Ångström
MICROSTRUCTURE LABORATORY

CHEMICAL SAFETY COURSE

Introduction to handling and treatment of chemicals in the
CLEANROOM

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PREFACE

The main purpose of this booklet is to provide Cleanroom users with an overview of safety policies and laboratory procedures. To accomplish this, everyone using the facilities in the Cleanroom should have a wide insight into the procedure regarding treatment of chemicals as well as knowledge of handling and use of equipment for processing of chemicals.

Any chemical and/or chemical reaction that goes out of control and runs away can create a serious incident with the risk of injury to people and damage to property and the environment by fire, explosion, burns (i. e. skin burns), and /or poisoning.

This booklet, that is created to be used in conjunction with **On-site-introduction for Cleanroom and Chemical Safety,** provides guidance on how you can ensure a safe chemical process along with appropriate emergency response.

A section of this booklet provides procedures concerning treatment of chemicals and work with different chemical equipment. The section provides also a brief description of some chemical with serious hazards.

Another section states procedures regarding decontamination and securing of the contaminated areas.

Treatment and disposal of chemical waste is also one of the subjects of discussion.

We wish to provide a safe and efficient environment for all Cleanroom users.

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Contents

Definitions

Chemical waste- A chemical that falls into one of the following categories:

- Any chemical that has past its expiration date.
- Mixture of chemicals which can not be reused.
- Chemical products due to decontamination or cleaning up chemical spills.

Contamination - Introduction into water, air, and soil of microorganisms, chemicals, toxic substances, wastes, or wastewater in a concentration that makes the medium unfit for its next intended use.

Chemical contamination- Defined as spill of chemicals out of a place where one has full control over them. In this case the spilled chemicals can damage the people, equipment, and environment. The process that one goes trough in order to clean up the spill (contaminant) is called decontamination.

Corrosive chemical- A corrosive chemical is one that -

- Causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact."
- Has a pH greater than 12 or less than 2.5.
- Is known or found to be corrosive to living tissue.

The major classes of corrosive chemicals are strong acids and bases, dehydrating agents, and oxidizing agents. Some chemicals, e.g., sulfuric acid, belong to more than one class. Inhalation of vapors and mists of these substances can cause severe bronchial irritation. These chemicals erode the skin and the respiratory epithelium and are particularly damaging

Dehydrating agents- Extreme heat is evolved when these substances are mixed with water, mixing should always be done by adding the agent to the water to avoid a violent reaction and spattering. Because of their affinity for water, these substances cause severe burns on contact with skin

The strong dehydrating agents include concentrated sulfuric acid, sodium hydroxide, phosphorus pentoxide, and calcium oxide.

Emergency - Any occurrence such as (but not limited to) equipment failure, rupture of containers, or failure of control equipment, which results in an uncontrolled release of a hazardous chemical into the workplace.

Explosive - A chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

First aid measures - Procedures regarding immediate care given to a person who is injured or who suddenly becomes ill. It can range from cleaning a cut and applying a bandage to helping someone who is choking or having a heart attack. First aid - Procedures regarding

Flammable - A chemical that falls into one of the following categories:

- Flammable aerosol - An aerosol that, when tested by the method described in 16 CFR1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening.
- Flammable gas - A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or a gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.
- Flammable liquid - Any liquid having a flashpoint below 100°F (37.8°C), except any mixture having components with flashpoints of 100°F (37.8°C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.
- Flammable solid - A solid, other than a blasting agent or explosive, that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44,(http://www.law.cornell.edu/cfr/text/16/1500.44) it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

Fume Hood- A device, located in a laboratory, enclosed on five sides with a moveable sash or fixed partial enclosure on the remaining side, constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory, which allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Hazardous Chemical – A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Incompatible chemicals - Incompatible chemicals give an undesired chemical reaction when mixed. This usually refers to substances that will react to cause an imminent threat to health and safety through an explosion, fire, and/or formation of toxic materials.

Material Safety Data Sheets (MSDSs) - Information on chemical products supplied by product manufacturers or distributors which includes information on the physical hazards, health hazards, safe handling procedures, and emergency and first aid procedures.

Neutralization - Any chemical reaction, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste, or so as to recover energy or material resources from the waste, or so as to render such waste non-hazardous, or less hazardous; safer to transport, store, or dispose of; or amenable for recovery, amenable for storage, or reduced in volume.

Oxidizing agent - A substance that removes electrons from another reactant in a redox chemical reaction. The oxidizing agent is "reduced" by taking electrons onto itself and the reactant is "oxidized" by having its electrons taken away.

Protective Laboratory Practices and Equipment- Those laboratory procedures, practices, and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective in minimizing the potential for employee exposure to hazardous chemicals.

Resinware -containers which are made of synthetic polymeric compounds physically resembling natural resin, e.g. polyvinyl, polystyrene, or epoxy.

Toxic chemicals- Any chemical which through its chemical action on life processes can cause death, temporary incapacitation or permanent harm to humans or animals. This includes all such chemicals, regardless of their origin or of their method of production, and regardless of whether they are produced in facilities, in munitions or elsewhere.

Wetbench - Typically fully automatic process tool used to carry out wet cleaning and etching operations in semiconductor processing; commonly includes several tanks each containing either cleaning/etching solution or deionized rinsing water in which wafers are immersed in predetermined sequence; typically includes also drying module.

1. TREATMENT OF CHEMICALS

This section provides procedures concerning treatment of chemicals and work with different chemical equipment. The section provides also a brief description of some chemical with serious hazards.

1.1 Assignment of responsibilities

Those who supervise and economically support your project study in the Cleanroom (i.e. supervisor, head of department) are the ones who are responsible for the nature of your study work.

Cleanroom Chemical Process Engineers (CPE) are those who are responsible to provide the chemical and equipment that you are in need to run chemical processes. They also provide all necessary guidance on how you can ensure a safe chemical process.

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1.2. Protective Laboratory Practices and Equipment

1.2.1. Preventive personal protection

To ensure a safely laboratory study one should go through the following lab procedure prior to processing any chemical

- Go through the procedures regarding your laboratory work step by step. Ask your supervisor and/or the Cleanroom CPE if there is any doubt about applicability of the procedures.
- Check if the chemical and equipment that you need are available in the Cleanroom. If Not, contact the CPE.
- Check if the equipment work properly.
- Read the Material Safety Date Sheet (MSDS) prior to using a chemical or material.
- Check if the personal protective clothing and equipment that you need are available in the Cleanroom.

1.2.2 Personal Protective Clothing and Equipment

- **Body protection**
  Those blue **Overalls** (used in the process laboratory) and **aprons** (used in analysis laboratory) are made of material that resists splash of chemical (but not solvents). During treatment of chemicals especially when the process is run in a **fume hood** one must wear an **extra apron (Blue protector Gown, thumb loop)**, these aprons are handed to the nearest place to the fume hoods.
  For decontamination one has to dress the dark blue aprons. These aprons are available in the decontamination kits (room 3R87 and 3R47).

- **Eye and face protection:**

  Eye and face protection are required in all laboratories where chemicals are used or stored. Face shields shall be worn when there is danger of splashing chemicals or flying particles, such as when chemicals are processed at Wetbenches and fume hoods or glassware is used under elevated or reduced pressure.

Face shields must be cleaned after use. **Do not** use **acetone** for cleaning. Cleanroom Cleaning Solution (5% IPA) or ethanol are adequate cleaning agents.

- **Hand protection**

  - **General**
    Gloves are worn to prevent contamination of you hand due to exposure to corrosive and toxic chemicals as well as infectious agents

    Another purpose of using gloves in the Cleanroom is to prevent particles and dirt spreading from our hands to the clean environment and/or clean surfaces.

    To prevent contamination of your hands or work surfaces, wash gloves thoroughly with water before removing them. Pull off disposable gloves inside out and dispose of them according to the nature of the contaminant. Always remove contaminated gloves before leaving the laboratory. Always wash your hands after removing gloves, **before** leaving the work area, and before eating, drinking, smoking, or applying cosmetics. Provide protection from chemicals.

  - **Use the right gloves**
    Many gloves are made for specific uses. For adequate protection, select the correct glove for the hazard in question. In the Ångström Laboratory's Cleanroom one can find three different types of gloves.

    - **Vinyl-gloves:** Transparent vinyl gloves are used when one is running a process other than chemical process. The purpose of using these gloves is to keep the

instruments and other contact surfaces clean. Vinyl gloves do not provide protection from chemicals. Vinyl gloves are generally used for relatively rough works.

- **Nitrile gloves:** Nitrile gloves have texture finger tips to provide extra grip in wet or dry conditions. In comparison with Vinyl gloves Nitrile gloves are more practical for fine works. Nitrile gloves are not strong chemical resistance gloves and should be used together with **Latex** gloves for treatment of chemicals.
- **Latex gloves:** Latex gloves provide protection from wide range of aggressive acids, and bases. Ideal for wet chemical applications

- **Important notes**

  If the gloves are contaminated with hydrofluoric Acid, cyanide , or any other toxic chemical they must be consider as chemical waste and must be disposed of. Do as follows;

  1. If the gloves are contaminated with **Cyanide** dispose of them in the waste-box in the **Toxic** Fume Hood.
  2. If the **gloves** and/or **wipers** are contaminated with hydrofluoric Acid:
     a. Take a yellow plastic bag (Room 3R47) write “HF” on it and leave the HF-contaminated objects in the bag.
     b. Leave the bag unclosed in the Acid Fume Hood in room 3R75.
     c. Contact the Cleanroom CPE and inform them on the waste.

The Cleanroom **users** are responsible to **wash** the **glove** and **clean** the **face shields** before hanging them on their respective places

Do **not** leave the **gloves and face shield on** the **tables**, not even temporarily. They contaminate the tables, which in turn hazards the other users and Cleanroom Cleaning Crew.

- **Staffs in charge of gloves and protector aprons**

  - **Catrin Håkansson**
    Vinyl and Nitrile Gloves

  - **Farhad Zamany**
    Latex Gloves, Blue protector Gown (blue aprons), and shoe covers.

- **Foot protection**

  Chemical resistant Shoe/Boot covers are used to protect the feet from being exposed to aggressive chemicals. These covers have to be used together with the other protective wears if complete body protection is required. For more information refer to Appendix 12.

1.3. General guidelines for chemical processing

This section provides a quick checklist to assist you conduct your laboratory studies safely and in compliance environmental health and safety regulations. The guidelines consist of three different checklists that one should go through them at three different occasions.

1.3.1 Before starting to run the chemical process in the Cleanroom

1. Apply for access to the Cleanroom.
2. Attend the courses
    a. Cleanroom On-site-introduction
    b. The Cleanroom course
    c. Chemical safety course
    d. Wetbench license
3. Go through all references regarding your studies and take notes on;
    a. all chemical, instruments, Glassware, resienware (Appendix A1), Personal protective clothing and Equipment, and materials that you will be in need
    b. safety percussions and extra warning notices.
    c. decontamination equipment that will be needed (Appendices A2-A3)
4. Contact the Cleanroom CPE and check if the articles mentioned in item 3 are available in the Cleanroom.
   To check the list of available chemicals in the Cleanroom and MSL's chemical storage room you can visit the Uppsala University chemical website database (KLARA). For further information regarding user name, password, and user manual contact the Cleanroom CPE
5. Mark your chemical (non-standard chemicals) with your name, Dept. name, Telephone number, and color coding dot.
6. Read the *Material Safety Data Sheets* (MSDS) of all chemicals that you will be using and check if those are available in their respective places in the MSDS-files in the Cleanroom.
7. Find the instruction regarding disposal of your chemical as waste and instruction for neutralizing your chemical as spill (Appendix A4) or contact the Cleanroom CPE.
8. Write down the procedure for your project studies in details.
9. Make a list of chemical or chemical groups that are incompatible with your chemicals.
10. If you run your studies in a laboratory location where treatment of HF and/or Cyanide are allowed, do as follows;
    a. read the instruction regarding "*first aid measures*" for these chemicals
    b. check if the HF-antidote gel is available in the assigned places (Not to be more than two years old).
11. Check;
    a. if all equipment, benches, and fume hoods that you will be in need are working properly.
    b. if the ventilation system is working.
    c. If there is, a proper and sufficient place to measure and process your chemicals.

12. Finally check the location of the following emergency items:
    a. equipment emergency shut down bottom
    b. emergency alarm bottom.

c. emergency telephones and emergency telephone numbers.
d. fire extinguisher
e. emergency doors
f. eye Washers

Note 1: Practically the bench and the fume hood that you are working with should be in the same room and should be near enough to each other. Contact the CPE if you do not find a suitable place to carry out your process(es).

Note 2: Before and after every treatment one should check if the gloves do not have holes on them. Gloves with hole should not be used and should be considered as acid waste and must be disposed of through regulation for disposal of chemical wastes. If gloves with hole on are not contaminated with HF and /or toxic chemical they should be left in Trash-boxes in the acid hoods.

1.3.2 After running a process

a. Leave all instruments and equipment back to their proper place after use.
    1. Glassware and resienware (class II and III) that were used during the process should be placed in their proper box for further machine wash. Note that class I materials must be washed by distilled water and placed directly in their respective shelf.
    2. Balances, Magnet stirrer, hotplates (heating plates) must be cleaned (with Cleaning solution[*]) before leaving them to their respective place (the cabinet in room 3R47).

b. Wash and clean the equipment after use.
    2. Wetbenches, spin benches, fume hoods must be cleaned after use
    3. Baths should be emptied and washed, in case it is requested. Note that the baths with pump should not be left empty. Such baths should be filled with DI water and the the water should be circulated until the pump is completely filled with the water.

c. Treatment and handling of chemical waste and contaminated laboratory ware.
    1. Bottles containing chemical waste should have the chemical waste-label on. Information on content of the bottles should be written on these labels. These bottles should be placed in proper chemical cabinet.
    2. Follow instruction given in “Note2, section 1.3.1”
    3. If the wipers, gloves or other disposal laboratory ware are contaminated with **HF** or toxic chemicals they should be deposed off **as follows:**
        - Take a yellow plastic bag (Room 3R47)
        - Fill the bag with contaminated objects
        - Write HF or name of toxic chemical on the bag or use the label for chemical waste. Wash the gloves and clean the face shields

[*] Cleaning solution: DI water 95%, Isopropyl alcohol 5%

before you leave them in their assigned places. Note that the face shields should be cleaned with Isopropyl alcohol but not acetone.

1.3.3 After completion of the studies in the Cleanroom.

a. Collect all your belongings from clean room, Empty your blue box and leave it to the Cleanroom CPE
b. Leave the tweezer, timer, and chemicals to the CPE, If others will not use the chemicals.
c. Check if you have left any unlabeled chemical waste.

1.4. Providing of chemicals for use in the Cleanroom

The Clenroom CPE are in charge of ordering and placing the chemicals that are regularly used (**standard chemicals**) in microstructure laboratory. List of standard chemicals, that are available in each chemical cabinet, are attached to their respective cabinet.
Chemicals other than standard chemicals are defined as **non- standard chemicals,** including mixture of two or more standard chemicals.
Those Cleanroom users who want to order non-standard chemicals should contact Clenroom CPE. Non-standard must be marked with:

- name of chemical (if mixed solution)
- user name
- user group/department
- date
- color coding dot

Use compatible blank labels.

Visit KLARA (Chemical Database Website), https://secure.port.se/Alphaquest/app_Uu/ to check the list of available chemicals in MSL and all faculties of Uppsala University. Contact CPE to get

1.5. Treatment of chemicals in the Cleanroom

Measuring, weighing, and mixing of chemical should be processed in the proper fume hood and one should dress proper protective wear during the treatment.
Use both of your hands to hold the container of chemicals while transporting them. If the containers are more than on use chemical transport cart (available in the rear lock) to transport them.

Dress proper protective wear before you start to transport the chemical for further treatment

Empty bottles of chemicals should be placed in their respective shelf in the chemical` cabinets. Note that that the bottles **should not be rinsed out** but should be emptied properly.

Only the empty bottles of photoresist have to be rinsed by **acetone** before being placed in their respective shelf.

1.6. Storage of chemicals in the Cleanroom

Chemicals and chemical waste have to be store in ventilated cupboards. Only compatible chemicals are allowed to be stored in the same cupboard. There are mainly three different types of cupboard that are assigned for storage of chemicals of three different groups:

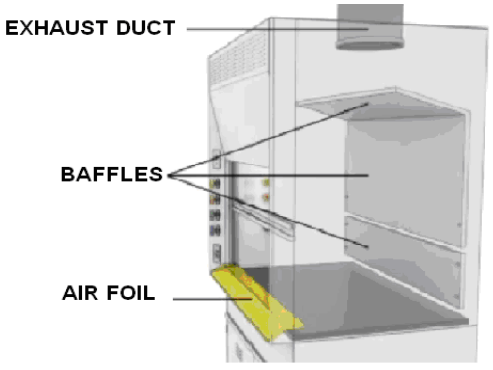
a. Acid cupboards: Chemicals that are inorganic acids, base, oxidizing or water based chemicals, as well as non-toxic inorganic salts should be stored in such cupboards. These cupboards are connected to the acid exhaust system.
b. Acid cupboards (solid).
c. Solvent cupboards. These cupboards are assigned for storage of only organic solvents. Solvent cupboard are connected to the solvent exhaust system
d. Toxic chemical cupboards: Are connected to toxin exhaust system and used for storage of toxic chemicals. Note that:
    - The toxin cupboards must always kept locked.
    - HF and buffered HF should be stored in the acid cupboards but not toxin cupboards.

If you want to store a mixture of different chemicals contact the CPE for further assistance.

1.7. General safety Guidelines for Fume Hoods and Wetbenches

Before working with the hoods and/or benches check the followings:

- choose the right hood and /or bench depending to the nature of the chemical that you want to treat (i.e. acid Hood/Bench or solvent Hood/Bench).
- check if the ventilation face velocity of the hood is between 0.4 –0.8 m/sec and the minimum velocity at the middle of the bench is bout 0.5 m/sec.
- check if the necessary personal protections are available in the laboratory location.



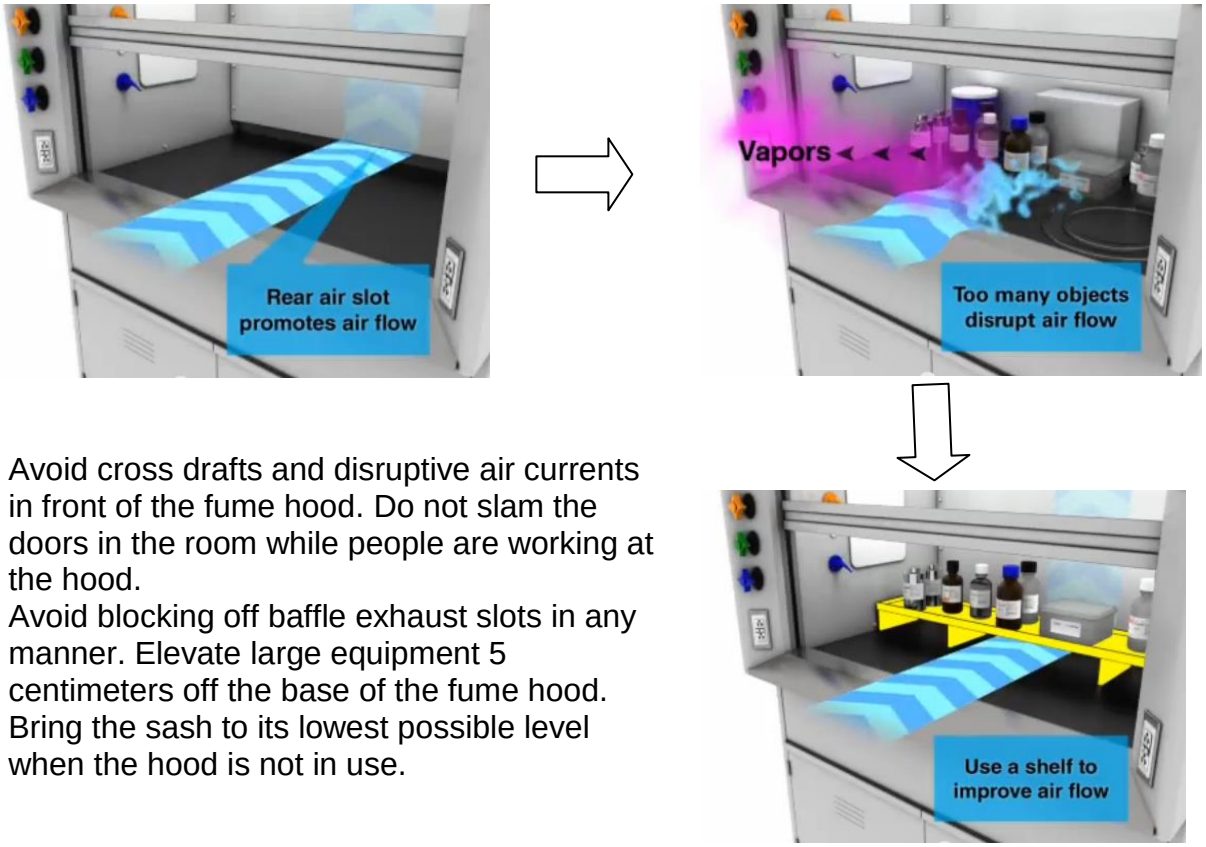
1.7.1 Fume Hoods

a. The hood sash must be marked at maximum use

opening (vertical sliding
sash only). Do not use the hood with the sash above this mark.

b. Do not place your face inside the hood. Keep hands out as much as possible.

c. Keep sources of emission 25 centimeters inside the hood.
d. The hood should not be used for chemical storage except for strongly malodorous compounds.
e. Chemicals stored in the hood must be in a capped or covered container. The content chemical must be identified by name, concentration, and hazard symbol. Avoid storing large mount of chemicals in the hood, it obstructs airflow and reduces usable space.



f. Avoid cross drafts and disruptive air currents in front of the fume hood. Do not slam the doors in the room while people are working at the hood.
g. Avoid blocking off baffle exhaust slots in any manner. Elevate large equipment 5 centimeters off the base of the fume hood.
h. Bring the sash to its lowest possible level when the hood is not in use.

Use of coat apron, blue protector gown, is compulsory while treating chemicals in a fume hood.

1.7.2 Wetbenches

Those who want to work with Wetbenches have to get the “Wetbench license”.

a. Standard wet processes are carried out in the Wetbench-baths.
b. It is compulsory to dress personal protective clothing while working at Wetbenches.
d. Do not mix the chemicals in the baths. Mixing of the chemicals should take place in fume hoods.
e. Baths with circulating pump should not be left empty.

f. Baths with circulating pumps and heaters:
   - always operate the pump before turning the heater on.
   - to cool the bath turn off the heater first and wait until the temperature of the bath drops down to about 25-35 ^{o}C then turn off the pump
g. Do not place your face directly above the bath.
h. Don not leave wipers, glassware, and any other items with large areas on the benches' perforated surfaces.

If one is approaching to a Wetbench she/he has to wear at least the face shield.

1.7.3 Resist spinner bench

These benches are used to spin photoresist layer on a chips or wafer. Photoresist (is of different types and contains polymer and solvent) acetone and IPA are the most common chemicals that are treated at such benches.

a. All wipers and syringes contaminated with photoresist should be disposed in the waste trash boxes, which are connected to ventilation system.
b. While filling the syringes with photoresist write the name of photoresist and the date on the syringes, if they are to be reused.

1.7.4 General guidelines for processing of chemicals at Hoods and Wetbenches

a. Clean up the spills after any process
   • Use the clean room wipers
   • Leave the contaminated wipers in the right trash box, in the fume hoods.
   • Wipers contaminated with HF should be treated in a different way
   • The yellow roll wipers are not Clean Room compatible;
      1. used to absorb large amount of chemicals on the floor.
      2. must not be left on the floor for a long time
      3. the contaminated yellow wipers should be placed in the yellow bag with a label indicating the name of contaminant. The bag must be kept in the fume hood in room 3R75, in the process Lab., or in any proper fume hood in the analyses lab.
      4. Inform CPE immediately

b. Each wafer carrier has room number and process name on it. It is absolutely forbidden to use the carriers in a process or in a room other than the places that they have been assigned to be used.
c. Always check if the Teflon cover of the Stirring rod or the magnetic stir bars are not torn up or abraded. The bars and/or rods with damaged Teflon cover must be disposed.

1.8. Labware, Instruction for Use

a. Pick up the labware you need from the shelves in the dishwasher room (3R52).

b. Disposable beakers shall always be used for dirty processes that risk contaminating the beakers permanently.

c. • For ultra-clean processes, it is recommended to clean brand new disposable beakers with RCA standard clean (excluding HF-dip) prior to use.

d. • It is absolutely forbidden to leave vessels containing chemicals in any place other than in fume hoods.

e. • If you leave vessels containing chemicals in a fume hood, even for a short time, always mark them with contents, concentration, and your name.

f. • After use, empty, rinse, and manually clean the labware. Remove any markings.

g. • After pre-cleaning, take the labware to the dishwasher room (3R52) and put it with openings up in one of the boxes for used labware. There is one box for reusable labware and one box for disposable labware.

h. • Designated staff will run the dishwasher.

f. Use the right resinware for right process (Appendix A1.1-2)

All process laboratory users are responsible to learn the rules regarding handling of glassware.

Use of wrong glassware contaminates the container which in turn damages the others process studies.

1.9. Acid and solvent drains

In the Cleanroom one can spill out the liquid chemical wastes in their respective drain (solvent drain or acid drain).
Note that **not all chemical allowed to be spilled out in these drains**. The drains are connected to their respective tanks. To spill out a chemical waste in the drain, do as follows:

a. check to which chemical group the waste belongs (acid or solvent)
b. check if the waste is allowed to be poured in the drain (Sections 1.9.1and 1.9.2).
c. open the tap/valve under
d. spill out the waste
e. close the tap/valve.

Important notes:

i. The reactions which take place between some strong oxidizer and flammable solvents may results in powerful explosions. The reaction between hydrogen peroxide, as oxidizing agent, of concentration over 50%, and acetone as flammable solvent is a good example for such explosion. Nitric acid, Sulfuric acid and some other inorganic acids act as strong oxidizers which in contact with flammable solvents may cause a severe increase in the burning rate of combustible solvent. For that reason, **it is absolutely forbidden to pour acids, bases, oxidizer, inorganic salts, and water based chemicals in solvent drain or solvent wastes in acid drain.**

ii. Warm chemicals have to be cooled down to room temperature before drain disposal.

No acid is allowed to be drain disposed in the solvent drains or vice versa.

Contact the Cleanroom CPE if you are unsure about spilling out the chemical waste in to the drains or not.

1.9.1 Solvent drains

Only **halogen free** organic wastes that are not **environmentally hazardous,** are allowed to be spilled out in these drains. Some solvent fume hoods have two drains.

Solvent Drain

Only the following solvents are allowed to spill out in this drain:

Acetone	**Methanol**
Ethanol	**Propylene glycol**
Ethylene Glycol	**1-propanol**
Formaldehyde	**2-propanol**

Solvents that are hazardous to environment must be kept in bottles as waste.

The solvent drain is the one that have the following notice above it. In the notice, one can find the list of solvents that are allowed to be poured in the drain.

If because of any reason container of a solvent has to be rinsed with water, this water has to be poured in the solvent drain too. Note that the solvent must be halogen free and not hazardous to environments.

1. 9.2 Acid drain

Mainly nontoxic acids and bases are allowed to be drain disposed in the acid drain. Strong acid waste must be diluted before being drain disposed in the acid drain or should be considered as a waste that is collected and disposed in accordance with The Cleanroom guidelines for chemical waste (Section 3.). To dilute en acid one should do as follows:

1. Pour acid in relatively large amount of water but not vice versa.
2. Dilution should take place in the acid fume hoods.
3. Dilution processes sometimes create heat, this means that one should cool down the solution prior to drain disposal.

1.10 Chemical emergency and First aid measures

The purpose of this section is to go through those procedures that guide us how to rescue a victim who is exposed to hazardous chemical and how to prevent further improvement of the contamination.

a. Rescue the victim, following the instruction given in section 4 of the chemicals' respective MSDS, or read Appendix A6.
b. Shutdown the equipment that victim was working with (push the emergency shutdown bottom).
c. Inform the Cleanroom CPE.
d. Call emergency if necessary, Ambulance, Rescue Center, and Toxin-Information (Appendix A7).
e. Inform the others to evacuate the contaminated area.
f. Decontaminate the area if possible.
g. Report the accident to the Cleanroom Safetyman.

In The Emergency Call, one must give The Name, Concentration, volume, and exposure-time of the chemical that has caused the harm. This information will help the physician to be well prepared for further rescue.

1.10.1 Eyewashes

Two types of eyewashes are available in the Cleanroom. The first type is the wall mount ones, which are available in all laboratory locations where treatment of chemicals are allowed. The other type is portable eyewash bottle. These eyewash bottles are used while moving the victim to the eye clinic.

The wall mount eyewashes are not connected to any drain and water will be poured on the floor. Do not worry about the floor being wet while using the eyewashes or the showers.

1.11. Hazardous chemicals

"What is it that is not poison? All things are poison, and nothing is without poison. It is the dose only that makes a thing not a poison."
— Paracelsus (1493-1541)

All chemicals are considered to be hazardous materials, especially those which are treated in a wrong way. In following sections, we will be discussing the chemicals that should be treated or handled with special care.

1.11.1. Hydrofluoric acid (HF)

Hydrofluoric acid is both corrosive and toxic. Toxic effect appears with;

a. Inhalation
b. Skin contact
c. Swallowing

Severe burns occur after exposure of concentrated (i.e. 50% or stronger solution) HF acid to 1% or more Body Surface Area (BSA), exposure to HF acid of any concentration to 5% or more BSA, or inhalation of HF acid fumes from a 60% or stronger solution. The vast majority of cases involve only small areas of exposure.

Local effects include tissue destruction and necrosis. Burns may involve underlying bones.

Systematic fluoride poisoning from severe burns is associated with sudden death. Deaths have been reported from concentrated acid burns to as little as 2.5%BSA

Time of exposure to onset of symptoms is related to the concentration of the HF acid.

Concentration	Hours before onset of symptoms
> 50%	Immediately produces symptoms with deep and painful tissue damages.
20- 50%	Immediately. Sign of deep tissue damages are shown after several hours
12%	1 hour. Sign of deep tissue damages are shown after 24 hours.
< 7%	Several hours

HF Warning notices are attached to all entrance doors to the rooms where treatment of Hydrofluoric acid is allowed. In the corridor near to these rooms one can fined HF-antidote gels which are used to apply to the skin being exposed to HF.

Before handling HF check if HF-antidote gel is available and the gel is not more than 2 years old. Note that the gel has to be unused and must be disposed of after use.

1.11.2. Potassium Hydroxide, KOH

Causes blindness immediately after contact with eyes.

1. While cooling the KOH baths, especially the baths with inline heater, keep the pump in operation.
2. Wear always face shield even if you want to control the KOH level in the bath.
3. Follow the instruction for EYES IN CONTACT WITH HARMFUL LIQUIDS, Appendix A6, as first aid measure for Potassium Hydroxide.

1.11.3 7-UP (Piranha), H_2SO_4+H_2O_2 (1:1)

$$H_2O_2 + H_2SO_4 \longrightarrow H_2SO_5 + H_2O_2$$

Peroxymonosulphuric acid (Caro's acid)

7-UP solution is very energetic and potentially explosive. If concentration of H_2O_2 is at 50% or greater, an explosion could occur. Mixing hot 7-up solution with organic compounds may cause an explosion. This includes acetone, photoresist, Isopropyl alcohol, and nylon.

Handling and protection

1. Users are advised to handle the solution during operational hours (07:00-17:00).
2. Mix the solution in a acid fume hood (with sash at working level) and wear the protection (***Trionic or Latex gloves, face shield and apron***).
3. To mix Piranha solution add, always, H_2O_2 to H_2SO_4. The mixture produces an exothermic reaction (greater than 100 °C)
4. Hot 7-up explodes in air tight container. Solution must be cooled in an **open** container and stored as waste in en closed container (preferably glass container). The container should be labeled (per instruction for chemical waste).

1.11.4 Cyanide, CN

"Cyanide" refers to large group of chemical compounds. Each chemical in this family contains a chemical unit called the cyanide ion $[C \equiv N]^{1-}$. Any compound which contains Carbon(C) and nitrogen (N) could, under specific conditions, produce the cyanide ion. This cyanide ion is responsible for cyanide poisoning. A small amount of cyanide can be present in the body without causing any symptoms (no symptoms are expected if the blood cyanide level is 0.2 ppm).

Cyanide compound can enter the body by **inhalation**, **absorption** through the skin or eyes, and **swallowing**.

The degree of cyanide compound toxicity, in the body, depends on how easily the cyanide ion is released from rest of the compound (i.e. Toluene Diisocyanate, TDI, and Sodium Thiocyanate). One of the most serious effects of cyanide is that it interferes with action of certain chemicals known as enzymes, which help the cell of the body use oxygen. As a result, the cell cannot use oxygen, begin to deteriorate and may die.

Symptoms: The symptoms for cyanide poisoning are based on symptoms which are shown when there is lack of oxygen in the body. The early symptoms of cyanide poisoning are:

- Vertigo
- Anxiety
- Nausea
- Vomiting
- Weakness
- Headache
- Giddiness
- Confusion

These may be the only symptoms in the person who has been exposed to a small amount of cyanide and who is **removed from the exposure immediately**.

In addition to the above-mentioned symptoms, **skin contact** with Potassium Cyanide or sodium Cyanide can irritate or **blister** the skin. **Swallowing** most cyanide compounds causes

- Bitter, burning test in the mouth
- Watering of the mouth
- Tightness or numbness in the throat.

1.11.5. Cadmium

The Cadmium compound which is treated in the Cleanroom is Cadmium Acetate and its waste is in form of Cadmium Sulfate. Treatment takes place in room 3R07 (Solar Cell Group). Liquid cadmium compound waste (CdSO4) is kept in the assigned place in that room for further transport and the contaminated wipers (the wipers are contaminated by CdSO4 and Thiourea, CH_4N_2S) are disposed of in a ventilated Yellow Trash Bag in room 3R47. The bag is removed by only authorized people.

Symptoms: Long exposure to Cadmium causes cancer. This is the potential for harm to the kidneys and lungs. Effect of Short exposure can include:

- sore eyes, nose and throat;
- coughing, headache, dizziness, and weakness.
- chill, fever, chest pain and breathlessness. If swallowed the following symptoms may occur:

  Nausea, vomiting, diarrhea, muscular cramps and salivation.
  Those who treat Cadmium and /or Cadmium compounds have to be well informed on precaution regarding treatment of these chemicals.

Following are list of some useful articles on Cadmium.

a. CADMIUM AND YOU
   [PDF] INDG391 - **Cadmium** and you - working with **Cadmium** - are you at risk ?

b. CADMIUM
   http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=15

c. KADMIUM
   Kadmiumexponering hos kvinnor i Västsverige, 20-29 år och 50-59 år

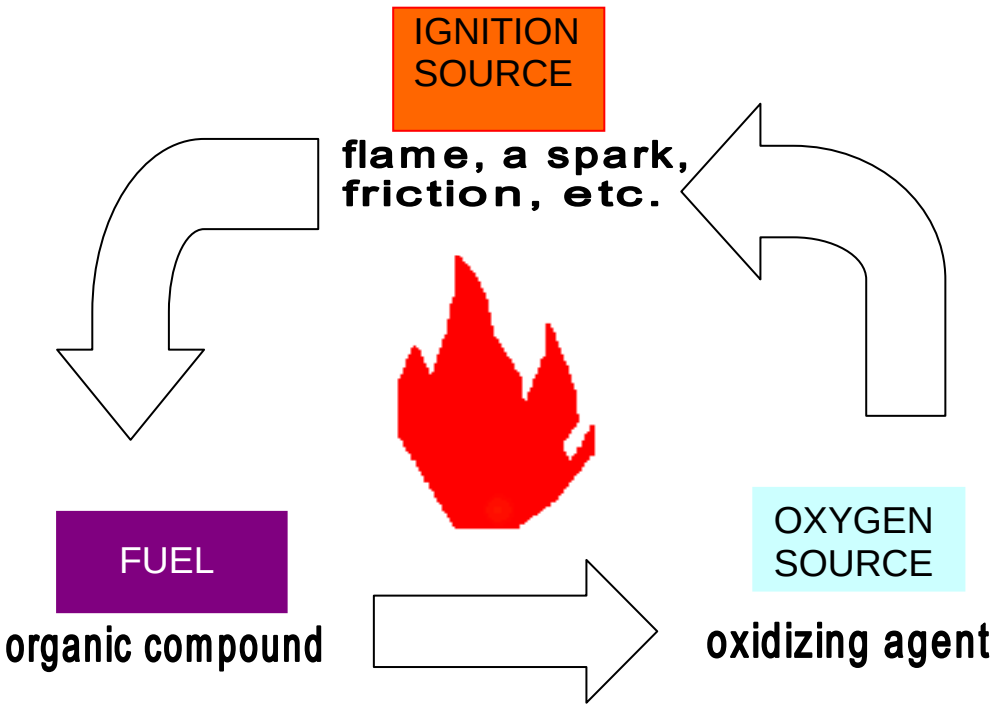
d. KADMIUM I LIVSMEDEL
   http://www.gunnarlindgren.com/kadmiumlivs.html

Do not forget to wash you hands when you leave the clean room no mater if you have handled or treated any chemical. Think that you have touched an unassigned contaminates equipment or area.

1.11.6. OXIDIZING AGENTS

Oxidizers, because of their chemical structures, have excess oxygen which may be liberated, especially at higher temperatures.

The primary hazard associated with this class of compounds lies in their ability to act as an oxygen source, and thus to readily stimulate the combustion of organic materials.



Classification System for Oxidizing Materials

Oxidizers may be grouped into 4 classes based on their ability to affect the burning rate of combustible materials or undergo self-sustained decomposition. This classification system was established by the National Fire Protection Association (NFPA 43A, 1980) as a means to provide information on safe storage of oxidizing materials. These materials are classified according to the following guidelines shown in Table below.

Class Rating	Hazard Description
Class 1	An oxidizing material whose primary hazard is that it may increase the burning rate of combustible material with which it comes in contact.
Class 2	An oxidizing material that will moderately increase the burning rate or which may cause spontaneous ignition of combustible material with which it comes in contact.
Class 3	An oxidizing material that will cause a severe increase in the burning rate of combustible material with which it comes in contact or which will undergo vigorous self-sustained decomposition when catalyzed or exposed to heat.
Class 4	An oxidizing material that can undergo an **explosive reaction** when catalyzed or exposed to heat, shock or friction.

Typical examples of each class of oxidizing agent are shown in Appendix A11

2. DECONTAMINATION

Chemical contamination is defined as spill of chemicals out of a place where one has full control over them. In this case the spilled chemicals can damage the people, equipment, and environment. The process that one goes through in order to clean up the spill (contaminant) is called decontamination.

To decontaminate the spill one has to use the equipment in decontamination kit (room 3R47, in process laboratory or room 3R87, in analysis laboratory). When ordering new chemical check if the equipment in the kit are sufficient (Appendices A2 and A3) to clean up this chemical in case the chemical acts as contaminant.

All Cleanroom users are responsible to clean up small amount of spill, read sections 1.3.2 and 1.7.4.

Cleanroom CPE should clean up large amount of spill or unknown spills. In case you notice, a large amount of contamination do as follows:

a. Inform the Clean Room CPE
b. Inform the others to evacuate the contaminated area
d. Do not leave the contaminated place until the CPE reach the location.

Some contaminants, especially those chemical with high concentrations must, for more safety, be **neutralized** prior to being cleaned up (appendix A4).

3. CHEMICAL WASTE AND SHARP WASTE

Liquid chemical waste which are not allowed to be poured in the chemical drains and solid chemical waste should be removed to the waste storage room. The waste is later delivered to the community's chemical waste stations.

Chemical waste containers shall always be labeled with the complete chemical name. **Abbreviations, trade names, or chemical formulas are not permitted**.

When the chemical waste are mixed, the amount and concentration of constituents must be listed on the container or on a log next to the container. Note that there are some chemicals Which are incompatible with each other and should not be mixed. Appendix A8 shows a list of incompatible chemical.

Do not mix your chemical waste with that of the others even if those are compatible with your chemical. You are only allowed to mix your own chemical waste in case they are compatible with each other.

3.1. Treatment of the chemical waste

The last step of an experiment should include treatment of the chemical waste to reduce the hazards or toxicity of by-products. **All Cleanroom users are responsible to collect, identify, and remove their chemical waste to the assigned places**. Follow the procedure given in Appendix A9 and Appendix A10.

3.2 Handling of Sharp waste

All broken glassware and wafers should be **decontaminated** before being disposed of. Contact the Cleanroom CPE if the waste is contaminated or it is a **metal waste**. Dispose the right waste in the right can or pail (room 3R15and 3R47).

a. Stainless Steel Trash Can with foot pedal: For clean sharp wafers only.
b. Trash pail (Plastic): For clean and sharp laboratory glassware.

Trash bag (with bag holder): For cadmium waste (room 3R47)

Appendices

A1	General Properties Of Resin Type Products
A2	Decontamination Kit And Instruction For Decontamination (Process Laboratory).
A3	Decontamination Kit And Instruction For Decontamination (Analysis Laboratory).
A4	Quick Reference For Spill Cleanups.
A5	Filter Guide.
A6	Emergency Treatment, In The Case Of Having Been Exposed To Chemicals.
A7	Emergency Telephone Numbers.
A8	Chemical Incompatible Tables.
A9	Handling Of Chemical Waste And Sharp Waste in The Cleanroom.
A10	Cancerogenous substances
A11	Oxidizing Materials (as Classified by the NFPA*)
A12	Chemical resistant wears

Appendix A1

GENERAL PROPERTIES OF RESIN TYPE PRODUCTS

The properties listed below are the general properties of the resin type. Different grades of the same resin can cause considerable variation in the physical properties.General properties are given to help you better understand why a particular resin was chosen for product use.

FLUROCARBON RESINS

PTFE (polytetrafluoroethylene) is a fully fluorinated opaque, white polymer with the lowest coefficient of friction of any solid. A common known brand is Teflon® PTFE from DuPont. PTFE has high impact strength, is subject to creep and is resistant to virtually all chemicals and solvents.

PFA (perfluoroalkoxy) is a fluorinated translucent , slightly flexible polymer with low coefficient of friction and outstanding anti-stick properties. A commonly known brand is Teflon® PFA from DuPont. PFA has excellent stress crack resistance and because of its exceptional purity, does not pose an outgassing problem. PFA is resistant to virtually all chemicals and solvents.

ETFE (ethylene tetrafluoroethylene) is a white translucent resin that has higher strength than fully fluorinated polymers. A commonly known brand is Tefzel® ETFE from DuPont. Glassreinforced grades have outstanding creep resistance. However, ETFE has somewhat lower chemical resistance than PFA or PTFE. Strong oxidizing acids, organic bases and sulfuric acid at high concentrations, near their boiling points, will affect ETFE to varying degrees.

ECTFE (ethylene chlorotrifluoroethylene) has a higher strength than fully fluorinated polymers. A commonly known brand is Halar® ECTFE form Ausimont, Inc. ECTFE has better creep resistance than PTFE or PFA. ECTFE has excellent abrasion resistance and impact strength at room cryogenic temperatures. ECTFE is resistant to wide variety of corrosive chemicals and organic solvents but is not resistant to hot amins.

PVDF (polyvenyliden fluoride) is an opaque, white resin with high strength and abrasion resistance, similar to ECTFE. Commonly known brands are Kynar® PVDF from Atochem and Solef® PVDF from Solvay. PVDF is resistant to most bases, salts, strong acids, oxidizing agents and organic solvents. PVDF has poor resistance to organic bases and certain organic solvents at room temperature.

NONFLUROCARBON RESINS

PP (polypropylene) is a translucent or transparent polymer that is highly flexible. PP is durable with good impact strength. PP has good resistance to strong mineral acids and basis, alcohols and some solvents. PP has poor resistance to chlorinated and aromatic solvents, concentrated hydrochloric acid and hydrogen peroxide at elevated temperatures.

PE (Polyethylene) is available in various degrees of crystallinity, including LDPE (low density polyethylene), HDPE (high density polyethylene). These polyethylene materials have chemical resistance similar to polypropylene. Strong oxidizing agents will eventually cause embrittlement. Some solvents will cause softening and swelling of the resin.

PMMA (polymethyl metacrylate) is a clear, rigid polymer with good impact strength. The clarity of PMMA is equal to glass and is used with transparent colors to control UV light transmittance.

Appendix A1 (continued)

GENERAL PROPERTIES OF RESIN TYPE PRODUCTS

PMMA has excellent dimensional stability. PMMA has good resistance to bases, oils, most mineral acids, salt solutions and detergents, but is attacked by most solvents.

PS (polystyrene) is a transparent, rigid, brittle polymer with excellent dimensional stability. PS is subject to stress cracking and some of the higher impact grades incorporate butadiene for added impact strength. PS is resistant to water, weak acids and bases, and detergents, but is attacked by most organic solvents.

ABS (acrylonitrile butadiene styrene) is a rigid, tough polymer with good impact strength. ABS is available in transparent and colored grades. ABS is resistant to most acids, bases, salt solutions and many alcohols, but is attacked by most organic solvents.

PC (polycarbonate) is rigid, transparent polymer with high impact strength that is also available with transparent colors to control UV transmittance. PC has good dimensionally stability and is generally compatible with weak acids, bases, oils and alcohols at room temperature. PC is attacked by organic solvents and concentrated acids and bases at elevated temperature.

PSO (polysulfone) is strong, colorable, yellowish clear polymer. PSO has good thermal stability and rigidity at high temperatures. PSO is highly resistant to aqueous mineral acids, bases, and salts solutions and has good resistance to detergents, oils and alcohols even at elevated temperatures and stresses. PSO is not compatible with most organic solvents, specially alcohol

PES (polyetherfulfone) has excellent heat resistance, dimensional stability and creep resistance. PES has good resistance to most inorganic chemicals, aliphatic hydrocarbons and most solvents including chlorinated and fluorinated reagents. PES is attacked by esters, ketones, methylene chlorides and polat aromatic.

PEI (polyetherimide) is a clear amber polymer. A commonly known brand is Ultem® PEI from G. E. Plastics. PEI c an be colored with opaque colorants. It has excellent long-term resistance to creep at high temperature and stress. PEI is UV light resistant and has excellent dimensional stability. PEI has good resistance to most oils, alcohols, and dilute mineral acids, dilute bases and salt solutions. It is attacked by organic solvents.

PBT (polybutyl terephthalate) is a high-strength, rigid polyester. PBT has low creep, even at high temperatures. PBT has excellent dimensional stability and can be molded into shapes that can not be attained with other polymers. PBT can be glass-filled to produce a higher strength material. PBT is resistant (at room temperature) to dilute acids and bases, detergents, aqueous salt solutions, oils, alcohols and many organic solvents. Chemicals attack occurs more rapidly at elevated temperature.

PPS (polyphenylene sulfide) is dark opaque. PPS has excellent dimensional stability with low creep and high strength PPS has good resistance to acids, bases, solvents, alcohols and many organics at elevated temperatures. PPS is attacked slightly by formic acid, some organics and long-term exposures in hot oxidizing agents.

PEEK (polyethetetherketone) is a cream colored polymer which can be supplied in a limited range of colors. PEEK has excellent flexural and tensile properties at very high temperatures. PEEK is tough

Appendix A1 (continued)

GENERAL PROPERTIES OF RESIN TYPE PRODUCTS

and abrasion resistant to attack by a very wide range of organic and inorganic chemicals. The only common solvents that attack PEEK are concentrated sulfuric acid and concentrated hydrofluoric acid.

PETG (polyethylene terephthalate-glycol) is an amorphous copolyester. It is clear, strong, tough and dimensionally stable. Although PETG is attacked by esters, ketones and chlorinated solvents, It has better stress cracking resistance than PC in many other environments.

HPP (high performance polyester) is a clear transparent material with excellent colorability. HPP high impact strength is equal to or grater than PC.

PAS (Polyaryarylsulfone) is a high temperature amorphous polymer. Like PES, it has excellent dimensional stability and creep resistance. It is vulnerable to attack by esters, ketones and hydrocarbons. It is chemically resistance to steam, acids, alkalies and salts.

Appendix A2

Decontamination kit and instruction for decontamination (Process Laboratory)

Contents :

Full face Mask
PH-indicator paper
Protective gloves
Yellow plastic bags
Protective filters (with instruction, Appendix A4)
HF-tester
Protective boot
Disposal boot cover
Disposal Apron
Quick Reference For Spill Cleanups

For assistance contact:

Farhad Zamany , mobile 070425044, E-mail: farhad.zamany@angstrom.uu.se

INSTRUCTION

1. The **Cleanroom users** are supposed to use the kit for small decontamination. Large amount of spill or spill of toxic chemical as well as HF should be decontaminated by Cleanroom CPE. Always contact the chemist for detailed instructions.

2. Identify the spilled chemical if the contaminant is unknown. Start with the worst possible case (i. e. color less liquid can be HF). Use the HF tester to identify if the unknown liquid is HF.

3. Mix the necessary neutralization solution, in case it is needed (read Appendix A4).

4. Pick up right protective clothing and filter (appendix A5) depending onto the nature of the spilled chemical.

5. Neutralize the spilled chemical with its respective neutralization solution. Use yellow wiper to absorb the spill.

6. Take a yellow plastic bag and fill it with contaminated;
    a. yellow wiper
    b. gloves
    c. aprons and disposal covers

    Identify the name of contaminant in the bag, your name and Dept. name, and the date using the chemical waste Labels.

7. Place the bag(s) in a proper Fume Hood or in the washstand in room 3R85.
8. Inform the Cleanroom CPE and report the contamination to the Safety officer.

Appendix A3

Decontamination kit
and instruction for decontamination
(Analysis Laboratory)

Contents :

Full face Mask
PH-indicator paper
Protective gloves
Disposal Apron
Protective filters (with instruction, Appendix A4)
Protective boot
Quick Reference For Spill Cleanups
Disposal boot cover
Yellow plastic bags

For assistance contact:

Farhad Zamany , mobile 0704250844, E-mail: farhad.zamany@angstrom.uu.se

INSTRUCTION

1. The **Cleanroom users** are supposed to use the kit for small decontamination. Large amount of spill or spill of toxic chemical as well as HF should be decontaminated by Cleanroom CPE. Always contact the chemist for detailed instructions.

2. Mix the necessary neutralization solution, in case it is needed (read Appendix A4).

3. Pick up right protective clothing depending onto the nature of the spilled chemical.

4. Neutralize the spilled chemical with its respective neutralization solution. Use yellow wiper to Absorb the spill.

5. Take a yellow plastic bag and fill it with contaminated yellow wiper, gloves, aprons and disposal covers. Identify the name of contaminant in the bag, your name and Dept. name, and the date using the chemical waste Labels.

6. Place the bag(s) in a proper Fume Hood.
7. Inform the Cleanroom CPE and report the contamination to the Safety Man/ Officer.

Appendix A4

QUICK REFERENCE FOR SPILL CLEANUPS

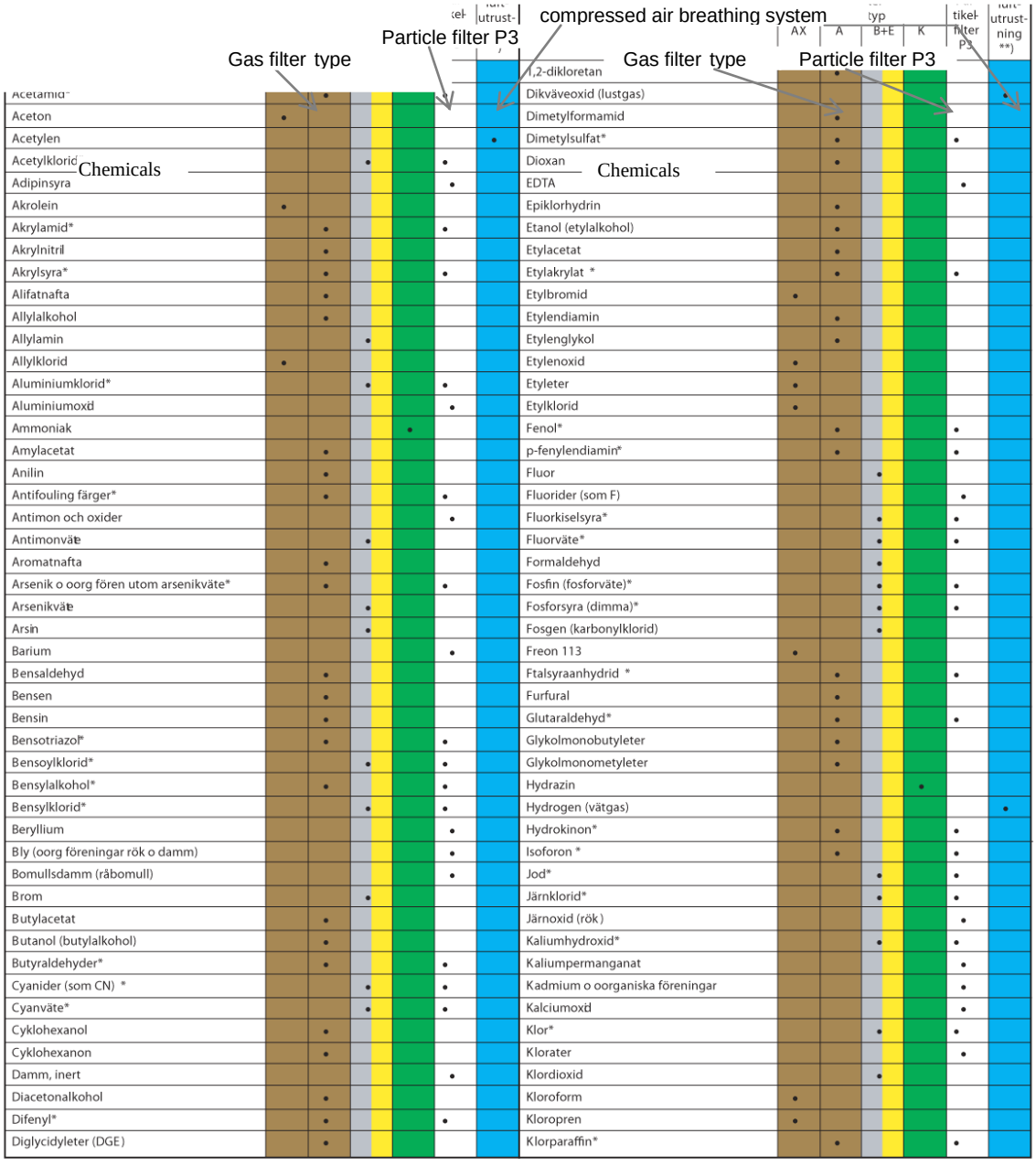
CHEMICAL SPILLED	CLEAN UP
Acids, organic	Apply sodium bicarbonate. Absorb with Yellow Wiper.
Acids, inorgani	Apply sodium bicarbonate/calcium oxide or sodium carbonate/calcium oxide. Absorb with Yellow Wiper. Note: Hydrofluoric acid is an exception to this general practice; see below.
Acid chlorides	Do not use water. Absorb with sand or sodium bicarbonate.
Aldehydes	Absorb with Yellow Wiper.
Aliphatic amines	Apply sodium bisulfite. Absorb with Yellow Wiper.
Aromatic amines	Absorb with Yellow Wiper. Avoid skin contact or inhalation.
Aromatic halogenated amines	Absorb with Yellow Wiper. Decontaminate with 10% ceric ammonium nitrate solution.
Azides (potential explosives)	Absorb with Yellow Wiper. Decontaminate with 10% ceric ammonium nitrate solution.
Bases (caustic alkalis)	Neutralize with acid or commercial chemical neutralizers and absorb with Yellow Wiper.
Carbon disulfide (flammable and toxic)	Absorb with Yellow Wiper.
Chlorohydrins	Absorb with Yellow Wiper. Avoid skin contact or inhalation.
Cyanides	Wet or mist solids before sweeping, or use a HEPA filter vacuum to collect the solids. Absorb liquids with Yellow Wiper or vermiculite.
Halides, organic or inorganic	Apply sodium bicarbonate.
Halogenated hydrocarbons	Absorb with Yellow Wiper.
Hydrazine	Absorb with Yellow Wiper. Avoid organic matter.
Hydrofluoric acid	Absorb with calcium carbonate (or calcium oxide) rather than sodium bicarbonate. The use of sodium bicarbonate will lead to the formation of sodium fluoride, which is considerably more toxic than calcium fluoride. Be careful in the choice of Yellow Wipers used to absorb the acid. Certain pillows contain silicates that are incompatible with hydrofluoric acid.
Inorganic salt solutions	Apply soda ash
Mercaptans/organic sulfides	Neutralize with calcium hypochlorite solution. Absorb with Yellow Wiper.
Nitriles	Sweep up solids. Absorb liquids with Yellow Wiper.
Nitro compounds, organic nitros	Absorb with Yellow Wiper. Avoid skin contact or inhalation
Oxidizing agents	Apply sodium bisulfite.
Peroxides	Absorb with Yellow Wiper.
Phosphates, organic and related	Absorb with Yellow Wiper.
Reducing substance	Apply soda ash or sodium bicarbonate

Reference: Reagent Chemicals, MCB Manufacturing CPE, Inc., 1981, pp. 359-402.

Appendix A5

FILTER GUIDE

Available filters' code	Used as	EN-standard	Filter type
T105 1000	Particle filter	EN-371	AX
T1061703	Combined filter	EN-141	A2/B2/E2/K2/P2



*) När 2 punkter i tabellen är markerade skall filtren kombineras. D v s båda skall användas samtidigt.
Förfilter 221 skall alltid användas. *OBS! Kan aldrig ersätta partikelfilter 210/310.*

**) Tryckluftutrustning kan alltid användas i stället för filterskydd. Det skall alltid användas vid gaskoncentrationer över 0,5 vol %. Bör användas vid tunga eller långvariga arbeten.

Tryckluftmatade skydd får dock ej användas i miljöer som är omedelbart hotande till liv och hälsa.
Användaren måste riskfritt kunna avlägsna sig från arbetsplatsen om lufttillförseln upphör eller om andningsskyddet av annat skäl måste tas av.

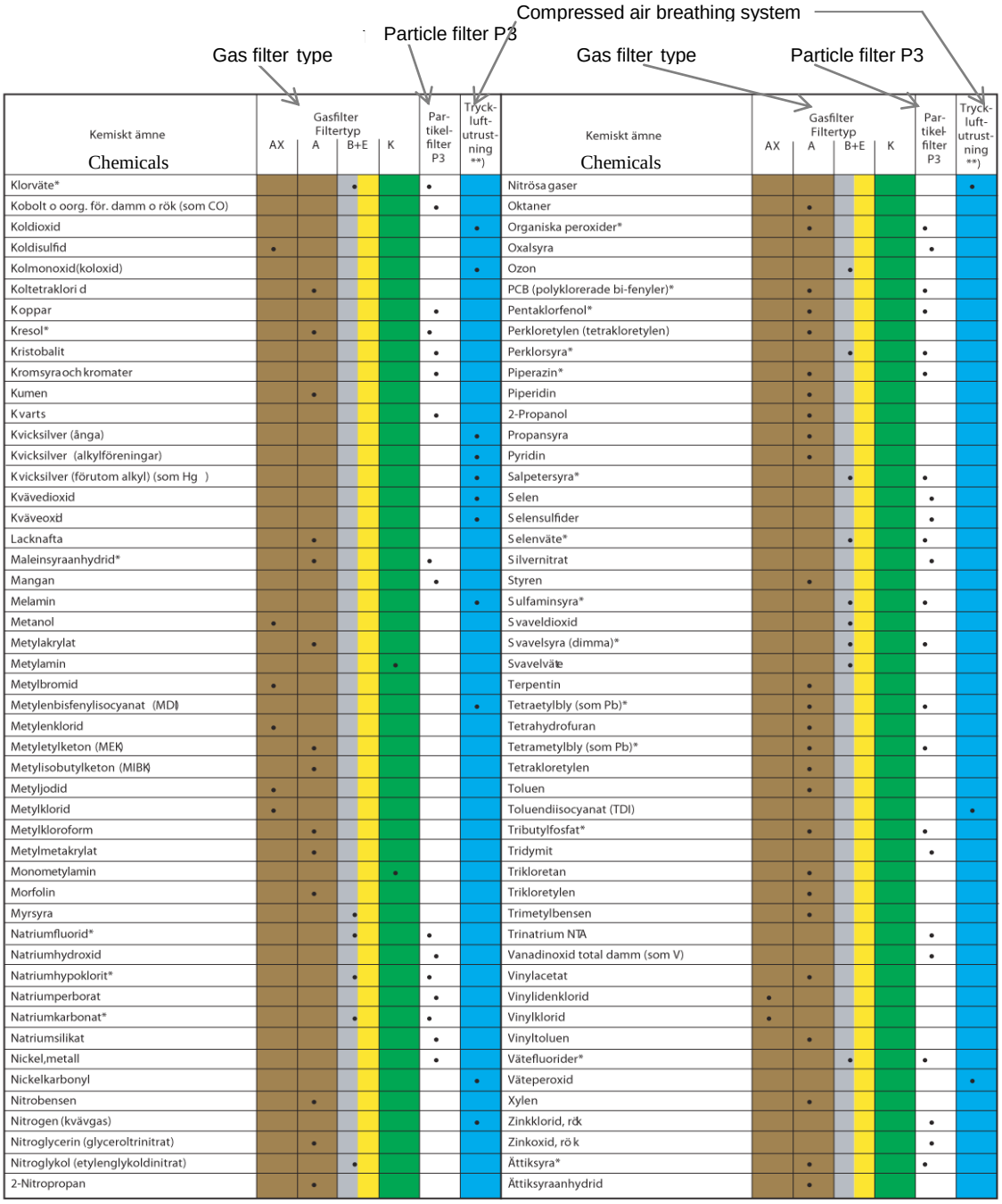
Frågor rörande filterval och användningsteknik kan också ställas direkt till Sundström Safety AB.

2006-07-06

Appendix A5 (continued)

FILTER GUIDE

Available filters' code	Used as	EN-standard	Filter type
T105 1000	Particle filter	EN-371	AX
T1061703	Combined filter	EN-141	A2/B2/E2/K2/P2



Kemiskt ämne / Chemicals	Gasfilter Filtertyp AX	A	B+E	K	Partikelfilter P3	Tryckluftutrustning **)
Klorväte*			•		•	
Kobolt o oorg. för. damm o rök (som CO)					•	
Koldioxid						•
Koldisulfid	•					
Kolmonoxid(koloxid)						•
Koltetraklorid		•				
Koppar					•	
Kresol*		•			•	
Kristobalit					•	
Kromsyra och kromater					•	
Kumen		•				
Kvarts					•	
Kvicksilver (ånga)						•
Kvicksilver (alkylföreningar)						•
Kvicksilver (förutom alkyl) (som Hg)						•
Kvävedioxid						•
Kväveoxid						•
Lacknafta		•				
Maleinsyraanhydrid*		•			•	
Mangan					•	
Melamin						•
Metanol	•					
Metylakrylat		•				
Metylamin				•		
Metylbromid	•					
Metylenbisfenylisocyanat (MDI)						•
Metylenklorid	•					
Metyletylketon (MEK)		•				
Metylisobutylketon (MIBK)		•				
Metyljodid	•					
Metylklorid	•					
Metylkloroform		•				
Metylmetakrylat		•				
Monometylamin				•		
Morfolin		•				
Myrsyra			•			
Natriumfluorid*			•		•	
Natriumhydroxid					•	
Natriumhypoklorit*			•		•	
Natriumperborat					•	
Natriumkarbonat*			•		•	
Natriumsilikat					•	
Nickel,metall					•	
Nickelkarbonyl						•
Nitrobensen		•				
Nitrogen (kvävgas)						•
Nitroglycerin (glyceroltrinitrat)		•				
Nitroglykol (etylenglykoldinitrat)			•			
2-Nitropropan		•				

Kemiskt ämne / Chemicals	Gasfilter Filtertyp AX	A	B+E	K	Partikelfilter P3	Tryckluftutrustning **)
Nitrösa gaser						•
Oktaner		•				
Organiska peroxider*		•			•	
Oxalsyra					•	
Ozon			•			
PCB (polyklorerade bi-fenyler)*		•			•	
Pentaklorfenol*		•			•	
Perkloretylen (tetrakloretylen)		•				
Perklorsyra*			•		•	
Piperazin*		•			•	
Piperidin		•				
2-Propanol		•				
Propansyra		•				
Pyridin		•				
Salpetersyra*			•		•	
Selen					•	
Selensulfider					•	
Selenväte*			•		•	
Silvernitrat					•	
Styren		•				
Sulfaminsyra*			•		•	
Svaveldioxid			•			
Svavelsyra (dimma)*			•		•	
Svavelväte			•			
Terpentin		•				
Tetraetylbly (som Pb)*		•			•	
Tetrahydrofuran		•				
Tetrametylbly (som Pb)*		•			•	
Tetrakloretylen		•				
Toluen		•				
Toluendiisocyanat (TDI)						•
Tributylfosfat*		•			•	
Tridymit					•	
Trikloretan		•				
Trikloretylen		•				
Trimetylbensen		•				
Trinatrium NTA					•	
Vanadinoxid total damm (som V)					•	
Vinylacetat		•				
Vinylidenklorid	•					
Vinylklorid	•					
Vinyltoluen		•				
Vätefluorider*			•		•	
Väteperoxid						•
Xylen		•				
Zinkklorid, rök					•	
Zinkoxid, rök					•	
Ättiksyra*		•			•	
Ättiksyraanhydrid		•				

Appendix A6

FIRST AID MEASURES

INHALATION OF HARMFUL SUBSTANCES

Symptoms: Coughing, difficulty in breathing, wheezing.

In the case of inhalation of harmful substances the victim must always be examined by medical personal.

First aid suggestions

- Remove victim from contaminated zone and place in fresh air.
- Unfasten victim's clothing.
- Make the victim rest in a sitting position.
- Unconscious victims should be laid in the semi-prone position.

HARMFUL SUBSTANCES IN CONTACT WITH THE SKIN

Symptoms: Burns, nausea, exhaustion.

In the case of large areas of the skin having been harmed the victim must always be examined by medical personal.

First aid suggestions

- *Wash the area with copious quantities of water for at least 15 minutes.*
- *Remove rings, watches and contaminated clothing.*
- *Wash the area with soap and water.*
- *Call Toxin-Information Centre for further information.*

HF (hydrogen fluoride)

Symptoms: Severity of the damage depends on the amount of exposure and the concentration. Pain is the major symptom. Pain in mouth, fever, breathing difficultiesVomiting, and rapid drop in blood pressure ***if swallowed****. Chills, fever, chest pain, coughing, eyes choking* ***if inhaled****. Bluish colored lips and finger nail* ***if skin is exposed to HF.***

The victim must always be examined by medical personal.

First aid suggestions

- Call medical personal first and seek medical advice immediately.
- After **swallowing**: give the victim plenty of Calcium Sandoz solution(10 gr /½ water)
- After **inhalation**: fresh air. Keep airways free.
- After contact **with skin:**
  1. Carefully Remove contaminated clothing to prevent further exposure
  2. Wash the contaminated skin area with copious quantities of water for at least 10 minutes.

Appendix A6 (continued)

3. Massage HF antidote gel into the area that was exposed to HF. Repeat continuously until the victim receives medical assistance.

EYES IN CONTACT WITH HARMFUL LIQUIDS
The victim must always be examined by medical personal.

First aid suggestions
- Wash eyes with copious quantities of water for at least 15 minutes at the eye/face wash (wall mount).
- Hold the eyelids apart and wash the area under them.
- Keep on washing the eyes (with the eye wash bottle) while transferring the victim to the Eye Clinic.

SWALLOWING HARMFUL CHEMICALS
Symptoms: Stomach-ache, unconsciousness, nausea and exhaustion.

In the case of swallowing of harmful chemicals the victim must always be examined by medical personal.

First aid suggestions
- Give 1-2 glasses of liquid, preferably water or milk to the victim in order to dilute the swallowed chemical. **This treatment is not applicable to unconscious victims**.
- **Avoid** any treatment that makes the victim vomit, as this can damage the oesophagus.
- An unconscious victim must be laid in the semi-prone position.

CYANIDE POISONING
Early symptoms: weakness, headache, giddiness, confusion, vertigo, anxiety, nausea, vomiting.

First aid suggestions

- Call Toxin-Information for medical assistance.
- Remove the victim to fresh air
- In the case of **skin contact:** Remove contaminated clothing, flush the contaminated skin for 15 to 20 minutes with lukewarm water.
- In the case of **swallowing**: Vomiting should not be induced. Victim should drink 200-300 ml water. Nothing should be given by mouth if victim losing consciousness.

Appendix A7

EMERGENCY TELEPHONE NUMBERS

IN EMERGENCY CASES (00)112

(Ambulance, Rescue Center, and Toxin-Information)

OTHER IMPORTANT TELEPHONE NUMBERS

HOSPITAL	**operator**	**(00) 611 00 00**
(Akademiska sjukhuset)		
Emergency	**operator**	**(00) 611 00 00**
Eye- Clinic (Emergency)		**(00) 611 51 31**
AMBULANCE		**(00) 112**
		(00) 13 93 30
TOXIN-INFORMATION		**(00) 08-33 12 31**
FIRE SERVICE (fire prevention)		**(00) 727 30 20**
COMMUNITY'S CHEMICAL WASTE STATION		**(00) 727 93 78**

NOTE: IN THE EMERGENCY CALL, THE HARMED PERSON MUST GIVE THE NAME, CONCENTRATION, VOLUME, AND EXPOSURE-TIME OF THE CHEMICAL / GAS THAT HAS CAUSED THE HARM. THIS INFORMATION WILL HELP THE PHYSICIAN TO BE WELL PREPARED FOR FURTHER RESCUE.

Appendix A8

CHEMICAL INCOMPATIBILITY TABLE (DO-NOT-MIX TABLE)

The following are chemical incompatibilities that all people who work in the Cleanroom should be familiar with. The list is from Prudent Practices for Handling and treatment of Chemicals as well as mixing of different chemical wastes. The list should not be considered complete. Questions as to the compatibility of chemicals not listed should be referred to MSDS databases, the chemical manufacturer or current literature.

CHEMICAL	INCOMPATIBILITIES
Acetic Acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxide and permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Acetone	Concentrated nitric and sulfuric acid mixtures
Alkali and Alkaline Earth Metals (such as powdered aluminum or magnesium, calcium, lithium, sodium, potassium,)	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide and halogens
Ammonia (anhydrous)	Elemental mercury (in manometers for example), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Ammonium Nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrites, sulfur, finely divided organic combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical Metals	Any reducing agent
Azides	Acids
Bromine	See chlorine
Calcium Oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon Tetrachloride	Sodium
Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials

Appendix A8 (continued)

CHEMICAL INCOMPATIBILITY TABLE (DO-NOT-MIX TABLE)

CHEMICAL	INCOMPATIBILITIES
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic and inorganic)
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	All other chemicals
Hydrocarbons(such as butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, combustible materials
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Sulfuric acid
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	Inorganic bases, amines

Appendix A8 (continued)

CHEMICAL INCOMPATIBILITY TABLE (DO-NOT-MIX TABLE)

CHEMICAL	INCOMPATIBILITIES
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen: flammable liquids, solids or gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorous (white)	Air, oxygen, alkalies, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulfuric and other acids
Potassium perchlorate (see also chlorates)	Sulfuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate, (similar compounds of light metals, such as sodium, lithium)
Tellurides	Reducing agents

Appendix A9

HANDLING OF CHEMICAL WASTE

1. Take a clean empty bottle with the chemical waste label on.

Chemical waste Date: _____

Contact person: _____

Phone: _____ Mobile: _____

Department: _____ Unit: _____

Contents
Water content: ___% pH: _____

Substances in % _____

_____

_____ Cancerogenous substances A ☐ B ☐

these bottles are available in rooms 3R47(process laboratory) and room 3R 87 (Analysis laboratory). Note that glass bottles should not be used as container for hydrofluoric acid.

2. Identify Cancerogenous substances waste's group (**A** or **B)** using the table given in Appendix A10.

3. Take the waste and the bottle in a suitable Fume Hood and Pour the waste in the bottle acting slowly.
4. If you have mixed two or more compatible waste in the same container for more safety check if the mixture is not warm. If the mixture is warm wait until it cools down to the room temperature.
5. Check if the cap is screwed tight. Place the waste in their assigned shelves in the chemical cabinets.

Appendix A10

Cancerogenous substances

Grupp A

Cancerframkallande ämnen	*CAS-nr*
2-Acetamidofluoren	53-96-3
4-Aminodifenyl	92-67-1
Benzidin	92-87-5
1,1'-Diklordimetyleter	542-88-1
1,2-Dibrom-3-klorpropan (DBCP)	96-12-8
N,N -Dimetyl-4-aminoazobensen	60-11-7
Erionit	66733-21-9
Hexametylfosfortriamid (HMPA)	680-31-9
Metylklormetyleter	107-30-2
20-Metylkolantren (3-metylkolantren)	56-49-5
N-Metyl-N-nitrosourea (MNU)	684-93-5
?-Naftylamin	91-59-8
4-Nitrodifenyl	92-93-3

Appendix A10 (continued)

Grupp B

Ämne	*CAS-nr*
Cancerframkallande ämnen	
p-Aminoazobensen	60-09-3
Auramin (4,4'-imidokarbonyl-bis(N,N- dimetylanilin))	492-80-8
Bensalklorid	98-87-3
Bensotriklorid	98-07-7
?-Butyrolakton	3068-88-0
4,4'-Diamino-3,3'-diklor- difenylmetan (MOCA, metylenbis(o- kloranilin))	101-14-4
2,4-Diamino-1-metoxibensen (2,4-diaminoanisol)	615-05-4
2,4-Diaminotoluen (2,4-Toluendiamin)	95-80-7
Dianisidin (3,3'-dimetoxibenzidin)	119-90-4
Diazometan	334-88-3
1,2-Dibrometan (etyldibromid)	106-93-4
1,2:3,4-Diepoxibutan	1464-53-5
Dietylsulfat	64-67-5
3,3'-Diklorbenzidin	91-94-1
2,2'-Diklordietyleter	111-44-4
2,2'-Diklorodietylsulfid (senapsgas)	505-60-2
1,1-Dimetylhydrazin	57-14-7
1,2-Dimetylhydrazin	540-73-8
Dimetylsulfat	77-78-1
Etylenimin (aziridin)	151-56-4
Etylentiourea	96-45-7
Etylmetansulfonat (EMS)	62-50-0
Fenyl-?-naftylamin	135-88-6
Hydrazin	302-01-2
4,4'-Metylendianilin (MDA, 4,4'- diaminodifenylmetan)	101-77-9
Metylmetansulfonat (MMS)	66-27-3
Monometylhydrazin	60-34-4
?-Naftylamin	134-32-7
N-Nitrosodimetylamin (N,N-dimetylnitrosamin)	62-75-9
1,3-Propansulton	1120-71-4
?-Propiolakton	57-57-8
1,2-Propylenimin	75-55-8
Tioacetamid	62-55-5
o-Tolidin (3,3'-dimetylbensidin)	119-93-7
Tris(2,3 -dibrompropyl)fosfat	126-72-7
Uretan (etylkarbamat)	51-79-6
Sensibiliserande ämnen	
2,4-Diaminotoluen (2,4-Toluendiamin)	95-80-7
3,3'-diklorbenzidin	91-94-1

Appendix A10 (continued)

Grupp B

Cancerframkallande ämnen	*CAS-nr*
S-[2-(Dimetylamino)etyl]-pseudotioureadihydro-klorid (PBA 1)	16111-27-6
Hexahydroftalsyraanhydrid	85-42-7
	13149-00-3
	14166-21-3
Metylhexahydroftalsyraanhydrid	25550-51-0
	19438-60-9
	48122-14-1
	57110-29-9
Metyltetrahydroftalsyraanhydrid	26590-20-5
	34090-76-1
	1694-82-2
	3425-89-6
	5333-84-6
	42498-58-8
Tetrahydroftalsyraanhydrid	85-43-8
	935-79-5
Reproduktionsstörande ämnen	
Etylenglykolmonometyleter[2] (2-Metoxietanol)	109-86-4
Etylenglykolmonometyleteracetat[2] (2-Metoxietylacetat)	110-49-6
Etylentiourea	96-45-7

Appendix A11

Oxidizing Materials

Class Rating	Examples
Class I	aluminum nitrate ammonium persulfate barium chlorate barium nitrate barium peroxide calcium chlorate calcium nitrate calcium peroxide cupric nitrate Hydrogen peroxide (8-27.5%) lead nitrate lithium hypochlorite lithium peroxide magnesium nitrate magnesium perchlorate magnesium peroxide nickel nitrate nitric acid (<70% conc.) perchloric acid (<60% concen.) potassium dichromate potassium nitrate potassium persulfate silver nitrate sodium carbonate peroxide sodium dichloro-s-triazinetrione sodium dichromate sodium nitrate sodium nitrite sodium perborate sodium perborate tetrahydrate sodium perchlorate monohydrate sodium persulfate strontium chlorate strontium nitrate strontium peroxide zinc chlorate zinc peroxide
Class II	calcium hypochlorite (<50% wgt) chromium trioxide (chromic acid) halane hydrogen peroxide (27.5-52% conc.) nitric acid (>70% conc.) otassium permanganate odium chlorite (<40% wgt.) odium peroxide odium permanganate richloro-s-triazinetrione
Class III	ammonium dichromate hydrogen peroxide (52-91% conc.) calcium hypochlorite (>50% wgt.) perchloric acid (60-72.5% conc.) potassium bromate tassium chlorate otassium dichloroisocyanurate odium chlorate odium chlorite (>40% wgt.) dium dichloro-s-triazinetrion
Class IV	ammonium perchlorate ammonium permanganate guanidine nitrate hydrogen peroxide (>91% conc.) perchloric acid (>72.5%) potassium superoxide

(as Classified by the NFPA*)

*

Appendix A12

CHE MICAL RESISTANT WEARS
SHOE/BOOT COVERS, APRON, GLOVES, AND FACE SHIELD

Fume Hood works

It is compulsory to use shoe/boot covers(Figure 1), blue aprons (pp type), latex gloves, and face shield while handling;

a. strong and /or warm chemicals
b. toxic chemicals of any concentration (i.e. hydrofluoric acid).

For any chemical treatment, other than the above mentioned processes, use of only Latex gloves and face shield are compulsory.

Standard wet bench works

a. It is compulsory to use blue aprons, Latex gloves, and face shields while handling strong and /or warm chemicals,

b. It is compulsory to use shoe/boot covers, blue aprons, latex gloves, and face shield while handling toxic chemicals of any concentration (i.e. hydrofluoric acid).

For any chemical treatment, other than the above mentioned processes, use of only Latex gloves and face shield are compulsory.

Instruction for using Shoe/boot covers and other protective wears

1. Pick up the Shoe/boot covers from the Box in the room (figure 2). If not available bring one from its respective shelf at process lab. entrance.
2. Check, visually, if the covers are not damaged or torn off. If so, throw the covers in the trash box in the acid fume hood and bring a new one.
3. Always put on protective wears in the following order;
   shoe/boot covers>>>>apron>>>>>>Latex gloves.>>>>>face shields
4. After processing, check if any of the protective wears are contaminated;
   a. Wash the gloves and dry them before you hang them from the assigned place.
   b. Throw the apron and/or shoe/boot covers in the trash box in the acid fume hood, if damaged, torn off, or contaminated with chemicals other than toxic chemicals.

Appendix A12 (continued)

c. If any of the protective wears are contaminated by toxic chemicals (i.e. hydrofluoric acid), put them in a yellow plastic bag, fill and attach a chemical waste label and leave the bag in the assigned place (the fume hood in room 3R75).
d. Shoe/boot covers and aprons can be used if not damaged and/or contaminated.


Figure 1

Figure 2