

**STUDY MATERIAL FOR THE
CERTIFICATE OF FITNESS FOR:**

**HANDLING AND STORAGE OF HIGH
PRESSURE NON-FLAMMABLE GAS
CYLINDERS**

G-46

**ALSO INCLUDED IN THIS BOOKLET YOU WILL
FIND THE FOLLOWING:**

1. NOTICE OF EXAMINATION (NOE)

About these study materials

These study materials will help you prepare for the written examination for the Certificate of Fitness for handling and storage of gas cylinders. The study materials includes information taken from the Fire Prevention Code, NFPA Standards, and the Fire Prevention Directives of the Bureau of Fire Prevention, NYFD. The study materials do not contain all the information you need to know in order to handle and store gas cylinders safely and efficiently. It is your responsibility to become familiar with all applicable rules and regulations of the City of New York, even if they are not covered in this material.

About the Test

You must pass a multiple choice test to qualify for the Certificate of Fitness. A score of 70% correct is required in order to pass the multiple choice test. All questions on the multiple choice test have four answer options. Only one answer option is correct for each question. If you do not answer a question, or if you mark more than one option, your answer will be scored as incorrect. Read each question carefully before marking your answer. There is no penalty for guessing on the multiple choice test.

Sample Questions

1. Who was the first President of the United States?

- (A) George Washington.
- (B) Thomas Jefferson.
- (C) Bill Clinton.
- (D) Malcolm X.

The correct answer is "A". You would tap "A" on your touch screen monitor.

2. What famous sports team plays at Shea Stadium in New York City?

- (A) The Jets.
- (B) The Dolphins.
- (C) The Giants
- (D) The Mets.

The correct answer is "D". You would tap "D" on touch screen monitor.

Introduction

The gases that are used most commonly in health care facilities include oxygen, nitrogen, nitrous oxide, carbon dioxide, and air. For example, oxygen is used to supply oxygen hoods, hyperbaric chambers, hypobaric chambers, incubators and oronasal or nasal masks. This document outlines New York City Fire Department regulations for the safe handling and storage of these gas cylinders. One primary regulation is that at least one certificate of fitness holder must be on duty 24 hours per day in a health care facility. This person is responsible for ensuring that all fire department regulations related to the safe handling and storage of medical gases are obeyed on the premises. Some of the regulations related to storage dictate that all compressed gas cylinders must meet the Department of Transportation (DOT) design specifications.

Characteristics of Non-flammable Gases

Oxygen

Oxygen, which makes up approximately 21% of the earth's atmosphere, is colorless, odorless, and fully life sustaining. Although oxygen cannot be ignited, it is a strong supporter of combustion. Oxygen aids in the ignition and burning of other materials and gases. Some combustibles, such as some oils, burn in oxygen with near explosive violence. Seamless steel cylinders are used to store gaseous oxygen at pressures up to 2200 pounds per square inch gauge (psig). Each cylinder must have a safety disk installed in the control valve connection. This disk will burst and release the oxygen into the atmosphere when the oxygen pressure in the cylinder reaches a dangerous level. For example, the disk will burst if the pressure increases because the cylinder has been exposed to extreme temperatures. According to DOT color coding specifications, cylinders used to store gaseous oxygen must be painted green. However, the certificate of fitness holder should not rely on the color coding system for identification. Instead, he or she should identify the cylinder's contents by reading the DOT markings stamped at the cylinder's neck or written on the cylinder's label. If the contents of the cylinder cannot be identified by one of these methods, the cylinder must be returned to supplier without using it.

Nitrogen

Nitrogen is a colorless, odorless, nontoxic and nonflammable gas. Although it is nontoxic, if it is released in a confined area it may cause people in the area to asphyxiate because it will displace the oxygen in the air. It is commonly used in health care facilities in surgery applications. It may be used with oxygen to create reconstituted Grade D air. Nitrogen is shipped and stored inside cylinders at pressures up to 2200 psig. These cylinders are generally color coded black.

Nitrous Oxide

Nitrous oxide is a colorless, odorless and noncombustible gas that does not sustain life. However, it does support combustion and some materials that do not normally burn in air will ignite and burn in nitrous oxide. Nitrous oxide is used in health care facilities as an anesthetic and analgesic. It is shipped in DOT approved cylinders at temperatures above 98 degrees Fahrenheit. Cylinders that hold gaseous nitrous oxide are color coded blue. Nitrous oxide must not be permitted to mix with oil or grease as they may combine with explosive violence.

Carbon Dioxide

Carbon dioxide is a compound formed by the combination of carbon and oxygen. Carbon dioxide is noncombustible, does not support combustion, and does not sustain life. Mixtures of carbon dioxide and oxygen may or may not be life supporting depending on the oxygen concentration and the duration of inhalation. At normal atmospheric conditions, carbon dioxide exists as a colorless and odorless gas that is approximately 1.5 times heavier than air. However, it can also exist as a solid or a liquid. An unique characteristic of carbon dioxide is its ability to exist simultaneously as a solid, a liquid, and a gas at -69.9 degrees Fahrenheit when the pressure is 60.4 psig. This point at which carbon dioxide can exist as a solid, a liquid, and a gas is called the triple point. At temperatures and pressures below the triple point, carbon dioxide may be either a solid or a gas, depending upon the conditions. Solid carbon dioxide at a temperature of -109.4 degrees Fahrenheit at atmospheric conditions transforms directly into a gas (sublimes) without passing through the liquid stage. Lower temperatures will result if carbon dioxide sublimes at pressures less than atmospheric conditions. At temperatures and pressures above the triple point and below 87.8 degrees Fahrenheit, carbon dioxide liquid and gas may exist in equilibrium inside a closed container. Within this temperature range, the pressure in a closed container holding carbon dioxide has a definite relationship to the temperature. At temperatures above 87.8 degree Fahrenheit, carbon dioxide cannot exist as a liquid regardless of the pressure.

Carbon dioxide is used in health care facilities in surgical applications. As a compressed gas, carbon dioxide is shipped and stored in standard storage cylinders that are color coded gray. Carbon dioxide cylinders have safety relief devices designed to vent to the atmosphere when the pressure inside the cylinder reaches a dangerous level. Because carbon dioxide is highly sensitive to atmospheric conditions (temperature and pressure), the cylinders should be filled up to 68% of their total capacity. This will give the carbon dioxide room to expand inside the cylinder should the atmospheric conditions change.

Air

Air exists as a colorless, odorless, tasteless, and fully life sustaining mixture of gases that make up the earth's atmosphere. Under normal atmospheric conditions, air is a mixture of approximately 21% oxygen, 78% nitrogen, and 1% trace gases. These trace gases include carbon dioxide and argon. Compressed air cylinders are color coded yellow.

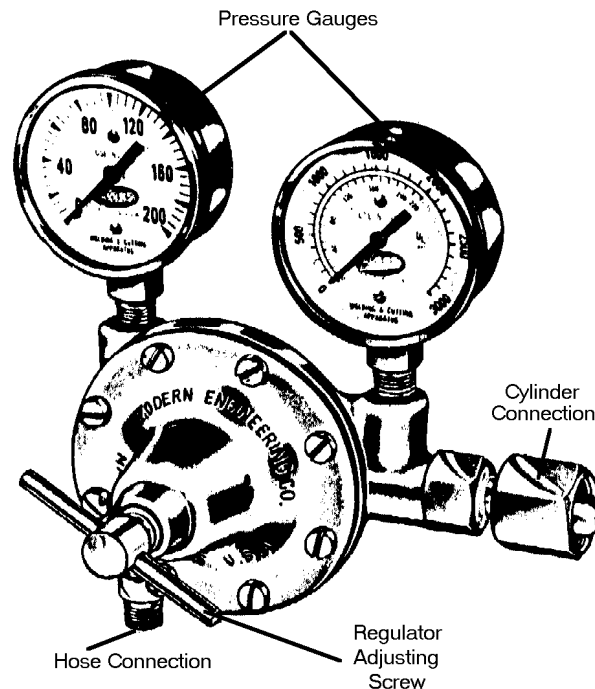
Compressed Medical Gas Cylinders

Medical gases are most commonly stored in "H" or "K" cylinders whose inside dimensions are 8 1/2" by 51". The water container capacity is approximately 1.54 cubic feet. Oxygen, nitrous oxide, and nitrogen are commonly stored in these cylinders. A hand truck must be used to transport "H" and "K" type cylinders from one location to another.

Some facilities may use the smaller and more portable "E" type cylinders whose dimensions are 3 3/8" x 26". The water container capacity of "E" type cylinders is approximately 0.238 cubic feet. Typically, the "E" cylinders are used to supply gas to a single location. For example, portable cylinders that supply breathing apparatus may be temporarily installed on stretchers and wheelchairs used to transport patients from one part of the hospital to the other. "E" cylinders may also be positioned next to patient beds when required. Portable cylinders attached to emergency medical equipment may be positioned in strategic locations throughout the hospital. For example, the cylinders may be attached to the crash cart positioned in the emergency room.

Pressure Regulation Devices

Compressed gas may be used only when an approved pressure regulation device is installed to control the gas flow from the cylinder. The certificate of fitness holder is responsible for making sure that compressed gas is never used without a pressure regulation device. Typically, two types of regulation devices are used in health care facilities: the regulator and the flowmeter. The regulator has one gauge that measures the pressure of the gas in the cylinder and another gauge that registers the rate of gas withdrawal from the cylinder. An example of a typical regulator is shown below.



Regulator

The flowmeter measures the rate of gas flow from the cylinder. The gas flow through the flowmeter is controlled by turning the adjusting knob on the flowmeter. The certificate of fitness holder must know how to operate all pressure regulation devices used at his or her facility. Needle valves or similar devices without regulating mechanisms should not be used in place of pressure reducing regulators because excessive pressures may develop downstream of such devices and result in possible damage to equipment or injury to personnel.

Threads and connections on the pressure regulation devices are designed such that they can only be used to control the discharge of a particular gas. For example, the threads or connections on an oxygen regulator will not fit the threads on a nitrous oxide cylinder. Regulators must not be modified or used where they were not intended to be used. Each regulator should be labeled in a manner that identifies the type of system where the regulator should be used.

Regulators, gauges, and valves used in health care facilities must be cleaned to industry standards prior to being placed into service. Contamination, such as oil or grease, may act as a fuel

when mixed with some medical gases. For example, oil or grease particles can react with explosive violence when exposed to oxygen. The certificate of fitness holder must keep a supply of clean replacement regulators, gauges, and flowmeters available in case of emergency at the health care facility. Defective regulation devices must be replaced immediately and arrangements must be made to have them repaired by the supplier or the manufacturer.

Connecting Pressure Regulation Devices

The cylinder's valve must be blown clear before a pressure regulation device is installed. This is done by slowly cracking the valve for an instant to get rid of contaminants (such as dirt and dust). Only approved wrenches or tools, provided by the gas supplier, may be used when connecting a regulating device. Once the regulation device has been connected to the cylinder valve, the gas must never be permitted to enter the regulating device suddenly because it may react violently with the contaminants in the system. This is especially important when the gas used is oxygen because it may react violently when it impacts with parts of the regulator.

Fire Extinguishers

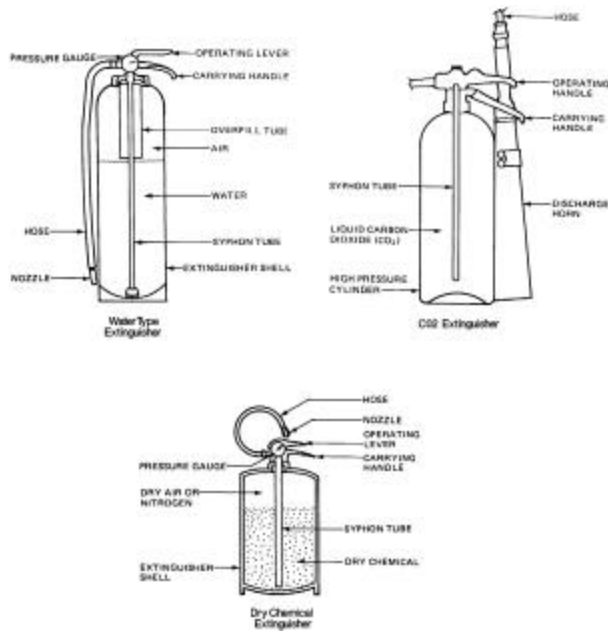
The certificate of fitness holder must know how and when to operate all fire extinguishers installed throughout the premises. The three classes of fires and the appropriate extinguishers are described below.

Class A Fires occur when ordinary combustible materials are ignited. For example, wood and paper fires are class A fires. Water type extinguishers should be used to extinguish these fires because they cool the fire while quenching the flame.

Class B Fires occur when flammable liquids, gases or greases are ignited. These fires must be extinguished by smothering the flame. The flame may be smothered using carbon dioxide, dry chemical or foam extinguishers. Water type extinguishers will not effectively extinguish class B fires.

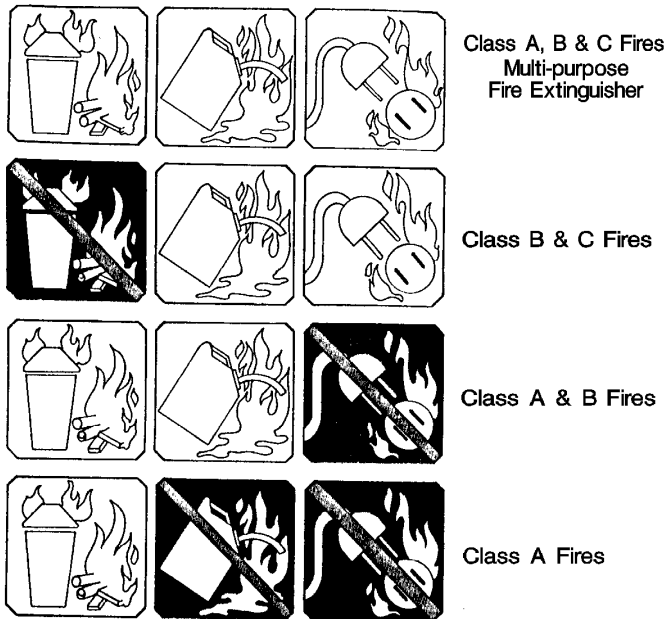
Class C Fires occur when electrical equipment catches fire. These fires must be fought with fire extinguishers that do not conduct electricity. Carbon dioxide and dry chemical extinguishers must be used to extinguish electrical fires. Foam and water type extinguishers must not be used to extinguish electrical fires.

Examples of water type, carbon dioxide and dry chemical extinguishers are shown on the following page.



Fire Extinguishers

Symbols may also be painted on the extinguisher. The symbols indicate what kind of fires the extinguisher may be used on. Examples of these symbols are shown below.



Symbols Painted on Fire Extinguishers

A symbol with a shaded background and a slash indicates that the extinguisher must not be used for that type of fire. The certificate of fitness holder must understand these symbols and must make sure that the fire extinguishers are kept in good working order at all times. Generally, operation instructions are clearly painted on the side of the fire extinguisher. They clearly describe how to use the extinguisher in case of an emergency. An example of these instructions is shown below.



Maintenance

The certificate of fitness holder must conduct regular inspections of the medical gas cylinders and related equipment to make sure that they are working correctly. Defective components in should be replaced immediately.

Sometimes the certificate of fitness holder will have to identify and correct medical gas leaks. Typically, leaks are easily identified and are repaired by tightening valve connections. However, slow leaks may be difficult to identify. In such cases, the certificate of fitness holder should perform a soap and water solution test to identify the leak. The steps involved in performing a soap and water solution test on the connection between a regulator and an oxygen cylinder are briefly described below.

- ? Connect the regulator, tighten the connection, and slowly open the cylinder's valve.
- ? Brush the solution on the connection and look for bubbles caused by a slow leak.
- ? When bubbles are detected, tighten the regulator connection and apply the solution again.
- ? If bubbles are still present, there may be a problem with the regulator and it should be replaced.
- ? The new regulator should also be tested. If the leak persists, there may be a problem with the cylinder. In such cases, the cylinder should be replaced.
- ? Never attempt to repair faulty regulators or cylinders. They must be sent to the supplier for repair.

Inspections

The certificate of fitness holder must make sure that all fire protection devices are kept in good working order. When a problem is suspected with any fire protection devices the certificate of

fitness holder must report it to his supervisor and make arrangements to have the problem corrected.

Fire Extinguisher Inspections

The extinguishers must be inspected by a qualified technician at least once every six months. Generally, the inspections are conducted by a representative of the company who holds the maintenance contract for the fire extinguishers. The certificate of fitness holder should record the testing date and the technician's name in the inspection log. All inspections must also be recorded on a tag attached to the extinguisher.

In addition, the certificate of fitness holder should visually inspect the fire extinguishers daily. He or she should make sure that they are positioned in the correct locations and are clearly visible. When a damaged extinguisher is discovered, it should be repaired or replaced immediately. The certificate of fitness holder should check to make sure that the fire extinguisher is fully charged. The condition of the extinguisher is checked by looking at the gauge connected to the top of the extinguisher. A needle that indicates the extinguisher's condition is positioned inside the gauge. When the needle points to the green area, the extinguisher is fully charged. When the needle points to the red area, the extinguisher needs to be recharged. When extinguishers need to be recharged, the certificate of fitness holder must make the arrangements.

Inspection log

It is recommended that the certificate of fitness holder keep a daily inspection log. This log should record the condition of the medical gas cylinders and related equipment, and the fire protection systems. It should be made available to fire department representatives upon request.

General Inspection Checklist

The certificate of fitness holder is required to make regular inspections and patrols of the assigned area of responsibility. These inspections will vary depending on the location. However, the following general guidelines will apply for all locations.

- ? The entire premises must be checked daily for potential fire ignition sources. Any potential ignition sources that are discovered must be corrected or removed immediately. For example, frayed electrical wires and defective electronic components must be either repaired or removed.
- ? Trash and garbage must not be allowed to accumulate anywhere inside the building. Accumulated trash is a fire hazard. It may be easily ignited by a stray spark. All trash and garbage must be removed from the premises.
- ? Interior fire alarm systems, when installed, must be tested daily by a certificate of fitness holder. It is not necessary to test all fire alarm boxes. Instead, one fire alarm box of each type should be tested daily.

All required fire department permits and certificates must be secured and posted. These permits are valid for a period of one year from the date they were issued. The results of all tests and inspections must be recorded in the inspection log and kept on file for at least 6 months. The log, permits, and certificates must be made available to fire department representatives upon request.

All fire extinguishers must be clearly visible. Signs must be posted indicating the locations of the extinguishers. Signs describing how to use the fire extinguishing devices must also be posted. The certificate of fitness holder must make sure that the extinguishers are inspected every six months. The fire extinguishers must be recharged after each time they are used or when required according to the type of extinguisher.

Storage of Cylinders

Extra cylinders that are not in use must be stored in approved storage enclosures. Storage enclosures must have a fire resistive rating of at least one hour and must meet the specifications outlined in the New York City Building Code. They must be adequately ventilated and capable of protecting the cylinders against extreme temperatures, the weather, and physical damage. Storage enclosures may be ventilated by installing louvers on the sides of the storage enclosure and/or by means of a mechanical exhaust system. When a mechanical exhaust system is installed, its controls must be positioned outside the storage enclosure's door.

Cylinders must be stored according to the following rules.

- ? Cylinders containing different gases should be stored apart and signs must be posted indicating the contents of the cylinders. Cylinders containing flammable gases must not be stored in the same room as those containing oxygen or nitrous oxide
- ? Cylinders should be protected against tampering by unauthorized individuals. This is especially important for cylinders containing nitrous oxide.
- ? When cylinders are not in use their protective caps must be in place.
- ? Oxygen cylinders must be secured in the upright position by a chain or bracket and must be at least 25 feet away from combustible or flammable materials.
- ? Extra cylinders must never be stored in the operating room.
- ? Carbon dioxide and/or dry chemical fire extinguishing equipment must be located near the storage enclosures. The certificate of fitness holder must know how to operate these extinguishers in case of an emergency.
- ? Full and empty cylinders should be stored separately and mandatory fire safety signs must be posted inside the storage enclosure. These signs must indicate the contents of the cylinders and a flow diagram for the gas supply system.
- ? A sign must be posted outside the storage enclosures indicating what gases are stored inside. An example of a sign indicating that oxygen is stored inside an enclosure is shown below. The sign should be painted red on a white background or white on a red background.

OXYGEN STORAGE NO SMOKING - NO OPEN FLAMES

Emergency Procedures

The certificate of fitness holder must know the locations of and how to operate all fire extinguishing devices and control devices installed at the facility. He or she must also know the locations of each fire alarm station on the premises and how to operate them. In case of a fire emergency, the certificate of fitness holder must activate the fire alarm, which will transmit an alarm to the fire department via a central monitoring station. The fire department must also be

contacted directly by phone in case of an emergency. The certificate of fitness holder must know the telephone number of the fire department Borough Communication Office. The borough phone numbers are listed below. These phone numbers must be posted near the phones most likely to be used in case of an emergency.

Manhattan	(212) 999-2222
Bronx	(212) 999-3333
Brooklyn	(718) 999-4444
Queens	(718) 999-5555
Staten Island	(718) 999-6666

Emergency Action Plan

Every health care facility must have an emergency action plan detailing procedures that must be followed during a fire and the evacuation of the building. The emergency action plan, which must be filed with and approved by the fire department, must include a disaster plan for the facility. The disaster plan must detail the actions that must be taken if a major catastrophe occurs in the building (such as an explosion). The certificate of fitness holder must know and understand his or her responsibilities as they are outlined in the facility's emergency action plan. These responsibilities may include assisting in the evacuation of the building, shutting off gas supplies and extinguishing fires.

Fire Drills

The certificate of fitness holder must participate in all fire drills held in the facility. At least twelve drills must be conducted annually. These drills should be conducted as follows: three during the day, six in the evening, three overnight. Typically, the fire drills include training in the following areas.

- ? Use of the fire alarm system.
- ? Fire department notification during an emergency.
- ? Responsibilities of the certificate of fitness holder during an emergency.
- ? Panic control.
- ? Fire extinguishment.

Fires in Health Care Facilities

Fire or explosion results from a combination of oxygen, fuel and an ignition source. When one of these is not present, the reaction cannot occur. Materials that burn in air may burn more vigorously and at a higher temperature in an atmosphere enriched with oxygen or nitrous oxide. Additionally, certain materials that do not burn in air do burn vigorously in an oxygen or nitrous oxide enriched atmosphere. When workers are exposed to an oxygen or nitrous oxide enriched atmosphere, they should immediately leave the area and should avoid all sources of ignition for at least 30 minutes.

If clothing has become saturated with oxygen or nitrous oxide, it should be removed and ventilated before being reused. It is not uncommon for a patient's bedding or clothing to become saturated

with oxygen when he or she is hooked up to respiratory treatment equipment. In such cases, flame spread may be extremely rapid and large quantities of water are required to extinguish the flame.

Permits

A fire department storage use permit is required when the combined high pressure non-flammable gas cylinders stored on the premises exceeds 20 cubic feet (water container capacity) or when the maximum capacity of any one cylinder exceeds 2.5 cubic feet. The certificate of fitness holder is responsible for ensuring that all required permits are secured and posted in visible locations.

Permits are valid for 12 months only. Enforcement action may be taken against the certificate of fitness holder when the required permits are not secured and posted. The enforcement actions may include fines and/or the revocation of the certificate of fitness.