Please report all accidents and near misses. Things happen and it is important to learn from others. Environmental Health and Safety and your colleagues appreciate hearing about incidents, reviewing their causes and learning from them.

SAFE USE OF HOUSE VACUUM SYSTEMS

Vacuum aspiration systems connected to a "house vacuum system" are vital for laboratory research, allowing efficient removal of aqueous waste and media sterilization. These systems, often maintained by Yale Facilities, use suction from a central vacuum pump. It is crucial to prevent contamination with hazardous materials. Improper setup, use, or inspection can lead to implosions and contamination, risking lost research and causing injuries. Approximately 5.0% of EHS laboratory safety surveys have identified vacuum system deficiencies.

The following examples illustrate the variety of issues, and the severity of outcomes, that can occur when house vacuum aspiration systems are used incorrectly in laboratory settings.

What Happened? (Four Incidents)

INCIDENT 1

A vacuum system inside a fume hood, lacking an overflow flask (Figure 1, Component B) and an in-line HEPA filter (Figure 1, Component C), was used for radioactive isotope experiments. A quarterly EHS radioactivity safety survey found the vacuum tubing and house vacuum line (D) was contaminated. Unable to decontaminate the system, the spigot was marked with radioactive tape.

INCIDENT 2

A researcher used a house vacuum system to filter-sterilize cell culture media in a biological safety cabinet (BSC). The system had a 4.0-liter collection flask (Figure 1, Component A) with bleach as a disinfectant and an in-line HEPA filter (Figure 1, Component C), but no overflow flask (Figure 1, Component B). The collection flask, not rated for vacuum work, had vacuum lines directly through the stopper. It imploded during filtration. The BSC partially shielded the researcher from flying glass, but a small amount of bleach splashed into their right eye.

INCIDENT 3

A researcher added bleach to a collection filter flask, mistakenly thinking it contained cell culture media. The bleach reacted with an unknown hazardous liquid, causing it to foam, spill over, turn orange, and emit a noxious odor. The flask was placed in a fume hood and the lab was evacuated. EHS was contacted, and Facilities increased the room's exhaust for several hours. An EHS response team removed the hazardous waste and ensured the area was safe. No one was injured. The unknown chemical was suspected to be either guanidinium isothiocyanate or hydrogen peroxide, but its identity was never confirmed.

INCIDENT 4

A researcher was cut when an old Pasteur pipette, used to apply plastic pipette tips with a benchtop vacuum system, shattered. The vacuum spigot was accidentally left off but the researcher thought it was on. This caused the pipette to break and cut through the researcher's glove.

What Went Right?

- Injuries were minimized by performing biological work in BSCs and within plastic tray containment.
- Lab members notified the Principal Investigator, and EHS was contacted or present for all incidents.
- Researchers participated in cleanup, remediation, and follow-up investigations.
- Researchers' actions on the scene helped reduce exposures or injuries.
- All injuries were minor, and injured researchers received prompt medical attention.
- EHS laboratory safety surveys identified issues in two incidents.

What Should Have Been Done Differently?

- Construct glass flask vacuum aspiration systems according to the diagram in Figure 1, including an in-line HEPA filter, and collection and overflow flasks appropriate for vacuum work. Avoid using glass Pasteur pipettes as aspirating tools or tube connections through stoppers due to injury risks.
- Perform a wipe test on the house vacuum connection when using the system with radioactive substances, ensuring an in-line HEPA filter is present.
- Label collection flasks with the full name of the hazardous contents.

What Corrective Actions Have Been Taken?

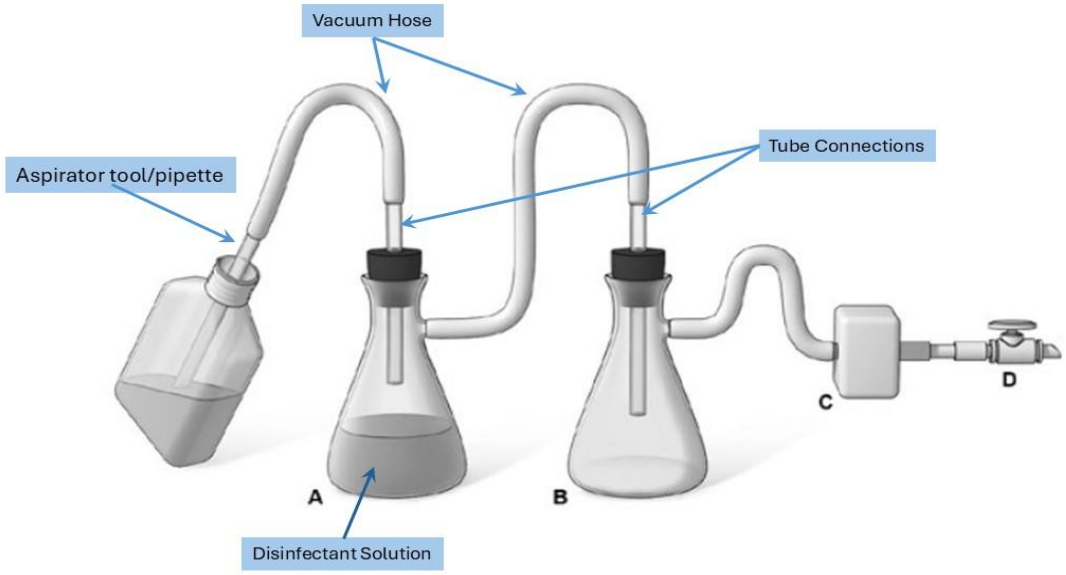
- Researchers were retrained on the correct components for house vacuum systems.
- SOPs and work practices were reviewed and updated.
- Incorrect flasks in vacuum systems were identified and replaced with filter flasks.

How Can Incidents Like This Be Prevented?

- Follow the vacuum system diagram in Figure 1 for setting up a house vacuum aspiration system. Portable "self-contained" vacuum aspiration systems are acceptable substitutes for glass Erlenmeyer filter-flask systems. Contact your EHS Safety Advisor for exceptions or if considering a self-contained system.
- Use an in-line HEPA filter when aspirating aqueous fluids.
- Avoid using glass pipettes for vacuum tube connections or as aspirators. Do not push a glass pipette through a stopper.
- Only use flasks rated for vacuum use. Proper flasks have a side-arm fitting and are labeled "Filter Flask." Alternatives include polypropylene vacuum traps or vacuum aspiration systems.
- Label the collection flask with the complete name of the contents, disinfectant, concentration, and date of preparation (e.g., "Bleach, 10%, 5/2/2025").
- Use filter flasks smaller than 4.0 liters to reduce the risk of implosion.
- Inspect filter flasks for damage (cracks, chips, etching, scoring) each time they are cleaned and discard any damaged flasks.
- Contact EHS for a risk assessment before using a house vacuum system with corrosive, flammable, or toxic solvents. HEPA filters do not prevent volatile organic solvent vapors from entering the house vacuum system.
- Refer to the Yale EHS Safety Guidelines for Vacuum Systems for additional information.

Illustrations

Figure 1-Typical and Properly Setup System



The collection flask (**A**) is used to collect the contaminated fluids into a suitable disinfectant solution. The collection flask must be labelled with the name of the disinfectant, the disinfectant concentration, and the date of preparation.The overflow flask (**B**) serves as a fluid overflow vessel. An in-line HEPA filter (**C**) is used to protect the vacuum system (**D**) from aerosolized contaminants.

Figure 2-Examples of Properly Setup Systems

More Information

- Yale House Vacuum System Safety Guidelines, June 2025 (https://ehs.yale.edu/sites/default/files/files/house-vacuum-systems-safety-guidelines.pdf)
- Yale Protection of Vacuum System from Containment, July 2015 https://ehs.yale.edu/sites/default/files/files/vacuum-system-protection.pdf
- Yale Biological Safety Manual, Environmental Health and Safety, August 2020 https://ehs.yale.edu/sites/default/files/files/biosafety-manual.pdf
- Biosafety in Microbiological and Biomedical Laboratories, 6th Ed, CDC, NIH, June 2020 https://www.cdc.gov/labs/pdf/SF__19_308133-A_BMBL6_00-BOOK-WEB-final-3.pdf
- Lab Manager, LabX Media Group, 2024 https://www.labmanager.com/10-tips-to-reduce-vacuum-flask-hazards-19030
- University of Wisconsin, Environment, Health & Safety, Office of Biological Safety, Vacuum Trap Assembly, Safeguards and Use https://ehs.wisc.edu/wp-content/uploads/sites/1408/2022/01/EHS-BIO-GUI-032-V02.pdf
- University of California, Berkeley. Office of Environment, Health & Safety, Vacuum System Hazards and Precautions, July 30, 2012 https://ehs.berkeley.edu/sites/default/files/publications/vacuum-systems-fact-sheet.pdf