FIRE DEPARTMENT • CITY OF NEW YORK

STUDY MATERIAL FOR THE CERTIFICATE OF FITNESS FOR SUPERVISION OF BATTERY SYSTEMS AND OTHER RELATED EQUIPMENT

B-29

ALSO INCLUDED IN THIS BOOKLET YOU WILL FIND THE FOLLOWING:

- NOTICE OF EXAMINATION (NOE)

Contents

NOTICE OF EXAMINATION

Title: **Examination for Certificate of Fitness for Supervision of Battery Systems and other related equipment (B-29)**

Date of Exam: Written exams are conducted Monday through Friday (except legal holidays) 8:00 AM to 2:30 PM.

REQUIREMENTS FOR WRITTEN EXAM

Applicants who need to take the exam must apply in person and bring the following documents:

1. Applicants must be at least 18 years of age.
2. Applicants must have a reasonable understanding of the English language.
3. Applicant must provide two forms of identifications; at least one identification must be government issued photo identification, such as a State-issued Driver's License or Non Driver's License or a passport.
4. 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, experience and the address where the applicant will work. The sample letter is on page 5 of this study material. If the applicants are self-employed or the principal of the company, they must submit a notarized letter attesting to their qualifications. For more info: http://www.nyc.gov/html/fdny/html/c_of_f/cof_requirements.shtml
5. Applicants must present a completed application for certificate of fitness (A-20 Form). http://www.nyc.gov/html/fdny/pdf/a20.pdf
6. Applicants not currently employed may take the exam without the recommendation letter. If the applicants pass the exam, FDNY will issue a temporary letter with picture for the job seeking purpose. The C of F card will not be issued unless the applicants are employed and provide the recommendation letter from his/her employer.
7. Special note:
   - Applicant must work directly for the employer on site at the premises.
   - Applicant must be trained and knowledgeable in the battery systems for which the applicant will provide supervision.
8. **APPLICATION FEE:**

   Pay the **$25** application fee in person by one of the following methods:
   - Cash
   - Credit card (*American Express, Discover, MasterCard, or Visa*)
   - Debit card (MasterCard or Visa)
   - Personal or company check or money order (made payable to *the New York City Fire Department*)

   A convenience fee of 2.49% will be applied to all credit/debit card payments for original or renewal certificates.

For fee waivers submit: ***(Only government employees who will use their C of F for their work- related responsibilities are eligible for fee waivers.)***

- A letter requesting fee wavier on the Agency's official letterhead stating applicant full name, exam type and address of premises; ***AND***
- Copy of identification card issued by the agency

9. **EXAM INFORMATION**

   The **B-29** exam will consist of **30** multiple-choice questions administered on a "touch screen" computer monitor. It is a time-limit exam. A passing score of at least 70% is required in order to secure a Certificate of Fitness. Call (718) 999-1988 for additional information and forms.

   Please always check for the latest revised booklet at FDNY website before you take the exam.

   http://www.nyc.gov/html/fdny/pdf/cof_study_material/B_29_st_mat.pdf

10. If all the requirements are meet and pass the exam a certificate will be issued the same day. Applicant who fails the exam will receive a failure report. To retake the exam applicants will need to submit a new application and payment.

RENEWAL REQUIREMENTS

This Certificate of Fitness must be renewed every ***THREE YEARS***. The renewal fee is **$15**. FDNY also reserves the right to require the applicants to take a re-examination upon submission of renewal applications.

You will receive a courtesy notice of renewal 90 days before the expiration date. However, it is your responsibility to renew your Certificate. It is very important to renew your C of F before it expires. Renewals submitted 90 days (up to one year) after the expiration date will incur a $25 penalty in addition to the renewal fee. Certificates expired over one year past expiration date will not be renewed. New exams will be required.

To change a mailing address:

- Submit a letter requesting the change of mailing address and a copy of your C of F with $5.00 fee.

To change a work location:

- Submit a letter from your current employer (on company letterhead) confirming that you are an employee and stating your new work location with a copy of your C of F and a $5.00 fee

To request a replacement certificate:

- Submit a driver's license or passport, social security number, mailing address and a $5.00 fee.

The certificate can be renewed **On-line**, **by Mail** or **in Person**.

- **Renewal online**

If you are an individual, make sure you have your 12 digit Certificate of Fitness Access ID. This can be found on your Renewal Notice. If you do not have your Renewal Notice, your Access ID is your 8 digit Certificate of Fitness number and the last four digits of your social security number. If you are submitting renewals on behalf of a company's employees, the company must be approved by FDNY and have an 8 digit Company Code. To request approval, email pubrenew@fdny.nyc.gov.

Renewal fee can be paid by one of the following methods:

- Credit card (American Express, Discover, MasterCard, or Visa)
- Debit card (MasterCard or Visa)
- E-check

A fee exempted applicants cannot renew online only by mail or in person.

If all the requirements are met, the certificate of fitness will be mailed out within 10 days. For online renewal go to: **https://a836-citypay.nyc.gov/citypay/FDNYCOF**

- **Renewal by mail**

Mail your Renewal Notice (if you did not receive a Renewal Notice, a copy of your certificate), along with your fee payment Personal or company check or money order (made payable to *the New York City Fire Department*)

For fee waivers submit: ***(Only government employees who will use their C of F for their work- related responsibilities are eligible for fee waivers.)***

- A letter requesting fee waiver on the Agency's official letterhead stating applicant full name, exam type and address of premises; ***AND***
- Copy of identification card issued by the agency

and if applicable, supporting documents to:

NYC Fire Department (FDNY)
Cashier's Unit
9 MetroTech Center, 1st Floor
Brooklyn, NY 11201

If all the requirements are met, the certificate of fitness will be mailed out within four to six weeks.

- **Renewal in person**

Submit your Renewal Notice (or if you did not receive a Renewal Notice, a copy of your certificate), along with your payment by one of the following methods:

- Cash
- Credit card (*American Express, Discover, MasterCard, or Visa*)
- Debit card (*MasterCard or Visa*)
- Personal or company check or money order (*made payable to the New York City Fire Department)*

For fee waivers submit: ***(Only government employees who will use their C of F for their work- related responsibilities are eligible for fee waivers.)***

- A letter requesting fee waiver on the Agency's official letterhead stating applicant full name, exam type and address of premises; ***AND***
- Copy of identification card issued by the agency

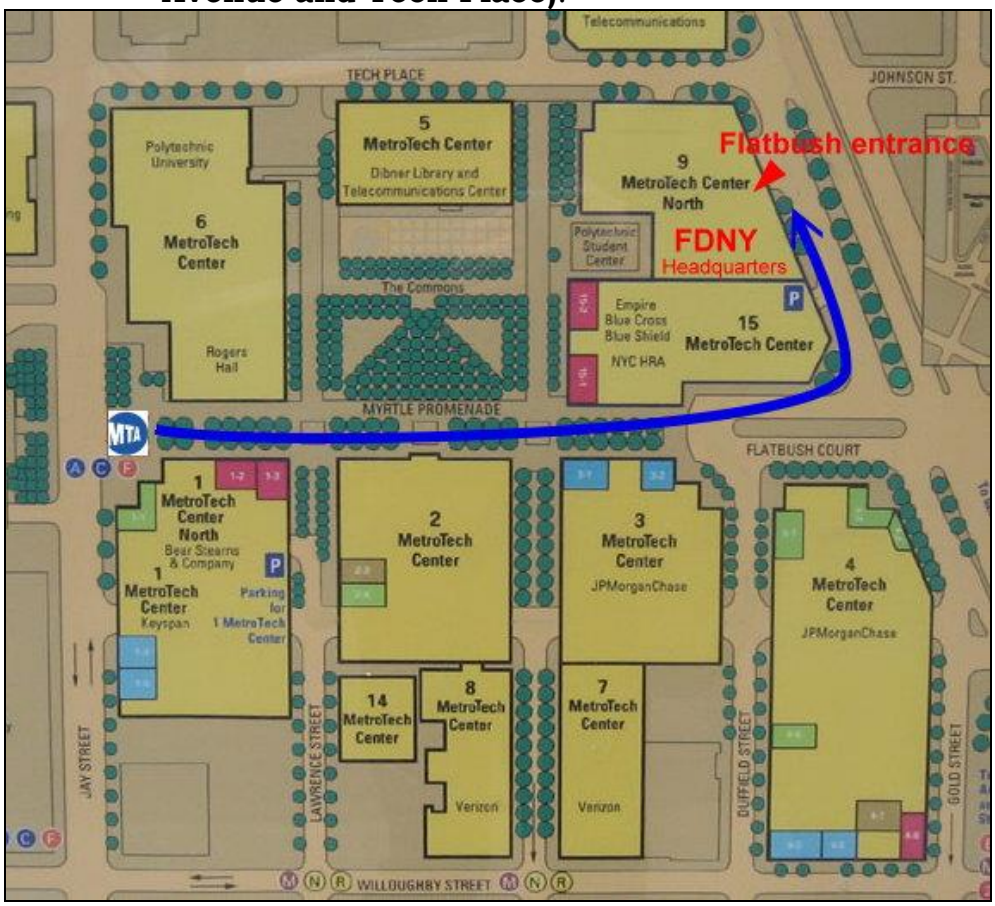
and if applicable, your supporting documents to:

NYC Fire Department (FDNY)
Cashier's Unit
9 MetroTech Center, 1st Floor
Brooklyn, NY 11201

If all the requirements are met, the certificate of fitness will be issued the same day.

A convenience fee of 2.49% will be applied to all credit/debit card payments for original or renewal certificates.

<u>EXAM SITE</u>: FDNY Headquarters, 9 MetroTech Center, Brooklyn, NY. Enter through the **Flatbush Avenue entrance (between Myrtle Avenue and Tech Place)**.



<Sample of employer recommendation letter>

Fire Department Date: _____

Bureau of Fire Prevention
9 Metro Tech Center
Brooklyn, NY 11201-3857

Dear Sir/Madam:

I am pleased to recommend _____ to apply for a B-29
(Applicant's name)

Certificate of Fitness for Supervision of Battery Systems. The applicant works directly for our company on site at _____.
(Address of premises where the certificate is to be used)

The applicant will be responsible for providing general supervision for the battery system(s) in the following location(s) of the premises mentioned above. The applicant is trained and knowledgeable in the battery system(s).

1. (example) Room 204 on the 1st floor of the building

2. _____

3. _____

The applicant is familiar with the emergency procedures for all of the system(s) listed above, including the name(s) and telephone number(s) of the person(s) that can be contacted 24-hours per day/7-days per week to provide additional information regarding such systems to emergency responders.

The applicant is of GOOD CHARACTER and is PHYSICALLY ABLE to perform the duties and functions required by the holder of the Certificate of Fitness.

_____	_____	_____
(Printed name of Employer)	(Employer's title)	(Signature of Employer)

NOTE: ***The recommendation letter should be on employer's letterhead. If not on employer's letterhead, signature must be notarized.***

STUDY MATERIAL AND TEST DESCRIPTON

About the Booklet

This study material will help you prepare for the written examination for the Certificate of Fitness for Supervision of Battery Systems.

The study material includes information taken from the new 2014 NYC Fire Code Chapter 6, NYC Fire Department Rules, Chapter 9 and NFPA Standard 25, (2011 Edition) Inspection, Testing and Maintenance of Water Based Fire Protection Systems. **It is critical that you read and understand this booklet to help increase your chances of passing this exam.**

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 test. All questions have four answer options. Only ***one*** answer is correct for each question. If you do not answer a question, or if you mark more than one answer to a single question, your answer to that question will be scored as incorrect. Read each question carefully before marking your answer. There is no penalty for guessing.

SAMPLE QUESTIONS

1. Which of the following are allowed to be used while taking a Certificate of Fitness examination at 9 Metro Tech Center?

I. cellular phone
II. study material booklet
III. reference material provided by the FDNY
IV. mp3 player

A. III only
B. I, II, and III
C. II and IV
D. I only

Only reference material provided by the FDNY is allowed to be used during Certificate of Fitness examinations. Therefore, the correct answer would be A. You would touch "A" on the computer terminal screen.

2. If the screen on your computer terminal freezes during your examination, who should you ask for help?

A. the person next to you
B. the firefighters in the testing room
C. the examiner in the testing room
D. the computer help desk

If you have a computer related question, you should ask the examiner in the testing room. Therefore, the correct answer would be C. You would touch “C” on the computer terminal screen.

3. In the case you do not know the answer to a question while taking an examination you should _____.

A. ask the person next to you for help
B. ask the firefighters in the testing room for help
C. ask the examiner in the testing room for help
D. not ask about test questions since FDNY staff CANNOT assist applicants

You should not ask about examination questions or answers since FDNY staff cannot assist applicants with their tests. Therefore, the correct answer would be D. You would touch "D" on the computer terminal screen.

CERTIFICATE OF FITNESS RESPONSIBILITIES AND DUTIES

Certificate of Fitness holders should be aware that they may be required to demonstrate their knowledge and proficiency in their duties related to their Certificates at the time of original and renewal applications, and at any time Fire Department representatives are conducting an inspection of a premises. The Fire Department can deny, not renew, suspend or revoke a Certificate of Fitness for misconduct, which would include the failure of the Certificate of Fitness holder to properly fulfill his or her duty for any reason.

The Certificate of Fitness holder must keep the Certificate of Fitness readily available for inspection by any representative of the Fire Department and at all times while operating or supervising a battery system facility for which the Certificate of Fitness is required.

In addition to any other penalties provided by law, misconduct on the part of an applicant or holder of a Certificate of Fitness shall be grounds for denial, non-renewal, suspension or revocation of a certificate, and denial of an application for a certificate or the opportunity to take a certificate examination. Such misconduct includes, but is not limited to:

- The failure of Certificate of Fitness holders to properly fulfill their duties
    - i.e. B-29 COF holders will be held accountable when they fail to report a spill, they may have their Certificate of Fitness revoked
- Any false and fraudulent conduct in connection with an application for a certificate or the duties of a certificate holder, including:
    - False or fraudulent statements or submissions
    - Unauthorized changes or use of a Certificate of Fitness or possession of a fraudulent Certificate of Fitness
    - Cheating on Certificate of Fitness examination
    - Impersonating another person or allowing oneself to be impersonated

- The failure of Certificate of Fitness holders to promptly notify the Fire Department of any change in the applicant's or Certificate of Fitness holder's residence address, or work location
- Any other conduct that decreases the integrity or reliability of an applicant or Certificate of Fitness holder
- Compromising the integrity or confidentiality of a Fire Department examination

IMPORTANT: **Information marked and boxed "good to know" is only required for technical workers, and will NOT be on the B-29 Certificate of Fitness exam. However, it is information of which you should be aware and understand.**

1. INTRODUCTION

Batteries are used as a power source for many different things, ranging from cell phones to an entire building. Their significance lies in the fact that building owners and tenants are demanding 24/7 availability of uninterruptible power for their businesses. Battery systems, specifically, uninterruptible power supply (UPS) systems are capable of providing this constant operation that is required by thousands of banking and financial firms, hospitals, hotels, and other entities engaging in critical operations.

In terms of providing power to a building, the UPS Battery System is a backup to the main power grid (normal power). The primary purpose of a UPS system is to provide current to a load for a short period of time in the event of a power failure. The system may be necessary in case of an emergency when and where there is a widespread loss of power. When a building with a "UPS" system suddenly loses power from the utility company the UPS system becomes the sole power provider for all designated connections. (For example during an earthquake or hurricane, once the power goes out, this UPS Battery System turns on for a brief period of time, much like a generator). The difference is that a UPS battery system switches on instantaneously so that there is no down-time or absence of power. A building with a UPS system, but no emergency generator, will lack power if the UPS system has fully discharged. Nonetheless, buildings with UPS systems are better prepared than buildings with only emergency generators.

As with all technologies, there is always the possibility of a failure, and as a result of that failure, there are potential catastrophes that can occur. In the case of a banking firm, millions if not billions of dollars could be lost if the battery system were to go out for even just a few minutes. A hospital would be putting lives at severe risk if the power went out for any amount of time.

Unfortunately, along with any other occupation that involves large amounts of electricity and energy being generated, these extensive battery systems can pose several hazards. Those hazards, could include, but may not limited to the following:

- Fire
- Explosion
- High voltage electricity
- Electrical and Acid burns
- Acid contamination

The NYC Building Code and the NYC Fire Code have requirements regarding the design of UPS battery systems. Plans for the installation of a UPS Battery System are required to be filed and approved by the NYC Department of Buildings. The design for each system is unique to a site; and therefore, the COF holder must become familiar with the system design for his or her facility.

IMPORTANT
The COF holder should periodically conduct a **visual inspection** of the entire battery system in an effort to identify any abnormal or irregular conditions. In the case of an emergency, the COF holder must have the means to contact and assist the FDNY however necessary. The **Certificate of Fitness holder MUST NOT attempt to perform any repairs to the systems that they have not been authorized or are qualified to make. Possession of a Certificate of Fitness does not authorize you to conduct servicing and repair.**

Qualified service personnel of the system (maintenance company) should be notified of any irregular situations or concerns observed by the Certificate of Fitness holder. If the Certificate of Fitness holder requires additional information about the system he or she should only rely on information provided by the manufacturer of the system or qualified service personnel. Authorized and qualified personnel shall be familiar with the UPS battery design, installation, preparation, charging and maintenance procedures for the specific facility.

UPS battery systems installed in a separate (unaccompanied) equipment room should be accessible **only to authorized personnel**.

1.1) PRE-EXISTING AND NEW INSTALLATIONS
In July of 2008, a new Fire Code was adopted in New York City. This code introduced specific regulations regarding the design and installation of lead-acid battery systems. In March, 2014 the Fire Code was modified to expand on the requirements for lead-acid battery systems. It added new requirements for **three additional types** of battery systems: nickel-cadmium, lithium ion, and lithium metal polymer; that were not regulated by the 2008 NYC Fire Code.

Uninterruptible Power Supply (UPS) systems that were installed **ON OR AFTER** July 1, 2008 shall **comply with the Fire Code edition in effect at the time they were installed**. UPS battery systems installed before July 1, 2008 – "pre-existing systems" – are **not required to comply with the <u>design, installation, and ventilation requirements</u> of the 2008 or 2014 Fire Codes.** Pre-existing systems are generally required to comply with the industry standards and manufacturer requirements in effect at the time they were installed.

The operational and maintenance requirements of the 2014 NYC Fire Code must be followed by B-29 Certificate of Fitness holders for both pre-existing and new installations. Examples of such:

Operational requirements are, recordkeeping, posting of signage, prohibition of smoking, and neutralization.

Maintenance requirements are those that relate to keeping equipment and premises in good working order and a safe condition.

- Housekeeping, periodic inspection of equipment, and prevention and removal of obstructions to means of egress are examples of maintenance requirements.

The Certificate of Fitness holder should be familiar with and understand the concept of "pre-existing installations" and the installation requirements in place at the time of installation, in order to correctly carry out his or her supervision responsibilities.

Any battery system in place today, regardless of installation date, must be under the **general supervision** (see definition) of a person holding a Certificate of Fitness from the FDNY. This applies to all **stationary** storage battery systems (i.e. facility standby power, emergency power or uninterrupted power supplies) having an electrolyte capacity of at least:

- 50 gallons for
  - flooded lead acid
  - nickel cadmium (Ni-Cd)
  - valve-regulated lead acid (VRLA),
- 1,000 pounds for
  - lithium-ion
  - lithium metal polymer

If a battery system does not meet these specifications it is NOT required to comply with the NYC Fire Code.

Other than ordinary repair and replacement, any alteration of a pre-existing installation requires that the portion of the system undergoing change be in compliance with the edition of the Fire Code in effect at the time the alteration was made.

The B-29 Certificate of Fitness does NOT authorize the C of F holder to perform any repairs on the battery system.

1.2) INSPECTIONS

In order to ensure that a battery system is properly working a B-29 Certificate of Fitness holder is primarily responsible for visual inspection. Battery systems

are not maintenance free and if not maintained properly could result in hazardous conditions leading to fires and other life-threatening emergencies.

All such visual inspections should be conducted by a B-29 Certificate of Fitness holder to provide general supervision.

The Certificate of Fitness holder should walk through and do a "quick" visual inspection ***at least*** once per day. "Quick" inspection includes checking for any unusual or abnormal visual, audible or auditory changes. **Do NOT touch the batteries.** If there are any signs of potential hazards, contact the service or maintenance company, or the manufacturer. **In the event of an emergency you must immediately contact the FDNY.**

An example of an inspection checklist is shown below:

Name _____
Date _____
COF Number _____
Phone Number _____
Location of System _____

List	Mark "x" if yes	Note
1. Do you have the means available to notify the FDNY in case of an emergency?	□	If no, speak to your supervisor and obtain such means before working with battery systems.
2. Do you have the means available to notify your supervisor in case of an emergency?	□	If no, obtain such means before starting your duty. (radios, communication devices, etc.)
3. Do you know where main shutoff switches/panels are?	□	If no, obtain such information before working with battery systems.
4. **Temperature**: Is ambient temperature within the specified range? (above 78°F)	□	If no, contact FSD or service company.
5. Is the battery system room clean, orderly, and spacious enough for maintenance to occur?	□	If no, contact FSD or service company.
6. **Ventilation**: Is it in good working order? Is there any alarm indication at the central station or central station?	□	If no, contact FSD or service company.
7. **Emergency spills**: Is there any evidence of electrolyte leakage?	□	If yes, contact FSD or service company.

If NO, mark "x" Is there sufficient amount of neutralizing agent present?	□	If no, contact FSD or service company.
8. If a hydrogen detector is present, are the readings within the acceptable range?	□	If no, contact FSD or service company immediately, as it is a very hazardous situation.
9. Are all alarms and detection systems in good working order?	□	If no, contact FSD or service company.
10. Is there a readily accessible key to the battery room in the key box that the FDNY can obtain access with?	□	If no, contact FSD or service company.
11. Is signage correctly posted?	□	If no, contact FSD or service company.
12. Is the thermal runaway detection system under normal condition (no alarms)?	□	If no, contact FSD or service company.
Comments:		

Some **visual inspections may include**, but is not limited to the following:

- Fire
- Explosion
- Acid/electrolyte spills
- Warning signs on alarm/detection systems

Ensure that all of the following are within required levels:

- Ambient temperature
- Humidity
- Adequate space between batteries
- Working ventilation
- Acceptable support of battery rack
- Hydrogen levels

The environment for the cells should be clean, cool and dry. The location should be selected to keep water, oil, and dirt away from all cells.

Also, ENSURE THE PRACTICE of the following safety guidelines, which should include, but not be limited to the following:

- Use caution when working on batteries (they represent a shock hazard).
- Prohibit smoking and open flames
- Avoid activities that increase the chances of arcing in the immediate vicinity of the battery.
- Verify unobstructed egress to and from the battery areas.
- Avoid the wearing of metallic objects such as jewelry.
- Verify that the battery monitoring system is operational (if applicable).

Audible inspections:

- No abnormal sounds in the ventilation ducts and fans (ventilation system will emit normal noise)
    - No squeaking, belt slipping, or loud noises
- No audible noise should be coming from the battery system, central panel, or hydrogen detectors
- Any unusual alarm/detection system alerts

Other signs of hazards:

- Acidic odor
- Burning odor
- Smoke

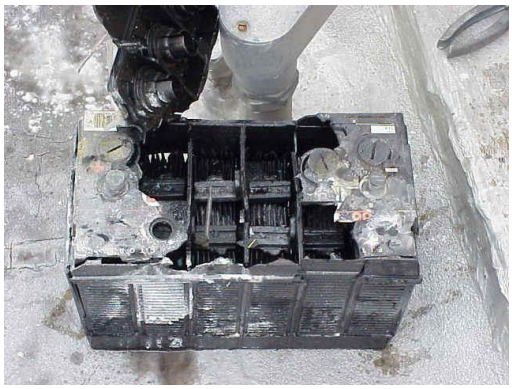
Lack of odor does not guarantee the area is free of hazards. **Hydrogen gas has NO odor, and thus cannot be relied on by smell.** Regardless of the odor, the UPS battery room should have a hydrogen detector with an alarm system. The older the battery becomes the faster hydrogen is produced.

1.3) HAZARDS

High voltage electricity:

- Fire
- Explosion
- Electrical and high temperature burns

If one of the above incidents occur contact 911 immediately.



Acid burns – Batteries that contain acids can cause severe burns. In case of skin contact with electrolyte, remove contaminated clothing and wash affected areas thoroughly with water.
If eye contact has occurred, wash for a minimum of 15 minutes with large amounts of running water and seek immediate medical attention.

Possible causes of an explosion would be:

- Electrolyte overcharge

- Safety valves/vents fail due to excess dirt and debris
- Spark inside the battery

Gas Release

- Explosion
- Personal injury (see following Material Safety Data Sheet (MSDS) health hazard)

Hydrogen gas - from the MSDS:

- Odorless Gas
- Highly flammable (Lower Explosive Limits 4.0, Upper Explosive Limits 75.0)
- Non-corrosive
- If inhalation has occurred, may cause damage to the lungs.
- Potential acute health effects:
    - Eyes and Skin: Contact with rapidly expanding gas may cause burns or frostbite.
    - Inhalation: Acts as a simple asphyxiant.
- Lighter than air

Batteries containing **lithium** have a greater potential danger. If one of these batteries were to ignite, the lithium would react with the oxygen producing MORE oxygen. Thus adding fuel to the fire and making the hazard increasingly difficult to extinguish.

If the battery system type is lithium ion or lithium metal polymer, suppression systems should be adequate to extinguish these difficult hazards.

1.4) MULTI-TENANT BUILDINGS

The majority of buildings in NYC are not occupied by a single tenant, and therefore will probably have more than a single UPS system within the building. Each tenant is responsible for his/her own system, or systems. Typically one tenant will have a different C of F holder than the next tenant, so that tenants and entities can remain independent of one another. This does **not** mean that they cannot share a C of F holder.

For example, assume one building has 10 tenants occupying at least 10 floors. All of the situations below would be acceptable:

1. All 10 tenants in the building use the same C of F holder to inspect their systems. *(Very unlikely)*
2. Eight of the 10 tenants use the same C of F holder for inspections, and the other two each have their own C of F holders.
3. All 10 tenants in the building have separate C of F holders – meaning 10 different C of F holders are in the building on a daily basis. (*Preferred)*

The building manager is responsible to know the location of all UPS battery systems in their building, and know who is responsible for each UPS battery system.

1.4.1) SINGLE TENANT BUILDINGS

If there is only one tenant in a building then typically there will only be one C of F holder for all of the UPS systems occupying the building, whether it is one or 20. Again, this is not required. If the tenant desires 20 different inspectors for the 20 systems then that is acceptable.

The building FSD (if required) and the building owner should have access to a list of all the battery system COF holders, their respective contact information, and the exact location of the battery systems that they provided with general supervision.

1.5) DEFINITIONS

CAPACITY TEST – A controlled constant current or constant power discharge of a battery to a specified terminal voltage.

CITYWIDE STANDARD KEY – A key of special or controlled design, also known as a "2642" key, approved by the commissioner which serves to operate elevator emergency recall and emergency in-service operation service switches and other devices or locks as required by the construction codes, including the Building Code, NYC Fire Code or the NYC Fire Rules.

FIRE COMMAND CENTER – The principal attended or unattended location where the status of the detection, alarm communications and control systems is displayed, and from which the system(s) can be manually controlled.

CENTRAL STATION – A facility that receives alarm signals from a protected premises and retransmits or otherwise reports such alarm signals to the FDNY.

FLOAT CHARGE – A constant potential charge applied to a battery to maintain it in a fully charged condition while minimizing degradation or water consumption.

GENERAL SUPERVISION – Except as otherwise provided in the Fire Code, supervision by the holder of any Certificate of Fitness who is responsible for performing the duties outlined but need not be personally present on the premises at all times.

KEY BOX – A secure device with a lock operable only by a citywide standard key or other approved key. The purpose is to have a readily accessible key for FDNY to enter the battery room in case of emergency.

STATIONARY STORAGE BATTERY – A storage battery designed for use in a stationary installation, in which electrochemical cells are interconnected to supply a nominal voltage of direct current power. The nominal voltage rating of a stationary storage battery is a function of the number of cells connected in a series, and the discharge capacity is a function of the size of the cells. Stationary storage batteries are characterized by their ability to be restored to a fully charged condition by reversing the flow of the electric current after discharge.

UNINTERRUPTIBLE POWER SUPPLY (UPS) – A power supply used to provide alternating current power to a load for some period of time in the event of a power failure.

UPS SYSTEM CAPACITY – the ability to deliver power to the load for a specified amount of time, measured in volt-amps (VA).

RATED CAPACITY (LEAD-ACID) – The capacity assigned to a cell by its manufacturer for a given discharge rate, at a specified electrolyte temperature and specific gravity, to a given end-of-discharge voltage.

SERVICE TEST – A test of a battery's capability, in an "as-found" condition, to satisfy the battery duty cycle.

SPECIFIC GRAVITY (SG) – The comparison of density compared to water

THERMAL RUNAWAY – occurs when more heat is being generated than released, thus causing an increase in temperature of the battery.

1.5.1) BATTERY SYSTEM ANATOMY

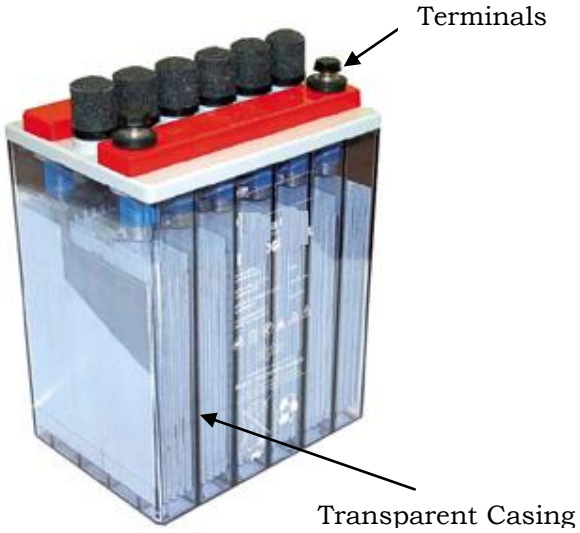
The process by which a battery creates electricity heavily depends on what kind of battery it is; however, they all have a flow of electricity within each cell,

called current. Batteries have positive and negative electrodes which the current flows between.

Good to know:
Lead acid battery:

- The positive electrode, made of lead oxide, forms lead sulfate on discharge, and generates oxygen gas during overcharge.
- The negative electrode, made of pure sponge lead, forms lead sulfate on discharge, and generates hydrogen gas during overcharge.
- NOTE: Practical cells are not made with pure lead but have small amounts of antimony or calcium alloyed in the plate material to add strength and simplify manufacture. The alloying element has a great affect on the life and water consumption of the batteries. Antimony-alloyed plates provide longer life but calcium-alloyed plates are much preferred over antimony since it has 8x less water consumption.

Every battery has a metallic positive and negative **plate**. For rechargeable batteries, the charges on the plates are reversed when the battery is being charged.



Electrolyte – a chemical medium (liquid or solid) that allows the flow of electrical charge between the cathode and anode (electrodes/plates).

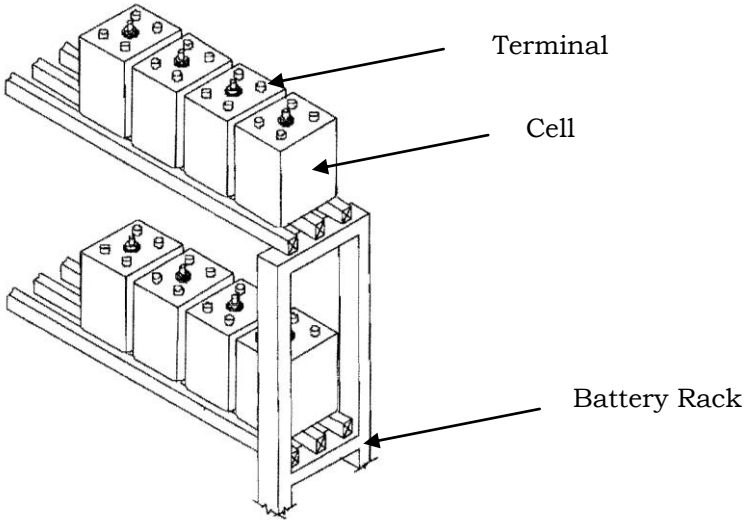
Cell – A single connection between the plates and electrolyte which produces a specific voltage (i.e. one AA battery has one cell). In battery systems there are multiple cells in order to provide enough voltage and energy for the entire load.

Jar – A container that houses a cell or group of cells. Typically 6 cells will be connected inside the jar; however, jars can also be referred to as cells.

Terminal - the electrical contacts used to connect a load to a single cell or multiple-cell battery

Transparent Battery Casing – The purpose of transparent casing is to allow for a visual internal inspection.

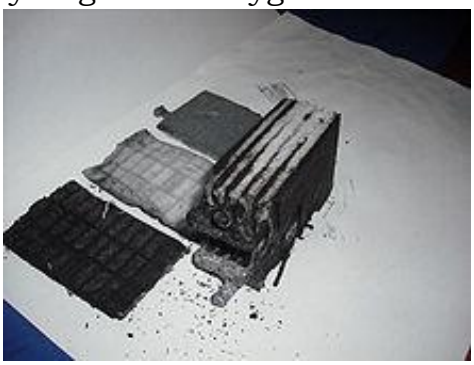
Battery Rack – A structure used to support a group of cells. Commonly made of steel with an acid resistive component covering the material.



FULL RACK OF CELLS

1.5.2) TYPES OF BATTERIES
(from FC 602.1)
NONRECOMBINANT BATTERY – A storage battery in which hydrogen and oxygen gases created by electrolysis (using electricity to start a chemical reaction) are vented into the air outside of the battery.

RECOMBINANT BATTERY – A storage battery in which hydrogen and oxygen gases created by electrolysis are converted back into water inside the battery instead of venting into the air outside of the battery.



Disassembled VRLA Battery

NOTE: Safety Caps
Safety caps for stationary storage battery systems shall comply with the Fire Code. Vented lead acid, nickel-cadmium and other types of nonrecombinant batteries shall be provided with safety venting caps.

LEAD ACID BATTERIES:

VENTED (FLOODED) LEAD ACID BATTERY (wet cell) – A lead-acid battery consisting of cells that have electrodes immersed in liquid electrolyte. Flooded lead-acid batteries have a provision for the user to add water to the cell and are equipped with a flame-arresting vent which permits the escape of hydrogen and oxygen gas from the cell in a diffused manner such that a spark, or other ignition source, outside the cell will not ignite the gases inside the cell.

VALVE-REGULATED LEAD ACID BATTERY (VRLA) - a lead-acid battery consisting of sealed cells furnished with a valve that opens to vent the battery whenever the internal pressure of the battery exceeds the ambient pressure by a set amount. The liquid electrolyte in the cells is immobilized in an absorptive glass mat (AGM cells or batteries) or by the addition of a gelling agent.

NICKEL CADMIUM (Ni-Cd) – A nonrecombinant, alkaline storage battery in which the positive active material is nickel oxide, the negative contains cadmium and the electrolyte is potassium hydroxide.

LITHIUM-ION BATTERY – A storage battery in which an electrical current is generated by lithium ions embedded in a graphite or nickel metal-oxide substrate placed in a thick carbonate mixture or gelled polymer electrolyte.

LITHIUM METAL POLYMER BATTERY – A storage battery in which an electrical current is generated by the interaction between lithiated positive active material electrically separated from metallic lithium or lithiated negative active material, and nonaqueous liquid or polymerized electrolytes.

1.6) TRAINED vs. CERTIFIED

The difference between these two descriptions of expertise is the legitimacy and documentation of an individual's experiences.

TRAINED: To be taught or be knowledgeable in a specified area/field; may have some experience, but may not be authorized to perform their specific trade or work. For example, someone who is trained may be qualified to operate the equipment but not authorized because of lack of COF from FDNY.

CERTIFIED: To be certified entails official, authorized training given by a company or entity. Certification ensures you are tested and have achieved a position where you are qualified to do specialized work. You may or may not have the necessary experience, but you are authorized based on examination.

1.7) LEAD ACID BATTERIES: VENTED vs. VRLA

[This section will be provided to you as a reference material during the test]

VENTED (Flooded)	***VRLA***
– Free flowing electrolyte – Transparent casing for visual inspections – Larger footprint – Need to maintain – More robust – High gassing – Need active ventilation	– No free electrolyte – No transparent casing – Space savings – Less maintenance – Sensitive to environment – Low gassing – No ventilation • unless in cabinets

	Vented (Flooded)	***VRLA***
Life Expectancy	20 years	5 years
Space Required	More space	Less space – stacked
Floor Load	300–500 lbs/sq.ft.	900–1000 lbs/sq.ft.
Water Additions	As needed	Not possible (applies to both lithium batteries)
Specific Gravity Readings	As needed	Not possible
Experience	Over 100 years	Approximately 30 years
Reliability	Good	Less predictable
Battery Room	Required	Required
Cost	Usually higher initial cost	Less initial cost for 5-10 year

Free-Flowing Electrolyte	
Vented lead acid	Yes
Nickel cadmium	Yes
VRLA	No
Lithium ion	No
Lithium metal polymer	No

Transparent Casing	
Vented lead acid	Yes
Nickel cadmium	Yes
VRLA	No
Lithium ion	No
Lithium metal polymer	No

Good to know:
- Leads to higher float current and lower life expectancy
- VRLA, lithium metal polymer batteries and other batteries susceptible to thermal runaway must be provided with a listed device or other approved method to preclude, detect and control thermal runaway.

2. FIRE SAFETY REGULATIONS

The fire safety system is implemented and maintained based on a prescribed procedure from licensed engineers and the Fire Department. There should be a Letter of Approval from the FDNY to each battery system premise detailing the necessary safety measures and design requirements after papers and plans are filed, reviewed, and processed.

2.1) FDNY EMERGENCY ARRIVAL

The following is the list of important information that the FDNY should have access to upon arrival:

- Access to Building Information Card (BIC)
- Emergency contact numbers of FSD and/or respective COF holder 24/7
- Appropriate signage
- Location of UPS
- Other hazardous material within the proximity of the UPS system
- Floors and areas the UPS system serves
- Type of battery system
    - Composition of the battery – material/hazards
- Shut off switch/button and controls location and its accessibility
- Service/maintenance contracting company and its phone number
- Date of system installation
- Other protocols as required

Where access to or within a building is restricted because of locked doors or other means of entrance, or whereas immediate access would be needed for lifesaving or firefighting purposes in the event of a fire or other emergency, the Fire Department may require that keys be kept in a key box installed in an approved location. The owner shall ensure that the key kept in the lock box is replaced whenever a lock securing the area, box or cabinet is changed or rekeyed. [506.2.2]

2.2) EMERGENCY PROTOCOL

Every premise where battery systems are installed and operated must have a **FIRE SAFETY and EVACUATION PLAN** detailing procedures that must be followed in the case of an emergency, fire, acid spill, gas leak, or other dangerous situation. The plan should highlight appropriate and safe evacuation of the premises, as well as possible approaches to system shutdown. **The Certificate of Fitness holder MUST know and understand his or her responsibilities as they are outlined in the fire safety and evacuation plan of a premises.**

The B-29 COF holder must be fully familiar with battery system emergency procedures. The Certificate of Fitness holder **MUST** know the locations and how to operate all shut down switches, fire extinguishing devices and control devices installed in the system area, such as sprinklers and fire extinguishers. He or she must also know the location of each fire alarm, if applicable, and how to operate them. **Diagrams of the system and signs must be posted at conspicuous locations and control room, and indicate hazards, safety protection systems and egress.** Keys to the battery room shall be readily available in the control room or front desk of the building.

The Fire Department strongly recommends that Certificate of Fitness holders of battery system supervision be trained to alert the building FSD, the maintenance or service company, and the Fire Department immediately at any sign of danger.

In all cases, the Fire Department must be contacted FIRST and directly by phone <u>in case of a fire emergency</u> or serious safety condition, by immediately dialing <u>911</u>. As a secondary contact, it is suggested to have the Fire Department Borough Communication Office phone numbers posted near the telephones most likely to be used in case of an emergency, which will bring you directly to the borough communications office. These phone numbers are:

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

2.2.1) HAZARDOUS MATERIAL LIAISON

One or more responsible persons shall be designated by the building owner to serve as a hazardous material liaison to the Fire Department in connection with any emergency response to the premises, for purposes of providing access to the location(s) of all hazardous materials including battery systems on the premises, providing access to material data safety sheets (MSDS), and otherwise assisting in the development and implementation of emergency procedures. They are prohibited from installing and physically maintaining the battery system.

2.2.2) FIRE COMMAND CENTER

The official names and telephone numbers, including a 24-hour contact number, of such responsible persons shall be available at the fire command

center and battery system location(s). Keys accessing battery system locations shall be available at the fire command center. Battery system locations, including battery type and hazardous materials, shall be listed on the building information card (BIC). [2703.9.1.1] A record of the ventilation system's operational status is required to be maintained at the fire command center.

2.2.3) SHUT DOWN PROCEDURES

Emergency procedures detailing how to shut down the power from the battery system shall be posted on or near the battery system or kept in an approved location on the premises. The procedures shall also include a 24-hour/7-day per week telephone number by which the owner can be contacted to provide additional information to emergency responders. [608.10]

There should be a shutoff switch/valve/control panel located outside of the battery room, in case of an emergency situation within the battery room.

Shutoff Situations: In emergency situations, the FDNY may want to shut off the entire system, or sections of it that are either causing the problem or can potentially be in danger from it. Depending on the business or tenant, shutting down the UPS system may be a major business interruption that could have exceptionally large economic impacts. It is recommended to have trained personnel present 24/7 to assist FDNY in case of emergency.

If the FDNY field unit representatives and/or FSD feel the necessity of shutting off the system while the building owner or tenant is not present they may do so. **The final decision regarding battery system shutdown during an emergency will be made by the FDNY, who will decide the best and safest practice to deal with the emergency.**

The responsibilities of the Certificate of Fitness holder, if present, are to assist the FDNY with whatever is deemed necessary, whether that be locations of specific rooms or systems, access to keys, or specific emergency procedures.

There can be either a manual trip or automatic trip, although having both would be ideal.

2.3) BATTERY REQUIREMENTS

(FC TABLE 608.1)

[This table will be provided to you as a reference material during the test]

REQUIREMENT	**NONRECOMBINANT BATTERIES**		**RECOMBINANT BATTERIES**		**OTHER**
	Flooded Lead Acid Batteries	**Flooded Nickel-Cadmium (Ni-Cd) Batteries**	**VRLA Batteries**	**Lithium-Ion Batteries**	**Lithium Metal Polymer**
Safety caps	Venting caps (608.2.1)	Venting caps (608.2.1)	Self-resealing flame-arresting caps (608.2.2)	No caps	No caps
Thermal runaway management	Not required	Not required	Required (608.3)	Not required	Required (608.3)
Spill control	Required (608.5)	Required (608.5)	Not required	Not required	Not required
Neutralization	Required (608.5.1)	Required (608.5.1)	Required (608.5.2)	Not required	Not required
Ventilation	Required (608.6.1; 608.6.2)	Required (608.6.1; 608.6.2)	Required (608.6.1; 608.6.2)	Not required	Not required
Signage	Required (608.7)	Required (608.7)	Required (608.7)	Required (608.7)	Required (608.7)
Seismic protection	Required (608.8)	Required (608.8)	Required (608.8)	Required (608.8)	Required (608.8)
Smoke detection	Required (608.9)	Required (608.9)	Required (608.9)	Required (608.9)	Required (608.9)
Occupied Area Location	Not allowed (608.4)	Not Allowed (608.4)	Allowed (608.4)	Allowed (608.4)	Allowed (608.4)

2.3.1) SAFETY CAPS

- **Nonrecombinant** batteries – Vented lead acid, nickel-cadmium and other types of nonrecombinant batteries shall be provided with safety venting caps.

- **Recombinant** batteries – VRLA batteries shall be equipped with self-resealing flame-arresting safety vents.

NOTE: If safety vents may fail and lead to explosion if accumulation of excess dirt and debris occurs.

2.3.2) THERMAL RUNAWAY

VRLA and lithium metal polymer battery systems shall be provided with a listed device or other approved method to preclude, detect and control thermal runaway.

2.3.3) SPILL CONTROL AND NEUTRALIZATION

An approved method and materials for the control and neutralization of a spill of electrolyte shall be provided in areas containing lead-acid, nickel-cadmium or other types of batteries with free-flowing liquid electrolyte. [608.5]

Exception**:** VRLA, lithium-ion, lithium metal polymer and other types of sealed batteries with immobilized electrolyte shall not require spill control.

Neutralization

Nonrecombinant battery – For battery systems containing lead-acid, nickel-cadmium or other types of batteries with free-flowing electrolyte, the method and materials shall be capable of neutralizing a spill of the total capacity from the largest cell or block to a pH between 5.0 and 9.0. [608.5.1]

Recombinant battery – For VRLA and other types of sealed batteries with immobilized electrolyte, the method and material shall be capable of neutralizing a spill of 3 percent of the capacity of the largest VRLA cell or block in the room to a pH between 5.0 and 9.0.

Exception**:** Lithium-ion and lithium metal polymer batteries shall not require neutralization. [608.5.2]

Where more than 5 gallons (19 L) of corrosive liquids are stored, handled or used, a sufficient quantity of suitable neutralizing or absorbing agents shall be provided. [2706.10] The B-29 COF should check with manufacturer recommendations to verify quantity of material.

Spill containment and management issues are addressed differently based on how and when they occur.

All of the following are necessary actions to be performed after an electrolyte spill:

- Containment
- Absorption
- Neutralization

These activities should be performed by qualified and authorized individuals in accordance with all applicable laws, regulations, and internal company policies. The removal and/or neutralization of an electrolyte spill will result in the production of hazardous waste, which must be disposed of properly and with caution.

This certificate is NOT a certification that the COF holder is qualified and trained to contain, absorb, or neutralize hazardous materials.

Absorbent will be used by the FDNY in event of emergency for mitigation. Diking with absorbent material is the **recommended** method for containment. If qualified, the COF holder may use the on-hand absorbent material to surround and contain the acid spill.

In the event of any sulfuric acid or other electrolyte spill, the cleanup (NOT the same as neutralization) is to be performed by a service or maintenance company.

The order of actions to be taken by the COF holder immediately after a spill occurs should be as follows.

I. Notify FDNY
II. May use absorbent material to contain spill, if qualified
III. Guide FDNY/serviceman to neutralizing agent
IV. Notify service/maintenance company

In case of battery electrolyte spill, the Certificate of Fitness holder must notify the Fire Department by phone immediately. The Certificate of Fitness holder must know the telephone number of the Fire Department Dispatcher number in the borough where the building is located.

Good to know:

- For a flooded battery, electrolyte spills can occur at any time during battery life. Most spills occur during transportation or installation activities. Other reasons of why spills may occur is because of: maintenance activities, seismic events, and operational failures.

2.3.4) VENTILATION

Ventilation of stationary storage battery systems shall comply with the Fire Code. [608.6]

Ventilation must be provided to prevent the accumulation of hydrogen gas in the battery room, particularly at the ceiling.

Ventilation for flooded lead acid, flooded Ni-Cd and VRLA batteries shall be provided in accordance with the Mechanical Code and the following requirements:

1. The ventilation system shall be designed to limit the maximum concentration of hydrogen to **1%** of the total volume of the room;

2. Continuous ventilation shall be provided at a minimum rate of 1 cubic foot per minute per square foot of floor area of the room. <u>If flow rate is less than this then hydrogen will accumulate to hazardous levels.</u>

When VRLA batteries are installed inside a cabinet, such cabinet shall be approved for use in occupied spaces and shall be mechanically or naturally vented by one of the following methods:

1. The cabinet ventilation shall be designed to limit the maximum concentration of hydrogen to 1 percent of the total volume of the cabinet during the worst-case event of simultaneous "boost" charging of all batteries in the cabinet;

2. Continuous ventilation shall be provided at a rate of not less than 1 cubic foot per minute per square foot of floor area covered by the cabinet. The room in which the cabinet is installed shall also be ventilated as stated above. [608.6.2]

Mechanical ventilation systems where required by the Fire Code shall be supervised by an approved <u>central station</u> or shall initiate an audible and visual signal at a constantly attended on-site location. [608.6.3]

The central station company will contact the responsible employee for further action if the ventilation system is not in good working order, if central station monitoring is required.

Codes must be adhered to by either a natural or mechanical ventilation system, to prevent accumulation of hydrogen. If the building contains a pre-existing system then the Certificate of Fitness holder shall adhere to industry standards at that time. If there is no ventilation in the battery room, it is possible that ventilation was not required at the time of system installation.

2.3.5) SEISMIC PROTECTION

The battery systems shall be seismically braced in accordance with the NYC Building Code. [608.8]

2.3.6) SIGNAGE

Signs and instructions should be posted near battery room for personnel, in case of emergency with no trained or designated FSD on site.

The signage that may be used in battery areas include but are NOT limited to the following:

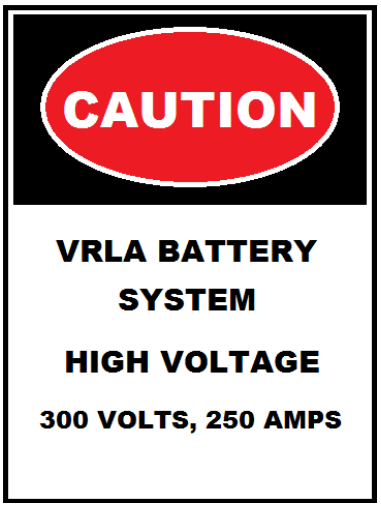
Any potential hazards, safety precautions or instructions, shutoff switch locations, or other important information is recommended to be posted conspicuously.

Exit signs are required by the NYC Department of Buildings.

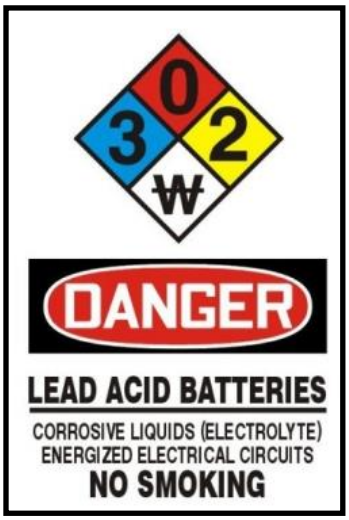
A durable sign that reads as follows must be posted on **doors** into electrical equipment rooms or buildings containing stationary battery systems: "CAUTION: This room contains energized battery systems. Battery electrolyte solutions may be corrosive." [608.7.1] For example:

Cabinets shall have a sign or marking identifying the type of battery system, the electrical rating (voltage and current) of the system, and applicable chemical and fire hazards. [608.7.2]

Examples of cabinet signs would be the following:



NFPA 704 diamond signs are required to be posted in battery areas with a minimum of 55 gallons of corrosive material. The sulfuric acid specific sign is shown below:



2.4) DETECTION SYSTEMS

Battery monitoring can be used to enhance data collection, trending, and to store a record of battery system parameters. Battery monitoring can also provide remote visibility and alert personnel of impending problems; however, such monitoring is not a substitute for periodic visual inspections.

2.4.1) FIRE DETECTORS

Smoke detection: A 24/7, approved automatic smoke detection system shall be installed in accordance with the NYC Building Code in rooms containing stationary battery systems. [608.9]

Good to know:

- A **smoke detector** is a device that detects smoke, which is an indicator of imminent fire, in a battery system setting.
- Smoke is a collection of airborne solids, liquid particles, and gases which occur when a material burns, such as during a fire.
- Smoke detectors detect fire quicker than heat detectors by sensing smoke particles. The smoke particles may or may not be visible to the human eye.

2.4.2) GAS DETECTORS

Automatic gas detection and alarm systems have signals indicating when there are signs of hazardous concentrations of gas (Hydrogen). Early detection of a high gas concentration by volume allows for proper safety procedures. Any alarm must send a signal to the gas detection panel and the control room for the COF and maintenance company to take action.

Hydrogen Detector

A gas detector is a device which detects the presence of various gases within an area, usually as part of a safety system. This type of equipment is used to detect a specific concentration of gas, and send a notification to the appropriate trained staff so that they can take necessary action. Gas detectors in a battery room are installed to detect hydrogen gas concentration by volume.

All gas detectors should be calibrated on a schedule in accordance with the manufacturer's recommendations. A hydrogen detection system should be tested periodically to ensure it is in good working order.

If there is no hydrogen detector installed in the battery room, then the C of F holder should bring a portable hydrogen detector which can be used as a substitute when making inspection rounds.

Portable Hydrogen Detector

2.5) SUPPRESSION SYSTEMS AND EQUIPMENT

Although sprinkler systems are not required by the 2014 NYC Fire Code, they are highly recommended to be installed in battery areas, in case of fire emergency. The sprinklers should be positioned or located whereby they do not directly release water onto the battery cells and cause an explosion. Suppression systems should have inspections and testing as needed.

<u>Good to know:</u>

1. Battery-charging areas shall be provided with a portable fire extinguisher complying with the requirements of the Fire Code having a minimum 4-A:20-B:C rating within 20 feet of the battery charger.

2.5.1) FIRE EXTINGUISHERS

B-29 COF holders should be familiar with the use of portable fire extinguishers. Portable fire extinguishers weighing 40 lbs. or less must be installed so that the top of the extinguisher is not more than 5 ft. above the floor. Hand-held portable fire extinguishers weighing more than 40 lbs. must be installed so that the top of the extinguisher is not more than 3.5 feet above the floor. The clearance between the bottom of the extinguisher and the floor must not be less than 4 inches. In other words, **no fire extinguisher is allowed to be on the floor.**

Fire extinguishers must be located in conspicuous locations where they will be readily accessible and immediately available for use. These locations must be along normal paths of travel.

It is important to remember that portable fire extinguishers should only be used when there is an available means of egress that is clear of fire. Users must keep a clear and accessible means of egress. This is important because if the fire intensifies or if the user is unable to extinguish the fire, it is imperative that there is still an unobstructed means of egress. Portable fire extinguishers are important in preventing a small fire from growing into a catastrophic fire; however, they are not intended to fight large or spreading fires. By the time the fire has spread, fire extinguishers, even if used properly, will not be adequate to extinguish the fire. Such fires should be extinguished by the building fire extinguishing systems or trained firefighters only. In the event that a fire extinguisher has been discharged, it must be fully recharged or replaced prior to being used again.

In case of any fire, 911 must be called. Fire extinguishers must be used in accordance with the instructions painted on the side of the extinguisher. They clearly describe how to use the extinguisher in case of an emergency. The Certificate of Fitness holder should be familiar with the use of portable fire extinguishers. When it comes to using a fire-extinguisher, remember the acronym **P.A.S.S.** to help make sure you use it properly. **P.A.S.S.** stands for: **P**ull the pin from handle**; A**im at base of fire; **S**queeze the lever; **S**weep side to side.

2.5.2) DIFFERENT TYPES OF PORTABLE FIRE EXTINGUISHERS

Fire extinguishers are classified by the type of fire that they will extinguish. Some fire extinguishers can only be used on certain types of fires, while other fire extinguishers are made to extinguish more than one type of fire. The portable fire extinguisher classification is indicated on the right side of the extinguisher. For more detailed information regarding the different portable fire extinguisher classifications and the types of fires they extinguish, reference the following chart.

A **Class A** fire extinguisher is used for ordinary combustibles, such as wood, paper, some plastics and textiles. This class of fire requires the heat-absorbing effects of water or the coating effects of certain dry chemicals. Extinguishers that are suitable for **Class A** fires should be identified by a triangle containing the letter "A." If in color, the triangle should be green.

A **Class B** fire extinguisher is used for flammable liquid and gas fires such as oil, gasoline, etc. These fire extinguishers deprive the fire of oxygen and interrupt the fire chain by inhibiting the release of combustible vapors. Extinguishers that are suitable for **Class B** fires should be identified by a square containing the letter "B." If in color, the square should be red.

A **Class C** fire extinguisher is used on fires that involve live electrical equipment which require the use of electrically nonconductive extinguishing agents. (Once the electrical equipment is de-energized, extinguishers for Class A or B fires may be used.) Extinguishers that are suitable for **Class C** fires should be identified by a circle containing the letter "C." If in color, the circle should be blue.

A **Class D** fire extinguisher is used on combustible metals such as magnesium, titanium, sodium, etc., which require an extinguishing medium that does not react with the burning metal. Extinguishers that are suitable for **Class D** fires should be identified by a five-point painted star containing the letter "D." If in color, the star should be yellow.

A **Class K** fire extinguisher is used on fires involving cooking media (fats, grease and oils) in commercial cooking such as restaurants. These fire extinguishers work on the principal of saponification. Saponification takes place when alkaline mixtures such as potassium acetate, potassium citrate or potassium carbonate are applied to burning cooking oil or fat. The alkaline mixture combined with the fatty acid creates a soapy foam on the surface which holds in the vapors and steam and extinguishes the fire. These extinguishers are identified by the letter **K**.

The sign to the right indicates three types of fire extinguishers that can or cannot be used for ordinary combustibles, flammable liquid and electrical fires.

The sign to the left indicates the location of the fire extinguisher.

2.6) BUILDING INFORMATION CARDS

UPS battery information will be located under the Hazardous Materials section of the BIC. The information that should be listed includes:

- Location of UPS battery systems
- Floors and areas the UPS system serves
- Shut down switch location

An example of a BIC with the UPS information is shown on the following page.

FIRE SAFETY AND EMERGENCY ACTION PLAN (APPENDIX B-2)
BUILDING INFORMATION CARD

1. BUILDING INFORMATION

BIN#

Address: Zipcode

AKA:

Construction Class:

Office Floors:

Residential Floors:

Hotel Floors: No. of Rooms:

Retail Floors:

Public Assembly Areas:

Location of Day Care:

Building Population During **Regular** Business Hours: Building Population During **Non Regular** Business Hours:

2. BUILDING STATISTICS

Stories Above Grade: Below Grade :

Height (ft): Ground Level Floor Area (sq.ft):

Type of Construction:

Truss Construction: Roof: Floors: If yes, Floors:

Horizontal Connections:

Locations:

Roof Setback Levels:

3. EXIT STAIRWAYS

(Select number of stairwells)

Designation	Floors Served	Pressurized	Standpipe

Re-entry Floors:

Access/Convenience Stair Located Between Floors:

Roof Access Provided by Stairwells:

Fire Tower: If yes, Location:

4. ELEVATORS

(Select number of Elevator Banks)

Bank Designation	Car Numbers	Floors Served

Freight Elevator Bank(s): N/A

Sky Lobby(s): If yes, Location(s):

5. VENTILATION

HVAC Zones:

Building Management System (BMS):

Location:

Smoke Management System (BMS): Purge Capability:

Location of Mechanical rooms:

6. UTILITIES

(Select number of Oil Tanks. If additional, include in Box 8)

UPS-See Hazmat Section

All Fuel Oil Tank Locations (Capacity): (gallons)

Location: (gallons)

Location: (gallons)

Natural Gas Service: Shutoff Location:

Emergency Generator Location:

Roof Storage: If Other:

7. FIRE PROTECTION SYSTEM

Standpipe Location(s):

Standpipe isolation Valve Location(s):

FD Connections Location(s):

Building Fully Sprinklered:

Fully Sprinklered Floors:

Partiality Sprinklered Floors:

Non Sprinklered Floors:

Pressure Reducing Valve Floor Locations: N/A

Fire Pump Location(s):

Non-water Fire Extinguishing Systems:

Locations:

8. HAZARDOUS MATERIALS

2 (Select number of Hazardous Materials. If over 6 provide additional sheet)

NAME OF PRODUCT/QUANTITY	LOCATION
UPS Battery System (Serves floors 1-15)	Room 1.1
UPS Battery System (Serves floors 15-25)	Room 1.2

Special Notes:

Shut down switches are located in battery room main control panel.

9. COMMUNICATIONS

Communication for FDNY:

Number of Radios for FDNY Use:

24 hr. Location:

10. TEMPORARY CONSIDERATIONS

11. Building Fire Safety Information

Fire Safety / EAP Director:

Work Number:

Emergency Number:

Building Engineer:

Work Number:

Emergency Number:

Managing Agent:

Work Number:

Emergency Number:

3. MONITORING SYSTEM HEALTH

The Certificate of Fitness holder should periodically conduct a **visual inspection** of the entire battery system. Such inspections should be conducted as frequently as needed to ensure safe and efficient operation. **Premises should be inspected daily for signs of battery failure and possible hazard and safety risks.**

There shall be a 24-hour smoke alarm system (automatic and manual systems) including detectors (recommended) and other safety devices. Diagrams and signs of the battery system must be posted at conspicuous locations, and indicate hazards, safety protection systems and egress.

Qualified service personnel of the system should be notified of any irregular situations or concerns observed by the C of F holder. If the Certificate of Fitness holder requires additional information about the system he or she should only rely on information provided by the manufacturer of the system or qualified service personnel. **The Certificate of Fitness holder MUST NOT attempt to perform any repairs to the systems that they have not been authorized or are qualified to make.** Authorized and qualified personnel should be familiar with the UPS battery design, installation, preparation, charging and maintenance procedures for the specific facility.

3.1) CYCLE LIFE

Battery Cycle Life is defined as the number of complete charge-discharge cycles a battery can perform before its nominal capacity falls below 80% of its initial rated capacity. Once a battery reaches the end of its battery cycle life, it will not recharge to more than 80% of its initial rated capacity. The actual ageing process results in a gradual reduction in capacity over time. When a cell reaches its specified lifetime it does not stop working suddenly.

Good to know:

- Lifetimes of 500 to 1200 cycles are typical.
- The ageing process usually abides by a constant rate – so a cell whose capacity had fallen to 80% after 1000 cycles will probably have a capacity of 60% after 2000 cycles.
- Thus, in normal cases there is no need to fear a sudden death when a cell has reached the end of its specified life – but it should be replaced at that point.

3.1.1) LIFE LIMITING FACTORS

Two main life limiting factors are temperature and charge.

Temperature has a significant impact on battery systems in both life expectancy and battery performance. A higher temperature will increase the capacity of the battery, but decrease its life expectancy. A lower temperature will decrease the capacity, but may not affect life expectancy. Thus, the ideal ambient temperature is between 72° and 78° F (23°-26° C).

If the operating temperature becomes too hot the following is likely to happen:

- Accelerates corrosion of the positive electrode and self-discharge
- Increase in float current
- Increases amount of oxygen recombined (Recombinant only)
- Can cause thermal runaway (usually VRLA only)

Charge and **float voltage** maintain capacity and minimize electrode corrosion. Overcharging **and** undercharging will increase corrosion, thus decreasing life expectancy. Also, the charge and float voltage determine the onset of gassing and venting in batteries.

Good to know:

Charging Methods

- Batteries should be maintained in a fully charged state in order to optimize battery performance and life expectancy.
- Boost Charge - An overcharge of arbitrary length (e.g. high rate charge for 60 hours)
  Do not handle cells during or after boost charge for 24 hours, because of the hazard of possible overcharge and excess in electrolyte.

- Equalize Charge - An extended charge to a measured end point. This charge ensures complete restoration of the active materials in all the plates of the cells (found after a discharge).

- Freshening Charge - A charge given to a battery following non-use, storage or installation. Sometimes referred to as initial charge since this term includes initial charging of dry charged (wet) cells.

- Mixing Charge - A charge given after adding an appreciable amount of water. Performed only if reasonable mixing or diffusion is not expected (can't equalize because of the design of the installed battery).

- Trickle Charge - A charge given to a battery with no external load connected to it in order to maintain the battery in a fully charged condition.

3.2) ROOM DESIGN AND CONSTRUCTION

Battery systems may be installed in the same room as the equipment to which they provide power.

Battery room design and construction must comply with the Building Code. [608.4]

- UPS battery systems installed in a locked, separate (unaccompanied) equipment room accessible only to authorized personnel, may be installed on an open rack for ease of maintenance.
- Only VRLA, lithium-ion, and lithium metal polymer batteries may be installed in an occupied area. Such batteries shall be housed in a noncombustible cabinet to prevent access by unauthorized personnel. Such cabinets shall be located within 10 feet of the equipment to which the batteries they house provide power.

Adequate space for the each cell is highly recommended. Each cell should be accessible for the addition of water (if possible) and for taking individual cell voltage and hydrometer readings.

Ventilation must be provided to ensure that pockets of trapped hydrogen gas do not develop, particularly at the ceiling.

Good to know

Floors should be reasonably level. Shim up to ¼ inch maximum (depends on manufacturer requirements) to level battery rack or cabinet front to rear and side to side. Floors must be capable of supporting the weight of the battery as well as any auxiliary equipment.

Also, proper diking methods should be utilized in the battery room, with a wall that extends with an appropriate height; in case of a large spill, the walls will be a secondary containment for the solution.

- Anchoring should meet all local, state, and federal codes and all industry standards. **Floor anchoring and its design are the responsibility of the user.**
- Batteries designed for racks or cabinets should be installed on racks specifically designed for those batteries by the manufacturer. Use of any other rack design is the responsibility of the user.
- It is recommended that the racks be grounded in accordance with NEC and/or local codes, in order to further stabilize the structure of the rack.

Good to know:
Batteries should be unpacked, installed and charged as soon as possible after receipt; however, if this proves to be impractical, the instructions below should be followed for storing the battery before installation:

- Store batteries in a clean, dry and cool location. Storage at higher temperatures or humidity will result in accelerated rates of self-discharge and possible deterioration of battery performance and life. Do not allow direct sunlight to shine on the system.
- Do NOT stack battery pallets. DAMAGE MAY OCCUR AND THE WARRANTY WILL BE VOIDED.

- Do NOT store flooded batteries longer than the following intervals without giving periodic freshening charges.
    - Lead Antimony – every three months
    - Lead Calcium – every six months
- Under higher temperature conditions, more frequent charging may be required.

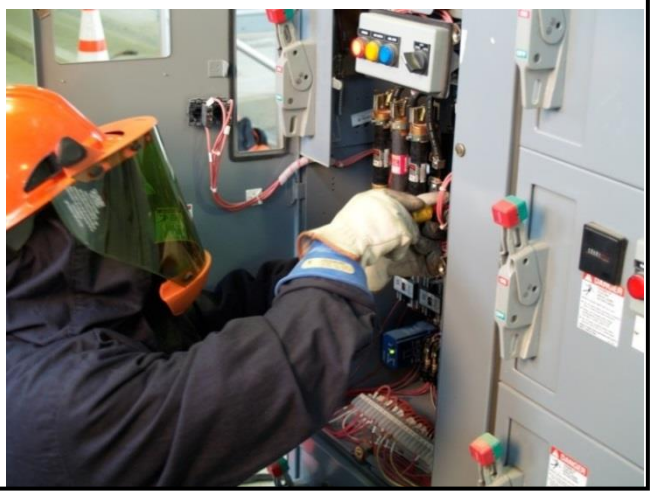
- Storage times exceeding the above may result in plate sulfation, which may adversely affect electrical performance and expected life.

- Give the battery a *freshening charge* before the end of the recommended storage interval. Repeat *freshening charge* for each additional storage interval until the battery is installed.

- A maximum total storage time before installation is specified by each manufacturer, for example, two years from date of shipment from the factory to the customer.

Advance Preparation
If freshening time interval is likely to be exceeded in storage, make advance preparation to have an adequate charger available and adjacent to an appropriate AC supply voltage. Positioning of the cells to accept the temporary intercell connectors is another consideration of advance planning.

WARNING: FAILURE TO CHARGE AS NOTED VOIDS THE BATTERY'S WARRANTY



MAINTENANCE REGULATION

EQUIPMENT
The following protective equipment shall be worn by personnel who perform battery inspection work or made available to such personnel:

- Safety Equipment – to prevent injury
    - Safety glasses / face shields

        - Acid-resistant gloves
        - Rubber apron
        - Eye wash station
        - Neutralizing agent – in case of an acid spill
    - Hydrometer – to take specific gravity (SG) readings
    - Flashlight
    - Thermometer
        - Bulb to measure ambient temperature
    - Calibrated digital voltmeter – for measuring cell voltage
    - Torque wrench – for use on terminals
    - Special battery cell testing tools
        - Cell pressure tester
    - AC/DC Clamp-on type ammeter
        - (Capable of 0.1 amp resolution.)
    - Optional Equipment
        - Digital micro-ohm meter.
            - Batteries systems sized for high rate discharge - UPS etc.
        - Conductance or impedance meter.
            - Useful for testing batteries of unknown condition, prior to capacity tests.
        - Digital camera

STANDARD CLEANING

To perform a standard cleaning of the battery, follow the procedure below:

1. Disconnect the battery
2. Wipe off any accumulation of dust on the cell covers with a cloth dampened with clean water.
3. If the cell covers or jars are damp with spilled electrolyte, wipe with a cloth dampened with a solution of sodium bicarbonate and cold water, mixed in the proportions of 1.0 lb/1.0 gal of water. Follow this by wiping with a cloth dampened in clear water and then wipe dry with a clean cloth.

CORROSION CLEANING

To clean mild corrosion from cell posts, follow the procedure below:

1. Disconnect the battery.
2. Remove corrosion by wiping with a cloth dampened with bicarbonate of soda solution [mix 1 gallon (4l) of water with 1 lb. (500g) of bicarbonate of soda]. Follow with a cloth dampened with clear water.
3. Dry with a clean cloth.
4. With a small paintbrush, apply a light coat of heated NO-OX-ID grease to the entire bolted connection.

HEAVY CORROSION CLEANING

If the routine cleaning of bolted connections has been neglected, heavy post corrosion may occur. The performance of the battery under load could be adversely affected, and this condition could present a safety hazard.

To perform the heavy corrosion cleaning, follow the procedure below:

1. Arrange to maintain continuity of the circuit, if required.
2. Unbolt and remove connectors.
3. Apply a solution of bicarbonate of soda and water to the cell posts and connectors to neutralize the corrosion (as described in the above section).
4. Clean the contact surfaces by rubbing the surface of the post or terminal and plated contact surfaces with a stiff-bristle nonmetallic brush/pad. **Exercise care so you do NOT remove the plating on the connectors, terminal plates or lugs, exposing copper.**
5. Recoat the contact surfaces with a thin application of the NO-OX-ID grease, heated to a liquid form and applied with a small paintbrush.
6. Reinstall and tighten connections to appropriate re-torque value.

CLEANING FLAME ARRESTORS

When cells are overfilled with electrolyte (above the high level line) or are excessively overcharged, the diffuser material of the flame arrestor may become partially clogged from electrolyte spray. Replace all flame arrestors having clogged pores or clean the arrestors as follows:

Immerse the flame arrestor several times in a plastic bucket filled with fresh water. After each immersion, eject the water by vigorous shaking or with an air blast. Following the immersion of 15 flame arrestors, dump and refill the bucket with clean water.

Do not use any cleaning or neutralizing agents in the cleaning water, since any dry residue may clog the pores of the diffuser material.

REPLACING OR ISOLATING A CELL

To replace or isolate a cell for maintenance, follow the procedure below:

1. Arrange to maintain the continuity of the circuit, if required.
2. Unbolt and remove connectors.
3. Remove and replace cell OR isolate the required cell.
4. Reinstall and torque connections according to specified values.

ADDING WATER

Cells on charge normally show a very gradual lowering of the electrolyte level over a period of time; this happens because of loss of water from the electrolyte. Hydrogen and oxygen gasses are liberated by electrolysis as a result of the charging current.

Cells also lose water from normal evaporation at a rate relative to the cell temperature and the humidity.

At regular intervals this water loss must be replaced with distilled, deionized or approved water, so as to maintain the electrolyte level at the mid-point between the high and low level lines marked on the jar while on float.

Cells are equipped with flame arrestors with a filling funnel. Add water through the filling funnel by removing the dust cap, but without removing the flame arrestors from the cell covers.

The best time to add water to the stationary lead-acid battery is when the recharge or equalizing charge is about two-thirds completed. In this condition, the electrolyte should be brought up to the high line. If temperatures may possibly drop below freezing, water should be added at the start of the recharge or equalizing charge to ensure thorough mixing with the acid solution.

FREQUENCY

A minimum of once a year is mandatory for maintenance by a qualified technician (service company).

Monthly Checks

- Float voltage measured at the battery terminals
- General appearance and cleanliness of the battery, battery rack or battery cabinet, and the battery area
- Charger output amps and volts
- Electrolyte levels
- Cracks in cells or evidence of electrolyte leakage
- Evidence of corrosion at terminals, connectors, racks, or cabinets
- Ambient temperature and condition of ventilating equipment
- Pilot cell voltage, specific gravity and electrolyte temperature
- Evidence of voltage leaks to ground, or unintentional battery grounds
- All battery monitoring systems are operational (if installed)

Quarterly Checks

- For lead-antimony cells, specific gravity of 10% of the cells of the battery (optional for calcium cells), and float charging current
- For technologies other than lead-antimony, if battery float charging current is not used to monitor state of charge, specific gravity (SG) of 10% of the cells
- Voltage of each cell
- Total battery voltage (same if in parallel)
- Temperature of a sample 10% of the battery cells
- Randomly select and check 10% of intercell connection resistances

Annual Checks

- For lead-antimony batteries, specific gravity (SG) of all cells of the battery. If battery is not antimony, if battery float charging current is not used to monitor state of charge specific gravity of all cells of the battery.
- Cell-to-cell and internal resistance test with micro-ohm meter
- Check all bolted connections as indicated in IEEE 450 to see if re-torquing is required - tighten to according specifications if so
- Structural integrity of the battery rack and/or cabinet
- Capacity testing (every 3 years)

- Perform detailed visual inspection of each cell
    - Perform the following steps where applicable for seismic installations:
        - 1) Inspect the battery to verify an intercell spacer is present between each battery jar.
        - 2) Inspect the intercell spacers in place for deterioration (broken, warped, crumbling, etc.).
        - 3) Verify that the space between each of the end-rails and the end battery jars is less than or equal to 3/16 in. or a value specified by the manufacturer.
    - Verify that the electrolyte level of each cell is between the high- and low-level marks imprinted on the cell case
    - Examine the plates in each cell for sulfation
        - NOTE—Sulfation can be detected on the positive plate edges by shining a light source on the plates, which will reflect off the sulfate crystals.
    - Examine the plates in each cell for the proper color that indicates a fully charged battery based on the manufacturer's information.

For VRLA batteries, the recommended maintenance is as follows:

Monthly Checks

- Total system voltage
- Charger output current voltage
- Ambient temperature/ventilation
- Visual inspection

Quarterly Checks

- Temperature of each cell
- Cell internal ohmic readings (impedance)
- Intercell connector resistance (UPS)

Bi-annual Checks

- Individual cell voltages

Annual Checks

- Intercell connector resistance
- Detailed internal visual inspection
- Capacity testing

TESTING

Capacity tests should be completed for new or replacement batteries as part of acceptance testing.

Regularly scheduled inspections include tests for charger voltage, battery current, cell voltages and visual conditions of the cells.

Load testing is highly recommended to check on the batteries influence on the entire building system. It is a measure of the amount of load being withdrawn from the battery. For safety, it is important to verify that the load test leads are clean, in good condition, and connected with sufficient length of cable to minimize the risk of accidental arcing in the vicinity of the battery. Also verify that all connections to load test equipment include appropriate short-circuit protection.

Periodic testing of capacity, cell resistance and intercell resistance done according to IEEE standards. Typically, these tests are only done every 180 or 360 days.

4. RECORDKEEPING

Record keeping documents keep track of battery system conditions and related activities, and help monitor operational or safety related parameters. **Records** should be kept on the premises to document detailed readings of system parameters, pertaining to temperature, if the ventilation is operational, or as they concern hydrogen readings, if applicable. (107.7 maintain records for 3 years). **A log book** should be kept on the premises to document the overall operation, condition, and activities in the battery systems during each shift. Log books and records should be adequately completed on a daily basis. A **maintenance summary sheet** should document the actual maintenance work performed, who performed the work, servicing and testing documentation and other relevant information. Either an electronic or manual version may be used.

The Certificates of Fitness must be available on the premises, as should the original records, and made available to FDNY representatives upon request.

4.1) Sample Inspection Sheet

The inspection log **can** vary for each manufacturer/user but the parameters are similar.

The following inspection sheet may be used as a log book for the inspections.

This form will be accepted as is by the FDNY.
Sample sheet would have similar information to the example below:

Name _____
Date _____
COF Number _____
Phone Number _____
Location of System _____

List	Mark "x" if yes	Note
1. Do you have the means available to notify the FDNY in case of an emergency?	□	If no, speak to your supervisor and obtain such means before working with battery systems.
2. Do you have the means available to notify your supervisor in case of an emergency?	□	If no, obtain such means before starting your duty. (radios, communication devices, etc.)
3. Do you know where main shutoff switches/panels are?	□	If no, obtain such information before working with battery

		systems.
4. **Temperature**: Is ambient temperature within the specified range?	□	If no, contact FSD or service company.
5. Is the battery system room clean, orderly, and spacious enough for maintenance to occur?	□	If no, contact FSD or service company.
6. **Ventilation**: Is it in good working order? Is there any alarm indication at the central station or command center?	□	If no, contact FSD or service company.
7. **Emergency spills**: Is there any evidence of electrolyte leakage? *If NO, mark "x"* Is there sufficient amount of neutralizing agent present?	□ □	If yes, contact FSD or service company. If no, contact FSD or service company.
8. If a hydrogen detector is present, are the readings within the acceptable range?	□	If no, contact FSD or service company immediately, as it is a very hazardous situation.
9. Are all alarms and detection systems in good working order?	□	If no, contact FSD or service company.
10. Is there a readily accessible key to the battery room in the key box that the FDNY can obtain access with?	□	If no, contact FSD or service company.
11. Is signage correctly posted?	□	If no, contact FSD or service company.
12. Is the thermal runaway detection under normal condition (no alarms)?	□	If no, contact FSD or service company.
Comments: Comments (**if no**):		