Introduction to NNF Safety

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NNF Safety Overview

- NCSU has a state-of-the-art cleanroom located in MRC.
- This cleanroom contains a number of hazards, so it is critical that all users are comfortable with:
  - the potential risks of working in the cleanroom
  - what steps should be taken in case of emergency
- Therefore, all users of the NNF facility must pass a safety test before receiving access to the cleanroom.

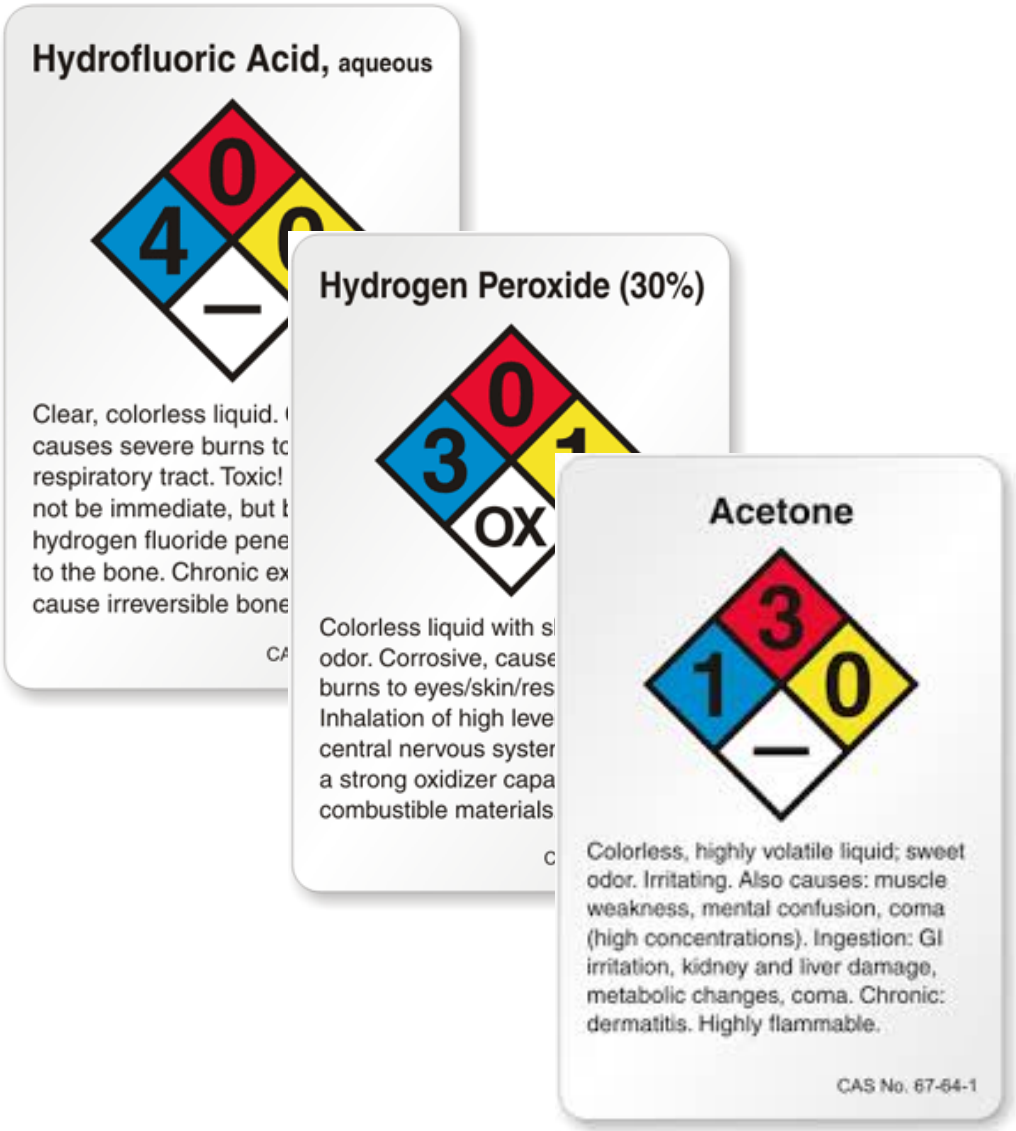
Basic NNF Safety Rules

- No eating or drinking (this includes chewing gum) in the facility.
- Never attempt to operate equipment unless you are an approved user.
- Always report any equipment alarms to NNF staff promptly.
- Always report injuries to NNF staff promptly.
- Always be alert to what is going on around you.
- Use appropriate personal protective equipment (PPE) when handling hazardous materials.
- Contact Campus Public Safety (911) in case of:
  - Fire
  - Any exposure to hazardous chemicals or gases
  - Injuries that require immediate medical attention
  - Major chemical spills
  - Facility evacuation

After-hours work policy

- NNF hours will be 8am – 8pm Monday-Friday
  - At least one NNF staff member will be present during those hours
  - All standard processes are available to users
- Weekend work in NNF will be allowed if and only if all of the following conditions are met:
  - Users are NCSU students or employees
  - At least two NNF-certified users are present at all times; i.e. “the buddy system”
  - The user, the buddy, and the work to be done ***has been approved, in advance, by Dr. Barletta***
  - No acids or hazardous/flammable gasses are to be used

Potential hazards in NNF



- Chemicals
  - Acids
  - Caustics (bases)
  - Flammables
- Compressed Gases
- High Temperatures
- High Voltage

Safety Systems

- Smoke detection system
  - AnaLASER System manufactured by Fenwal
  - Detects diluted smoke & overheat by-products

- Fire suppression system
  - Discharges CO_2 in a chemical hood when it is triggered by the flash (flame) detector.

- Honeywell gas monitoring system
  - Continuously monitors air for toxic and pyrophoric gases
  - Light/horn trees for this system are throughout the lab
  - Below the trees are red emergency gas off (EGO) buttons.
  - They will shut down all gas zones that are related to that area

Building evacuation

- In the event of a fire or toxic gas alarm, everyone in MRC must evacuate the building.
  - Leave the facility as quickly as possible through nearest emergency exit.
  - As you exit, visually survey your work area to see if anyone has been left in the facility. If you see someone that needs assistance, call 911 immediately.
  - Leave your clean room attire on. Do not take time to undress or logout.
  - Personnel working in the NNF should meet at the far right corner of the brickyard plaza.
  - All doors out of the lab can be used in the case of an emergency. **Cleanroom integrity is secondary to safety.**
- The air handler units will shut down to minimize potential spread of toxic gases.
- Loss of power in the cleanroom will also trigger a building evacuation.

Gas cylinder safety

- Every compressed gas cylinder – even those the contain nonhazardous gases – are potentially dangerous.
  - Gas cylinders contain a large amount of energy due to their pressurized contents
  - All gas cylinders need to be secured at all times
- Additionally, NNF uses many gases that are flammable, toxic, or corrosive.
  - Toxic gases pose a special threat, as they are not visible in the atmosphere
- Thus, only NNF staff members are authorized to handle gas cylinders directly.

Chemical Safety: General

- Always check the label of a chemical before using it.
  - Do not use any chemicals that are unlabeled!
- Make yourself aware of the safety concerns and proper handling of the chemicals before starting your work.
- Always read the information contained in the Safety Data Sheet (SDS) for the chemical(s) you will be using.
- Keep chemicals away from the edges of the work space.
- Use proper fume hood for all chemicals:
  - Hoods are labeled throughout facility.
  - Acids/bases should not be used in solvent hoods, and vice-versa
  - Perchloric acid based compounds (e.g., chromium etch) can only be used in one designated location in facility.
  - Fume hood sashed should be kept at 11”.

Chemical safety: Acids/Bases

- Only use acids in hoods approved for their use
  - DO NOT use acids in solvent hoods
  - Potential for explosion (e.g., HNO_3 + acetone)
  - Oxidizers (such as HNO_3) should **never** be mixed with flammable solvent (such as acetone), even if done in a fume hood.
- Always be aware when you are working with an acid or base
  - Example – Did you know that photoresist developer is a base?
  - Alkaline solubility of a photoresist increases upon exposure
  - That is what allow the developer to “wash away” exposed areas
- Empty acid or base bottles should be triple-rinsed before disposal.

Chemical Safety: Hydrofluoric Acid

- Hydrofluoric acid (HF) poses a specific threat due its potential to attack bone
- If HF makes contact with skin:
  - Rinse with water for 15 minutes
  - Apply calcium gluconate gel
  - Seek medical attention
- HF is an etchant for SiO_2, and therefore cannot be stored in glass containers.

Chemical Safety: Solvents

- Only use solvents in hoods approved for their use.
  - DO NOT use solvents in acid hoods.
  - Potential for explosion (e.g., HNO_3 + acetone)
  - Oxidizers (such as HNO3) should **never** be mixed with flammable solvent (such as acetone), even if done in a fume hood.
- Most solvents are considered to be both flammable and toxic

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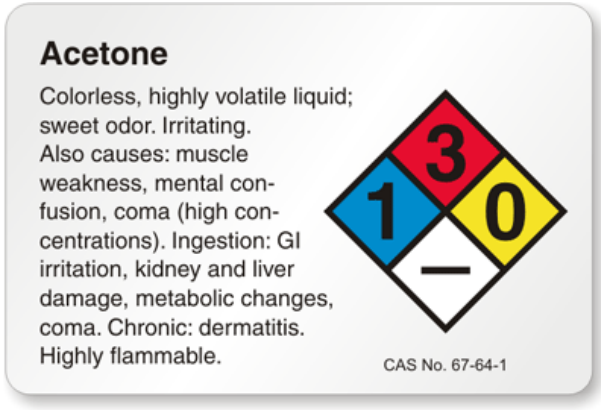

- Empty solvent bottles should be aerated in a solvent hood for 48 hours prior to disposal.

Chemical Safety: Spills

- Small chemical spills (<100mL) that remain in the fume hood can be cleaned up by users
  - For solvents: use spill pillows or towels to clean up spill, then transfer absorbed solvent to plastic bag and send out as hazardous waste.
  - For acids: neutralize, then use spill pillows to absorb
  - EXCEPTION: Any spill with HF requires notification of Environmental Health & Safety
- ANY chemical spills outside of the fume hood require evacuation of the lab
- Be cautious of spent (used) oil from vacuum pumps
  - Should be treated as hazardous
  - May contain toxic residual materials from process(es) for which it was used

Personal Protective Equipment (PPE)

- Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to hazards that cause serious workplace injuries and illnesses (OSHA definition)
- PPE is required for specific tasks within the NNF
- For example, when working with acid, NNF users must wear:
  - Safety glasses
  - Face shield
  - Chemical apron
  - Chemical gloves

Safety Data Sheets (SDS)

- The Hazard Communication Standard (HCS) (29 CFR 1910.1200(g)) requires that the chemical manufacturer, distributor, or importer provide Safety Data Sheets (SDSs) for each hazardous chemical to downstream users to communicate information on any hazards.
- Each SDS is formatted in a 16-section format including information such as chemical composition, first aid, and storage recommendations.
- All users should familiarize themselves with the SDS of every chemical they will be handling in the facility.
- All users should become familiar with the terminology used in an SDS (e.g., acute vs. chronic assimilation)