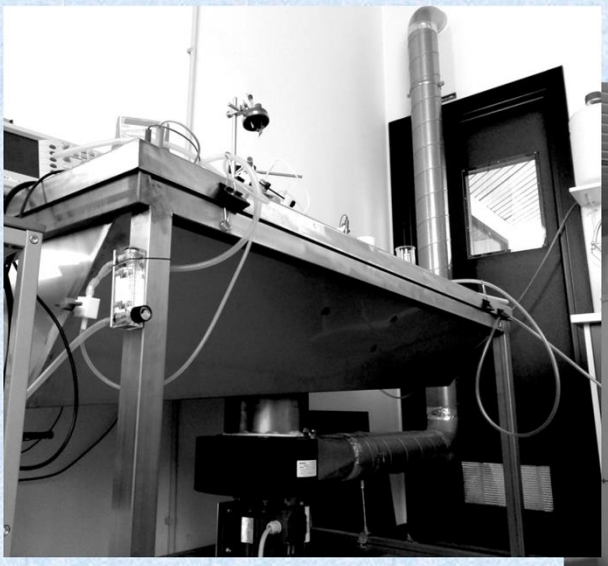
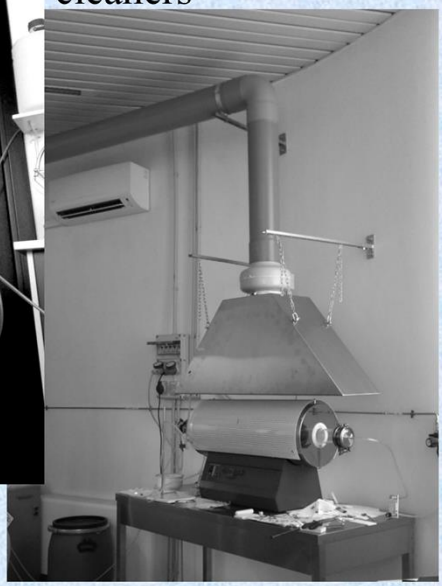


table aspirated from below

dedicated vacuum cleaners



personal protective equipment and rules

- wear tyvek or similar suit
- disposable nitrile gloves
- full face masks equipped with AP3 filters

used in the operations of opening the "tallio" kiln, in the cases of filter cleaning and in all cases where there may be the risk of producing fine powders or vapors containing thallium

- access restriction
- training
- biological health checks to the personnel involved

Workers authorized to access have undergone specific training and are subject to specific controls for the assessment of personal contamination on urine

is required used PPE like

Wear tyvek

Gloves

Face mask sed in the operations of opening the "tallio" kiln, in the cases of filter cleaning and in all cases where there may be the risk of producing fine powders or vapors containing thallium

SIMPLE QUESTIONS

- What does it mean?

»CORROSION

»EXPLODING BOMB

»FLAME

SIMPLE QUESTIONS

- How do I know if a substance is carcinogenic from the label on the bottle?
  - I read the Hazard statement
  - I read like Hazard statement H350
  - I read the Hazard pictograms

SIMPLE QUESTIONS

- Can I work with volatile substances with the front screen open fume hood?
  - YES, but the window must be open
  - NO
  - NO, and the window must be open

SIMPLE QUESTIONS

- How many types of masks can I use to protect myself from fine particles?
  - I have only one kind of mask
  - depends on the toxicity of the powders
  - up to three different types of masks and with three different filters in relation to the particle size of the powder