STUDY MATERIAL FOR THE EXAMINATION FOR CERTIFICATE OF FITNESS FOR

Supervision of Medical Gases Bulk O_2/NO_2

G-17

INSIDE THIS BOOKLET YOU WILL FIND THE FOLLOWING:

NOTICE OF EXAMINATION (NOE)

REVISED 05/16/2001

NOTICE OF EXAMINATION FOR

Title: **Examination for the Certificate of Fitness for The Supervision of Medical Gases Bulk O_2/NO_2 (G-17)**

Date of Test: Written tests are conducted Monday through Friday (except legal holidays) 9:00 AM to 2:30 PM.

QUALIFICATION REQUIREMENTS

1. Applicants must be at least 18 years of age.
2. Applicants must have a reasonable understanding of the English language.
3. Applicants must present a letter of recommendation from his/her employer. The letter must be on official letterhead and must state the applicant's full name, character, physical condition, experience, and address of premises where applicant will be employed.
4. Applicants must present two (2) forms of satisfactory identification i.e., driver's license and passport picture ID.

APPLICATION INFORMATION

Application Fees: $25.00 for originals and $15.00 for renewals. The fee may be paid in cash, money order, or personal check payable to New York City Fire Department. The $25.00 fee must be payable by all applicants prior to taking the Certificate of Fitness test. Application forms are available at the Public Certification Unit, 1st floor, 9 MetroTech Center, Brooklyn, NY 11201.

TEST INFORMATION

Test: The test will consist of an evaluation of applicant's education and experience. Call (718) 999-1986 for additional information and forms.

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 medical gases. 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 medical gases 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. **According to fire department regulations, who is directly responsible for making sure that all fire department regulations regarding the handling and storage of medical gases in healthcare facilities are obeyed?**
   A) The certificate of fitness holder.
   B) The engineering staff only.
   C) The engineering staff and the certificate of fitness holder.
   D) The owner of the building and the engineering staff.

The correct answer is "**A**". You would press "**A**" on your touch-screen computer terminal.

2. **Why are regulators required when compressed medical gas cylinders are used to supply medical equipment?**
   A) To prevent the rapid ignition of the gases.
   B) To increase the gas pressure as it leaves the cylinder.
   C) All answers are correct.
   D) To control the pressure at which the gas is released from the cylinder.

The correct answer is '**D**". You would press "**D**" on your touch-screen computer terminal.

HANDLING AND STORAGE OF MEDICAL GASES

Introduction

The gases that are used most commonly in healthcare 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 medical gases. One primary regulation is that at least one certificate of fitness holder must be on duty 24 hours per day in a healthcare 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 bulk storage tanks must be designed to meet American Standards for Mechanical Engineers (ASME) design specifications and that all compressed gas cylinders must meet the Department of Transportation (DOT) design specifications.

CHARACTERISTICS OF MEDICAL 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. Both gaseous oxygen and liquefied oxygen are commonly used in healthcare facilities.

Gaseous Oxygen

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.

Liquefied Oxygen

Oxygen becomes a pale blue liquid when it is cooled to -297 degrees Fahrenheit. To store liquid oxygen, cryogenic cylinders and tanks are used. Each cryogenic cylinder and tank has two walls, and an insulating material is placed in a vacuum that exists between the walls. The combined effect of the insulating material and the vacuum minimizes vaporization due to heat leaks. Liquid oxygen is typically stored in large tanks mounted in fixed locations or on flatbed trucks. Standard sized

liquid oxygen cylinders are usually placed in a single location because they are extremely heavy and not easily transported. Small, portable liquid oxygen cylinders are sometimes installed in strategic locations in a healthcare facility, but portable cylinders are primarily used for home care applications.

When liquid oxygen is released into an area under normal atmospheric conditions, the liquid oxygen vaporizes and causes a highly visible fog. The fog occurs because the cold boil-off gases condense the moisture in the air. When one volume of liquid oxygen is vaporized, it will produce approximately 860 volumes of gas at atmospheric pressure and room temperature. When liquid oxygen is released into an open area, the oxygen quickly dissipates. However, when liquid oxygen is released into a confined area, the concentration of oxygen may dramatically increase and create an oxygen-rich atmosphere that can pose a serious threat to life and property when exposed to an ignition source. The certificate of fitness holder can determine the oxygen concentration in a given area using a commercially available oxygen monitor.

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 healthcare facilities in surgery applications. It may be used with oxygen to create reconstituted Grade D air. Typically, nitrogen is shipped and stored in a liquid state inside cryogenic cylinders or cryogenic tanks at temperatures slightly above its boiling point of -320 degrees Fahrenheit. When a bulk nitrogen distribution system is installed in a healthcare facility it must be capable of delivering nitrogen at 160 psig at it maximum flow rate. Nitrogen may also be 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 healthcare facilities as an anesthetic and analgesic. Typically, nitrous oxide is shipped and stored in a liquid state inside DOT approved cryogenic cylinders at temperatures below 98 degrees Fahrenheit. In a gaseous state, 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 may be delivered throughout the healthcare facility via a bulk distribution system or individual cylinders installed in strategic locations. For example, these cylinders may be attached to hospital crash carts. 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. However, liquefied carbon dioxide is stored in cryogenic cylinder or storage tanks. All 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. A bulk carbon dioxide distribution system may be installed in some healthcare facilities. Liquefied carbon dioxide may cause severe burns or frostbite when it comes into contact with human tissue.

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. Air, taken from the atmosphere and stored in cylinders or bulk storage tanks under pressure, is sometimes used in healthcare facilities. For example, when purified it may be mixed with oxygen and used to ventilate a patient's lungs to avoid giving the patient pure oxygen to breathe. Air may be distributed through a facility-wide piping distribution system at pressures up to 2000 psig at its maximum flow rate. However, compressed air cylinders, which are color coded yellow, are most commonly used. Portable cylinders may also be used to supply medical equipment. Grade D air, which is reconstituted from oxygen and nitrogen, is used in some healthcare facilities. Air may also be taken directly from the local atmosphere and distributed through the facility when no contaminants in the form of particulate matter, odor, oil vapor, or other gases have been added to the air. However, the local air may not be equal in purity and dryness to Grade D reconstituted air.

Compressed Medical Gases

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.

Liquefied Medical Gases

Materials that are soft and pliable at normal temperatures may become hard and brittle when immersed in a liquefied gas. Skin should not be exposed to a liquefied gas or its vapors because exposure can have a burn-like effect on the skin. Even brief exposure can have an adverse impact on the body's delicate tissues. For example, the eyes may be severely damaged if splashed with liquid oxygen. Damage to the skin can also occur if it touches an non-insulated pipe or vessel used to carry or store a liquefied gas. The cold metal can cause the skin to stick fast and then tear when an attempt is made to withdraw from the metal. The certificate of fitness holder must exercise great care to ensure that only compatible materials are exposed to liquefied gases.

Heat leak, which causes vaporization of liquefied gases, is always present in liquefied gas systems. When a liquefied gas vaporizes, enormous pressures can develop inside the storage tank. Similarly, vapors trapped between two closed valves can create enormous pressures. If these pressures become too high, the tank will rupture and may cause an explosion. A pressure relief device must be installed in each storage tank and in all sections of the distribution system where vapors may be trapped. Pressure relief devices are designed to release the vapors into the atmosphere in a controlled manner when the pressure build-up reaches dangerous levels. The certificate of fitness holder must check and record pressures and the liquefied gas levels inside all storage tanks every shift. When necessary, the equipment must be adjusted to the correct settings.

Liquefied gases may be transferred into storage tanks and/or cryogenic cylinders from tank trucks. The certificate of fitness holder must observe transfer operations and make sure that all fire department regulations are obeyed during the transfer. These regulations are briefly outlined below.

? All tanks and cryogenic cylinders used during transfer operations must be approved by the Department of Transportation (DOT). Since no standard color system has been established for cryogenic cylinders, the certificate of fitness holder must take great care to ensure that the correct cryogenic cylinders are used during the transfer process. The contents of the cryogenic cylinders may be determined by reading the label attached to the cylinder.

? The tank truck must be parked on a noncombustible surface, such as concrete, and its wheels must be shocked to prevent rolling during transfer operations.

? The surrounding area must be cleared of flammable and combustible materials, and unauthorized personnel must be removed from the immediate area.

? Persons handling the liquid gases and related equipment should wear appropriate safety equipment (glasses, gloves, etc.).

? All hoses, valves, connections and gaskets should be inspected for leaks and physical damage before transfer operations begin. Defective equipment must be replaced before proceeding with the transfer.

? After the hoses have been purged, the transfer hose should be connected to the storage tank or cryogenic cylinder. The control valve on the tank or cylinder must be opened slowly, and then the valve on the supply tank should be opened slowly. If a leak is detected while transferring the liquefied gas, the transfer must be stopped and the pressure relieved from the hoses. Then the leaking connection must be tightened. If a leak persists, all transfer operations must be postponed until the appropriate repairs are made by qualified personnel.

? After the transfer is completed and the valves on the supply and receiving tanks have been closed, the pressure must be relieved from the hoses before they are disconnected. When a hose is disconnected, it must be drained of the liquefied gas and the safety caps must be replaced. When oxygen or nitrous oxide is being transferred, the hose must not be drained onto a combustible material or a surface contaminated with oil, grease, asphalt, kerosene, cloth, or tar, as any of these may react violently with the gas.

Safety Equipment

It is recommended that safety glasses and loose fitting gloves be worn when handling liquefied gases. Ideally, a full face shield should be worn because it gives added protection against accidental exposure. Clothing made of natural fibers (such as cotton) rather than synthetic fabrics (such nylon or polyester) is also recommended. Synthetic fabrics may cause static build-up which can result in their rapid ignition when exposed to an oxygen or a nitrous oxide enriched atmosphere.

Distribution Systems

Typically, facility-wide distribution systems are supplied by liquefied gas stored in bulk storage tanks or cryogenic cylinders. They may also be supplied by gas stored in banks of compressed gas cylinders. When liquefied gases are used they must pass through a vaporization unit before entering the distribution system. When banks of compressed cylinders are used, they are connected to the distribution system through a manifold designed to regulate the gas pressure. Many manifold systems have an Ohio valve or similar valve installed that automatically switches between different banks of cylinders when the gas supply falls below acceptable levels. For example, when oxygen supply falls below 45 psig, the manifold will automatically switch to the second bank of oxygen cylinders. Each distribution system must be capable of supplying the medical gas to station outlets at the required maximum flow rate. For example, an oxygen distribution system must be capable of supplying oxygen in a gaseous state to station outlets at 50-55 psig at its maximum flow rate.

Compressed gas cylinders may also serve as a reserve supply when a bulk storage system is installed. Again the system automatically switches over to the reserve supply when pressure falls below acceptable levels. Some systems require the certificate of fitness holder to manually operate the Ohio valve on the manifold system. If the manually operated valve is installed, a warning signal is transmitted when the valve must be switched to the second bank of cylinders. Check valves are installed in manifold system between each cylinder and the manifold header. Check valves are designed to prevent the loss of gas from the manifold header when a safety relief device on an individual cylinder opens or when a cylinder lead fails.

Bedside and operation station outlets, which are equipped with either a threaded or a quick connect terminal keyed to each gas used, are also installed on the distribution system. In addition, several remote shutoff valves are installed on the gas distribution system. These valves are used to shut off the gas supply to zones of the distribution system in case of an emergency. For example, supply to a given zone may be shut off during a fire or when repairs are being made to the system. The certificate of fitness holder must know the location of each shut off valve on the system and how to shut off the gas supply to each zone in the healthcare facility. The valves must be clearly labeled so that they are easily identified. An example of a typical sign is shown below.

CAUTION - OXYGEN VALVE
DO NOT CLOSE EXCEPT IN CASE OF AN EMERGENCY
THIS VALVE CONTROLS SUPPLY TO EMERGENCY ROOM

Alarms designed to transmit an audible and/or visual signal when a problem is detected must be installed on medical gas distribution systems. For example, an alarm will sound when the pressure in an oxygen distribution system falls 20% below the normal operating level. This might occur when a major leak occurs in the system or when the Ohio valve does not automatically change over to the reserve bank of cylinders. Typically, an alarm will sound at several locations in the healthcare facility, including the certificate of fitness holder's office, security offices and the nursing stations. As soon as the alarm is sounded, the certificate of fitness holder must take immediate action to have the problem corrected. All alarms systems must be approved for use by the fire department.

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 or distribution outlet station. 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 healthcare 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.

.G.REG1.PCX;350 pt;375 pt;PCX

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, valves, and piping used in healthcare facilities must be 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 flowing through an oxygen distribution system at high velocities could start a fire by hitting valve seats or elbows. The certificate of fitness holder must keep a supply of clean replacement regulators, gauges, and flowmeters available in case of emergency at the healthcare 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, the cylinder valve or distribution system valve must be opened slowly. 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 at the healthcare facility. The three classes of fires and the appropriate extinguishers are described below.

Class A Fires 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 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.

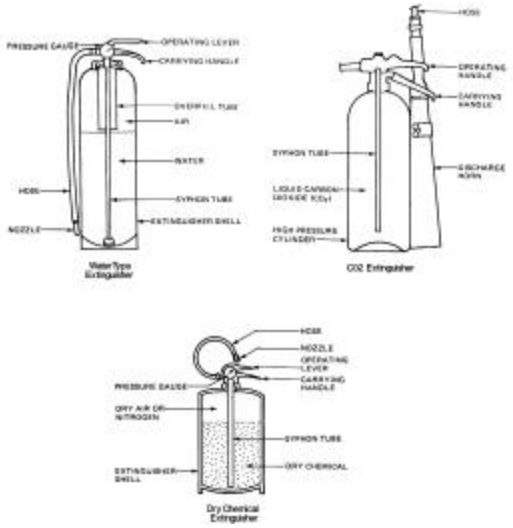
Class C Fires Class C fires occur when electrical equipment catches fire. These fires must be fought with fire extinguishers that do not conduct electricity. Carbon dioxide and dry chemical

extinguishers must be used to extinguish electrical fires. Foam and water type extinguishers must not be used to extinguish electrical fires.

Class D fires Class D fires are caused by ignitable metals, such as magnesium, titanium, and metallic sodium, or metals that are combustible under certain conditions, such as calcium, zinc, and aluminum. Generally, water should not be used to extinguish these fires.

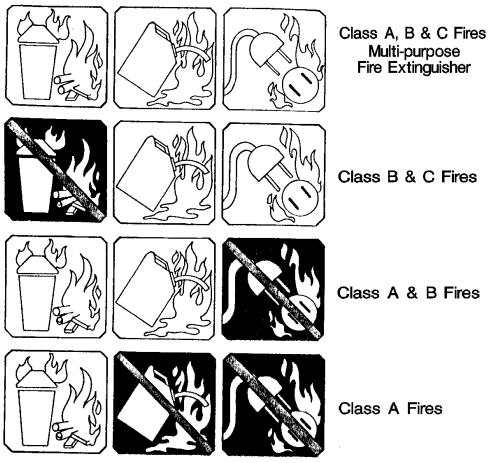
A multi-purpose dry chemical fire extinguisher may be used to extinguish Class A, B, or C fires.

Examples of Water type, C02 and Dry Chemical extinguishers are shown below.



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.

Operation Instructions for a Fire Extinguisher

Maintenance

Regular inspections should be conducted to make sure that the entire medical gas system and related equipment are working correctly. The certificate of fitness holder must visually inspect and record the settings and conditions of all gauges to the medical gas distribution system. For example, when a bulk oxygen system is installed, the pressure and the liquid oxygen level in the storage tank must be recorded. Defective components in the system should be replaced immediately. The certificate of fitness holder must notify the fire department and his or her supervisor when major defects are discovered in the system. He must also make sure that prompt corrective action is taken to repair the defect. For example, the fire department must be notified when a major leak is discovered in the distribution system. Violations may be issued to and enforcement action taken against the certificate of fitness holder when major defects are not reported.

Sometimes the certificate of fitness holder will have to identify and correct a leak in the system. 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.

Testing

Bulk, liquefied oxygen receivers and storage tanks must be pneumatically pressure tested every five years and this test must be conducted by the system maintenance company and observed by a fire department representative.

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

A daily inspection log should be maintained by the certificate of fitness holder. This log must record the condition of the medical gas supply systems and the fire protection systems. It is recommended that the following information be recorded in the log and made available to fire department representatives upon request.

- ? Number of inspections conducted
- ? Pressure of medical gas supply lines
- ? Liquefied gas levels in storage tanks
- ? Condition of medical gas equipment
- ? Condition of fire protection systems
- ? Defects discovered
- ? Violations that have been noted

? Date, name and signature of the certificate of fitness holder who conducted the inspections

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 to 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 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 healthcare 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 extinguishing.

Tissue Exposure

As stated earlier, if tissue comes into contact with liquefied gases, the contact will produce damage similar to that associated with thermal burns. Such contact causes severe deep freezing with extensive destruction of tissue. In the event of exposure, restrictive clothing should be loosened, clothing saturated with gas should be removed and medical attention should be sought. The affected areas should be immersed in water at a temperature between 105 and 115 degrees Fahrenheit to reduce freezing. Direct heat should not be applied to the affected area and the area should not be rubbed because these actions may cause additional damage to the tissue. The affected area should be covered with a sterile protective dressing to protect it from further injury.

Spills

In the unlikely event of a major liquefied gas spill, the fire department must be notified immediately. The certificate of fitness holder must work with the fire safety director and fire department personnel during the emergency. All potential sources of ignition (such as open flames and motorized vehicles) must be extinguished or removed and unauthorized personnel must be evacuated from the immediate area. When possible, the source of the spill or leakage should be shut off and efforts made to ventilate the area. It is also considered a good safety practice to discharge water spray over the spill area to aid in the evaporation of the gas.

Transfilling Hazards

The certificate of fitness holder must make sure that no attempt is made to transfer compressed gas from a cylinder into a container or another cylinder. This practice is extremely hazardous and may result in an explosion.

Fires in Healthcare 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 capacity of the oxygen 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.