

Scientific Equipment & Furniture Association
Recommended Practices

SEFA 11-2019

Liquid Chemical Storage Cabinets

**SEFA World Headquarters
65 Hilton Avenue
Garden City, NY 11530**

**Tel: 516-294-5424
Fax: 516-294-2758
www.sefalabs.com**



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SEFA 11—Liquid Chemical Storage Committee Members

Co-Chairs

**Sascha Kunkel - asecos GmbH
Gregory Rice - JUSTRITE Mfg., L.L.C.,**

AirClean Systems

Air Master Systems

BSA Life Structures

Creative Solutions

DLR Group

Fundermax

HOK Architects

Institutional Casework

Jeio Tech Co., Ltd.

Kewaunee Scientific

Lab Crafters

Kirksey Architects

Mott Manufacturing

Samin Science

SmithgroupJJR

Trespa

Yamato Scientific

Foreword

SEFA Profile

The Scientific Equipment and Furniture Association (SEFA) is an international trade association comprised of manufacturers of laboratory furniture, casework, fume hoods and members of the design and installation professions. The Association was founded to promote this rapidly expanding industry and improve the quality, safety and timely completion of laboratory facilities in accordance with customer requirements.

SEFA Recommended Practices

SEFA and its committees are active in the development and promotion of Recommended Practices having domestic and international applications. Recommended Practices are developed by the association taking into account the work of other standard-writing organizations. Liaison is also maintained with government agencies in the development of their specifications.

SEFA's Recommended Practices are developed in and for the public interest. These practices are designed to promote a better understanding between designers, architects, manufacturers, purchasers, and end-users and to assist the purchaser in selecting and specifying the proper product to meet the user's particular needs. SEFA's Recommended Practices are periodically updated. The Recommended Practices are numbered to include an annual suffix which reflects the year that they were updated. SEFA encourages architects to specify these Recommended Practices as follows: "SEFA 11-2019".

SEFA Glossary of Terms

SEFA has developed a Glossary of Terms (SEFA 4-2010) for the purpose of promoting a greater understanding between designers, architects, manufacturers, purchasers and end users. The terms defined by SEFA are frequently used in contracts and other documents, which attempt to define the products to be furnished or the work involved. The Association has approved this Glossary in an effort to provide uniformity among those who use these terms. Where a specific Recommended Practice contains definitions, which differ from those in the Glossary of Terms, then the definitions in the specific Recommended Practice should be used.

SEFA encourages all interested parties to submit additional terms or to suggest any changes to those terms already defined by the Association. The definitions should be used to help resolve any disputes that may arise or to incorporate the applicable terms in any contract or related documents.

SEFA Disclaimer

SEFA uses its best effort to promulgate Recommended Practices for the benefit of the public in light of available information and accepted industry practices. SEFA does not guarantee, certify, or assure the safety or performance of any products, components, or systems tested, installed, or operated in accordance with SEFA Recommended Practices or that any tests conducted under its Recommended Practices will be non-hazardous or free from risk. SEFA encourages the use of third party independent testing where appropriate.

1.0 Scope

These Recommended Practices apply to Liquid Chemical Storage Cabinets located in Laboratories. This document includes discussions of Flammable and Combustible cabinets, Filtered Storage Cabinets, Acid storage, Base Storage, and Corrosives.

These Recommended Practices are intended to be used to supplement the knowledge of a trained qualified professional. National, State or Local Codes always take precedence and should be observed.

2.0 Purpose

This document is intended to provide end users and planners with information on the type of storage cabinet required, construction, installation and the basic considerations to determine which chemicals should be stored together and which chemicals should not be stored together in the Laboratory.

3.0 Definitions

Acid compound – Any of a class of compounds that in aqueous solution turns blue litmus red and reacts with bases and with certain metals to form salts. A compound that dissociates in a solvent to produce the positive (+) ion of the solvent.

Acid Storage Cabinets – Cabinets in which acids are stored to avoid having large quantities of hazardous material in the laboratory work area. This reduces the risk of injury or damage to the work area of the laboratory. See hazardous Material Cabinets for more information.

Aerosol Propellant -Agent responsible for developing pressure in aerosol containers. The propellant is sometimes flammable and considered a hazardous waste.

Approved – Acceptable to the authority having jurisdiction.

Authority Having Jurisdiction – (AHJ) - An organization, office or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, and installation, or a procedure.

Auto ignition temperature - The auto ignition temperature of a substance is the lowest temperature at which it will spontaneously ignite in a normal atmosphere without an external source of ignition and it is also the required temperature of a heat source to ignite an ignitable atmosphere.

Base compound – (an alkali) A compound that is capable of so uniting with an acid as to neutralize its acid properties and form a salt. A compound that yields hydroxyl (-) ions in solution.

Base Storage Cabinets – Cabinets in which bases are stored to avoid having large quantities of hazardous material in the laboratory work area.

Fire Area – OSHA 1910.106(a)(12) A Fire Area is defined as an area of a building separated from the rest of the building by construction having a fire resistance rating of at least 1 hour and having all communicating openings properly protected by an assembly having a fire protection rating of at least 1 hour.

EN 14470-1 Fire resistance rating - A fire-resistance rating means the duration for which a passive fire protection system, in this case a storage cabinet, can withstand a fire resistance test.

NFPA 30 - Fire resistance rating is a cabinet's ability to keep the inside temperature below 325°F (163°C) which is a conservative temperature well below the auto ignition temperature of 99% of flammable liquids that could be stored during a 10-minute fire test per NFPA 251.

FM Global (FM) - A nationally recognized independent testing laboratory established by the insurance industry to which manufacturers submit their products for evaluation of ability to meet safety requirements under intended use. Products meeting these requirements are "FM approved."

Filtered Storage Cabinet - Continuously vented chemical storage cabinet equipped with its own filtration and ventilation device designed to eliminate the propagation and accumulation of manufacturer pre-approved and verified toxic contaminants. A filtered storage cabinet is typically not attached to any external exhaust system.

Flammable Liquids - Per OSHA/GHS, flammable liquid means any liquid having a flashpoint at or below 199.4°F (93°C).

- Category 1 shall include liquids having flashpoints below 73.4 °F (23 °C) and having a boiling point at or below 95 °F (35 °C).
- Category 2 shall include liquids having flashpoints below 73.4 °F (23 °C) and having a boiling point above 95 °F (35°C).
- Category 3 shall include liquids having flashpoints at or above 73.4 °F (23 °C) and at or below 140 °F (60 °C).
- Category 4 shall include liquids having flashpoints between 140 °F (60 °C) and 199.4 °F (93°C).

Flammable Liquids Storage Cabinet - Used to store and organize flammable liquids in approved closed containers. To guard liquids stored from their auto ignition temperature of the liquids stored in the event of a fire. Flammable liquids storage cabinets are often used to increase the maximum allowable quantities, to separate incompatible materials, and should be locked to prevent unauthorized access.

Flashpoint - is the lowest temperature that a flammable liquid can form an ignitable vapor in mixture with air. It is a measurement which we rate the volatility for a flammable liquid.

GHS - Globally Harmonized System of Classification and Labeling of Chemicals

Hazardous material storage cabinets - Hazardous chemicals can be reactive, causing explosions, fires, contamination and can be corrosive, toxic, etc., Storage in these cabinets can include: corrosive solids, corrosive liquids, flammable solids, organic peroxide formulations, oxidizer solids or liquids, pyrophoric solids or

liquids, toxic or highly toxic solids or liquids, unstable solids or liquids, water-reactive solids or liquids in segregation. These cabinets can be required by fire codes to increase the maximum allowable quantities, separate incompatible materials, and should be locked to prevent unauthorized access.

Laboratory work area – The main area of the laboratory where chemicals are used during experiments, testing or teaching.

Litmus – a blue dye stuff made by fermenting certain coarsely powdered lichens. It is turned red by acids and remains blue when treated with an alkali.

May - When used indicates an alternate requirement or option.

Poison – General term for chemicals that can injure or kill by ingestion or contact.

Preparation Room – Room usually located adjacent to the laboratory for preparing chemical compounds and experiments to be used in the laboratory. Chemical storage cabinets are usually located in the preparation room.

Shall - Where used, indicates a mandatory requirement.

Should – Where used indicates recommendation.

Solvent – Substance that dilutes or disperses another substance. Ranging from water and air to complex hydrocarbons.

Toxic Chemical - A chemical that can produce injury if inhaled, swallowed, or absorbed through the skin.

Vent – Ducting or piping system designed to remove or change the air in an enclosed space like a storage cabinet.

4.0 Construction

4.1 Flammable/Solvent Storage Cabinets

4.1.1 Purpose

Flammable Liquid Storage Cabinets are used to store and organize flammable liquids in approved closed containers. To guard liquids stored from their auto ignition temperature in the event of a fire. Flammable Liquid storage cabinets are often used to increase the maximum allowable quantities, to separate incompatible materials, and should be locked to prevent unauthorized access.

According to OSHA and GHS regulations the definition of flammable and combustible liquids has changed to Flammable Liquids. Flammable Liquid Storage Cabinets are designed and constructed for Flammable liquid storage only. They are not intended for the storage of small cylinders of compressed or liquefied gases, especially those that are flammable. Likewise, incompatible materials, whether liquid or solid, should not be stored in these cabinets.

4.1.2 Construction

There are two permissible concepts (see AHJ) for Flammable Liquid Storage Cabinets.

US Construction/Performance Standards:

Labor Law:

OSHA Flammable Liquids 1910.106(d)(3), (1)(2)
OSHA Safety and Health Regulations for Construction 1926.152(b)(2), (1)(2)

Fire Code:

NFPA 30 Flammable and Combustible Liquids Code 9.5 (1)(2)
NFPA 1 Fire Code 66.9.5, (1)(2)
IFC 5704.3.2 (2)(3)

Flammable Liquids Cabinets must have the following warning: "FLAMMABLE - KEEP FIRE AWAY." Per OSHA, this labeling must be "in conspicuous lettering".

Cabinets should be:

- (1) FM 6050 and/or
- (2) UL 1275 approved;
- (3) Some codes will require cabinets to have self-close doors. Check with Authority Having Jurisdiction (AHJ) for codes having jurisdiction.

Canadian Performance Standards:

National Fire Code of Canada Div. B Sec. 4.2.10.5. shall conform to ULC/ORD-C1275

Note: Some Provinces and localities in Canada will allow cabinets in compliance to the NFPA 30 or FM 6050 Approved. Check with Authority Having Jurisdiction (AHJ).

Storage cabinets shall be designed and constructed to limit the internal temperature to not more than 325 degrees Fahrenheit when subjected to a 10 minute fire test using the standard time-temperature curve as set forth in Standard Methods of Fire Tests of Building Construction and Materials, NFPA 251-1969 which is incorporated by reference as specified in OSHA Section 1910.6. All joints and seams shall remain tight and the door shall remain securely closed during the fire test. Cabinets shall be labeled in conspicuous letters "Flammable – Keep Fire Away."

European Performance Standards:

Flammable Liquids Storage cabinets shall meet the requirements of EN 14470-1. Self-closing doors are mandatory. Cabinets must be marked according to section 8 of EN 14470-1 and must specifically indicate the fire resistance rating (type classification) of the cabinet (15,30,60 or 90 minutes). Cabinets must be independently third party tested by an accredited testing institute.

4.1.3 Venting

Typically the requirements for venting are dictated by the AHJ.

Cabinets are not required to be vented for fire protection purposes; however, if venting is required the following shall apply:

The vent openings shall be ducted directly to a safe location outdoors or to a treatment device designed to control volatile organic compounds (VOCs) and ignitable vapors in such a manner that will not compromise the specified performance of the cabinet or safety and in a manner that is acceptable to the authority having jurisdiction. For non-vented flammable storage cabinets, it is recommended that the vent openings shall be sealed with the bungs supplied with the cabinet or with bungs specified by the manufacturer of the cabinet.

Vent bungs accommodate a (US) 2"NPT (DN50) threaded rigid steel pipe. Any blowers should be specified as safe for handling flammable fumes (explosion proof) and should be installed to evacuate fumes from the cabinet using negative pressure (suction) to avoid dispersing fumes into the room itself.

Cabinets made to European Standard EN 14470-1 come with self-closing vent openings and require no manual sealing. The self-closing is triggered at a temperature of approx. 158°F (70°C).

It is recommended to retain a professional engineer to design a vent system and follow the guidelines listed here. Also, it is important that they consult the local building codes, fire codes, and the authority having jurisdiction to understand the laws and to look for recommendations/ interpretations prior to making the investment.

Venting voids the UL listing, if applicable, as site conditions cannot be verified by UL.

4.2 Hazardous Storage Cabinets

4.2.1 Purpose

The purpose of a Hazardous Storage Cabinet is to restrict the access to chemicals that might be harmful or dangerous to students or other personnel not qualified to have access and/or to provide an appropriate corrosive resistant environment for storage of hazardous materials. Also cabinets should and shall be designed such that in case of an accidental spill the cabinet will safely contain the spill. These chemicals may

include but are not limited to Corrosives, Acids, Bases, Oxidizers, Poisons and other chemicals not of a Flammable or Combustible nature.

4.2.2 Construction

The interior of the cabinet shall be treated, coated or constructed of materials that are not reactive with the chemical being stored. The secondary containment trough shall be constructed with the same chemical resistance and with a depth of 2" minimum.

Doors may be provided with a suitable means of locking and securing the cabinet. This locking mechanism must be compatible with the chemical being stored.

The use of Metal Fasteners and shelf supports inside cabinet must have the same chemical resistance as the interior of the cabinet.

Cabinets should be clearly marked with a minimum 2" letters and so identified with the chemical that is being stored. Eg., ACIDS, BASES, POISONS, etc.

Hazardous Storage Cabinets shall be so designed that all chemicals are not stored above shoulder height with the overall cabinet height of not more than 65". Special care shall be taken to secure tall cabinets to walls. Special care shall be taken to provide seismic anchorage as required per local codes.

If vented, cabinet should be vented from the bottom since most Hazardous Vapors are heavier than air, however lighter than air chemicals need vents located at the top of the cabinet. This venting shall not compromise the ability for the cabinet to contain a spill should one occur inside the cabinet. Also a mechanical exhaust ventilation is preferred and it should comply with NFPA 91.

The installation of the vent into the ductwork of a fume hood exhaust is preferred.

4.2.3 Venting Hazardous Storage Cabinets

Venting is recommended to exhaust noxious fumes that may build-up in an enclosed acid storage cabinet, and cause discomfort and/or compromise the respiratory health of laboratory personnel. When a plastic product for venting of cabinets is specified, it is recommended that polyolefin pipe be used. See ASTM 1412. PVC piping should not be used for venting, as it will burn black if ignited and produce chlorine gas.

5.0 Requirements

5.1 Flammable Liquid Storage Cabinets

Flammable Liquid Storage Cabinets should be approved as being acceptable by the authority having jurisdiction.

Cabinets should be independently tested by approved third party testing facilities certifying that the cabinets meet one of the following performance standards:

UL 1275

FM 6050

ULC 1275

EN-14470-1

or an agency acceptable to the authority having jurisdiction;

5.2 Hazardous Storage Cabinets

Hazardous Storage Cabinets should be approved as being acceptable by the authority having jurisdiction.

5.3 Shelf Loads

Should not exceed manufacturer's recommendation.

6.0 Location

Liquid Chemical Storage Cabinets shall be in an area of the laboratory with low traffic away from the main work area. It is important to segregate incompatible chemicals. Eliminate ignition sources such as open flame, hot surfaces, electrical equipment or static electricity from the storage area. Make sure appropriate fire extinguishers and/or sprinkler systems are in the area. An eyewash and safety shower must be readily accessible to areas where liquid chemicals are stored, per OSHA 1910.106(d)(3)(I). Consult laws and codes and the authority having jurisdiction for further information.

Do not store chemicals in Fume hoods or under sinks where there may be exposure to water. Do not store chemicals on bench tops. Such storage is more vulnerable to accidental breakage by laboratory, housekeeping, and emergency response personnel. Never store chemicals on the floor.

7.0 Installation

Installation shall be performed by an experienced laboratory equipment installer. Metal cabinets should be securely installed and grounded when necessary; if chemicals are being dispensed directly from a cabinet then a method for grounding the container must also be provided.

8.0 Storage Recommendations

In developing a storage plan many factors must be considered: types of materials to be stored, quantities, sensitivity to sun light, moisture, and other chemicals. Some distinct types of acids shouldn't be stored together. Some chemicals require special allowances for venting and special caps that will vent in case of gas pressure build up. The following should be helpful in establishing a chemical storage plan.

8.1 General

- 1) Store chemicals that are compatible and

of the same hazard class. Flammables should be stored with flammables and oxidizers with oxidizers.

- 2) Do not expose chemicals to direct sunlight and keep them away from area heaters or heat sources.
- 3) Corrosive chemicals should be stored in plastic trays large enough to contain spills and leaks.
- 4) Label all chemicals by name and concentration, include dates received and date opened.
- 5) Do not store hazardous chemicals higher than 60" above the finished floor.
- 6) Solid chemicals should be separated from liquids.
- 7) Chemicals should not be stored under sinks or in fume hoods.
- 8) Never store flammable liquids in un-fire-rated refrigerators. These refrigerators contain ignition sources that may cause sparks.
- 9) Never store chemicals and food in the same refrigerator.
- 10) Explosion-proof refrigerators shall comply with NFPA 42 12.2.2 (2004) & NFPA 70 National electric code.
- 11) Flammables should never be stored with Corrosives (ACIDS/BASES)
- 12) Review with the authority having jurisdiction; University or EHS professional with regard to allowable limits.

8.2 Acid Storage

- 1) Store large bottles of acids on lower shelves of acid storage cabinets.
- 2) Oxidizing acids should be stored separately from organic acids, flammables, and combustible materials.

- 3) Acids should be stored separately from bases and active metals like sodium, magnesium, and potassium.
- 4) Keep acids separated from chemicals that can generate toxic gases on contact, such as sodium cyanide and iron sulfide.
- 5) Store Acids in chemical resistant trays that are capable of containing any spillage or leakage.
- 6) Some acids are incompatible and should be stored separately.
- 7) Never store cyanides with acids or oxidizers
- 8) Acid should be returned to cabinets in approved safe closed containers and free of harmful residues as part of hygiene safety protocol

8.3 Base Storage

- 1) Store Bases and Acids separately.
- 2) Large bottles of bases should be stored on lower shelves or in a corrosive cabinet.
- 3) Store Bases in chemical resistant trays that are capable of containing any spillage or leakage.
- 4) Some bases are incompatible and should be stored separately.
- 5) Bases should be returned to cabinets in approved safe closed containers and free of harmful residues as part of hygiene safety protocol.

8.4 Flammable Liquid Storage

- 1) Always store flammables in approved enclosures.
- 2) Always be aware of static electricity when transferring flammable liquids from one container to another, especially metal containers. Metal flammable storage cabinets should be grounded.
- 3) Make sure that all flammables stored together are compatible.

4) Review NFPA guidelines for flammable storage.

8.5 Peroxide Forming Chemical Storage

1) Peroxide forming chemicals should be stored in airtight containers in a dark, cool, and dry place.

2) Peroxide forming chemicals should be properly disposed of before the date of expected peroxide formation (six months after opening).

3) Make sure that all peroxide forming chemicals are stored by compatibility.

4) Shock sensitive and detonable materials are to be stored in secondary containers large enough to hold the container contents in case of breakage; i.e., picric and perchloric acids.

5) Picric, if dry, must remain dry; if wet, it must remain wet. Crystal formation on caps, etc., poses an imminent danger. Containers should be routinely inspected for peroxide formation. Chemicals should be labeled with date received, date opened, and disposal/expiration date.

6) Suspicion of peroxide contamination should be immediately investigated.

8.6 Water Reactive Chemical Storage

1) Water Reactive chemicals should be stored in a cool and dry place.

2) Make sure that all water reactive chemicals are stored by compatibility.

8.7 Oxidizer Storage

1) Oxidizers should be stored away from flammables, combustibles, and reducing agents (e.g. zinc, alkaline metals, etc.)

2) Make sure that all oxidizers are stored by compatibility.

3) Never store cyanides with acids or oxidizers.

8.8 Toxic Compounds

1) Toxic compounds should be stored according to the nature of the chemical, with the appropriate security employed when necessary.

2) A "Poison Control Network" telephone number should be posted in the laboratory along with CDC contact information. (Center for Disease Control)

3) Make sure that all toxins are stored by compatibility.

Essential Laboratory Reference for Hygiene, Safety, and compliance to laws:

1) OSHA Laboratory Guide Lines:
<https://www.osha.gov/Publications/laboratory/OSHA3404laboratory-safety-guidance.pdf>

2) EPA Laboratory Disposal Information:
<https://www.epa.gov/sites/production/files/2015-06/documents/lesdid.pdf>

3) One of the best references on laboratory safety and hygiene is Prudent Practices in the Laboratory:
<https://www.nap.edu/catalog/12654/prudent-practices-in-the-laboratory-handling-and-management-of-chemical>

Others:
<http://www.ehso.com/ChemicalStorageGuidelines.htm>

<http://ehs.berkeley.edu/sites/default/files/lines-of-services/hazardous-materials/chemicalstoragebooklet.pdf>

<https://www.osha>

Note! Care must also be taken when disposing of materials. Separate waste containers should be

used for each type of waste.

9.0 Ventilation Recommendations

Reference NFPA 45 for proper ventilation Guidance when US Concept or FM Approval Standard Cabinets are employed.

10.0 Reference Sources

(All sources refer to the latest edition)

- ANSI/AIHA Z9.5 – 2012 Laboratory Ventilation Standard
- ASTM F1412-16 (American Society for Testing and Materials) Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems”
- CANADA-ULC/ORD-C1275 Guide For The Investigation Of Storage Cabinets For Flammable Liquid Containers
- EN 14470-1 - Safety Cabinet Standard for Flammable Products
- FM 6050 Storage Cabinets (Flammable and Combustible Liquids)
- IBC International Building Code
- IFC International Fire Codes
- Merriam-Webster: Dictionary and Thesaurus
- NFPA 1 Fire Code
- NFPA 400 Hazardous Material Code
- NFPA Flammable & Combustible Liquids Code
- NFPA Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Combustible Particulate Solids
- NFPA Standard on Fire Protection for

Laboratories Using Chemicals

- OSHA 29 CFR 1910.106 Flammable Liquids
- UL 1275 Standard for Flammable Liquid Storage Cabinets
- University of California Berkeley, Office of Environment, Health & Safety (EH&S Fact Sheet 2014)

Important Industry Resources

- American National Standards Institute (ANSI) www.ansi.org
- California Air Resources Board (CARB) Title 13 - <https://ww2.arb.ca.gov>
- Department of Transportation (DOT) - www.dot.gov
- Environmental Protection Agency (EPA) 40 CFR - www.epa.gov
- FM Global (FM) - www.fmglobal.com
- International Code Council (ICC) - www.iccsafe.org
- *International Fire Code*© 2012 Edition
- National Fire Code of Canada (NFC) - www.nationalcodes.ca
- National Fire Protection Association (NFPA) - www.nfpa.org
- *NFPA 30, Flammable Combustible Liquids Code – 2015 Edition*
- *NFPA 1, Fire Code™ – 2012 edition*
- *Fire Protection Guide to Hazardous Materials, 13th ed.*
- National Institute for Occupational Safety & Health (NIOSH) - www.cdc.gov/niosh
- Occupational Safety and Health

Administration - www.osha.gov
(OSHA 29 CFR 1910 (.106, .123, .125, .144, .1200
and 1926.252)

- OSHA/EPA Occupational Chemical Database - <https://www.osha.gov/chemicaldata/>
- Underwriters Laboratories - www.ul.com
- Underwriters Laboratories of Canada - www.ulc.ca