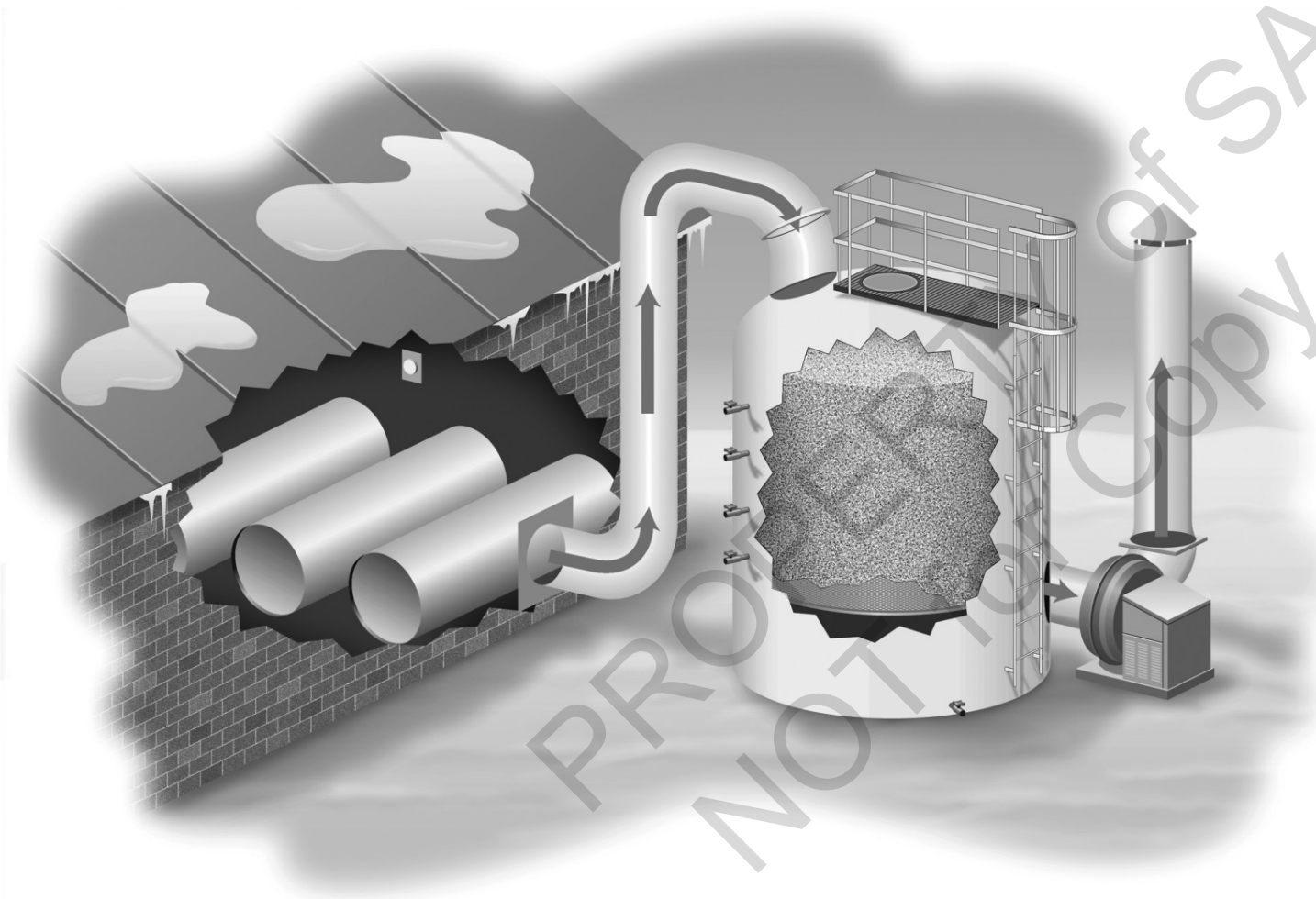


Chlorine is “Toxic”



- State Fire Code (IFC)
- OSHA Occupational Safety & Health Standards
 - OSHA PSM
 - EPA RMP



OSHA PSM and EPA RMP Thresholds

- OSHA's PSM Threshold is 1,500 pounds of Cl₂
- EPA's RMP Threshold is **2,500** pounds Cl₂

If the facility has an RMP covered Cl₂ process, then a “TREATMENT SYSTEM” may be REQUIRED by the State Fire Code!

If the facility is utilizing “short-filled” cylinders (i.e. <1500 lbs) AND they have ONLY one (1) cylinder in the room, they would NOT be required to have a “treatment system”

OSHA's Weakness Below PSM Threshold

- Below these amounts... there is NO OSHA standard for Design, Storage, and Handling Cl₂

So, what does one do to ensure a level of safety?

NOTE: EPA has an RMP General Duty Clause they could use, but OSHA sort of has it's hands tied below the PSM threshold for Cl₂

State Fire/Mechanical/Building Codes

International Codes-Adoption by State (Sept. 2020)

ICC makes every effort to provide current, accurate code adoption information. Not all jurisdictions notify ICC of code adoptions.

X = One or more state or local agencies/jurisdictions have adopted an edition of the specific code. However, the particular code is not used as a standard for all buildings. Blank = The specific code has not been adopted by any state or local jurisdiction in the state. "15" = Number indicates the specific code edition that is adopted as a mandatory state minimum.

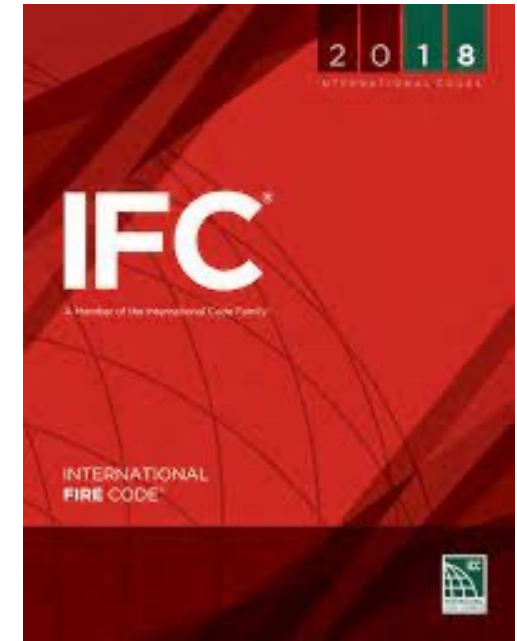
	IBC	IRC	IFC	IMC	IPC	IPSDC	IFGC	IqCC	IECC-R	IECC-C	IPMC	IEBC	ISPSC	ICCPC	IWUIC	IZC	ICC 700
Alabama	15	15	15	15	15	X	15		15	90.1-2013	X	15	X	X	X	X	
Alaska	12	X	12	12			12		18	90.1-2018							
Arizona	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Arkansas	12	12	12	09	06	X	06	X	09	09	X	X					
California	18	18	18						State specific (Exceeds 2018 IECC)	State specific (Exceeds 90.1-2016)	X	18	X		X		
Colorado	X	X	X	X	18	X	18	X	X	X	X	X	X	X	X	X	X
Connecticut	15	15	15	15	15				15	15	X	15					
Delaware	X	X		15	15	X	X		18	90.1-2016	X	X	X				
District of Columbia	15	15	15	15	15		15	15	15	15	15	15	15				
Florida	15	15		15	15		15	X	15	15	X	15					
Georgia	18	18	18	18	18		18		15	15	X	X	18		X		X
Hawaii	18	18			X				18	18		X					
Idaho	15	12	15	12			12	X	12	15		15	*15		X		X
Illinois	X	X	X	X	X	X	X	X	18	18	X	X	X	X	X	X	X
Indiana	12	18	12	12	06		12		state specific (09 min)	state specific (90.1-2007 min)							
Iowa	15	15	15	18	X	X	X		12	12	X	15	X			X	
Kansas	X	X	X	X	X	X	X		X	X	X	X					
Kentucky	15	15	12	15					09	12	X	15					
Louisiana	15	15	X	15	15		15		09	90.1-2007	X	15	X				
Maine	15	15							09	90.1-2013	X	15					

<https://www.iccsafe.org/wp-content/uploads/Master-I-Code-Adoption-Chart-Sept-2020.pdf>



How is Cl₂ classified by the Codes?

- The codes are built upon the **CLASSIFICATION** of the Hazardous Material (HAZMAT)
- Cl₂ is classified as a
 1. COMPRESSED GAS,
 2. CORROSIVE GAS, and
 3. TOXIC GAS



NOTE: Some facilities manage Cl₂ as a “Highly Toxic” Gas, but by definition it is ONLY a “Toxic” gas

Why is Cl₂ classified as a Compressed Gas?

Compressed Gas is a material, or a mixture of materials, that:

1. is a gas at 68°F (20°C) or less at 14.7 psia (101 kPa) of pressure, **AND**
2. has a boiling point of 68°F (20°C) or less at 14.7 psia (101 kPa) which is either liquefied, nonliquefied, or in solution, except those gases which have no other health or physical hazard properties are not considered to be compressed until the pressure in the packaging exceeds 41 psia (282 kPa) at 68°F (20°C)

Why is Cl₂ classified as a Compressed Gas?

The states of compressed gases are **CATEGORIZED** as follows:

- 1. NON-LIQUIFIED COMPRESSED GASES** are gases, other than those in solution, that are in a packaging under the charged pressure and are ENTIRELY GASEOUS at 68°F (20°C)
- 2. LIQUEFIED COMPRESSED GASES** are gases that, in a packaging under the charged pressure, are partially liquid at a temperature of 68°F (20°C)
- 3. COMPRESSED GASES** in solution are nonliquefied gases that are **DISSOLVED IN A SOLVENT**
- 4. COMPRESSED GAS MIXTURES** consist of a **mixture of two or more compressed gases** contained in a packaging, the hazard properties of which are represented by the properties of the mixture as a whole

Cl₂ is shipped as either **NON-LIQUIFIED COMPRESSED GAS** or as a **LIQUEFIED COMPRESSED GAS**

Toxic Gas vs. Highly Toxic Gas

Highly Toxic	Toxic
<ul style="list-style-type: none">• LD50 of ≤ 50 mg/kg body weight oral albino rat 200 - 300 gOR• LD50 of ≤ 200 mg/kg body weight continuous 24 h contact (or less if death occurs before 24 h) albino rabbits 2 - 3 kgOR• LC50 ≤ 200 ppm by volume of gas or vapor, or > 2 mg/L dust/fume/mist continuous inhalation for 1 h (or less if death occurs in less than 1 h) to albino rats 200 - 300 g.	<ul style="list-style-type: none">• 50 mg/kg $< LD50 \leq 500$ mg/kg (body weight) oral albino rat 200 - 300 gOR• 200 mg/kg $< LD50 \leq 1000$ mg/kg (body weight) continuous 24 h contact (or less if death occurs before 24 h) albino rabbits 2 - 3 kgOR• 200 ppm $< LC50 \leq 2000$ ppm (by volume of gas or vapor), or 2 mg/L $< LC50 \leq 20$ mg/L (dust, fume, mist) continuous inhalation for 1 h (or less if death occurs in less than 1 h) to albino rats 200 - 300 g

Chlorine's LC50 = 293 ppm

NOTE: Sulfur Dioxide's (SO₂) LC50 = 2,520 ppm

Toxic Gas vs. Highly Toxic Gas

Highly toxic*	Toxic*
<p>Arsine (AsH₃) Cyanogen (CN₂) Diazomethane (CH₂N₂) Diborane (B₂H₆) Fluorine (F) Hydrogen Cyanide (HCN) Hydrogen Selenide (H₂Se) Nitric Oxide (NO) Oxygen difluoride (OF₂) Phosgene (COCl₂) Phosphine (PH₃) Perfluoroisobutylene (C₄F₈) Selenium Hexafluoride (SeF₆) Stibine (SbH₃) Sulfur Tetrafluoride (SF₄) Tellurium Hexafluoride (TeF₆)</p>	<p>Boron Tribromide (BBr₃) Bromine Chloride (BrCl) Bromomethane (CH₃Br) Chlorine (Cl₂) Chlorine trifluoride (ClF₃) Cyanogen (C₂N₂) Dichlorosilane (H₂Cl₂Si) Germane (GeH₄) Hydrogen Fluoride (HF) Hydrogen Sulfide (H₂S) Perchloryl Fluoride (ClFO₃) Phosphorus Pentafluoride (PF₅) Silicon Tetrafluoride (SiF₄) Silicon Tetrachloride (SiCl₄) Trifluoroacetyl Chloride (C₂ClF₃O) Tungsten Hexafluoride (WF₆)</p>

*Highly Toxic gases would also be a Category 1 (Acute Toxicity) per OSHA; Category 2's would be Toxic Gases

Cl₂ Application

Cl₂ is a “Toxic”, “Corrosive” “Compressed Gas” and the areas where it is **STORED, DISPENSED, USED AND HANDLED MUST** meet the minimum requirements of:

- Chapter 50: Hazardous Materials—General Provisions
 - [SECTION 5001 GENERAL](#)
 - [SECTION 5003 GENERAL REQUIREMENTS](#)
 - [SECTION 5004 STORAGE](#)
 - [SECTION 5005 USE, DISPENSING, AND HANDLING](#)

Chapter 60: Highly Toxic and Toxic Materials

- [SECTION 6004 HIGHLY TOXIC AND TOXIC COMPRESSED GASES](#)
- [Chapter 53: Compressed Gases](#)
- [Chapter 54: Corrosive Materials](#)*

*Nothing additional in Chapter 54, as it is really geared towards corrosive liquids.

IFC Chapter 50: Hazardous Materials-

SECTION 5001, GENERAL PROVISIONS

5001.1 Scope

- PREVENTION, CONTROL and MITIGATION of dangerous conditions related to **storage**, **dispensing**, **use** and **handling** of hazardous materials shall be in accordance with this chapter.
- This chapter shall apply to **ALL HAZARDOUS MATERIALS**, including those materials regulated elsewhere in this code, except that where specific requirements are provided in other chapters, those specific requirements shall apply in accordance with the applicable chapter.
- Where a material has **MULTIPLE HAZARDS**, **ALL HAZARDS** shall be addressed.

IFC Chapter 50: Hazardous Materials-

SECTION 5001, GENERAL PROVISIONS

SECTION 5001, GENERAL

5001.2.2.2 Health hazards

The material categories listed in this section are classified as **HEALTH HAZARDS**.

A material with a primary classification as a **HEALTH HAZARD** can also pose a physical hazard.

1. Highly toxic and **TOXIC** materials
2. Corrosive materials

IFC Chapter 50: Hazardous Materials-

SECTION 5003, GENERAL REQUIREMENTS

5003.1 Scope

The **storage**, **use** and **handling** of **ALL HAZARDOUS MATERIALS** shall be in accordance with this section.

5003.1.1 Maximum Allowable Quantity (MAQ) per control area
The maximum allowable quantity per control area shall be as specified in **Tables 5003.1.1(1) - 5003.1.1(4)**.

IFC Chapter 50: Hazardous Materials-

SECTION 5003, GENERAL REQUIREMENTS

MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA -

- The maximum amount of a hazardous material allowed to be **STORED OR USED** within a control area inside a building or an outdoor control area.
- The maximum allowable quantity per control area is based on
 1. the material state (solid, liquid or gas) and
 2. the material storage or use conditions

EXCEEDING this amount will place the use area or building into a **HAZARDOUS OCCUPANCY** classification.

IFC Chapter 50: Hazardous Materials-

SECTION 5003, GENERAL REQUIREMENTS

TABLE 5003.1.1(2)

MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIAL POSING A HEALTH HAZARD^{a, c, f, h, i}

MATERIAL	STORAGE ^b			USE-CLOSED SYSTEMS ^b			USE-OPEN SYSTEMS ^b	
	Solid pounds ^{d, e}	Liquid gallons (pounds) ^{d, e}	Gas cubic feet at NTP (pounds) ^d	Solid pounds ^d	Liquid gallons (pounds) ^d	Gas cubic feet at NTP (pounds) ^d	Solid pounds ^d	Liquid gallons (pounds) ^d
Corrosives	5,000	500	Gaseous 810 ^e Liquefied (150)	5,000	500	Gaseous 810 ^e Liquefied (150)	1,000	100
Highly Toxics	10	(10)	Gaseous 20 ^g Liquefied (4) ^g	10	(10)	Gaseous 20 ^g Liquefied (4) ^g	3	(3)
Toxics	500	(500)	Gaseous 810 ^e Liquefied (150) ^e	500	(500)	Gaseous 810 ^e Liquefied (150) ^e	125	(125)

For SI: 1 cubic foot = 0.02832 m³, 1 pound = 0.454 kg, 1 gallon = 3.785 L.

- a. For use of control areas, see Section 5003.8.3.
- b. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.
- c. In retail and wholesale sales occupancies, the quantities of medicines, foodstuff or consumer products and cosmetics, containing not more than 50 percent by volume of water-miscible liquids and with the remainder of the solutions not being flammable, shall not be limited, provided that such materials are packaged in individual containers not exceeding 1.3 gallons.
- d. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1. Where Note e also applies, the increase for both notes shall be applied accumulatively.

e. Maximum allowable quantities shall be increased 100 percent where stored in approved storage cabinets, gas cabinets or exhausted enclosures. Where Note d applies, the increase for both notes shall be applied accumulatively.

f. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 5003.11, see Table 5003.11.1.

g. Allowed only where stored in approved exhausted gas cabinets or exhausted enclosures.

h. Quantities in parentheses indicate quantity units in parentheses at the head of each column.

i. For gallons of liquids, divide the amount in pounds by 10 in accordance with Section 5003.1.2.

The MAQ of 810 cubic feet for corrosive and toxic gases established in the table is based on a single 150-pound cylinder of chlorine

IFC Chapter 50: Hazardous Materials-

SECTION 5003, GENERAL REQUIREMENTS

The MAQ of **810 cubic feet** for corrosive and **TOXIC GASES** established in table 5003.1.1(2) is based on a single 150-pound cylinder of chlorine

- $\text{Cl}_2 = 5.38$ cubic ft/pound
- 150 pounds of Cl_2 is 807 cubic feet

IFC Chapter 50: Hazardous Materials-

SECTION 5003, GENERAL REQUIREMENTS

5003.1.3 Quantities NOT EXCEEDING the MAQ

The **storage**, **use** and **handling** of hazardous materials in quantities **NOT exceeding their MAQ** shall be in accordance with **Sections 5001 and 5003**.

5003.1.4 Quantities EXCEEDING the MAQ

The **storage**, **use** and **handling** of hazardous materials in quantities **EXCEEDING the MAQ** shall be in accordance with this chapter.

IFC Chapter 50: Hazardous Materials-

SECTION 5003, GENERAL REQUIREMENTS

5003.8.4 Gas rooms

Where a **GAS ROOM** is used to **INCREASE** the MAQ or provided to comply with the provisions of [Chapter 60 - HIGHLY TOXIC AND TOXIC MATERIALS](#), the gas room shall be in accordance with Sections [5003.8.4.1](#) and [5003.8.4.2](#).

Gas Room - A separately ventilated, fully enclosed room in which only compressed gases and associated equipment and supplies are stored or used.

IFC Chapter 50: Hazardous Materials-

SECTION 5003, GENERAL REQUIREMENTS

5003.8.4.1 Construction...

5003.8.4.2 Ventilation system

The ventilation system for gas rooms shall be designed to operate at a **NEGATIVE PRESSURE** in relation to the surrounding area.

Highly toxic and **TOXIC GASES** shall also comply with Section 6004.2.2.6.

The ventilation system shall be installed in accordance with the **International Mechanical Code**.

IFC Chapter 50: Hazardous Materials-

SECTION 5003, GENERAL REQUIREMENTS

6004.2.2.6 Gas rooms

Gas rooms shall comply with Section 5003.8.4 and both of the following requirements:

1. The **exhaust ventilation from gas rooms shall be directed to an EXHAUST SYSTEM.**
2. Gas rooms shall be equipped with an approved automatic sprinkler system. Alternative fire-extinguishing systems shall not be used.

EXHAUST SYSTEM - An assembly of connected ducts, plenums, fittings, registers, grilles and hoods through which air is conducted from the space or spaces and exhausted to the outdoor atmosphere.

IFC Chapter 50: Hazardous Materials-

SECTION 5003, GENERAL REQUIREMENTS

5003.8.5 Exhausted enclosures

Where an **EXHAUSTED ENCLOSURE** is used to **INCREASE** MAQ or where the location of hazardous materials in exhausted enclosures is provided to comply with the provisions of **Chapter 60 - HIGHLY TOXIC AND TOXIC MATERIALS**, the exhausted enclosure shall be in accordance with Sections 5003.8.5.1 through 5003.8.5.3.

EXHAUSTED ENCLOSURE - An appliance or piece of equipment which consists of a top, a back and two sides providing a means of local exhaust for capturing gases, fumes, vapors and mists. Such enclosures include **laboratory hoods, exhaust fume hoods and similar appliances and equipment** used to retain and exhaust locally the gases, fumes, vapors and mists that could be released. Rooms or areas provided with general ventilation, in themselves, are **NOT** exhausted enclosures.

IFC Chapter 50: Hazardous Materials-

SECTION 5003, GENERAL REQUIREMENTS

5003.8.5.1 Construction...

5003.8.5.2 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 systems used for highly toxic and **TOXIC GASES** shall also comply with Items 1, 2 and 3 of [Section 6004.1.3](#).
- The ventilation system shall be installed in accordance with the IMC.

IFC Chapter 60: HIGHLY TOXIC AND TOXIC MATERIALS

6004.1.3 Exhausted enclosures

Exhausted enclosures containing highly toxic or **TOXIC COMPRESSED GASES** shall comply with Section 5003.8.5 and the following requirements:

1. The average ventilation velocity at the face of the enclosure shall be **NOT LESS THAN** 200 feet per minute with **NOT LESS THAN** 150 feet per minute
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

IFC Chapter 50: Hazardous Materials-

SECTION 5003, GENERAL REQUIREMENTS

5003.8.6 Gas cabinets

Where a GAS CABINET is used to increase the MAQ or where the location of compressed gases in gas cabinets is provided to comply with the provisions of Chapter 60- HIGHLY TOXIC AND TOXIC MATERIALS, the gas cabinet shall be in accordance with Sections 5003.8.6.1 through 5003.8.6.3.

IFC Chapter 50: Hazardous Materials-

SECTION 5003, GENERAL REQUIREMENTS

5003.8.6 Gas cabinets

5003.8.6.1 Construction...

5003.8.6.2 Ventilation

1. Gas cabinets shall be provided with an **exhaust ventilation system**.
2. The ventilation system for gas cabinets shall be designed to operate at a **negative pressure** in relation to the surrounding area.
3. Ventilation systems used for highly toxic and **TOXIC GASES** shall also comply with **Items 1, 2 and 3 of Section 6004.1.2**.
4. The ventilation system shall be installed in accordance with the IMC.

IFC Chapter 60: HIGHLY TOXIC AND TOXIC MATERIALS

6004.1.2 Gas cabinets

Gas cabinets containing highly toxic or **TOXIC COMPRESSED GASES** shall comply with Section 5003.8.6 and the following requirements:

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 or 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

IFC Chapter 50: Hazardous Materials-

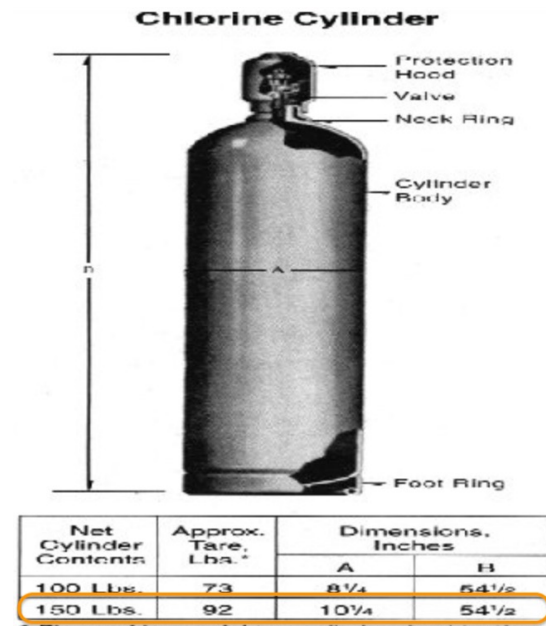
SECTION 5004, STORAGE

5004.1 Scope

Storage of hazardous materials in amounts **EXCEEDING** the MAQ shall be in accordance with Sections 5001, 5003 and **5004**.

Storage of hazardous materials in amounts **NOT EXCEEDING** the MAQ shall be in accordance with Sections 5001 and 5003.

Remember... The MAQ for Cl_2 is 810 cubic ft, which is one (1) 150-pound cylinder.



IFC Chapter 50: Hazardous Materials-

SECTION 5004, STORAGE

5004.3 Ventilation

INDOOR STORAGE AREAS and **STORAGE BUILDINGS** shall be provided with **MECHANICAL EXHAUST VENTILATION** (or natural ventilation where natural ventilation can be shown to be acceptable for the materials as stored)

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IFC Chapter 50: Hazardous Materials-

SECTION 5004, STORAGE

5004.3.1 System requirements

EXHAUST VENTILATION systems shall comply with **ALL** the following:

1. Installation shall be in accordance with the IMC.
2. Ventilation shall be at a rate of **NOT LESS THAN** 1 cubic foot per minute per square foot of floor area
3. Systems shall **operate continuously** unless alternative designs are approved.
4. A **manual shutoff control** shall be provided outside of the room in a position adjacent to the access door to the room or in an approved location. The switch shall be a break-glass or other approved type and shall be labeled: **VENTILATION SYSTEM EMERGENCY SHUTOFF**.
5. Exhaust ventilation shall be designed to consider the **density of the potential fumes or vapors** released.
 1. fumes or vapors heavier than air, exhaust shall be taken from a point **within 12" of the floor**
 2. fumes or vapors lighter than air, exhaust shall be taken within 12" of the highest point of the room
6. The location of **BOTH** the exhaust and inlet air openings shall be designed to provide air movement across **ALL PORTIONS OF THE FLOOR OR ROOM** to prevent the accumulation of vapors
7. Exhaust air shall not be recirculated to occupied

IFC Chapter 50: Hazardous Materials-

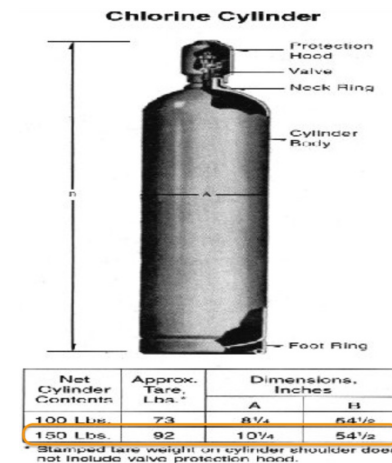
SECTION 5005 **USE, DISPENSING** AND **HANDLING**

5005.1 General

Use, dispensing, and handling of hazardous materials in amounts **EXCEEDING** the MAQ shall be in accordance with Sections 5001, 5003 and **5005**.

Use, dispensing, and handling of hazardous materials in amounts **NOT EXCEEDING** the MAQ shall be in accordance with Sections 5001 and 5003.

Remember... The MAQ for Cl_2 is 810 cubic ft, which is one (1) 150-pound cylinder.



IFC Chapter 50: Hazardous Materials-

SECTION 5005 **USE, DISPENSING AND HANDLING**

5005.1.9 Ventilation

Indoor dispensing and use areas shall be provided with **EXHAUST VENTILATION** in accordance with Section 5004.3.

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IFC Chapter 50: Hazardous Materials-

SECTION 5005 **USE, DISPENSING AND HANDLING**

5005.2.1.1 Ventilation

Where gases, liquids or solids having a **HAZARD RANKING OF 3 OR 4** in accordance with **NFPA 704** are **dispensed** or **used**, **MECHANICAL EXHAUST VENTILATION** shall be provided to capture gases, fumes, mists or vapors **AT THE POINT OF GENERATION.**

5005.2.2.1 Ventilation

Where **CLOSED SYSTEMS** are designed to be **opened as part of normal operations**, ventilation shall be provided in accordance with Section 5005.2.1.1.

IFC Chapter 60: SECTION 6004

HIGHLY TOXIC AND TOXIC COMPRESSED GASES

6004.1 General

The storage and use of highly toxic and TOXIC COMPRESSED GASES shall comply with this section.

6004.1.3 Exhausted enclosures

EXHAUSTED ENCLOSURES containing highly toxic or TOXIC COMPRESSED GASES shall comply with Section 5003.8.5 and the following requirements:

1. The average ventilation velocity at the face of the enclosure shall be not less than 200 feet per minute with **NOT LESS THAN** 150 feet per minute.
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.

IFC Chapter 60: SECTION 6004

HIGHLY TOXIC AND TOXIC COMPRESSED GASES

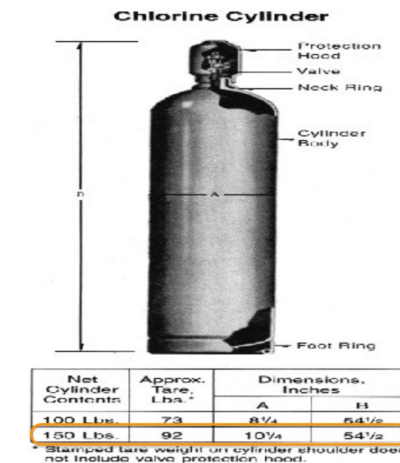
6004.2.1.1 Quantities **NOT EXCEEDING** the MAQ

The **INDOOR STORAGE OR USE** of highly toxic and **TOXIC GASES** in amounts **NOT EXCEEDING** the MAQ shall be in accordance with Sections 5001, 5003, 6001 and 6004.1.

6004.2.1.2 Quantities **EXCEEDING** the MAQ

The **INDOOR STORAGE OR USE** of highly toxic and **TOXIC GASES** in amounts **EXCEEDING** the MAQ shall be in accordance with Sections 6001, 6004.1, 6004.2 and Chapter 50.

Remember... The MAQ for Cl_2 is 810 cubic ft, which is one (1) 150-pound cylinder.



IFC Chapter 60: SECTION 6004

HIGHLY TOXIC AND TOXIC COMPRESSED GASES

6004.2.2.1 Cylinder and tank location

CYLINDERS shall be located within:	PORTABLE and STATIONARY TANKS shall be located within:
GAS CABINETS	-----
EXHAUSTED ENCLOSURES	EXHAUSTED ENCLOSURES
GAS ROOMS	GAS ROOMS

6004.2.2.2 Ventilated areas

The room or area in which **GAS CABINETS** or **EXHAUSTED ENCLOSURES** are located shall be provided with **EXHAUST VENTILATION**.

Gas cabinets or exhausted enclosures shall not be used as the sole means of exhaust for any room or area.

IFC Chapter 60: SECTION 6004

HIGHLY TOXIC AND TOXIC COMPRESSED GASES

6004.2.2.6 Gas rooms

GAS ROOMS shall comply with Section 5003.8.4 and **BOTH** of the following requirements:

1. The EXHAUST VENTILATION from **gas rooms** shall be directed to an **EXHAUST SYSTEM**.
2. **GAS ROOMS** shall be equipped with an approved automatic sprinkler system. Alternative fire-extinguishing systems shall not be used.

IFC Chapter 60: SECTION 6004

HIGHLY TOXIC AND TOXIC COMPRESSED GASES

6004.2.2.7 Treatment systems

The EXHAUST VENTILATION from gas cabinets, exhausted enclosures, and gas rooms, and local exhaust systems required in Sections 6004.2.2.4 and 6004.2.2.5 SHALL BE DIRECTED TO A TREATMENT SYSTEM.

The treatment system shall be utilized to handle the accidental release of gas and to process exhaust ventilation.

The treatment system shall be designed in accordance with Sections 6004.2.2.7.1 through 6004.2.2.7.5 and Section 510 – Hazardous Exhaust Systems of the IMC.

IFC Chapter 60: SECTION 6004

HIGHLY TOXIC AND TOXIC COMPRESSED GASES

Exceptions to treatment systems:

1. Highly toxic and TOXIC GASES—STORAGE

A treatment system is **NOT** required for cylinders, containers and tanks in **storage** where **ALL** the following controls are provided:

1. Valve outlets are equipped with **gas-tight outlet plugs or caps**
2. **Handwheel-operated valves** have handles secured to prevent movement
3. **APPROVED CONTAINMENT VESSELS** or containment systems are provided



IFC Chapter 60: SECTION 6004

HIGHLY TOXIC AND TOXIC COMPRESSED GASES

SECTION 6004 HIGHLY TOXIC AND TOXIC COMPRESSED GASES

Exceptions to treatment systems:

2. TOXIC GASES—USE

1. Treatment systems are **NOT** required for **TOXIC GASES** supplied by **CYLINDERS OR PORTABLE TANKS:**

**A 1-ton Cl₂ container holds ~1,600 pounds of water*

- a) **NOT EXCEEDING 1,700 POUNDS WATER CAPACITY, AND**
 - b) where a **GAS DETECTION SYSTEM** complying with Section 6004.2.2.10, **AND**
 - c) listed or approved **AUTOMATIC-CLOSING FAIL-SAFE VALVES** are provided.
2. The gas detection system shall have a sensing interval not exceeding 5 minutes.
 3. **AUTOMATIC-CLOSING FAIL-SAFE valves shall be located immediately adjacent to cylinder valves and shall close when gas is detected at the PEL by a gas sensor monitoring the exhaust system at the point of discharge from the gas cabinet, exhausted enclosure, ventilated enclosure, or gas room.**

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Exception 2 is for toxic gases supplied by cylinders limited to a size of 1,700 pounds water capacity. The 1,700-pound limit was derived as follows:

A 1-ton Cl₂ container typically holds about 1,600 pounds of water, and a filling density of approximately 125% of the water capacity is allowed for chlorine [1,600 x 1.25 = 2,000 pounds]. The resulting weight of product in a filled container is one 1-ton for Cl₂. The maximum capacity of 1,700 pounds versus 1,600 pounds is intended to accommodate manufacturing variations that occur from one container to the next, but this does not affect the ultimate gas capacity of a filled container, which is limited to 2,000 pounds regardless of the variation in water capacity.

Source: 2018 IFC Code and Commentary

$$1,600 \text{ lbs} \times 125\% \text{ (filling density)} = 2,000 \text{ pounds}$$

Cl₂ Container Dimensions and Weights¹

Capacity		100 lb.	150 lb.	2,000 lb.
Volume of liquid Cl ₂ (approximate at 60°F)	gal	8.42	12.64	168.5
Tare Weight	lb.	63-115	85-140	1,300-1,650
Outside Diameter	in.	8.25-10.75	10.25-10.75	30
Cylinder Height	in.	39.5 - 59*	53 - 56*	
Ton Container Length				79.75 – 82.5

*Heights are to the top of the valve protection housing. The height to the center of the valve outlet is about 3.5 in. (89 mm) less.

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6004.2.2.7.1 Design

TREATMENT SYSTEMS shall be capable of diluting, adsorbing, absorbing, containing, neutralizing, burning or otherwise processing the contents of the LARGEST SINGLE VESSEL of COMPRESSED GAS.

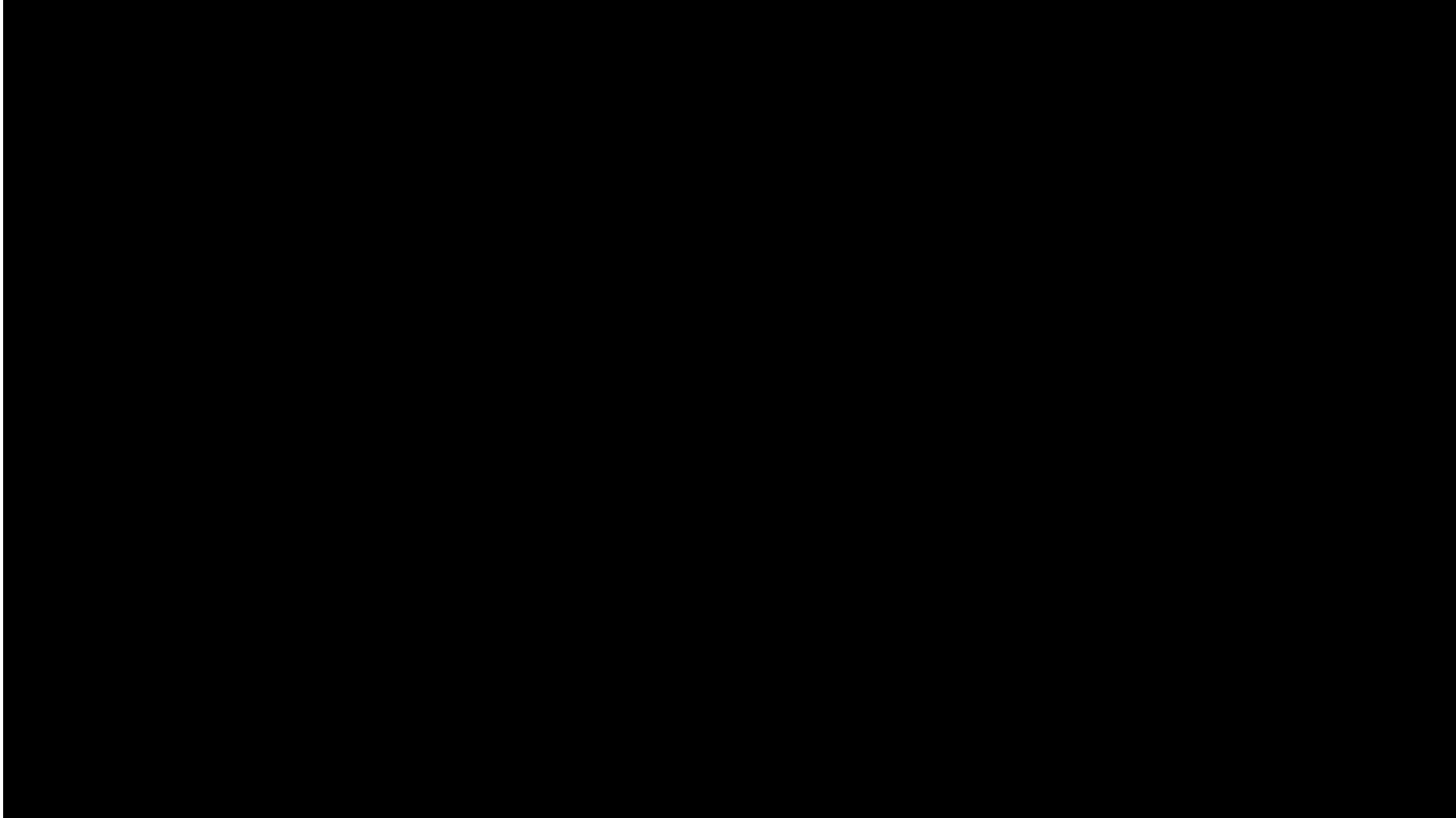
Where a **TOTAL CONTAINMENT SYSTEM** is used, the system shall be designed to handle the maximum anticipated pressure of release to the system when it reaches equilibrium.



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TOTAL CONTAINMENT SYSTEM



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6004.2.2.7.2 Performance

TREATMENT SYSTEMS shall be designed to reduce the maximum allowable discharge concentrations of the gas to **½ of the IDLH** at the point of discharge to the atmosphere.

Cl₂ IDLH = 10 ppm, so the discharge of treatment MUST BE NO MORE THAN 5 ppm!

Where **MORE THAN ONE GAS** is emitted to the **TREATMENT SYSTEM**, the **TREATMENT SYSTEM** shall be designed to handle the **WORST-CASE RELEASE** based on:

1. the **RELEASE RATE**,
2. the **QUANTITY**, and
3. the **IDLH** for all compressed gases stored or used

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6004.2.2.7.3 Sizing

TREATMENT SYSTEMS shall be sized to process the **MAXIMUM WORST-CASE RELEASE OF GAS** based on the **MAXIMUM FLOW RATE** of release from the **LARGEST VESSEL** utilized.

The **ENTIRE CONTENTS** of the largest compressed gas vessel shall be considered.

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6004.2.2.7.5 Portable tanks and cylinders

- The **MAXIMUM FLOW RATE OF RELEASE** for portable tanks and cylinders shall be calculated based on the total release from the cylinder or tank **WITHIN THE TIME** specified in Table 6004.2.2.7.5.
- Where portable tanks or cylinders are equipped with **APPROVED EXCESS FLOW** or **REDUCED FLOW VALVES**, the worst-case release shall be determined by the **MAXIMUM ACHIEVABLE FLOW** from the valve as determined by the valve manufacturer or compressed gas supplier.
 - Reduced flow and excess flow valves shall be permanently marked by the valve manufacturer to indicate the maximum design flow rate.
 - Such markings shall indicate the flow rate for air under normal temperature and pressure.

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TABLE 6004.2.2.7.5
RATE OF RELEASE FOR CYLINDERS AND PORTABLE TANKS

VESSEL TYPE	NONLIQUEFIED (minutes)	LIQUEFIED (minutes)
Containers	5	30
Portable tanks	40	240

COMPRESSED GAS CONTAINER - A pressure vessel designed to hold compressed gases at pressures greater than one atmosphere at 68°F (20°C) and includes cylinders, containers and tanks.

TANK, PORTABLE - A packaging of **more than 60-gallon capacity** and designed primarily to be loaded into or on or temporarily attached to a transport vehicle or ship and equipped with skids, mountings or accessories to facilitate handling of the tank by mechanical means. It does **NOT** include any cylinder having **less than a 1,000-pound water capacity**, *CARGO TANK, TANK CAR TANK or TRAILERS* carrying cylinders of **more than 1,000-pound water capacity**.

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6004.2.2.8 Emergency power

Emergency power shall be provided for the following systems in accordance with Section 604:

1. Exhaust ventilation system
2. Treatment system
3. Gas detection system
4. Smoke detection system
5. Temperature control system
6. Fire alarm system
7. Emergency alarm system

6004.2.2.8.1 Fail-safe engineered systems

Emergency power shall **NOT** be required for mechanical exhaust ventilation, treatment systems and temperature control systems where **APPROVED FAIL-SAFE ENGINEERED SYSTEMS ARE INSTALLED.**

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6004.2.2.10 Gas detection system

A gas detection system complying with Section 916 shall be provided to detect the presence of gas at or below the PEL or ceiling limit of the gas for which detection is provided.

The system shall be capable of monitoring the **DISCHARGE FROM THE TREATMENT SYSTEM** at or below $\frac{1}{2}$ the IDLH limit and **SHALL INITIATE** a response in accordance with Sections 6004.2.2.10.1 through 6004.2.2.10.3 if the gas detection alarm is activated. $\frac{1}{2}$ IDLH of $\text{Cl}_2 = 5 \text{ ppm}$

EXCEPTION: A gas detection system is **NOT** required for toxic gases when the physiological warning threshold level for the gas is at a level below the accepted PEL for the gas.

Cl_2 has an odor threshold lower than its TLV of 1.0 ppm; but this “exception” is **NOT** recommended!

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6004.2.2.10.1 Alarms

The gas detection system shall initiate a local alarm and transmit a signal to a **CONSTANTLY ATTENDED** control station when a short-term hazard condition is detected.

The alarm shall be **BOTH AUDIBLE** and **VISIBLE** and shall provide warning **BOTH INSIDE** and **OUTSIDE** the area where gas is detected.

The **AUDIBLE ALARM** shall be **distinct** from all other alarms.

Exception: Signal transmission to a constantly attended control station is **NOT** required where **NOT more than one (1) cylinder** of highly toxic or toxic gas is stored

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6004.2.2.10.2 Shut off of gas supply

The gas-detection system shall **AUTOMATICALLY** close the shutoff valve **at the source on gas supply piping and tubing** related to the system being monitored for whichever gas is detected.

Exception: Automatic shutdown is **NOT** required for reactors **utilized for the production of** highly toxic or toxic compressed gases where such reactors are:

1. Operated at pressures less than 15 psig
2. Constantly attended
3. Provided with emergency shutoff valves that have ready access

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6004.2.2.10.3 Valve closure

Automatic closure of shutoff valves shall be in accordance with the following:

1. Where the gas-detection sampling point initiating the gas detection system alarm is within a **GAS CABINET** or **EXHAUSTED ENCLOSURE**, the **shutoff valve in the gas cabinet or exhausted enclosure** for the specific gas detected **shall automatically close**.
2. Where the gas-detection sampling point initiating the gas detection system alarm is within a **GAS ROOM** **and** compressed gas containers are **NOT** in **gas cabinets** or **exhausted enclosures**, the **shutoff valves on all gas lines** for the specific gas detected **shall automatically close**.
3. Where the gas-detection sampling point initiating the gas detection system alarm is **within a piping distribution manifold enclosure**, the shutoff valve for the compressed container of specific gas detected supplying the manifold shall automatically close.

Exception: Where the gas-detection sampling point initiating the gas-detection system alarm is at a use location or within a gas valve enclosure of a branch line downstream of a piping distribution manifold, the shutoff valve in the gas valve enclosure for the branch line located in the piping distribution manifold enclosure shall automatically close.