



Compressed Gases

Compressed gases are any gases or mixture of gases exerting a gauge pressure of 26 pounds per square inch at 68 °F. Federal regulations specify how these gases must be stored and managed. You should also check with your local fire marshal to see if your area has more restrictive requirements.

Definitions

Compressed Gases—The Dangers

Compressed gases are dangerous because they are under pressure and because they may be oxidizers and they may be corrosive, flammable, toxic, or highly toxic. Be sure you know the type of compressed gas you are dealing with so you know the proper management requirements.

See Hazardous Materials Storage Cabinets (page 94).

See Keeping Incompatible Hazardous Materials Separated (page 100).

See The Transition to Hazardous Waste (page 98).

See Hazardous Product Containers (page 96).

Gas values in this guide are given in standard cubic feet. The capacities of some types of gas cylinders in standard cubic feet are given in Table A-2-1 on page 55-11 of *NFPA 55*.



Many types of compressed gas cylinders may be used in USDA Forest Service operations. This page and the next page outline some restrictions that would apply to all types of gas cylinders. Later pages provide additional restrictions for specific types of compressed gases.

General Requirements

Managing Compressed Gas Cylinders

- Only trained personnel should handle compressed gases.
- Do not allow cylinder valves to become contaminated.
- Do not place cylinders so they are part of an electrical circuit.
- Do not expose cylinders to temperature extremes; do not use cylinders that have been exposed to fire.
- Notify the supplier if a cylinder is leaking, corroded, or has been exposed to fire.
- Cap the valve when the cylinder is not in use.
- Move cylinders with a handtruck—not by dragging or carrying.
- Do not weld sling attachments to cylinders.
- Use backflow preventers as part of compressed gas systems.
- Only use tools provided by the supplier to open or close valves.
- Use pressure regulators; keep valves closed when cylinders are not being used.
- Do not refill cylinders or store them in boneyards; return them to the supplier.
- Mark empty cylinders as *EMPTY* and close the valves; return cylinders to the vendor or dispose of them properly.
- Check cylinders for corrosion, leaks, or damage; remove defective cylinders from service.
- Partially full cylinders or cylinders with residual gas must be treated as full cylinders.
- Secure cylinder storage areas against unauthorized entry.
- Secure cylinders to a fixed object, mobile devices designed for moving compressed gas cylinders, or within a rack, framework, cabinet, or similar assembly.
- Do not position cylinders where they could drop more than half of their height.
- Do not expose cylinders to falling objects.
- Separate gases by compatibility; when gases present multiple hazards, use the most stringent restrictions.
- Separate cylinders of incompatible gases by 20 feet or by 5-foot-tall barrier with a ½-hour fire rating (see page 101 for an explanation of incompatible gases).



Storage restrictions differ depending on whether compressed gases are stored indoors or outdoors. These restrictions are in addition to the general requirements on the preceding page.

Compressed Gas Storage

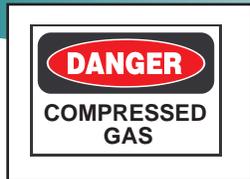
Indoor Restrictions

- Floors of storage areas must be noncombustible or constructed so their combustibility is limited (see *NFPA 55*).
- Shelves used for storing cylinders must be noncombustible.
- Rooms and cabinets where compressed gases are stored must be labeled *COMPRESSED GAS*.
- Indoor heating must not spot-heat cylinders to more than 125 °F.

Outdoor Restrictions

- Outdoor storage areas may be covered with noncombustible materials, so long as the materials obscure no more than 25 percent of the perimeter.
- Outdoor storage areas must be kept clear of dry vegetation and combustible materials for at least 15 feet.
- Outdoor control areas must be at least 20 feet from property lines that can be built on, and any street, alley, or public way.
- For properties larger than 10,000 square feet, up to two control areas are allowed if they are separated by 50 feet.
- For properties larger than 35,000 square feet, additional control areas are allowed if they are separated by at least 300 feet.
- Provide physical barriers to prevent cylinders from being damaged by vehicles.
- Do not store cylinders on the ground or in an area where water can accumulate.

Be sure to check pages 82 to 92 for specific compressed gas restrictions.





Special restrictions apply to corrosive gases, especially on the amounts of corrosive gases that may be stored. These restrictions are in addition to those on the previous two pages.

Corrosive Gases

Inside Storage

No more than 810 cubic feet of corrosive gas may be stored in each control area.

The amount of corrosive gas allowed in a control area may be increased by 100 percent if the cylinders are stored in an approved gas cabinet or in an enclosure with exhaust ventilation.

Outside Storage

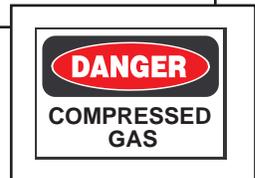
No more than 810 cubic feet of corrosive gas may be stored in each control area.



Permit/Exempt Amounts

Storing more than 200 cubic feet of corrosive compressed gas *onsite* requires a permit from your local fire marshal.

The local fire marshal may not elect to require permits based on the quantities of hazardous materials stored. Check with your local fire marshal for specific permitting requirements.





Special restrictions apply to flammable gases. These restrictions are in addition to those on pages 81 and 82.

Flammable Gases

General Storage of Flammable Compressed Gases

- Have a fire extinguisher (carbon dioxide or dry chemical) available.
- Use nonsparking tools.
- Segregate cylinders of flammable gases from oxidizing, pyrophoric (capable of spontaneous ignition), and toxic gases (20 feet minimum).
- Do not allow smoking or open flames within 20 feet of the storage area.
- Keep flammable compressed gases at least 20 feet away from flammable liquids and solids.
- Store cylinders in the upright position (no more than 45 degrees from vertical) unless the cylinder is designed to operate in the horizontal position or has a water volume of less than 1.3 gallons.



The *preferred* storage locations for flammable compressed gas cylinders (listed in the order of priority) are outdoors, in a separate building, or in a separate room.



Cylinders of flammable compressed gas can be stored inside a building, but outside storage is recommended. If you wish to store larger quantities of flammable gas indoors, contact your hazmat coordinator.

Flammable Gases

Indoor Storage (Not Recommended)

The only exception is for cylinders that do not hold more than 250 standard cubic feet of gas used for maintenance or to operate equipment. Flammable gas must not be used or stored inside a building unless it is a specially designed hazmat building.



Permit/Exempt Amounts

Storing more than 200 cubic feet of flammable compressed gas *onsite* requires a permit from your local fire marshal.



Storing flammable compressed gas cylinders outdoors is preferred. If you wish to store large quantities of flammable gas outdoors, contact your hazmat coordinator.

Flammable Gases

Outdoor Storage (Recommended)

A maximum of 750 cubic feet of gas may be stored in each control area.

A maximum of 15 gallons of liquefied gas may be stored in each control area.



Permit/Exempt Amounts

Storing more than 200 cubic feet of flammable compressed gas *onsite* requires a permit from your local fire marshal.



Special restrictions apply to oxidizer gases. These restrictions are in addition to those on pages 81 and 82. Outdoor storage is recommended for oxidizer gases.

Oxidizer Gases

General Requirements—Oxidizer Gases

- Ensure that equipment and valves used with oxygen and nitrous gases do not become contaminated with oil, grease, or other hydrocarbons.
- Store cylinders of oxidizer gases at least 20 feet away from flammable gases, combustibles, oils, and greases.
- Limit sources of ignition.



Indoor Storage of Oxidizer Gases (Not Recommended)

The only exception is for cylinders that do not hold more than 250 standard cubic feet of oxidizer gases used for maintenance or to operate equipment. Oxidizer gas must not be used or stored inside a building unless the building is specially designed for hazardous materials.

Outdoor Storage of Oxidizer Gases (Recommended)

No more than 1,500 cubic feet of oxidizer gas can be stored in each control area.

No more than 15 gallons of liquefied oxidizer gas may be stored in each control area.



Permit/Exempt Amounts

A permit from a fire marshal is required to store more than 504 cubic feet of oxidizer compressed gas *onsite*.

The local fire marshal may not elect to require permits based on the quantities of hazardous materials stored. Check with your local fire marshal for specific permitting requirements.



There is no limit on the amount of compressed inert and asphyxiant gases that may be stored in one storage area.

Inert Gases



Permit/Exempt Amounts

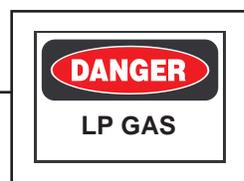
A permit is required if you are storing more than 6,000 standard cubic feet of inert compressed gas.

The local fire marshal may not elect to require permits based on the quantities of hazardous materials stored.
Check with your local fire marshal for specific permitting requirements.



This guideline applies to storing and transporting portable cylinders of liquefied petroleum gas (LPG). It does not cover dispensing or system installation. If you have liquefied petroleum gas at your USDA Forest Service unit, a service provider can service the units or you can replace depleted cylinders with full ones. Transporting and servicing LPG compressed gas cylinders is included in the regulations. These restrictions are in addition to those on pages 81 and 82. See your hazmat coordinator for dispensing requirements.

Liquefied Petroleum Gas Storage



LPG Storage Restrictions (General Requirements)

- Only a trained service supplier should dispense LPG.
- *NO SMOKING* signs should be posted and enforced; do not allow open flames, smoking, welding, or other sources of ignition within 20 feet of LPG.
- NO LPG should be vented to the atmosphere.
- Storage areas must have *COMPRESSED GAS* and *NO SMOKING* signs.
- If LPG is stored near vehicles, pipes or other suitable barriers should protect the cylinders from being damaged by vehicles.
- Cap all valves when storing LPG.
- Store LPG cylinders in an upright position (or at least no more than 45 degrees from vertical); the relief valve must be in contact with vapor in the cylinder. This requirement does not apply to cylinders with water volume less than 1.3 gallons (such as fuel canisters for lanterns or camp stoves) or cylinders designed to be used in the horizontal position.
- Store LPG cylinders at least 20 feet from flammable and combustible liquids and solids.
- Treat empty LPG cylinders as if they were full.
- A permit may be required to store, use, handle, or dispense LPG. Check with your local fire marshal.





The storage of containers (cylinders and tanks) of LPG is regulated to minimize hazards and protect the safety of personnel. Some specific requirements apply; check with your local fire marshal for possible additional requirements. **Indoor storage of LPG is NOT recommended.** For additional information on indoor storage of LPG, contact your hazmat coordinator.

Liquefied Petroleum Gas Storage

Indoors
(NOT Recommended)

LPG Indoor Storage (NOT Recommended)

- Minimize the cylinders' exposure to excessive temperatures, physical damage, or tampering.
- Do not store cylinders near exits, stairways, or areas used to leave a building.
- Do not store cylinders on roofs.
- Do not store LPG cylinders in basements or low areas where gases could accumulate.



Storage Limits in Areas Accessible to the Public

Cylinders stored in locations *accessible* to the public may have a maximum water capacity of 2.5 pounds (about 1 pound of LPG). The amount of LPG in all of the containers must not exceed 200 pounds.

Storage Limits in Residences

LPG storage in residences is limited to two DOT-approved cylinders with a maximum water capacity of 2.7 pounds each (about 1 pound of LPG each); for smaller cylinders, their total water capacity must not exceed 5.4 pounds.

Storage Limits in Areas That Are **Not** Accessible to the Public

Cylinders stored in locations that are *not* accessible to the public are limited to a maximum of 735 pounds water capacity (three 25-gallon or fifteen 5-gallon cylinders of LPG) per area. Storage areas must be separated by 300 feet if they are on the same floor.



There are some restrictions on outdoor storage of LPG. Check with your fire marshal to see how these regulations are applied in your area. **Outdoor storage of LPG is recommended.** For outdoor storage of large quantities of LPG, contact your hazmat coordinator.

Liquefied Petroleum Gas Storage

Outdoors (Recommended)

Alley, gravel road, street, or highway

Commercial or private property
USDA Forest Service property line



USDA Forest Service buildings
(inhabited or uninhabited)

Distance depends on the amount of gas stored and the cylinder size; see your hazmat coordinator.

Distance depends on the amount of gas stored and the cylinder size; see your hazmat coordinator.

Each control area may store only LPG containers with less than 125 pounds water capacity; the total amount of LPG stored must be less than 500 pounds water capacity.

Control Area

Provide at least 20 feet between a control area and an LPG dispensing station.



LPG Outdoor Storage (Recommended)

- Minimize the cylinders' exposure to excessive temperatures, physical damage, or tampering.
- Cylinders stored in locations accessible to the public must be enclosed in a lockable, well-ventilated enclosure or rack.
- The storage area must be at least 20 feet from any doorway or opening in a building.
- An outdoor storage area may be covered if the cover and supports are of noncombustible construction and no more than 25 percent of the area's perimeter is obstructed.
- Combustible materials (such as weeds) must be removed within 10 feet of LPG cylinders.



Requirements depend on the amount of compressed gases being transported. These requirements include placarding, the type of vehicle that can be used, and the types of roads that can be traveled. Transportation by aircraft must be coordinated with aircraft owners or operators. Transportation of compressed gases by aircraft is discussed in chapter 6 of *Interagency Aviation Transport of Hazardous Materials*.

Transportation



USDA Forest Service-Operated Pickups and Trucks

General Requirements

- Do not transport cylinders in closed-body vehicles.
- Ventilate shipping compartments.
- Secure cylinders with racks, boxes, cartons, or lashing.
- Transport cylinders upright with all valves closed and protected.
- Do not transport compressed gases with incompatible materials.
- Use the labels, *FLAMMABLE GASES*, *NON-FLAMMABLE GAS*, *OXYGEN*, or *INHALATION HAZARD*, as appropriate.
- Use vehicle placards if you are transporting 1,001 pounds or more of compressed gases or any quantity of compressed gas that represents an inhalation hazard.
- If the load is 1,001 pounds or more, the driver must have a commercial driver's license, hazmat endorsement, a medical certificate, and training.
- Carry a fire extinguisher (18 pounds, B:C) in a vehicle transporting LPG.
- Do not transport leaking cylinders.

- Shipping papers are required when transporting a total weight of more than 440 pounds (including cylinders) of most corrosive, flammable, oxidizer, and inert gases (such as ammonia, acetylene, oxygen, argon, nitrogen, butane, and propane) or when transporting any cylinder that weighs 220 pounds or more (including the cylinder). See your hazmat coordinator for details.
- Regardless of how much hazardous materials are being shipped, the driver *must* be informed of types of products and their quantities.
- Remember, to avoid the complexities of shipping papers, placarding, and emergency response training, keep the total weight of *all* hazardous materials *below* 440 pounds and the weight of each cylinder *below* 220 pounds.
- Do not park a vehicle loaded with LPG inside a building.
- No smoking while loading and unloading.
- Use care to avoid dropping cylinders during loading and unloading.



Vehicle Placard



Vehicle Placard



Vehicle Placard



Vehicle Placard



Examples of Compressed Gases Used in the USDA Forest Service

Corrosive (and Poisonous) Gases

- Anhydrous ammonia (nonflammable) **1005**

UN (United Nations)
Identification
Number

Flammable Gases

- Acetylene **1001**

Oxidizing Gases

- Oxygen (nonflammable) **1072**

Inert Gases

- Argon **1006**
- Nitrogen **1066**

Liquefied Petroleum Gases

- Butane **1011**
- Propane **1978**

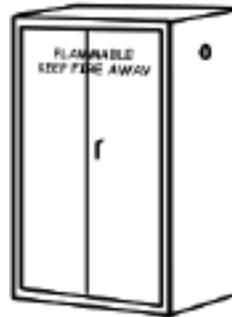
If you have anything other than the products shown above, contact your hazmat coordinator for specific guidance—restrictions and dangers may be significantly higher than for the compressed gases described here.

Hazardous Materials Storage Cabinets



Design and Construction

- The cabinets you purchase for hazardous materials storage must have:
 - Double-walled construction of metal with welded or riveted joints.
 - A built-in secondary containment or *sill* in the bottom of the cabinet.
 - Three-point door latches.
- Wooden cabinets are allowed only for storing flammable and combustible liquids. They must be made of 1-inch-thick exterior plywood with rabbeted joints fastened in two directions.
- Self-closing doors may be required in some jurisdictions. Check with your local fire marshal.
- Flammable and combustible liquid cabinets must have red lettering on a contrasting background saying: *FLAMMABLE—KEEP FIRE AWAY*.
- Cabinets containing other types of hazardous materials must have red lettering on a contrasting background saying: *HAZARDOUS—KEEP FIRE AWAY*.



Commercial storage cabinets can be purchased in a range of sizes for many different hazardous materials. However, all cabinets must meet certain design and construction criteria to be acceptable.

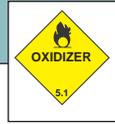
Cabinet Venting

Venting generally is not recommended because it may reduce the cabinet's fire resistance. However, some jurisdictions may require venting.

If you vent the cabinet, you must vent to the outside, the vent must have a flashback protection device, and there must be an internal fan to ensure air circulation.



Cabinet Storage Limits



Every commercial cabinet that meets the OSHA codes is designed to store a certain volume of product. In addition, there are limits of how much of a particular product can be stored in a container. Here are some guidelines:

- Store no more than a total of 60 gallons of class I flammable liquids and class II combustible liquids. Do not exceed the cabinet's design size; all containers must be sound and tightly closed.
- Store no more than 120 gallons of class III combustibles.
- Do not store more flammable solids than the maximum specified for the cabinet.
- Do not store more oxidizers than the maximum specified for the cabinet.
- Do not store more corrosives than the maximum specified for the cabinet.

Label the cabinet for the type of product being stored.

Other Considerations

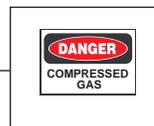
- Only compatible materials can be stored in the same cabinet.
- Compressed gas cylinders (no matter how small) cannot be stored in storage cabinets.
- A total of 120 gallons of a combination of class I, II, and IIIA materials may be stored in a single cabinet so long as the capacity of the cabinet is not exceeded; no more than 60 gallons of class I and II materials can be stored in a single cabinet.

Firewall Equivalent

Commercial cabinets that meet OSHA specifications also qualify for the 1-hour firewall or 20-foot separation of incompatible materials. If you store incompatible materials in separate cabinets that meet OSHA specifications, you can put the cabinets next to each other. HOWEVER, there are limits to how many cabinets you can use; refer to the section covering the specific type of hazardous product for more information.

Hazardous Product Containers

Compressed Gases



Compressed gas products come in a variety of sizes. These guidelines address only portable containers. Bulk containers have additional safety and regulatory issues. If you have installed a bulk container, check with your unit's hazmat coordinator. Never rely on the color of the cylinder to determine its contents.

Liquefied Petroleum Gas



Liquefied petroleum gas, propane, propylene, butane, butylenes) suppliers provide containers that are portable or fixed in place. These cylinders are measured in *water capacity* in pounds, LPG capacity in gallons, and tare weight in pounds; the size of each cylinder must be marked. All cylinders must have a pressure relief valve. Liquefied petroleum gas containers must be in good physical shape and not have bulges, dents, gouges, or excessive corrosion; damaged containers must be removed from service. All containers must have barriers protecting them from physical damage.

Container Labeling

ALL containers and cylinders must have the original manufacturer's label or an equivalent label. These labels are the only means workers can use to identify the types of hazardous materials with which they may be working. MSDSs are always a requirement as well—they should be readily available in the work area.



Container Functions

Product containers can be used for transportation, storage, and dispensing. Each function has its own specific set of requirements. A container that is legal for dispensing may not be legal for storage or transportation.

Flammable Liquids

Flammable liquids are a special type of hazardous material that have specific container requirements. Flammable liquids (such as gasoline) are the hazardous product that is most commonly dispensed at USDA Forest Service units. Ensure that proper containers are used. The requirements for class IA, IB, and IC flammable liquids and class II combustible materials are:

- Do not use glass containers of any size.
- Do not use plastic containers for storage; the only exception is the use of Dolmar two-compartment, 1-gallon containers for chain saw fuel. Replace plastic containers (except Dolmars) with the safety transport can.
- Jerricans may be used to store class IB or IC flammable liquids.
- Metal drums up to 55 gallons are acceptable for class IA, IB, and IC flammable liquids so long as the drum is sound, tightly closed, and is approved by the DOT.
- Safety cans holding 5 gallons or less can be used to store class IA, IB, and IC flammable liquids; these containers must be red and have a spring-loaded, self-closing lid and functioning flash arrester.
- Metal containers (pint, quart, gallon, 2 gallon, 5 gallon) provided by the original manufacturer are acceptable as long as they are sound and securely closed.
- Metal containers holding more than 60 gallons, but less than 660 gallons, are portable tanks; all portable tanks must be approved by the DOT and marked with the proper shipping name (as defined by the DOT) and identification numbers.
- Dolmar containers are to be used only for transporting and dispensing gasoline, not for storing gasoline; however, oil can be stored in Dolmar containers.

Recommendation: Plastic containers (except Dolmars) and other unapproved containers should be drained of gasoline, air dried, and recycled as scrap or discarded in the trash (check with your recycler or landfill before discarding) and replaced with an approved container.

Label, label, label:
proper labels are an extremely important
part of container management.

The Transition to Hazardous Waste

When Does a Product Become a Waste

A *product* becomes a *waste* when you decide it is no longer useful, it does not meet its original specifications and is not usable, or its shelf life has been exceeded for so long that it probably will not perform satisfactorily.

Find a Use Before Declaring a Product a Waste!

If you no longer need a product, the best approach is to find another use for it. If the product is paint, use it as an undercoating. Consider transferring the product to another USDA Forest Service unit. The more you can use up, the less you will have to deal with as a hazardous waste.

When a Product Becomes a Hazardous Waste

If products cannot be used or transferred, or if they no longer meet specifications or their shelf life has been seriously exceeded, you must declare them hazardous wastes and move them to your hazardous waste accumulation area. First, make sure the product has a proper manufacturer's label. Notify your hazardous waste coordinator when you move wastes to the hazardous waste accumulation area.

All containers of hazardous waste must be labeled as a hazardous waste:

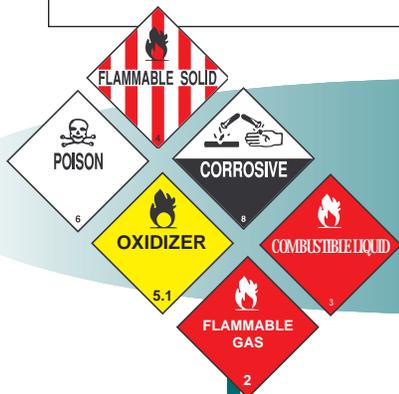
- The date you declared the product a hazardous waste must be marked on the label.
- The marked container must be moved to the hazardous waste accumulation area.
- The amount of hazardous waste moved to the accumulation area must be added to the area log.
- The hazardous waste, along with all other hazardous wastes, must be inspected routinely and disposal arrangements must be made before the allowable storage time onsite has expired.

What is a Hazardous Waste?

Hazardous wastes are any product wastes that:

- Have a flashpoint lower than 140 °F
- Have a pH lower than 2.5 or higher than 12.5
- Are reactive
- Fail the *TCLP* (Toxicity Characteristic Leaching Procedure) test, making it a toxic waste
- Contain a chemical listed by the EPA

See the *Hazardous Wastes* guideline (page 35).



Many of these products will become hazardous wastes; consult the product label and MSDS.

Refer to the *Hazardous Wastes* guideline (page 35).



If a product that becomes a waste no longer has the manufacturer's label (or the equivalent), and you can't positively establish what it is, you have to treat the waste as an *unknown*. See the *Unknown Wastes* guideline (page 34).



When products become wastes, be sure to keep them separated, just as you would keep incompatible products separated.

Keeping Incompatible Hazardous Materials Separated

Incompatible Materials Are Safer When They Are Separated!

Incompatible products and waste must be kept separated. This prevents the materials from reacting in ways that might cause them to burn, explode, produce poisonous gases, or cause other problems.

What Qualifies as **Separate**?

Except as noted elsewhere in this guideline, keeping incompatible products and wastes separated means physically separating them by at least 20 feet, or by a 1-hour firewall.

Some Storage Pointers

When you are storing flammable or combustible products, be sure you store them on compatible shelving (such as metal shelving). Storing flammable or combustible products on wood shelving is acceptable if the shelving is at least 1 inch thick. All shelving (except in approved cabinets) must have a lip or guard.

Using Storage Cabinets

Commercially available storage cabinets (such as cabinets for flammable liquids) that meet all OSHA design requirements fulfill the requirements of a 1-hour firewall. Other metal cabinets (such as square cabinets with a pyramidal top often found in USDA Forest Service units) do not have these features and should not be used to meet a 1-hour firewall requirement. Have your forest engineer determine if other types of mobile or portable storage units (such as U.S. Army units) meet the firewall or storage requirements.

Knowing the Hazardous Products That Are Incompatible

The graphic below is a general guide to the types of hazardous products you can store together and the types that you need to separate by 20 feet or a 1-hour firewall. Refer to the product label or MSDS to determine the product type.

The products indicated by the placards are compatible with each other if shown within the same red lines and incompatible with products shown in other areas surrounded by red lines. The red lines indicate a minimum of 20 feet separation or a 1-hour firewall. However, it may still be preferable to separate these products even farther; for instance, try not to store flammable solids with flammable liquids or compressed gases with flammables.

