

Approved Storage of Hazardous Materials

INTRODUCTION

Chemical storage, use, handling, and dispensing are regulated by several agencies, including Cal/OSHA, US EPA, local air and water districts, and the California Fire and Building Codes. The California Fire Code (CFC) has detailed guidance on how hazardous materials shall be stored within and outside of buildings. In general, it is considered safest when hazardous materials are stored within approved cabinets or enclosures appropriately designed for the materials being stored. Approved storage ensures the following:

- Chemicals will be safe from exposure to fires during emergencies (e.g., fire, earthquake, chemical spill or leak)
- Chemical spills will not negatively impact occupant evacuations
- Leaking gas cylinders will be exhausted directly to the exterior of the building
- Chemical exposure to first responders will be limited during emergencies
- Chemical reactions from incompatible materials will be avoided

The CFC allows for increases in Maximum Allowable Quantities (MAQs) for many types of hazardous materials due to the added safety of storing hazardous materials in approved storage. This “approved storage” credit allows for doubling of the MAQs for certain chemical classes.

While approved storage of hazardous materials clearly improves safety, there is some ambiguity in the CFC regarding how to apply the “approved storage” credit to hazardous material storage. For example, if one wanted to apply the “approved storage” credit to Class I flammable liquids, would **all** Class I flammable liquids need to be in approved storage or **only** those which exceeded MAQs? These two possible interpretations are reviewed and discussed.

BACKGROUND

Storage of hazardous materials is defined and used in multiple ways in the CFC. Each of these has significant impacts on MAQs. First, there is the difference between chemicals in **storage** vs. in **use**, as defined below. Second, there are hazardous materials which are stored *within* **approved storage** cabinets, exhausted enclosures, day boxes, listed safety cans, etc... These differences are outlined below. The focus of this white paper is the second use case involving approved storage.

Storage vs. Use:

Definitions (CFC):

Storage, Hazardous Materials. The keeping, retention or leaving of hazardous materials in closed containers, tanks, cylinders, or similar vessels; or vessels supplying operations through closed connections to the vessel.

Examples of hazardous materials in Storage:



Closed container. A container sealed by means of a lid or other device such that liquid, vapor or dusts will not escape from it under ordinary conditions of use or handling. (Examples above for storage are closed containers.)

Use (Material). Placing a material into action, including solids, liquids and gases.

Closed system. The use of a solid or liquid hazardous material involving a closed vessel or system that remains closed during normal operations where vapors emitted by the product are not liberated outside of the vessel or system and the product is not exposed to the atmosphere during normal operations; and all uses of compressed gases. Examples of closed systems for solids and liquids include product conveyed through a piping system into a closed vessel, system or piece of equipment.

Examples of hazardous materials In Use – Closed system:



Open system. The use of a solid or liquid hazardous material involving a vessel or system that is continuously open to the atmosphere during normal operations and where vapors are liberated, or the product is exposed to the atmosphere during normal operations. Examples of open systems for solids and liquids include dispensing from or into open beakers or containers, dip tank and plating tank operations.

Examples of hazardous materials In Use – Open system:



There is a higher hazard when hazardous materials are in use, as hazardous vapors are open to the atmosphere. Therefore, MAQ limits are lower for chemicals which are in use, relative to those in storage. Furthermore, closed containers located within *approved* storage are also safer than closed containers sitting out on a benchtop or on a shelf. As a result, most hazardous materials are allowed an MAQ increase when located in approved storage.

Approved Storage:

Storage in the CFC also refers to hazardous materials that are stored within *approved* hazardous materials storage cabinets, flammable liquids storage cabinets, gas cabinets, and more. RSS Chemicals refers to this as **Approved Storage**. Chemicals that are stored within approved storage cabinets, day boxes, gas cabinets, gas rooms, exhausted enclosures or in listed safety cans may increase MAQs for certain hazard categories. Cabinets and other enclosures must meet the criteria outlined below to qualify for a storage increase.

Approved Storage per CFC would include one of the following, specific to the type of material being stored: Note: Per CFC, cabinets must be **self-closing** and **self-latching**. There are many cabinets which close manually and are not considered approved. In some cases, a self-closing mechanism can be attached to manually closing cabinets if the integrity of the cabinet is

not compromised. A modified cabinet would not qualify as *approved* storage unless reviewed and accepted by the Fire Marshal.

Hazardous Materials Storage Cabinets. *These are suitable for most solid and liquid hazardous materials, with the exception of gases and flammable liquids.*

Construction. The interior of the cabinets shall be treated, coated or constructed of materials that are nonreactive with the hazardous materials stored. Such treatment, coating or construction shall include the entire interior of the cabinet. Cabinets shall either be listed in accordance with UL 1275 as suitable for the intended storage or constructed in accordance with the following:

1. Cabinets shall be of steel having a thickness of not less than 0.0478 inch (1.2 mm) (No. 18 gage). The cabinet, including the door, shall be double walled with a 1 ½ inch (38 mm) airspace between the walls. Joints shall be riveted or welded and shall be tight fitting. Doors shall be well fitted, self-closing and equipped with a self-latching device.
2. The bottoms of cabinets utilized for the storage of liquids shall be liquid tight to a minimum height of 2 inches (51 mm).

Warning markings. Cabinets shall be clearly identified in an approved manner with red letters on a contrasting background to read: HAZARDOUS – KEEP FIRE AWAY



Flammable Liquid Storage Cabinets. *These are suitable for flammable and combustible liquids.*

Design and Construction. Shall be in accordance with the following:

Materials. Cabinets shall be listed in accordance with UL 1275, or constructed of approved wood or metal in accordance with the following:

1. Unlisted metal cabinets shall be constructed of steel having a thickness of not less than 0.044 inch (1.12 mm) (18 gage). The cabinet, including the door, shall be double walled with 1 ½-inch (38 mm) airspace between the walls. Joints shall be riveted or welded and shall be tight fitting.
2. Unlisted wooden cabinets, including doors, shall be constructed of not less than 1-inch (25 mm) exterior grade plywood. Joints shall be rabbeted and shall be fastened in two directions with wood screws. Door hinges shall be of steel or brass. Cabinets shall be painted with an intumescent-type paint.

Labeling. Cabinets shall be provided with a conspicuous label in red letters on contrasting background that reads: “FLAMMABLE – KEEP FIRE AWAY.”

Doors. Doors shall be well fitted, self-closing and equipped with a three-point latch.

Bottom. The bottom of the cabinet shall be liquid tight to a height of 2 inches (51 mm).

Capacity. The combined total quantity of flammable and combustible liquids in a cabinet shall not exceed 120 gallons (454 L).



Safety Cans. Safety cans shall be listed in accordance with UL 30 where used to increase maximum allowable quantities per control area of flammable or combustible liquids in accordance with the MAQ Table.



Gas cabinets. *These are suitable for gases (hazardous or simple asphyxiant). They are not designed for cryogenic fluids.*

Construction. Gas cabinets shall be constructed with the following:

1. Not less than 0.097-inch (2.5 mm) (No. 12 gage) [steel](#).
2. [Self-closing](#) limited [access](#) ports or [noncombustible](#) windows to give [access to](#) equipment controls.
3. [Self-closing](#) doors.
4. Interiors treated, coated or constructed of materials that are compatible with the [hazardous materials](#) stored. Such treatment, coating or construction shall include the entire interior of the cabinet.

Ventilation. Gas cabinets shall be provided with an exhaust ventilation system. The ventilation system for gas cabinets shall be designed to operate at a negative pressure in relation to the surrounding area. Ventilation system shall be installed in accordance with the California Mechanical Code. Ventilation systems used for highly toxic and toxic gases shall also comply with the following:

1. The average ventilation velocity at the face of gas cabinet access ports or windows shall be not less than 200 feet per minute (1.02 m/s) with not less than 150 feet per minute (0.76 m/s) at any point of the access port of window.
2. Gas cabinets shall be connected to an exhaust system.
3. Gas cabinets shall not be used as the sole means of exhaust for any room or area.

Maximum number of cylinders per gas cabinet. The number of cylinders contained in a single gas cabinet shall not exceed three. (Note: for toxic and highly toxic gases, there is an exception for cabinets containing cylinders not exceeding one pound (0.454 kg) where net contents are allowed to contain up to 100 cylinders).



Exhausted Enclosures. *These are suitable for gases (hazardous or simple asphyxiant). They are not designed for cryogenic fluids. These may be suitable for highly toxic solids and liquids in Group H-8 occupancies (prior to 2007).*

Construction. Exhausted enclosures shall be of noncombustible construction.

Ventilation. Exhausted enclosures shall be provided with an exhaust ventilation system. The ventilation system for exhausted enclosures shall be designed to operate at a negative pressure in relation to the surrounding area. Ventilation system shall be installed in accordance with the California Mechanical Code. Ventilation systems used for highly toxic and toxic gases shall also comply with the following:

1. The average ventilation velocity at the face of the enclosure shall be not less than 200 feet per minute (1.02 m/s) with not less than 150 feet per minute (0.76 m/s).
2. Exhausted enclosures shall be connected to an exhaust system.
3. Exhausted enclosures shall not be used as the sole means of exhaust for any room or area.

Fire-extinguishing system. Exhausted enclosures where flammable materials are used shall be protected by an approved fire-extinguishing system.



Applying Approved Storage Credit in RSS Chemicals

RSS Chemicals allows the Control Area Admin to select whether individual hazard categories are being stored in Approved Storage. This is done separately per hazard category and control area. The default setting is “No Approved Storage.” Therefore, Control Area Admins need to determine whether or not hazardous materials in a control area are stored in approved storage that is appropriate for that hazard category. Once selected in RSS Chemicals, the “approved storage” credit is automatically applied when appropriate.

Per CFC, Maximum Allowable Quantities (MAQs) for some hazard categories shall be increased by 100 percent where stored in approved storage cabinets, day boxes, gas cabinets, gas rooms, exhausted enclosures or in listed safety cans.

There is some debate about how this “approved storage” credit shall apply. Consider a first floor control area in a Group B occupancy with an MAQ allowance of 120 gallons of Class I Flammable Liquids. If users stored their Class I Flammable Liquids in approved storage cabinets, the MAQ would double to 240 gallons for this control area.

Some Fire Marshals believe that of the 240 gallons of flammable liquids allowed, 100% must be within approved storage to apply the “approved storage” credit (Option 1). Others feel that because the MAQ Table allows 120 gallons of flammable liquids without approved storage, any flammable liquids above 120 gallons (not to exceed 240 gallons) would need be within approved storage to apply the “approved storage” credit (Option 2).

PROPOSED SOLUTION

Although Option 1 is the *ideal* scenario, it exceeds the minimum Fire Code requirements. A certain quantity of hazardous materials (not to exceed MAQs) is allowed without approved storage within control areas. Option 2 permits this baseline quantity (up to MAQ) *and* allows for the “approved storage” credit to be applied in a flexible manner.

In active laboratories, there are often researchers running experiments involving hazardous materials at all hours. At least some chemicals are in-use or on the benchtop most of the time. This would make it impractical to have 100% of all hazardous materials in storage (under Option 1). In addition, research lab space limitations can make it challenging to find sufficient space for cabinets for all hazardous materials, particularly if multiple cabinets are used to separate incompatible materials (e.g., separate cabinets for flammable liquids, oxidizers, and toxic materials). Some hazardous materials are also recommended to be stored at 4°C (refrigerator temperature), which makes cabinet storage unfeasible. Therefore, the recommended approach is to allow for application of the “approved storage” credit (as applicable) when any amount *exceeding* MAQs for a particular hazard category is within approved storage, not to exceed the allowable amount (double MAQs) (Option 2). In the above example, Class I flammable liquids

between 0-120 gallons would be allowed within the control area outside of approved storage cabinets. Any amount above 120 gallons, but no more than *an additional* 120 gallons (240 gallons maximum) would be permitted in a control area as long as the *additional volume* is stored within an approved storage cabinet. It is also acceptable to have 100% of hazardous materials stored within cabinets for applying the “approved storage” credit. Examples of different scenarios follow (all assumed to be 1st floor control areas with no sprinkler coverage):

1. **Control area A** has 180 gallons of Class I flammable liquids.
 - a. In approved storage cabinets: 60 gallons
 - b. Outside storage cabinets: 120 gallons

This area qualifies for the approved storage credit, as the baseline storage MAQ of 120 gallons outside cabinets is not exceeded. Control area A is compliant, as the total Class I flammable liquids is below 240 gallons ($120 \times 2 = 240$).

2. **Control area B** has 90 gallons of Class I flammable liquids.
 - a. In approved storage cabinets: 80 gallons
 - b. Outside storage cabinets: 10 gallons

This area qualifies for the approved storage credit, as the baseline storage MAQ of 120 gallons outside cabinets is not exceeded. Control area B is compliant, as the total Class I flammable liquids is below 240 gallons ($120 \times 2 = 240$).

3. **Control area C** has 270 gallons of Class I flammable liquids.
 - a. In approved storage cabinets: 240 gallons
 - b. Outside storage cabinets: 30 gallons

This area qualifies for the approved storage credit, as the baseline storage MAQ of 120 gallons outside cabinets is not exceeded. Control area C is NOT compliant, as the total Class I flammable liquids exceeds 240 gallons ($120 \times 2 = 240$).

4. **Control area D** has 180 gallons of Class I flammable liquids.
 - a. In approved storage cabinets: 20 gallons
 - b. Outside storage cabinets: 160 gallons

This area does not qualify for the approved storage credit, as the baseline storage MAQ of 120 gallons outside cabinets is exceeded. Control area D is NOT compliant, as the total Class I flammable liquids exceeds 120 gallons.

Each hazard category shall be evaluated separately for approved storage.

CONCLUSION

Approved storage for hazardous materials increases safety for building occupants and first responders. Maximum Allowable Quantity (MAQ) increases are allowed for many hazard categories in the California Fire Code. To apply these “approved storage” credits, control areas shall have no more than the baseline MAQ for a particular hazardous material outside of storage. Any quantity beyond the baseline amount shall be stored within approved storage in order to apply the “approved storage” credit. In new construction, including approved storage cabinets, exhausted enclosures, gas cabinets, and other options to accommodate all hazardous materials shall be encouraged.

ASSIGNING APPROVED STORAGE IN RSS CHEMICALS

Note: These directions are subject to change.

Access to edit the Control Area details requires that the user have the Control Area Admin role. This role should be granted only with Fire Marshal or EH&S Director authorization. To access the system, you can go directly to <https://app.riskandsafety.com/maq/>.

If you are already logged in, you can select ‘Chemicals’ from the ‘Apps’ menu, then choose ‘Chemical Admin’. Scroll to the ‘Reports’ section and select ‘Control Areas’.

KPI’s displayed are the numbers of

1. buildings with at least one control area over limits
2. buildings with at least one control area within 80% of the limits
3. buildings with all control areas under the limits
4. buildings with at least one room not assigned to a control area.

Edit the approved storage using these steps:

1. Select any of choices above, or the MAQ tile to search and filter buildings
2. Select a building from the list or use the search field to narrow down your search
3. Select a control area from the list
4. Select the three-dot menu in the lower right corner, then select ‘Edit Control Area Details’
5. Scroll to the ‘Approved Storage’ section and select the dropdown menu
6. Check the box next to the hazard class to which approved storage should be applied
7. Select ‘Save’

The MAQ baseline should now accurately reflect the “approved storage” credit.

REFERENCES

2022 [California Fire Code](#) (chapter 50 Hazardous Materials, chapter 57 Flammable and Combustible Liquids, chapter 60 Toxic and Highly Toxic Materials)

2022 [California Building Code](#)

2022 California Building Standards Commission ([all codes](#))