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NFPA 1221

Public Fire Service Communications

1984

National Fire Protection Association Batterymarch Park, Quincy, MA 02269

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Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

Statement on NFPA Procedures

This material has been developed under the published procedures of the National Fire Protection Association, which are designed to assure the appointment of technically competent Committees having balanced representation. While these procedures assure the highest degree of care, neither the National Fire Protection Association, its members, nor those participating in its activities accepts any liability resulting from compliance or noncompliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

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Standard for the Installation, Maintenance and Use of Public Fire Service Communication Systems

NFPA 1221-1984

1984 Edition of NFPA 1221

This edition of NFPA 1221, *Standard for the Installation, Maintenance and Use of Public Fire Service Communication Systems*, was prepared by the Technical Committee on Public Fire Service Communications, and acted on by the National Fire Protection Association, Inc. at its Fall Meeting held November 14-17, 1983 in Orlando, Florida. It was issued by the Standards Council on December 8, 1983, with an effective date of December 28, 1983, and supersedes all previous editions.

This 1984 edition of this standard was approved by the American National Standards Institute.

Origin and Development of NFPA 1221

This standard is the latest in a long series of editions dating back to 1898. Originally, it was part of a general standard on signaling systems but this material on municipal fire alarm systems was separated from the general standard in 1911. This standard has been revised and reissued in editions dated 1904, 1911, 1926, 1934, 1940, 1941, 1946, 1948, 1949, 1950, 1952, 1954, 1955, 1956, 1962, 1963, 1964, 1967, 1973, 1975, 1978, and 1980.

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This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

NOTE: Membership on a Committee shall not in and of itself constitute an endorsement of the Association or any document developed by the Committee on which the member serves.

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Standard for the Installation, Maintenance and Use of Public Fire Service Communication Systems

NFPA 1221-1984

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A or B.

For information on referenced publications, see Chapter 5.

Chapter 1 Fundamentals

1-1 Scope.

1-1.1 This standard covers the installation, maintenance and use of all public fire service communication systems and facilities. This standard is not intended as a design specification nor as an instruction manual.

1-1.2 These systems and facilities include, but are not limited to, public reporting, dispatching, telephone, and both two-way and microwave radio systems, all of which fulfill two principal functions: that of receiving fire alarms or other emergency calls from the public and that of retransmitting these alarms and emergency calls to fire companies and other interested agencies.

1-1.3 Fire alarm systems on private premises from which signals are received directly or indirectly by the Communication Center are covered by NFPA 71, *Standard for Central Station Signaling Systems*; NFPA 72A, *Standard for Local Protective Signaling Systems*; NFPA 72B, *Standard for Auxiliary Protective Signaling Systems*; NFPA 72C, *Standard for Remote Station Protective Signaling Systems*; NFPA 72D, *Standard for Proprietary Protective Signaling Systems*; and NFPA 74, *Standard for Household Fire Warning Equipment*.

1-1.4 A system or device having materials, methods of operation or forms different from those detailed in this standard, when examined and tested by the authority having jurisdiction according to the intent of the requirements and if found satisfactory, shall be judged the equivalent.

1-2 Management.

1-2.1 The system shall be under the control of a responsible jurisdiction employee.

1-3 Definitions. When the words defined in this section are used in this standard they have the meaning described below.

Alarm. A signal or message from a person or device indicating the existence of a fire or other emergency which requires fire department action.

Approved. Acceptable to the authority having jurisdiction.

NOTE: The National Fire Protection Association does not approve, inspect or certify any installations, procedures, equipment or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations which is in a position to determine compliance with appropriate standards for the current production of listed items.

Authority Having Jurisdiction. The "authority having jurisdiction" is the organization, office, or individual responsible for "approving" equipment, an installation, or a procedure.

NOTE: The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner since jurisdiction and "approval" agencies vary as do their responsibilities. Where public safety is primary, the "authority having jurisdiction" may be a federal, state, local, or other regional department or individual such as a fire chief, fire marshal, chief of a fire prevention bureau, labor department, health department, building official, electrical inspector, or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the "authority having jurisdiction." In many circumstances the property owner or his designated agent assumes the role of the "authority having jurisdiction"; at government installations, the commanding officer or departmental official may be the "authority having jurisdiction."

Auxiliary Alarm System. A system connected to the municipal fire alarm system to transmit an alarm of fire to the Communication Center. Fire alarms from an auxiliary alarm system are received at the Communication Center on the same equipment and by the same alerting methods as alarms transmitted from the boxes located on streets.

Box. A manually operated device used to send an alarm in event of an emergency.

Box Battery. The battery supplying power for an individual box where radio is used for the transmission of box alarms.

CAD (Computer Assisted Dispatching). A dispatching method or process, in which a computer and its associated terminal(s) is/are utilized to provide relative dispatch data (i.e., running assignments, address locations, equipment status, utility locations, special hazards, etc.) to the concerned dispatcher(s)/operator(s).

Circuit. The conductor, or radio channel, and associated equipment used to perform a definite function in connection with a fire alarm system. Specific types of circuits are defined below.

(a) *Box Circuit.* A circuit connected to boxes which transmit an alarm to the Communication Center. In Type B systems, box circuits usually connect to receiving equipment at fire stations.

(b) *Dispatch Circuit.* A circuit over which alarms are retransmitted automatically or manually from the Com-

munication Center to fire stations. (Formerly called Alarm Circuits.)

(c) *Local Circuit.* A circuit upon which the receipt of alarms over box circuits or retransmission of alarms over dispatch circuits does not depend.

(d) *Tie Circuit.* A circuit connecting a Communication Center and a Satellite Communication Center.

Common Battery. The battery used to power recorders, transmitters, relays and other Communication Center equipment and, if used, Satellite Communication Center equipment. This battery may also be used with Form 4 power supply. Common battery is also termed local or master.

Communication Center. The building or portion of a building used to house the central operating part of the fire alarm system; usually the place where the necessary testing, switching, receiving, retransmitting and power supp'/ devices are located.

Concentrator-Identifier. A facility for switching signals from box circuits over a smaller number of circuits to a fire alarm switchboard and identifying the operated box.

Converter. Any mechanical or electrical device that changes alternating current to direct current or changes direct current voltage to a higher or lower voltage, the latter commonly referred to as a direct current to direct current converter.

CRT. A general term used to abbreviate "Cathode Ray Tube," but as used in this standard is considered to include other display devices providing comparable functional capabilities.

Dynamotor. A machine which combines both motor and generator action in one magnetic field, either with two armatures or one armature having two separate windings.

Emergency. Any condition endangering, or thought to be endangering, life or property.

Engine-Driven Generator. A generator driven by an internal combustion engine.

Fire Station. A building occupied by mobile apparatus of the fire department. It may also include locations where other emergency equipment is housed.

Frequency (Radio). A frequency useful for radio transmission.

NOTE: The present practicable limits of radio frequency are roughly 10 kilohertz to 100,000 megahertz. Within this frequency range, electro-magnetic radiation may be detected and amplified as an electric current at the wave frequency.

Inverter. Any mechanical or electrical device that changes direct current to alternating current.

Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Line Battery. The battery used with Forms 2 and 3 power supply to power the individual box and alarm circuits.

Listed. Equipment or materials included in a list published by an organization acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The "authority having jurisdiction" should utilize the system employed by the listing organization to identify a listed product.

Master Box. A box that may also be operated by remote means.

Motor-Generator. A machine which consists of a generator driven by an electric motor.

Municipality. Any governmental unit, such as a county, city, town or fire protection district.

Operator. A trained person in the Communication Center who receives and retransmits an alarm.

Operations Room. The room in the Communication Center where alarms are received and retransmitted.

Parallel Telephone System. A telephone system in which an individual wired circuit is used for each box.

Power Source. The power obtained from the utility distribution system, an engine-driven generator or battery.

Power Supply. A device that receives its input power from a power source and converts the input power to the alternating current or direct current voltage(s) required to operate the system.

Public Reporting System. A system of alarm initiating devices, receiving equipment and connecting circuits (other than a public telephone network) used to transmit alarms from street locations to the Communication Center.

(a)* *TYPE A — PUBLIC REPORTING SYSTEM.* A system in which an alarm from a fire alarm box is received and is retransmitted to fire stations either manually or automatically.

(b)* *TYPE B — PUBLIC REPORTING SYSTEM.* A system in which an alarm from a fire alarm box is automatically transmitted to fire stations and, if used, to outside alerting devices.

Radio Channel. A band of frequencies of a width sufficient to permit its use for radio communication.

NOTE: The width of the channel depends upon the type of transmission and the tolerance for the frequency of emission. Normally allocated for radio transmission in a specified type of service or by a specified transmitter.

Rectifier. A device without moving parts which changes alternating current to direct current.

Repeater. A combination of apparatus for receiving either one-way or two-way communication signals and delivering corresponding signals that are either amplified or reshaped or both.

Satellite Communication Center or "Satellite." The building used to house part of the control equipment of a fire alarm system.

Series Telephone System. A telephone system in which a wired circuit is used to connect several boxes in series.

Solar Cell. A device that converts light or other radiant energy into electrical energy.

Self-Powered Box. A coded radio box which incorporates a self-contained power source capable of supplying or generating all power required for transmission of signals.

Shall. Indicates a mandatory requirement.

Should. Indicates a recommendation or that which is advised but not required.

Supervision. The monitoring of circuits and other system components to reveal defects or faults that would interfere with receipt or transmission of an alarm.

Tamper Signal. A distinctly identifiable signal required to be transmitted from all coded radio type boxes, when:

(a) Any attempt is made to gain unauthorized access to any part(s) of the box, not normally publicly accessible.

(b) Any time a box is struck or vibrated to the extent that the normal access to or operation of the box is impeded or endangered.

Terminal. Used in this standard in relation to CAD Systems/Networks, the word Terminal refers to an electronic device which combines a keyboard and CRT, allowing an interchange of information between a dispatcher/operator and one or more computers in the system/network.

Trouble Signal. A signal which indicates an abnormal condition.

Trunk Line. A telephone line or channel between telephone central offices or switching devices including lines to the fire alarm telephone switchboard.

User-Powered Box. A coded radio box utilizing power generated by the action of the user.

Chapter 2 General Requirements, Communication Centers and Fire Stations

2-1 Communication Center (Primary or Satellite).

2-1.1 Location.

2-1.1.1 If the building is located within 150 ft (46 m) of another structure, special attention shall be given to guard against damage from such exposure by protecting openings, and by constructing the roof to resist damage which might be caused by falling walls.

2-1.1.2 A Communication Center shall not be located below grade unless the structure is specifically designed for such a location. The floor elevation shall be above the 100-year flood plain prediction.

2-1.2 Construction.

2-1.2.1 The structure shall be designed and constructed in consideration of seismic and wind loads prevalent in its geographic location, and based on the requirements set forth in the applicable building codes.

2-1.2.2 The Communication Center shall be located in buildings classified as Fire-Resistive Construction, or Protected Noncombustible/Limited-Combustible Construction as defined by NFPA 220, *Standard Types of Building Construction*.

2-1.2.3 A Communication Center located in buildings of Unprotected Noncombustible/Limited-Combustible or Ordinary Construction as defined by NFPA 220, *Standard Types of Building Construction*, is acceptable if provided with a Class A fire-resistive roof covering and a sprinkler system in all areas of the building except the Communication Center and power room. The sprinkler system shall be completely supervised by the Communication Center.

2-1.2.4 When the building is occupied for purposes other than fire communications, the Communication Center shall be separated from the other portions of the building by vertical and horizontal separations having a fire resistance rating of at least 2 hrs. Openings shall be protected by self-closing or automatic fire doors or other assemblies having a fire resistance rating at least equal to that of the construction but not less than 1½ hour fire rating. If spaces adjoining the Communication Center are occupied by "Ordinary Hazard Occupancies," as defined in NFPA 13, *Standard for Installation of Sprinkler Systems* they shall be provided with an automatic fire alarm system, and if such spaces are occupied by "Extra Hazard Occupancies" as defined therein, they shall be provided with an automatic sprinkler system.

2-1.2.5 Interior finish material shall have a flame spread rating of 25 or less.

2-1.2.6 The Communication Center and other buildings housing essential operating equipment shall be protected against damage due to vandalism and civil disturbances. In Communication Centers constructed on the first floor of a building, with the floor at exterior grade level, direct exterior windows shall not be permitted. Entryways leading directly from the exterior shall be protected by two doors and a vestibule.

NOTE: Entry to the Communication Center shall be restricted to authorized persons only. The door openings shall be protected by not less than a Class B self-closing fire door assembly.

2-1.3 Utilities.

2-1.3.1 Warm air heating, ventilating, and air conditioning shall be by independent systems serving only the Communication Center.

2-1.3.2 No main water, sewer, storm sewer, or sprinkler lines shall pass through the Communication Center or Communication Center equipment rooms.

2-1.4 Fire Protection.

2-1.4.1 The Communication Center shall be provided with fire extinguishers to meet the requirements of NFPA 10, *Standard for Portable Fire Extinguishers*. There shall be at least two extinguishers having 2-A or greater ratings and two extinguishers having a combined rating of 20-B:C or greater; in lieu of these, two multipurpose extinguishers having 2-A:10-B:C ratings may be provided.

2-1.4.2 The Communications Center shall be provided, in its entirety, with an automatic fire alarm system connected to an audible and visual warning device at a location where someone is always on duty.

2-1.5 Emergency Lighting.

2-1.5.1 The Communication Center shall be equipped with an emergency lighting system which can be immediately placed in service and which shall be independent of the source normally used for lighting purposes. Illumination shall be great enough to permit all necessary operations.

2-1.5.2 In addition to the requirement of 2-1.5.1, the Communication Center shall be equipped with not less than one self-charging, battery pack lantern that automatically lights when power is interrupted.

2-1.6 Power.

2-1.6.1 General.

2-1.6.1.1 Two sources of power shall be provided, under all conditions, for operation of the communications network together with supporting related systems and equipment.

2-1.6.1.2 Power circuits, together with their associated motors, generators, rectifiers, transformers, fuses and controlling devices, shall be in accordance with the requirements of NFPA 70, *National Electrical Code®*.

2-1.6.1.3 The conductors of the power supply circuit shall be connected to the line side of the main service of a commercial light or power supply circuit or to the main conductors of an isolated power plant located on the premises except as permitted in 2-1.6.1.4. The circuit disconnecting means shall be so installed that it would be accessible only to authorized personnel.

2-1.6.1.4 Power may be obtained from the load side of the main disconnect switch only when buildings are for the exclusive housing of fire alarm and other emergency facilities.

2-1.6.1.5 Circuit protection, enclosed in a locked or sealed cabinet located immediately adjacent to the point of connection to the light and power conductors, shall be provided in series with each ungrounded conductor.

2-1.6.2 Power Source. The two sources of power for the Communication Center that are considered acceptable are:

(a)* One circuit from a utility distribution system and a second from an engine-driven generator and a standby storage battery having a 4-hr capacity. All standby storage batteries incorporated into a power source network shall be equipped with suitable chargers (float or trickle).

(b)* Two circuits from separate utility distribution systems, so serviced or connected that normal supply to one will not be affected by trouble which would put the other out of service. This would require supply from two building services on entirely separate distribution networks from independent generating stations.

(c)* Two engine-driven generators with one unit supplying normal system power and the other unit serving as standby with facilities to apply its power to the line within 30 seconds. A standby, storage battery having a 4-hr capacity shall be provided. All standby storage batteries incorporated into a power source network shall be equipped with suitable chargers (float or trickle). If two engine-driven generators are used as a second source of power, the fire alarm system 4-hr battery may be omitted.

2-1.6.3 Power Supply.

2-1.6.3.1 Local circuits at Communication Centers shall be supplied either in common with box or dispatch circuits or by a separate power source. The source of power for local circuits on which the operation of essential features of the system depends shall be supervised.

2-1.6.3.2 Visual and audible means to indicate a 15 percent or greater reduction of normal power supply (rated voltage) shall be provided.

2-1.6.4 Rectifiers, Converters, Inverters, Motor-Generators.

2-1.6.4.1 Rectifiers shall be supplied through an isolating transformer taking energy from a circuit not to exceed 250 volts.

2-1.6.4.2 Complete, ready-to-use spare units, or spare parts, shall be available in reserve.

2-1.6.4.3 One spare rectifier shall be provided for each ten required for operation but in no case less than one.

2-1.6.4.4 Leads from rectifiers or motor-generators, with storage battery floating, shall have fuses rated at no less than 1 ampere and not more than 200 percent of maximum connected load. Where not provided with battery floating, the fuse shall be not less than 3 amperes.

2-1.6.5 Engine-Driven Generator Sets.

2-1.6.5.1 The provisions of this section shall apply to generators driven by internal combustion engines.

2-1.6.5.2 The installation of such units shall conform to the provisions of NFPA 37, *Standard for Stationary Combustion Engines and Gas Turbines*, except as restricted by the provisions of this section.

2-1.6.5.3 The unit shall be located in an adequately ventilated, cutoff area of the building housing the Communication Center equipment; the room shall be used for no other purpose except storage of spare parts or equipment. Exhaust fumes shall be discharged directly outside the building.

2-1.6.5.4 Liquid fuel shall be stored in outside underground tanks and gravity feed shall not be used. Sufficient fuel shall be available for 12 hrs of operation at full load if a reliable source of supply is available, at any time, on 2 hrs' notice. If a source of supply is not reliable or readily available, or if special arrangements must be made for refueling as necessary, a supply sufficient for 24 hrs of operation at full load shall be maintained.

2-1.6.5.5 Liquefied petroleum gas and natural gas installations shall meet the requirements of NFPA 58, *Standard on Liquefied Petroleum Gases*, and NFPA 54, *National Fuel Gas Code*.

2-1.6.5.6 The unit shall be of sufficient capacity to supply power at least for operating all fire alarm facilities, and emergency lighting of the operating rooms or communications building.

2-1.6.5.7 A separate storage battery on automatic float charger shall be provided for starting the engine-driven generator.

2-1.6.6 Batteries.

2-1.6.6.1 Batteries shall be of the storage type; primary batteries (dry cells) shall not be used. All cells shall be of the spill-proof type, adequately vented and, as applicable, equipped with explosion inhibiting caps. Lead-acid batteries shall be in jars of glass or other suitable transparent materials; other types of batteries shall be in containers suitable for the purpose.

2-1.6.6.2 Batteries shall be located in the same building as the operating equipment, preferably on the same floor, readily accessible for maintenance and inspection. The battery space shall not be located below grade unless the structure is specifically designed for such a location, and shall be ventilated to prevent accumulation of explosive gas mixtures.

2-1.6.6.3 Batteries shall be mounted in such a manner as to provide effective insulation from the ground and from other batteries. The mounting shall be suitably protected against deterioration and consideration shall be given to stability, especially in territory subject to seismic disturbance.

2-1.6.6.4 Battery leads of both polarities shall not be in the same conduit, tubing, or cable between the battery terminals and fuses.

2-1.7 Electrical Wiring.

2-1.7.1 Circuit Conductors — General.

2-1.7.1.1 Wires shall be terminated so as to provide good electrical conductivity and prevent breaking from vibration or stress.

2-1.7.1.2 Circuit conductors on terminal racks shall be identified and isolated from conductors of other systems whenever possible and shall be suitably protected from mechanical injury.

2-1.7.1.3 All conduits or ducts entering buildings from underground duct systems shall be effectively sealed against moisture or gases entering the building.

2-1.7.1.4 Aerial wires to buildings shall contact only intended supports and shall enter through an approved weatherhead or suitable sleeves slanting upward and inward. Drip loops shall be formed on wires outside of buildings.

2-1.7.2 Wiring Inside Buildings.

2-1.7.2.1 At the Communication Center, conductors shall extend as directly as possible to the operating room in conduits, ducts, shafts, raceways or overhead racks and troughs of a type of construction affording protection against fire and mechanical injury.

2-1.7.2.2 All conductors inside buildings shall be in conduit, electrical metallic tubing, metal molding, or raceways. Installation shall be in accordance with NFPA 70, *National Electrical Code*.

2-1.7.2.3 Conductors shall have an approved insulation; the insulation or other outer covering shall be flame-retardant and moisture-resistant.

2-1.7.2.4 Conductors shall be installed as far as possible without joints. Splices will be permitted only in junction or terminal boxes. Wire terminals, splices and joints shall conform with NFPA 70, *National Electrical Code*.

2-1.7.2.5 Conductors bunched together in a vertical run connecting two or more floors shall have a flame-retardant covering sufficient to prevent the carrying of fire from floor to floor. This requirement shall not apply if the conductors are encased in a metallic conduit, or located in a fire-resistive shaft having fire stops at each floor.

2-1.7.2.6 Where cables or wirings are exposed to unusual fire hazards, they shall be properly protected.

2-1.7.2.7 Cable terminals and cross-connecting facilities shall be located in or adjoining the operations room.

2-1.7.2.8 When signal conductors, and electric light and power wires are run in the same shaft, they shall be separated by at least 2 in. (50 mm), or either system shall be encased in a noncombustible enclosure.

2-1.8 Staffing.

2-1.8.1 Number of Operators.

2-1.8.1.1 The number of operators shall be as follows:

(a) For jurisdictions receiving less than 600 alarms per year, alarms not retransmitted automatically shall be received and retransmitted to the fire force by a responsible and competent person always on duty for the purpose, as follows:

1. A specially designated person or persons, an employee of the local telephone company, or

2. A member of another jurisdictional agency, or

3. The house watch at a fire station, with facilities for transfer of service to another jurisdictional agency if the house watch responds to fires.

(b) For jurisdictions receiving from 600 through 2,500 alarms per year, at least one operator, especially trained for the service, shall be on duty at all times.

(c) For jurisdictions receiving more than 2,500 alarms per year, at least two fully trained and competent operators shall be on duty at all times.

(d) Additional operators and supervisors shall be provided as warranted by the actual traffic.

(e) The number of operators required to be on duty shall be increased to the satisfaction of the authority having jurisdiction when operators are expected to perform duties not directly connected with the receipt and transmission of fire alarms and other emergency traffic, except as otherwise provided in this standard.

(f) The number of operators required to be on duty shall be increased to the satisfaction of the authority having jurisdiction to handle peak traffic loads of a seasonal or temporary nature, such as brush fire periods, civil unrest, etc.

2-1.8.1.2 The operators shall be at the Communication Center and be capable of operating and testing the system unless other qualified persons are on duty and assigned to test the system.

2-1.8.2 Qualifications.

2-1.8.2.1 Operators shall be in good health and free from disabling physical and mental defects that would affect their ability to efficiently handle the duties assigned. They shall be temperamentally suited to the position, including being able to remain calm and take decisive action during emergencies, to remain alert during periods of inactivity and when carrying out normal repetitive operations, and to work harmoniously with other persons.

2-1.8.2.2 Operators shall be familiar with general fire department operations, and shall have access to information regarding the locations of streets, important structures including schools, hospitals and other buildings with a high life hazard, and congested and/or hazardous areas.

2-1.8.2.3 Operators shall have a working knowledge of the fire alarm system and shall be capable of making the prescribed tests. They shall be familiar with rules and regulations relating to equipment in use, including those of the Federal Communications Commission pertaining to radio.

2-1.9 Operating Practices.

2-1.9.1 Emergency calls, however received, shall be appropriately recorded and tabulated to indicate the origin of the call.

2-1.9.2 In cases where the Communication Center is not the primary answering agency for fire calls, the answering agency shall transfer the call directly to the fire alarm operator and remain on the line until assured that the transfer is effected. This transfer procedure shall be used instead of relaying the information to the operator.

2-1.9.3 All emergency alarms, including requests for multiple alarms, shall be transmitted to the proper fire department companies over the required dispatch circuit or circuits conforming to Chapter 3 of this standard.

2-1.9.4 An accurate indication of the status of all fire companies, i.e., in the station available for response, out of service at a fire, out of service due to other reasons, shall be readily available to the operators at all times.

2-1.9.5 Dispatch of apparatus in response to emergency calls shall be recorded. Records shall indicate companies and supervisory officers for first and subsequent alarms, time of acknowledgment by companies, time of arrival at scene and time back in service.

2-1.9.6 An audible warning or alerting signal, typically a distinctive tone or tones, shall precede any alarm transmitted by voice.

2-1.9.7 The first fire company arriving at the location of the alarm shall give a brief preliminary report on condition observed to the Communication Center.

2-1.9.8 All fire communications equipment shall be restored to normal condition as promptly as possible after each alarm in which the equipment functioned.

2-1.9.9 A report of operations summarizing important statistics shall be prepared annually.

2-1.10 Equipment Testing.

2-1.10.1 General.

2-1.10.1.1 Testing facilities shall be installed at the Communication Center and each Satellite Communication Center, if used, except that, if satisfactory to the authority having jurisdiction, those facilities for systems leased from a nonmunicipal organization may be located elsewhere.

2-1.10.1.2 Tests and inspections shall be made at intervals not less frequent than those specified in this standard.

2-1.10.2 Power.

2-1.10.2.1 An emergency power source other than batteries shall be operated to supply the system for a continuous period of 1 hr at least weekly. This test shall require simulated failure of the normal power source.

2-1.10.2.2 Periodic tests shall be performed to ensure that the batteries are capable of supplying the system with power when required to do so. The required tests and the maximum interval at which they are to be performed are as follows:

(a) For lead acid batteries:

	Maximum Interval
Measure Float Voltage	
Of entire battery or a pilot cell	1 week
Of each cell	3 months
Measure Specific Gravity	
Of a pilot cell	6 weeks
Of each cell	6 months
Discharge for 2 hours	1 year
Clean and Inspect	3 months
Calibrate Meters	1 year

To maximize battery life the battery voltage for lead acid cells shall be maintained within the limits shown in the table below:

Float Voltage	High Gravity Battery (Lead Calcium)	Low Gravity Battery (Lead Antimony)
Max.	2.25 volts/cell	2.17 volts/cell
Min.	2.20 volts/cell	2.13 volts/cell

High rate voltage 2.33 volts/cell.

NOTE: Both high and low gravity voltage is (+)0.07 volts and (-)0.03 volts.

(b)* For nickel cadmium batteries:

	Maximum Interval
Measure Float Voltage (1.42 volts per cell nominal)	
Of entire battery	3 months
Of each cell	1 year
Check State of Charge	6 months
Discharge for 2 hours	1 year
Clean and Inspect	3 months
Calibrate Meters	1 year

To maximize battery life the battery shall be charged as follows:

Float Voltage	1.42 volts/cell ± .01 volts
High Rate Voltage	1.58 volts/cell + .07 - 0.00

2-1.11 Maintenance.

2-1.11.1 When maintenance is provided by an organization or person other than the jurisdiction or its employees, complete written records of the installation, maintenance, test, and extension of the system shall be forwarded to the responsible jurisdiction employee as soon as possible. Notice of failure and restoration of service shall be made immediately to the responsible jurisdiction employee.

2-1.11.2 Maintenance by an organization or person other than the jurisdiction or a jurisdiction employee shall be by written contract, guaranteeing performance acceptable to the authority having jurisdiction.

2-1.12 Records.

2-1.12.1 Complete records, sufficient to assure reliable operation of all alarm system functions, shall be maintained in a satisfactory manner.

2-1.12.2 A complete record shall be kept by the municipality of all test and alarm signals, all circuit interruptions and observations or reports of apparatus failures or derangements, and all seriously abnormal or defective circuit conditions indicated by test or inspection; these records shall include the date and time of all occurrences.

2-1.12.3 When a combination of leased/owned facilities exists, records required to be maintained by the lessor for the municipality shall be specified.

2-1.12.4 A report of operations summarizing important statistics shall be prepared annually.

2-1.12.5 Records of wired circuits (box and dispatch) shall include: outline plans showing terminals and box sequence; diagrams of office wiring; materials including trade name, manufacturer and year of purchase or installation.

2-1.12.6 Emergency generating equipment periodic test records shall include: date and time; fuel, electrical, coolant and exhaust system conditions; and operating time.

2-1.13 Telephone Receiving Equipment.

2-1.13.1 Commercial Telephone.

2-1.13.1.1 General.

(a) The provisions of this section apply to the facilities necessary to receive alarms transmitted by citizens using the commercial telephone system.

(b) The provisions of this section shall apply regardless of whether other reporting systems are provided.

2-1.13.1.2 Directory Listing.

(a) A specific telephone number shall be assigned for fire alarm emergency service with a separate number assigned for normal fire department business. Telephone directory listings shall be as follows:

1. On the inside front cover of the white pages directory:

FIRE (Symbol optional) .....(FIRE NUMBER)

In the white pages directory:
FIRE DEPARTMENT
To report a fire.....(FIRE NUMBER)
Nonfire purposes .....(business number)

2. The fire department listing shall also appear in the white pages directory under the name of the municipality.

3. If the directory covers an area which is protected by more than one fire department or fire protection district, each such department or district shall be listed as outlined above.

4. Telephones installed in fire stations shall not be listed in the telephone directory.

(b) Where suitable arrangements have been made for the receipt and handling of all emergency calls for fire, police, ambulance, etc., at a single Communication Center, such as through the use of the national emergency number 911, the directory listing shall be appropriate.

2-1.13.1.3 Equipment and Operations.

(a) At the Communication Center, at least one telephone line shall be assigned for fire alarm emergency calls; in larger municipalities additional lines shall be so assigned. The number of lines shall depend upon the traffic handled.

NOTE: Additional telephone lines should be provided responsive to the business number as required.

(b) In addition to the above, at least one unlisted line shall be provided.

(c) For manual switching-type telephone systems, connections to assigned lines shall be made only for fire reporting. Where dial system service is used, provisions shall be made for automatically selecting the assigned emergency lines first and progressing to the general business lines when the emergency number is dialed, but the assigned lines shall not be made responsive to a dialing of the general business numbers.

(d) In cases where the Communication Center is not the primary answering agency for fire calls, the answering agency shall transfer the call directly to the fire alarm operator and remain on the line until assured that the transfer is effected. This transfer procedure shall be used instead of relaying the information to the operator.

(e) Fire calls received by telephone shall be recorded automatically and the receiving equipment shall be provided with capability of instant playback. Nonvoice alarms shall be graphically recorded.

(f) A voice recording facility shall be provided for each operator handling incoming alarms in order to eliminate the possibility of interference.

(g) Facilities shall be provided which will automatically record the time of receipt of each alarm.

(h) Where only one operator is on duty, if an incoming telephone call is not answered within 1 minute, a trouble indication shall be automatically transmitted to a location acceptable to the authority having jurisdiction.

(i) Where private fire alarm equipment arranged to automatically transmit a signal to the fire department over commercial telephone facilities is in use, a separate unlisted telephone line(s) shall be used to receive such signals. The private equipment shall not be permitted to automatically connect to the telephone lines required by 2-1.13.1.2(a), 2-1.13.1.3(a), or 2-1.13.1.3(b).

2-1.13.1.4 Supervision. Where the service is available, no less than 50 percent, but at least one, of the fire reporting trunk lines between the telephone company central office and the Communication Center shall be supervised. Supervision shall be in accordance with the provisions of 3-2.6.

2-1.13.2* Universal Emergency Number 911 Service.

2-1.13.2.1 General. Universal emergency number 911 service, where provided, shall meet the minimum requirements as specified in this section.

2-1.13.2.2 Circuits. At least two incoming 911 circuits shall be provided to each Communication Center or Public Safety Answering Point (PSAP) location, as applicable. These circuits shall have diverse routes.

If the Communication Center and PSAP are not located in a common facility, there shall be at least two tie circuits provided between the PSAP and each fire Communication Center served by said PSAP. Supervision of the tie circuits, when utilized, shall be consistent with the provisions of 2-1.13.1.4.

2-1.13.2.3 Circuit Protection. All conductors entering the PSAP shall be protected with devices, in the order named, starting from the exterior, as follows:

(a) A fuse rated at 3 amp minimum to 7 amp maximum and not less than 2000 volts;

(b) A lightning arrester; and

(c) A fuse or other device, such as a heat coil, rated at not more than ½ ampere; or

(d) Where the design of the equipment is such that other type protection is necessary, the recommendation of the manufacturer shall be followed.

2-1.13.2.4 Power Source. The PSAP location shall be powered by:

(a) A source which is not susceptible to variations in the utility distribution system.

(b) A source which is backed up by an emergency power source.

NOTE: Form 2B, a rectifier or motor-generator powered from two sources of alternating current, with a floating storage battery having a 4-hr standby capacity, is acceptable for this application.

2-1.13.2.5 PSAP Equipment.

(a) The PSAP equipment shall be capable of operating for 4 hrs in the event of temporary primary power source outages.

(b) Voice recording interfaces shall be provided on all incoming circuits.

(c) The PSAP equipment shall be designed such that an equipment failure shall not prevent calls from being

answered. Under failure conditions, the full feature complement does not have to be maintained; however, the calling party must be able to communicate with an attendant.

(d) The PSAP equipment shall be designed so that it can be manually forced (at the PSAP location by simulating a component failure) to operate in the failsafe mode.

2-1.13.2.6 Testing.

(a) *Power Source.* The power source shall be tested in accordance with 2-1.10.2.

(b) *Incoming Circuits.* Each incoming circuit shall be given an operational test at least weekly.

(c) *PSAP Equipment.* The PSAP equipment shall be operated in the failsafe mode at least weekly.

2-2 Fire Stations.

2-2.1 Power. Power for operating the necessary alarm receiving equipment shall meet the provisions of 2-1.6.

2-2.2 Electrical Wiring. Electrical wiring shall meet the provisions of 2-1.7.

2-2.3 Equipment Testing. Testing shall be conducted in accordance with the provisions of 2-1.10.

2-2.4 Telephones.

2-2.4.1 There shall be a telephone at each fire station.

2-2.4.2 Where there is no other means of voice communications with fire stations, the telephones at fire stations shall be arranged so that they cannot be called by the public except:

(a) Through a common switching point in the Communication Center, and

(b) Where there is but one fire station in the community.

NOTE: This is not meant to apply to the office of the chief and other executive officers or to the Communication Center which may be housed in a fire station.

2-2.5 Boxes at Fire Stations.

2-2.5.1 When no fire alarm box or public telephone is readily accessible at a fire station, a sign shall indicate the nearest means of alerting the fire station.

Chapter 3 Dispatching Systems

3-1 Fundamental Requirements of Fire Alarm Dispatching Systems.

3-1.1 General.

3-1.1.1 A fire alarm dispatching system shall be designed, installed, operated and maintained so as to provide the maximum practicable reliability for transmission and receipt of fire alarms.

3-1.1.2 Transmission of Other Signals.

3-1.1.2.1 A fire alarm dispatching system may be used for the transmission of other signals or calls of a public emergency nature provided such transmission does not interfere with the transmission and receipt of fire alarms.

3-1.1.2.2 When the system is used as a communications network for other agencies of the jurisdiction, the fire alarm operator shall not be required to take action or responsibility for routine calls, when the number of routine calls interferes with the proper handling of fire alarms.

3-1.2 Equipment and Installation.

3-1.2.1 All devices and equipment constructed and installed under this standard shall be suitable for the purpose for which they are intended.

3-1.2.2 All systems shall be installed in a workmanlike manner in accordance with the established practices and applicable requirements of this standard.

3-1.2.3 All the devices shall be designed to function satisfactorily under the climatic conditions to which they will be exposed.

3-1.2.4 Upon completion of a system installation, a satisfactory test of the entire equipment shall be made in the presence of the authorized representative of the purchaser and, if required by the authority having jurisdiction, in the presence of its representative.

3-1.2.5 All apparatus shall be restored to normal condition as promptly as possible after each test or alarm in which the apparatus functioned.

3-1.3 Dispatch Circuits — General.

3-1.3.1 Two separate dispatch circuits shall be provided for transmitting alarms, except as permitted in 3-2.3.2 and 3-1.3.3. A circuit terminating at a telephone instrument only shall not be considered as either of the required dispatch circuits.

3-1.3.2 One dispatch circuit shall consist of one of the following:

(a)* A supervised wired circuit; or

(b)* A radio channel with duplicate base transmitters, receivers, microphones and antennas; or

NOTE: Separate support structures for the duplicate antennas are not required provided the structure is adequately constructed.

(c) A microwave supervised carrier channel; or

(d) A polling or self-interrogating radio or microwave radio system with duplicate base transmitters, and equipment necessary for redundancy; or

(e) A properly arranged, supervised telephone circuit.

3-1.3.3* The second dispatch circuit need not be supervised and may be either a wired circuit or a radio channel. If radio is used as the second dispatch circuit, it need not have duplicate facilities. In those jurisdictions which receive less than 600 alarms per year the second dispatch circuit is not required.

3-1.3.4 If voice transmission is used as a dispatch method, the transmission of an alarm over the circuit used shall be preceded by an audible warning or alerting signal (typically a distinctive tone or tones) to differentiate the alarm from routine traffic.

3-1.3.5 Facilities for retransmitting alarms to fire stations shall be installed at the place where telephone alarms are received.

3-1.3.6 Two separate facilities shall be provided, one of which shall be connected to a supervised dispatch circuit, except as outlined in 3-2.3.2 and 3-1.3.3.

3-1.3.7 The facilities shall include automatic recording of alarms transmitted over the required dispatch circuit(s). Provisions shall be made to automatically record the date and time of transmission.

NOTE 1: Alarms may be transmitted by coded signals, or by signals for graphic or facsimile reproduction.

NOTE 2: Manual entry of date and time by the operator is satisfactory when graphic or facsimile transmission is used.

3-1.3.8 Automatic recording facilities, separate from that used for recording voice alarms from boxes, shall be provided for alarms transmitted by voice.

NOTE: When only one operator is required, a single recording facility may be used for the receipt and transmission of alarms by voice.

3-1.3.9 Devices for transmitting coded or other types of signals shall be arranged for manual setting and operations.

3-1.4 Power.

3-1.4.1 General.

3-1.4.1.1 Power circuits, together with their associated motors, generators, rectifiers, transformers, fuses and controlling devices, shall be in accordance with the requirements of NFPA 70, *National Electrical Code*.

3-1.4.1.2 The conductors of the power supply circuit shall be connected to the line side of the main service of a commercial light or power supply circuit or to the main conductors of an isolated power plant located on the premises except as permitted in 3-1.4.1.3. The circuit disconnecting means shall be so installed that it would be accessible only to authorized personnel.

NOTE: Power may be obtained from the load side of the main disconnect switch only when buildings are for the exclusive housing of fire alarm and other emergency facilities.

3-1.4.1.3 Circuit protection, enclosed in a locked or sealed cabinet located immediately adjacent to the point of connection to the light and power conductors, shall be provided in series with each ungrounded conductor.

3-1.4.2 Power Source. Each dispatch circuit or radio dispatch channel, and related alarm transmitting or receiving devices, including equipment at stations needing local power for operation, shall be provided with two sources of power. The two sources of power considered acceptable are:

(a)* One circuit from a utility distribution system and a second from an engine-driven generator and a standby battery having a 4-hr capacity.

(b)* Two circuits from separate utility distribution systems, so serviced or connected that normal supply to one will not be affected by trouble which would put the other out of service. This would require supply from two building services on entirely separate distribution networks from independent generating stations.

(c)* Two engine-driven generators with one unit supplying normal system power and the other unit serving as standby with facilities to apply its power to the line within 30 seconds. A standby, storage battery having a 4-hr capacity shall be provided. If two engine-driven generators are used as a second source of power, the fire alarm system 4-hr battery may be omitted.

3-1.4.3 Power Supply.

3-1.4.3.1 The forms and arrangements of power supply shall be classified as described in the paragraphs below.

NOTE: If the equipment required under 2-1.6 is adequate, with regard to electrical service/capacity, to satisfy the needs of the equipment in this section, said equipment need not be duplicated.

3-1.4.3.2 Form 2. Permissible for Type A systems only. Dispatch circuits served in multiple by:

(a)* *Form 2A.* A rectifier or motor-generator powered from a single source of alternating current, with a floating storage battery having a 24-hr standby capacity;

(b)* *Form 2B.* A rectifier or motor-generator powered from two sources of alternating current, with a floating storage battery having a 4-hr standby capacity;

(c)* *Form 2C.* Duplicate rectifier or motor-generator powered from two sources of alternating current with transfer facilities to apply power from the secondary source to the system within 30 seconds (*see 3-1.4.2*). Each rectifier or motor-generator shall be capable of powering the entire system.

NOTE: For forms 2A, 2B and 2C, these arrangements are permissible but are not recommended where circuits are wholly or partly open wire because of the possibility of trouble from multiple grounds.

3-1.4.3.2.1 Batteries, motor-generators or rectifiers shall be sufficient to supply all connected circuits without exceeding the capacity of any battery or overloading any generator or rectifier, so that circuits developing grounds or crosses with other circuits may be supplied each by an independent source to the extent required by 3-1.4.3.2.2 below.

3-1.4.3.2.2 Provisions shall be made in the operating room for supplying any circuit from any battery, generator, or rectifier. Enclosed fuses shall be provided at points where supplies for individual circuits are taken from common leads. Necessary switches, testing and signal transmitting and receiving devices shall be provided to permit the isolation, control, and test of each circuit, to the extent of at least 10 percent of the total number of dispatch circuits, but never less than two.

3-1.4.3.2.3 If common-current source systems are grounded, the ground shall not exceed 10 percent of resistance of any connected circuit and be located at one side of the battery. Visual and audible indicating devices shall be provided for each dispatch circuit to give immediate warning of ground leakage endangering operability.

3-1.4.3.3 Form 3. Each dispatch circuit served by:

(a) *Form 3A.* A rectifier or motor-generator powered from a single source of alternating current with a floating storage battery having a 60-hr standby capacity.

(b) *Form 3B.* A rectifier or motor-generator powered from two sources of alternating current with a floating storage battery having a 24-hr standby capacity.

3-1.4.3.4 Form 4. Each dispatch circuit served by:

(a)* *Form 4A.* An inverter powered from a common rectifier powered by a single source of alternating current, with a floating storage battery having a 24-hr standby capacity;

(b)* *Form 4B.* An inverter powered from a common rectifier receiving power from two sources of alternating current, with a floating storage battery having a 4-hr standby capacity;

NOTE: For Form 4A and Form 4B, it is permissible to distribute the system load between two or more common rectifiers and batteries.

(c)* *Form 4C.* A rectifier, converter or motor-generator receiving power by two sources of alternating current with transfer facilities to apply power from the secondary source to the system within 30 seconds (*see 3-1.4.2*).

3-1.4.3.5 Local circuits at Communication Centers shall be supplied either in common with dispatch circuits or by a separate power source. The source of power for local circuits on which the operation of essential features of the system depends shall be supervised.

3-1.4.3.6 Visual and audible means to indicate a 15 percent or greater reduction of normal power supply (rated voltage) shall be provided.

3-1.4.4 Rectifiers, Converters, Inverters, Motor-Generators.

3-1.4.4.1 Rectifiers shall be supplied through an isolating transformer taking energy from a circuit not to exceed 250 volts.

3-1.4.4.2 Complete, ready-to-use spare units, or spare parts, shall be available in reserve.

3-1.4.4.3 One spare rectifier shall be provided for each ten required for operation but in no case less than one.

3-1.4.4.4 Leads from rectifiers or motor-generators, with storage battery floating, shall have fuses rated at no less than 1 ampere and not more than 200 percent of maximum connected load. Where not provided with battery floating, the fuse shall be not less than 3 amperes.

3-1.4.5 Engine-Driven Generator Sets.

3-1.4.5.1 The provisions of this section shall apply to generators driven by internal combustion engines.

3-1.4.5.2 The installation of such units shall conform to the provisions of NFPA 37, *Standard for Stationary Combustion Engines and Gas Turbines*, except as restricted by the provisions of this section.

3-1.4.5.3 The unit shall be located in an adequately ventilated, cutoff area of the building housing the Communication Center equipment; the room shall be used for no other purpose except storage of spare parts or equipment. Exhaust fumes shall be discharged directly outside the building.

3-1.4.5.4 Liquid fuel shall be stored in outside underground tanks and gravity feed shall not be used. Sufficient fuel shall be available for 12 hrs of operation at full load if a reliable source of supply is available, at any time, on 2 hrs' notice. If a source of supply is not reliable or readily available, or if special arrangements must be made for refueling as necessary, a supply sufficient for 24 hrs of operation at full load shall be maintained.

3-1.4.5.5 Liquefied petroleum gas and natural gas installations shall meet the requirements of NFPA 58, *Standard on Liquefied Petroleum Gases*, and NFPA 54, *National Fuel Gas Code*.

3-1.4.5.6 The unit shall be of sufficient capacity to supply power at least for operating all fire alarm facilities, and emergency lighting of the operating rooms or communications building.

3-1.4.5.7 A separate storage battery on automatic float charger shall be provided for starting the engine-driven generator.

3-1.4.6 Batteries.

3-1.4.6.1 Batteries shall be of the storage type; primary batteries (dry cells) shall not be used. All cells shall be of the spill-proof type, adequately vented and, as applicable, equipped with explosion inhibiting caps. Lead-acid batteries shall be in jars of glass or other suitable transparent materials; other types of batteries shall be in containers suitable for the purpose.

3-1.4.6.2 Batteries shall be located in the same building as the operating equipment, preferably on the same floor, readily accessible for maintenance and inspection. The battery space shall not be located below grade unless the structure is specifically designed for such a location, and shall be ventilated to prevent accumulation of explosive gas mixtures.

3-1.4.6.3 Batteries shall be mounted in such a manner as to provide effective insulation from the ground and from other batteries. The mounting shall be suitably protected against deterioration and consideration shall be given to stability, especially in territory subject to seismic disturbance.

3-1.4.6.4 Battery leads of both polarities shall not be in the same conduit, tubing, or cable between battery terminals and fuses.

3-1.5 Testing.

3-1.5.1 General.

3-1.5.1.1 Tests and inspections shall be made at intervals not less frequent than those specified in this standard.

3-1.5.1.2 Testing facilities shall be installed at the Communication Center and the Satellite Communication Center, if used, except that, if satisfactory to the authority having jurisdiction, those facilities for systems leased from a nonmunicipal organization may be located elsewhere.

3-1.5.1.3 All apparatus shall be restored to normal condition as promptly as possible after each test or alarm in which the apparatus functioned.

3-1.5.1.4 Where supervisory devices or tests indicate that trouble has occurred anywhere on the system, the operator shall take appropriate steps to repair the fault or, if this is not possible, isolate the fault and notify the official responsible for maintenance.

3-1.5.2 Dispatching Systems.

3-1.5.2.1 Manual test of dispatch circuit instruments shall be made and recorded at least once in each 24 hrs. Circuits for transmission of signals graphically shall be tested by a message transmission.

3-1.5.2.2 Outside devices, radio, telephone or other facilities for alerting volunteer and off-duty fire fighters shall be tested daily.

3-1.5.2.3 At least twice daily all wired radio and voice amplification circuits shall be subjected to a talking test.

3-1.5.3 Power.

3-1.5.3.1 Emergency power sources other than batteries shall be operated to supply the system for a continuous period of 1 hr at least weekly. This test shall require simulated failure of the normal power source.

3-1.5.3.2 Periodic tests shall be performed to ensure that the batteries are capable of supplying the system with power when required to do so. The required tests and the maximum interval at which they are to be performed are as follows:

(a) For lead acid batteries:

	Maximum Interval
Measure Float Voltage	
Of entire battery or a pilot cell	1 week
Of each cell	3 months
Measure Specific Gravity	
Of a pilot cell	6 weeks
Of each cell	6 months
Discharge for 2 hours	1 year
Clean and Inspect	3 months
Calibrate Meters	1 year

To maximize battery life the battery voltage for lead acid cells shall be maintained within the limits shown in the table below:

Float Voltage	High Gravity Battery (Lead Calcium)	Low Gravity Battery (Lead Antimony)
Max.	2.25 volts/cell	2.17 volts/cell
Min.	2.20 volts/cell	2.13 volts/cell

High rate voltage 2.33 volts/cell.

NOTE: Both high and low gravity voltage is (+)0.07 volts and (-)0.03 volts.

(b)* For nickel cadmium batteries:

	Maximum Interval
Measure Float Voltage (1.42 volts per cell nominal)	
Of entire battery	3 months
Of each cell	1 year
Check State of Charge	6 months
Discharge for 2 hours	1 year
Clean and Inspect	3 months
Calibrate Meters	1 year

To maximize battery life the battery shall be charged as follows:

Float Voltage	1.42 volts/cell ± .01 volts
High Rate Voltage	1.58 volts/cell + .07 - 0.00

3-1.6 Records.

3-1.6.1 General.

3-1.6.1.1 Complete records, sufficient to assure reliable operation of all dispatching system functions, shall be maintained in a satisfactory manner.

3-1.6.1.2 When a combination of leased/owned facilities exists, records required to be maintained by the lessor for the jurisdiction shall be specified.

3-1.6.1.3 A report of operations summarizing important statistics shall be prepared annually.

3-1.6.2 Circuits. Records of wired dispatch circuits shall include: outline plans showing terminals and fire station sequence; diagrams of office wiring; materials including trade name, manufacturer and year of purchase or installation.

3-1.6.3 Operations.

3-1.6.3.1 Emergency calls, however received, shall be appropriately recorded and tabulated to indicate the source of origin.

3-1.6.3.2 Dispatch of mobile units in response to emergency calls shall be recorded. Records shall indicate units responding to all alarms, time of acknowledgment by units, time of arrival of first unit at scene and time back in service of all units.

3-1.6.4 Emergency Generating Equipment. Emergency generating equipment periodic test records shall include: date and time; fuel, electrical, coolant and exhaust system conditions; and operating time.

3-1.7 Circuit Construction and Arrangement.

3-1.7.1 The National Electrical Safety Code, National Bureau of Standards Handbook H30, shall be used as a guide for the installation of outdoor circuitry.

3-1.7.2 All installations shall be protected against damage due to mechanical injury, fire, falling walls, floods, corrosive vapors or other causes.

3-1.7.3 Open local circuits within single buildings are permitted for the operation of alerting devices and alarm equipment additional to that required by the standard.

3-1.7.4 All circuits shall be so routed as to permit ready tracing of circuits for trouble.

3-1.7.5 Circuits shall not pass over, under, through, or be attached to buildings or property which are not owned by, or under the control of, the municipality or the agency responsible for maintaining the system.

3-1.7.6 Alarm instruments installed in private buildings shall be on circuits separate from box and dispatch circuits.

3-1.8 Circuit Conductors — General.

3-1.8.1 Wires shall be terminated so as to provide good electrical conductivity and prevent breaking from vibration or stress.

3-1.8.2 Circuit conductors on terminal racks shall be identified and isolated from conductors of other systems whenever possible and shall be suitably protected from mechanical injury.

3-1.8.3 Except as otherwise provided herein, exterior cable and wire shall conform to International Municipal Signal Association specifications or equal.

Exception: Where circuit conductors are provided by a public utility on a lease basis, International Municipal Signal Association (I.M.S.A.) specifications shall not apply.

3-1.9 Cables.

3-1.9.1 General.

3-1.9.1.1 Cables which meet the requirements of Article 310, NFPA 70, *National Electrical Code*, for installation in wet locations are satisfactory for overhead or underground installation except that direct-burial cable shall be specifically approved for the purpose.

3-1.9.1.2 Paper or pressed pulp insulation is not considered satisfactory for emergency service such as a fire alarm system, except that cables containing conductors with such insulation may be acceptable if pressurized with dry air or nitrogen. Loss of pressure in cables shall be indicated by a visual or audible warning system located where someone is in constant attendance who can interpret the pressure readings and who has authority to have the indicated abnormal condition corrected.

3-1.9.1.3 Natural rubber-sheathed cable shall not be used where it may be exposed to oil, grease, or other substances or conditions which may tend to deteriorate the cable sheath. Braided-sheathed cable shall be used only inside of buildings when run in conduit or metal raceways.

3-1.9.1.4 Other municipally controlled signal wires may be installed in the same cable with fire alarm wires. Cables controlled by, or containing wires of, private signaling organizations can be used for fire alarm purposes only by permission of the authority having jurisdiction.

3-1.9.1.5 Signaling wires which, because of the source of current supply, might introduce a hazard, shall be protected and supplied as required for lighting circuits.

3-1.9.1.6 All cables, when installed, with all taps and splices made, but before connection to terminals, shall be tested for insulation resistance. Such tests shall indicate an insulation resistance of at least 200 megohms per mile between any one conductor and all others, the sheath, and ground.

3-1.9.2 Underground Cables.

3-1.9.2.1 Underground cables in duct or direct burial shall be brought aboveground only at points where liability of mechanical injury, or of disablement from heat incident to fires in adjacent buildings, is minimized.

3-1.9.2.2 Cables shall be in duct systems and manholes containing only low-tension signaling system conductors, low-tension secondary power cables, or both. If in duct systems or manholes containing power circuit conductors in excess of 250 volts to ground, fire alarm cables shall be located as far as possible from such power cables and shall be separated from them by a noncombustible barrier or by such other means as may be practicable to protect the fire alarm cables from injury.

3-1.9.2.3 All cables installed in manholes shall be properly racked and marked for identification.

3-1-9.2.4 All conduits or ducts entering buildings from underground duct systems shall be effectively sealed against moisture or gases entering the building.

3-1.9.2.5 Cable joints shall be located only in manholes, fire stations, and other locations where proper accessibility is provided and where there is little liability of injury to the cable by falling walls or by operations in the buildings. Cable joints shall be so made as to provide and maintain conductivity, insulation, and protection at least equal to that afforded by the cables which are joined. Cable ends shall be sealed against moisture.

3-1.9.2.6 Direct burial cable, without enclosure in ducts, shall be laid in grass plots, under sidewalks or in other places where the ground is not apt to be opened for other underground construction. If splices are made, such splices shall, where practicable, be accessible for in-

spection and tests. Such cables shall be buried at least 18 in. (0.5 m) deep and, where crossing streets or other areas likely to be opened for other underground construction, shall be in duct or conduit, or be covered by creosoted planking of at least 2-in. (50-mm) by 4-in. (100-mm) planks with half-round grooves, spiked or banded together after the cable is installed.

3-1.10 Aerial Construction.

3-1.10.1 Fire alarm wires shall be run under all other wires except communication wires. Suitable precautions shall be provided where passing through trees, under bridges, over railroads and at other places where injury or deterioration is possible. Wires and cables shall not be attached to a crossarm carrying electric light and power wires, except that circuits carrying up to 220 volts for municipal communication use are permitted. Such 220-volt circuits shall be tagged or otherwise identified.

3-1.10.2 Aerial cable shall be supported by messenger wire of adequate tensile strength, except as permitted in 3-1.10.3.

3-1.10.3 Two-conductor cable shall be messenger-supported unless it has conductors of No. 20 AWG or larger size and has mechanical strength equivalent to No. 10 AWG hard-drawn copper.

3-1.10.4 Single wire shall meet International Municipal Signal Association specifications and shall not be smaller than No. 10 Roebling gage if of galvanized iron or steel, No. 10 AWG if of hard-drawn copper, No. 12 AWG if of approved copper-covered steel, or No. 6 AWG aluminum. Span lengths shall not exceed manufacturers' recommendations.

3-1.10.5 Aerial wires to buildings shall contact only intended supports and shall enter through an approved weatherhead or suitable sleeves slanting upward and inward. Drip loops shall be formed on wires outside of buildings.

3-1.11 Leads Down Poles.

3-1.11.1 Leads down poles shall be protected against mechanical injury. Any metallic covering shall form a continuous conducting path to ground. Installation shall in all cases be such as to prevent water from entering the conduit.

3-1.11.2 Leads shall have 600-volt insulation approved for wet locations, as defined in NFPA 70, *National Electrical Code*.

3-1.12 Wiring Inside Buildings.

3-1.12.1 At the Communication Center, conductors shall extend as directly as possible to the operating room in conduits, ducts, shafts, raceways or overhead racks and troughs of a type of construction affording protection against fire and mechanical injury.

3-1.12.2 All conductors inside buildings shall be in conduit, electrical metallic tubing, metal molding, or raceways. Installation shall be in accordance with NFPA 70, *National Electrical Code*.

3-1.12.3 Conductors shall have an approved insulation; the insulation or other outer covering shall be flame-retardant and moisture-resistant.

3-1.12.4 Conductors shall be installed as far as possible without joints. Splices will be permitted only in junction or terminal boxes. Wire terminals, splices, and joints shall conform with NFPA 70, *National Electrical Code*.

3-1.12.5 Conductors bunched together in a vertical run connecting two or more floors shall have a flame-retardant covering sufficient to prevent the carrying of fire from floor to floor. This requirement shall not apply if the conductors are encased in a metallic conduit, or located in a fire-resistive shaft having fire stops at each floor.

3-1.12.6 Where cables or wirings are exposed to unusual fire hazards, they shall be properly protected.

3-1.12.7 Cable terminals and cross-connecting facilities shall be located in or adjoining the operations room.

3-1.12.8 When signal conductors and electric light and power conductors are run in the same shaft, the light and power conductors shall be in conduit.

3-2 Wired Dispatch Systems — Communication Center.

3-2.1 General. Dispatch circuits shall be provided in accordance with the provisions of 3-1.3.

3-2.1.1 A metallic dispatch circuit shall not be connected to alarm instruments in more than five fire stations.

3-2.1.2 Where a wired graphic or voice amplification circuit is used as one of the required dispatch circuits, such circuits shall be individual to each fire station or the instruments shall be connected in parallel in the circuit.

3-2.1.3 Coded signals shall be transmitted not slower than 2 strokes per second. If outside alerting devices are employed, transmission shall be over separate circuits, but shall be at a speed suitable for such devices.

3-2.1.4 A separate tie circuit shall be provided from the Communication Center to each Satellite Communication Center.

NOTE: In a Type B System, when all boxes in the system are of succession type, it is permissible to use the tie circuit as a dispatch circuit.

3-2.2 Requirements for Constant-Current Systems.

3-2.2.1 Means shall be provided for manually regulating current in dispatch circuits so that operating current is maintained within 10 percent of normal throughout changes in external circuit resistance from 20 percent above to 50 percent below normal.

3-2.2.2 The voltage supplied to maintain normal line current on dispatch circuits shall not exceed 150 volts, measured under "no load" conditions, and when box circuits are used as dispatch circuits the line current will not

be reduced below safe operating value by the simultaneous operation of four boxes.

3-2.2.3 Visual and audible means to indicate a 20 percent or greater reduction in the normal current in any dispatch circuit shall be provided. All devices connected in series with any dispatch circuit shall function properly when the dispatch circuit current is reduced to 70 percent of normal.

3-2.2.4 Sufficient meters shall be provided to indicate the current in any dispatch circuit and the voltage of any power source. Meters used in common for several circuits shall be provided with cut-in devices designed to reduce the probability of cross-connecting circuits.

3-2.3 Type B System.

3-2.3.1 A box circuit entering a fire station and connected there to automatic recording and sounding facilities shall be permitted as one of the two required dispatch circuits.

3-2.3.2 In those jurisdictions where fewer than 600 alarms per year are received, or where all stations have recording and sounding devices responsive to each box circuit, the second dispatch circuit is not required; only the supervised dispatch circuit facility need be provided.

3-2.3.3 In a Type B system, the requirements in the following paragraphs also apply.

3-2.3.4 Facilities shall be installed to transmit automatically alarms received from any box to all fire stations and, where employed, to outside sounding devices.

3-2.3.5 Control facilities shall permit any or all circuits to be individually connected to or disconnected from the repeating mechanism.

3-2.3.6 Code transmitting devices using metallic conductors shall be provided with means for transferring the facilities from one box circuit to another.

3-2.4 Circuit Protection.

3-2.4.1 General.

3-2.4.1.1 The protective devices shall be located close to, or be combined with, the cable terminals.

3-2.4.1.2 Lightning arresters suitable for the purpose shall be provided. Lightning arresters shall be marked with the name of the manufacturer and model designation.

3-2.4.1.3 All lightning arresters shall be connected to a suitable ground in accordance with NFPA 70, *National Electrical Code*.

3-2.4.1.4 All fuses shall be plainly marked with their rated ampere capacity. All fuses rated over 2 amp shall be of the enclosed type.

3-2.4.1.5 Circuit protection required at the Communication Center shall be provided in every building housing Communication Center equipment.

3-2.4.1.6 Each conductor entering a fire station from lines partially or entirely aerial shall be protected by a lightning arrester.

3-2.4.1.7 All conductors entering the Communication Center shall be protected by the following devices, in the order named, starting from the exterior circuit:

(a) A fuse rated at 3 amp minimum to 7 amp maximum and not less than 2000 volts;

(b) A lightning arrester;

(c) A fuse or circuit breaker, rated at ½ amp.

3-2.4.1.8 The ½ amp protection on tie-line circuits shall be omitted at the Satellite Communication Centers.

3-2.4.2 Protection on Aerial Construction.

3-2.4.2.1 At junction points of open aerial conductors and cable, each conductor shall be protected by a lightning arrester of weatherproof type or be suitably protected from the weather. There shall also be a connection between the lightning arrester ground and any metallic sheath and messenger wire.

3-2.4.2.2 Aerial open wire and nonmessenger supported two-conductor cable circuits shall be protected by a lightning arrester at intervals of approximately 2,000 ft (610 m).

3-2.4.2.3 All protective devices shall be accessible for maintenance and inspection.

3-2.5 Wired Dispatch Equipment — General.

3-2.5.1 All wired dispatch devices and instruments, the failure of which would adversely affect the operation of the system, shall be mounted upon noncombustible bases, pedestals, swithboards, panels or cabinets. All mounting shall be of such design and construction that all components will be readily accessible.

3-2.5.2 Wires on switchboards shall not be smaller than No. 24 AWG. Unsupported wires and wires subject to vibration shall be not smaller than No. 18 AWG. The outer covering over the insulation of such wires, or the insulation itself if no outer covering is present, shall be flame-retardant and moisture-resistant.

3-2.5.3 Equipment shall be so designed and installed that it shall be capable of performing its intended function at 85 percent and at 110 percent of the rated voltage.

3-2.5.4 The normal operation of the system shall not require the use of a ground return to secure any essential function. Circuits extending outside the Communication Center shall normally test free of ground. This shall not prohibit the use of the ground to secure functioning under abnormal line conditions, provided such use would not prevent reception or transmission of a signal under normal conditions if the circuit were accidentally grounded.

3-2.6 Supervision.

3-2.6.1 To assure operability, wired circuits and devices upon which transmission and receipt of alarms depend shall be under constant electrical supervision to give

prompt warning of electrical conditions adversely affecting operability.

3-2.6.2 The power supplied to all required circuits and devices of the system shall be supervised.

3-2.6.3 Trouble signals shall actuate a sounding device located where there is always a responsible person on duty.

3-2.6.4 Trouble signals shall be distinct from alarm signals and shall be indicated by both a visual light and an audible signal.

NOTE 1: The audible signal may be common to several supervised circuits and/or devices.

NOTE 2: A switch for silencing the audible trouble signal is permitted if the visual signal remains operated until the silencing switch is restored to its normal position.

3-2.6.5 The audible signal shall be responsive to faults on any other circuits which may occur prior to restoration of the silencing switch to normal.

3-2.7 Testing.

3-2.7.1 General. Tests and inspections shall be conducted in accordance with the requirements of 3-1.5. In addition, the following requirements shall apply.

3-2.7.1.1 Manual tests of the power supply for dispatch circuits shall be made and recorded at least once in each 24 hrs. Such tests shall include:

(a) Current strength of each circuit. Changes in current of any circuit, amounting to 10 percent of normal current, shall be investigated immediately.

(b) Voltage across terminals of each circuit, inside of terminals of protective devices. Changes in voltage of any circuit, amounting to 10 percent of normal voltage, shall be investigated immediately.

(c) Voltage between ground and circuits. When this test shows a reading in excess of 50 percent of that shown in test 3-2.7.1.1(b) above, the trouble shall be immediately located and cleared; readings in excess of 25 percent shall be given early attention. These readings shall be taken with a voltmeter of not more than 100 ohms resistance per volt.

NOTE 1: The voltmeter sensitivity has been changed from 1000 ohms per volt to 100 ohms per volt so that false ground readings (caused by induced voltages) will be minimized.

NOTE 2: Systems in which each circuit is supplied by an independent current source (Forms 3 and 4) will require tests between ground and each side of each circuit. Common current source systems (Form 2) will require voltage tests between ground and each terminal of each battery and other current source.

(d) A ground current reading shall be acceptable in lieu of 3-2.7.1.1(c) above. When this method of testing is used, all grounds showing a current reading in excess of 5 percent of the normal line current shall be given immediate attention.

(e) Voltage across terminals of common battery, on switchboard side of fuses.

(f) Voltage between common battery terminals and ground. Abnormal ground readings shall be investigated immediately.

NOTE: Tests (e) and (f) apply only to those systems using a common battery. If more than one common battery is used, each common battery shall be tested.

3-2.7.1.2 Manual tests of dispatch circuit instruments shall be made and recorded at least once each 24 hrs.

3-3 Wired Dispatch Systems — Fire Stations.

3-3.1 General.

3-3.1.1 A metallic dispatch circuit shall not be connected to alarm instruments in more than five fire stations.

3-3.1.2 Where a wired graphic or voice amplification circuit is used as one of the required dispatch circuits, such circuits shall be individual to each fire station or the instruments shall be connected in parallel in the circuit.

3-3.1.3 A separate tie circuit shall be provided from the Communication Center to each Satellite Communication Center.

NOTE: In a Type B system, when all boxes in the system are of succession type, it is permissible to use the tie circuit as a dispatch circuit.

3-3.2 Equipment in Fire Stations.

3-3.2.1 As required in 3-1.3, each fire station shall have two separate and distinct facilities for receiving notification from the Communication Center that response of the apparatus and men is expected, except as permitted in 3-1.3.3 and 3-2.3.2.

3-3.2.2 An audible signal device shall be connected to each of the two dispatch circuits. When coded signals are used for the supervised circuit, the signals shall also be visually recorded.

3-3.2.3 When watch is maintained at all times, instruments on all dispatch circuits shall be located in the vicinity of the watch desk. Alarm instruments need not be located elsewhere in the fire station except as necessary to alert all fire fighters.

3-3.2.4 Means of acknowledging receipt of an alarm from the fire station to the operator shall be provided. The acknowledgment may be made by radio (including that on apparatus when responding) or by metallic circuits, including departmental telephone facilities.

3-3.2.5 Alarms from the Communication Center shall be automatically received at each fire station.

3-3.2.6 An audible warning or alerting signal (typically a distinctive tone or tones) shall precede any alarm transmitted by voice.

3-3.2.7 For coded and graphic systems a permanent record and an audible signal are required to indicate the receipt of an alarm. The permanent record shall indicate the exact location for which the alarm is being received.

3-3.2.8 Facilities for reception of alarms from the Communication Center shall be installed where a house watch is constantly on duty, or be arranged to alert all personnel within the fire station premises.

3-3.2.9 When watch is not maintained, sufficient audible devices shall be installed throughout the fire station to ensure that all members are alerted to alarms at any hour.

3-3.2.10 Coded signals shall be received not slower than 2 strokes per second. If outside alerting devices are employed, reception shall be over separate circuits, but shall be at a speed suitable for such devices.

3-3.3 Type B System.

3-3.3.1 In a Type B System, the requirements in the following paragraphs also apply:

(a) Facilities shall be installed to automatically receive at all fire stations alarms from any box.

(b) In those municipalities which receive fewer than 600 alarms per year or where all stations have recording and sounding devices responsive to each box circuit, only the supervised dispatch circuit facility need be provided.

3-3.4 Testing.

3-3.4.1 Manual tests of the power supply for dispatch circuits shall be made and recorded at least once in each 30 days. Such tests shall include:

(a) Voltage across terminals of power source on receiving device side of fuses.

(b) Voltage between power source terminals and ground. Abnormal ground readings shall be investigated immediately.

3-3.4.2 Emergency generator equipment shall be operated to supply the system for a continuous period of 1 hr at least weekly.

NOTE: This test shall require simulated failure of normal power source.

3-3.4.3 Batteries supplying dispatch equipment shall be tested in accordance with 3-1.5.3.2.

3-3.5 Records. Emergency generating equipment periodic test records shall include: date and time; fuel, electrical, coolant and exhaust system conditions; and operating time.

3-3.6 Wiring in Fire Stations. At fire stations, conductors shall extend as directly as possible to alarm equipment in conduits, ducts, shafts, raceways or overhead racks and troughs of a type of construction affording protection against fire and mechanical injury.

3-3.7 Circuit Protection.

3-3.7.1 Each conductor entering a fire station from lines partially or entirely aerial shall be protected by a lightning arrester.

3-3.7.2 The protective devices shall be located close to, or be combined with, the cable terminals.

3-3.7.3 Lightning arresters suitable for the purpose shall be provided. Lightning arresters shall be marked with the name of the manufacturer and model designation.

3-3.7.4 All lightning arresters shall be connected to a suitable ground in accordance with NFPA 70, *National Electrical Code*.

3-3.7.5 All fuses shall be plainly marked with their rated ampere capacity. All fuses rated over 2 amp shall be of the enclosed type.

NOTE: Fuses are not recommended for conductors entering a fire station. If fuses are used, they must be rated at least 5 amperes.

3-3.8 Power.

3-3.8.1 Receiving devices at fire stations needing local power for operation shall be provided with two sources of power.

3-3.8.2 Power arrangements and facilities shall meet the requirements as given in 3-1.4.

3-4 Radio Dispatch Systems — Communication Center.

3-4.1 General.

3-4.1.1 Radio dispatch circuits, when used, shall be provided in accordance with 3-1.3.

3-4.1.2 If the primary transmitter fails upon operation, switchover to the second transmitter shall be automatic with audible and visual indications to the operator. However, if the transmitter controls are located where someone is always on duty, switchover facilities may be manually operated if it can be done within 30 seconds.

3-4.1.3 If radio is used as the second dispatch circuit, it need not have duplicate facilities. In those jurisdictions which receive fewer than 600 alarms per year the second dispatch circuit is not required.

3-4.1.4 If both of the dispatch circuits are radio, separate radio frequencies shall be provided.

3-4.1.5 If a radio channel is used as a dispatch method, the transmission of an alarm over the channel shall be preceded by an audible warning or alerting signal (typically a distinctive tone or tones) to differentiate the alarm from routine communications.

3-4.1.6 For municipalities receiving 2,500 or fewer requests for fire department related emergency assistance per year, it shall be permitted for them to share the same fire frequency(ies) provided a Continuous Tone Code Squelch System (CTCSS) or a Continuous Digital Coded Squelch System (CDCSS) is used.

3-4.1.7 Radio dispatch channels shall be separate from radio channels used for routine or fire ground communications.

3-4.2 Fusing — Circuit Protection. For wired portions of a radio dispatch circuit (i.e., antenna networks, etc.), circuit protection shall be provided in a manner consistent with the provisions of 3-2.4.

3-4.3 Radio Dispatch Equipment — General.

3-4.3.1 All radio dispatch devices and instruments, the failure of which would adversely affect the operation of the system, shall be mounted upon noncombustible bases, pedestals, swithboards, panels or cabinets. All mounting shall be of such design and construction that all components will be readily accessible.

3-4.3.2 The outer covering over wires, or the insulation itself if no outer covering is present, shall be flame-retardant and moisture-resistant.

3-4.3.3 Equipment shall be so designed and installed that it shall be capable of performing its intended function at 85 percent and at 110 percent of the rated voltage.

3-4.4 Supervision.

3-4.4.1 To assure reliability, wired circuits and devices upon which transmission and receipt of alarms depend, where required, shall be under constant electrical supervision to give prompt warning of conditions adversely affecting reliability. Supervised radio channels upon which transmission and receipt of alarms depend shall meet the requirements of 3-1.3.2 and 3-4.1.2.

3-4.4.2 The power supplied to all required circuits and devices of the system shall be supervised.

3-4.4.3 Trouble signals shall actuate a sounding device and visual signal located where there is always a responsible person on duty.

3-4.4.4 Trouble signals shall be distinct from alarm signals and shall be indicated by both a visual light and audible signal.

NOTE 1: The audible signal may be common to several supervised circuits and/or devices.

NOTE 2: A switch for silencing the audible trouble signal is permitted if the visual signal remains operated until the silencing switch is restored to its normal position.

3-4.4.5 The audible signal shall be responsive to faults on any other circuits which may occur prior to restoration of the silencing switch to normal.

3-4.4.6 When a single-wired circuit is used to connect the base radio transmitters with remote control units in compliance with 3-1.3.2(b) and (c), or (d), the wired circuit shall be supervised.

3-4.5 Testing. Tests and inspections shall be conducted in accordance with the applicable requirements of 3-1.5.

3-4.6 Records.

3-4.6.1 General. Records shall be maintained in accordance with the applicable requirements of 3-1.6.

3-4.6.2 Channels. Records of radio dispatch channels, and any associated wired circuits, shall include: outline plans showing transmitters and receivers; diagrams of interconnecting office wiring; materials including trade name, manufacturer and year of purchase or installation.

3-4.7 Electrical Wiring. Metallic interconnections and other electrical wiring shall meet the provisions of 3-1.7 through 3-1.12.

3-5 Radio Dispatch Systems — Fire Stations.

3-5.1 Each fire station shall have two independent facilities for receiving notification from the Communication Center that response of the apparatus and men is expected, except as permitted in 3-2.3.2.

3-5.2 Visual indication shall be provided to indicate that radio facilities are in the "ON" position.

3-5.3 An audible signal device shall be connected to the dispatch channel. When coded signals are transmitted over the radio channel, the signals shall also be graphically recorded.

3-5.4 When watch is maintained at all times, instruments on all dispatch circuits shall be located in the vicinity of the watch desk. Alarm instruments need not be located elsewhere in the fire station except as necessary to alert all fire fighters.

3-5.5 Means of acknowledging receipt of an alarm from the fire station to the operator shall be provided. The acknowledgment may be by radio (including that on apparatus when responding) or by metallic circuits, including departmental telephone facilities.

3-5.6 Alarms from the Communication Center shall be automatically received at fire stations.

NOTE: Voice alarms are recorded only at the Communication Center.

3-5.7 An audible warning or alerting signal (typically a distinctive tone or tones) shall precede any alarm transmitted by voice.

3-5.8 For coded and graphic systems a permanent record and an audible signal are required to indicate the receipt of an alarm. The permanent record shall indicate the exact location for which the alarm is being received.

3-5.9 Facilities for reception of alarms from the Communication Center shall be installed where a house watch is constantly on duty, or be arranged to alert all personnel within the fire station premises.

3-5.10 When watch is not maintained, sufficient audible devices shall be installed throughout the fire station to ensure that all members are alerted to alarms at any hour.

3-6 Radio Dispatching — Mobile Equipment.

3-6.1 The Communication Center shall be equipped for radio communication with fire apparatus.

3-6.2 All fire apparatus and other fire department emergency vehicles shall be equipped with two-way radios, FCC type accepted or approved.

3-6.3 A separate frequency shall be provided for fire ground communications for jurisdictions or multiple

jurisdictions on the same channel receiving 2,500 or more alarms per year, or when multiple jurisdictions share a common radio frequency.

3-6.4 Mobile radios shall be equipped with a transmit-indicating lamp.

3-6.5 Spare mobile radio units shall be provided for radio-equipped fire fighting apparatus as follows:

(a) A minimum of one spare unit for each model not directly interchangeable.

(b) A minimum of one spare unit for each 20 units in service.

3-6.6 All base stations and mobile radio transmitters shall be equipped with a carrier control timer to disable the transmitter in the event of a malfunction causing it to remain inadvertently on the air.

3-6.7 The jurisdiction shall adopt a uniform code for radio dispatching. When more than one jurisdicition is dispatched from a single Communication Center, or is involved in routine mutual aid operations with other jurisdictions, the code shall be common for all jurisdictions.

3-6.8 There shall be qualified technical assistance available for trouble analysis and repair either by in-house personnel or by outside contract maintenance service with a maximum response time of 2 hrs from time of notification.

3-6.9 All fire vehicles assigned to aircraft emergency responses shall also be equipped with radios capable of operating on the aircraft ground control emergency channels.

3-6.10 Mobile radios and associated equipment shall be water resistant in accordance with mil-spec 810-C.

3-6.11 When a data transmission function is utilized, mobile radios shall have the ability to transmit data without distortion and the equipment shall be designed to ensure full data stream transmission at full power.

3-6.12 If scanning devices are used, they shall have an automatic priority feature whereby the radio will revert to its primary channel automatically when the channel is being used. Scanning devices shall have a manual lock position to lock the receiver on its primary channel. No other lock position is permitted.

3-6.13 Mobile radios shall be capable of continuous tone coded squelch (CTCSS), or continuous digital coded squelch (CDCSS) operation to reduce interference/annoyance level.

NOTE: If operating in standard squelch systems, coded squelch circuitry may be partially or completely disabled.

3-7 Radio Dispatching — Portable Equipment.

3-7.1 This section applies to fire portable radio devices utilized as a part of a primary dispatch network. The criteria for similar devices used in miscellaneous services, including fire ground operations, are found in 3-10.3.

3-7.1.1 Portable radios shall conform to all FCC standards and be type accepted or approved by the FCC.

3-7.1.2 Fire portable radio equipment shall be manufactured for the environment in which it will be used. Equipment shall be water resistant in accordance with mil-spec 810-C, with size and construction making it capable of one-hand operation.

3-7.1.3 Fire portable radio transceivers shall not be placed into transmit mode except by operator action on a mechanically guarded switch.

3-7.1.4 Fire portable radio transmitters shall have a carrier controlled timer to disable the transmitter in the event of a malfunction that causes the transmitter to remain inadvertently on the air.

3-7.1.5 Multiple frequency fire radio transceivers shall be capable of changing channels while operators are wearing gloves.

3-7.1.6 Single unit chargers for fire portable radios shall be capable of charging fully while the radio is in the receiving mode.

3-7.1.7 Battery chargers for portable radios shall automatically revert to maintenance charge when battery is fully charged.

3-7.1.8 Battery chargers shall be capable of charging batteries independently and externally of the portable radio unit.

3-7.1.9 Spare batteries shall be maintained in sufficient quantities to permit reliable operation of fire portable radios.

NOTE: Rapid charge batteries and chargers may be utilized to reduce quantity of spare batteries needed.

3-7.1.10 Fire portable transceivers shall be capable of multiple frequency operation to enable a fire ground radio network to be organized independently of normal dispatch channels.

3-7.1.11 Fire portable radios shall be capable of continuous tone coded squelch (CTCSS), or continuous digital coded squelch (CDCSS).

NOTE: If operating in standard squelch systems, continuous codes squelch circuitry may be partially or completely disabled.

3-7.1.12 When a data transmission function is utilized from fire portable transceivers, the radio shall be capable of transmitting data without distortion, and the equipment shall be designed to insure full data stream transmission at full power.

3-7.1.13 When utilizing fire portable transceivers in a fire dispatch system, system design shall be such that a portable transceiver will be capable of operating properly within the dispatch area without the use of mobile RF amplifiers.

NOTE: These requirements do not apply to equipment used for biomedical operations.

3-7.1.14 If scanning devices are used, they shall have an automatic priority feature whereby the radio will revert to its primary channel automatically whenever the channel is being used. Scanning devices shall have a manual lock position to lock the receiver on its primary channel. No other lock position is permitted.

3-7.1.15 Radio pocket pagers powered by replaceable batteries shall indicate audibly before battery is incapable of operating the pager for alerting purposes.

3-8 Telephone Dispatch Systems — Communication Center.

3-8.1 General. This section applies to a telephone dispatch circuit when it is used as one of the dispatch circuits and satisfies the requirement in 3-1.3.2(e).

3-8.2 Circuit Protection.

3-8.2.1 General.

3-8.2.1.1 The protective devices shall be located close to, or be combined with, the cable terminals.

3-8.2.1.2 Lightning arresters suitable for the purpose shall be provided. Lightning arresters shall be marked with the name of the manufacturer and model designation.

3-8.2.1.3 All lightning arresters shall be connected to a suitable ground in accordance with NFPA 70, *National Electrical Code*.

3-8.2.1.4 All fuses shall be plainly marked with their rated ampere capacity. All fuses rated over 2 amp shall be of the enclosed type.

NOTE: Fuses are not recommended for conductors entering fire stations. If fuses are used, they must have at least a 5-amp rating.

3-8.2.1.5 Circuit protection required at the Communication Center shall be provided in every building housing Communication Center equipment.

3-8.2.1.6 Each conductor entering a fire station from lines partially or entirely aerial shall be protected by a lightning arrester.

3-8.2.2 Communication Center. All conductors entering the Communication Center shall be protected with devices, in the order named, starting from the exterior circuit as follows:

(a) A fuse rated at 3 amp minimum to 7 amp maximum and not less than 2000 volts;

(b) A lightning arrester;

(c) A fuse or other device, such as a heat coil, rated at not more than ½ ampere; or

(d) Where the design of the system is such that other type protection is necessary, the recommendation of the manufacturer shall be followed.

3-8.2.3 Protection on Aerial Construction.

3-8.2.3.1 At junction points of open aerial conductors and cable, each conductor shall be protected by a lightning arrester of weatherproof type, or be suitably protected from the weather. There shall also be a connection between the lightning arrester ground and any metallic sheath and messenger wire.

3-8.2.3.2 Aerial open wire and nonmessenger supported 2-conductor cable circuits shall be protected by a lightning arrester at intervals of approximately 2,000 ft (610 m).

3-8.2.3.3 All protective devices shall be accessible for maintenance inspection.

3-8.3 Supervision.

3-8.3.1 To assure operability, wired circuits and devices upon which transmission and receipt of alarms depend shall, where required, be under constant electrical supervision to give prompt warning of conditions adversely affecting operability.

3-8.3.2 The power supplied to all required circuits and devices of the system shall be supervised.

3-8.3.3 Trouble signals shall actuate a sounding device located where there is always a responsible person on duty.

3-8.3.4 Trouble signals shall be distinct from alarm signals and shall be indicated by both a visual light and audible signal.

NOTE 1: The audible signal may be common to several supervised circuits and/or devices.

NOTE 2: A switch for silencing the audible trouble signal is permitted if the visual signal remains operated until the silencing switch is restored to its normal position.

3-8.3.5 The audible signal shall be responsive to faults on any other circuits which may occur prior to restoration of the silencing switch to normal.

3-8.4 Testing. Tests and inspections shall be conducted in accordance with the applicable requirements of 3-1.5.

3-8.5 Circuit Construction and Arrangement.

3-8.5.1 Circuits shall be constructed and arranged in accordance with the provisions of 3-1.7.

Exception: These provisions shall not apply when circuitry is provided by a public utility on a lease basis.

3-8.5.2 Other signal wires under control of the utility as the agency responsible for maintenance of the system may be installed in the same cable with fire alarm wires. The dispatch circuits shall be well identified as emergency circuits at all points that may be exposed to maintenance personnel.

3-9 Telephone Dispatch Systems — Fire Stations.

3-9.1 Equipment in Stations.

3-9.1.1 Each fire station shall have facilities for receiving notification from the Communication Center that response of the apparatus and men is expected.

3-9.1.2 Voice Amplification. The telephone dispatch circuit shall be equipped with a loudspeaker(s) at the fire station for receipt of fire alarm messages.

3-9.1.3 The dispatch circuit shall be arranged to provide automatically an audible warning or alerting signal (typically a distinctive tone or tones) over the loudspeaker prior to transmission of an alarm message.

3-9.1.4 The dispatch circuit shall be arranged for acknowledgment of messages by removing the handset in the fire station which automatically removes the loudspeaker(s) from the circuit.

3-10 Commercial Telephones — Fire Stations.

3-10.1 General. In addition to the required dispatch circuits and receiving equipment, commercial telephone facilities shall be provided and shall meet the requirements of this section.

3-10.2 There shall be a telephone at each fire station.

3-10.3 Where there is no other means of voice communications with fire stations, the telephones at fire stations shall be arranged so that they cannot be called by the public except:

(a) Through a common switching point in the Communication Center, or

(b) Where there is but one fire station in the community.

NOTE: This is not meant to apply to the office of the chief and other executive officers or to the Communication Center which may be housed in a fire station.

3-11 Other Alerting Facilities — Volunteer and Off-Shift Fire Fighters.

3-11.1 Telephone Circuits.

3-11.1.1 For a telephone group alerting system a separate tie circuit shall be provided from the Communication Center to the telephone central office.

3-11.1.1.1 The tie circuit shall not be used for any other purpose or function than its intended purposes in a telephone group alerting system.

3-11.1.1.2 The tie circuit shall be supervised with visual and audible alarms in accordance with 3-2.6.

3-11.2 Alerting Facilities.

3-11.2.1 When outside alerting devices are used to indicate an alarm of fire they shall be suitably located for alerting all available fire department members.

3-11.2.2 When coded alerting devices are not operable at speeds of at least one actuation per second, a special operating circuit shall be provided. Three or four rounds of coded signals are required where outside alerting devices are operated for summoning fire fighters.

3-11.2.3 Telephone or other alerting facilities shall be provided for alerting all available fire department members. Where radio alerting receivers are employed, a secondary power supply shall be provided for each unit.

NOTE: Such facilities need not actuate an outside alerting device.

3-11.2.4 Electrical power essential for operation of alerting devices shall meet the requirement of 3-1.4. This shall include power for control equipment such as relays, timers, coders, etc., and where required, for operation of the alerting device itself.

3-11.2.5 Compressed air alerting devices shall have a distinctive tone; if coded, duration of blast shall be not less than ½ second nor longer than 1½ seconds with silent intervals of 1 to 1½ times the blast.

3-11.2.6 Storage tanks shall comply with ASME specifications for unfired pressure vessels and be equipped with a safety-relief valve. Size shall be such that, at 85 percent of normal pressure, eight times the largest number of blasts assigned to any box can be sounded but not less than 50 blasts.

3-11.2.7* Compressor shall have sufficient capacity to fill storage tanks to normal pressure within 30 minutes. Piping of ferrous materials shall be provided with adequate scale traps, accessible for ready cleaning. All piping shall be arranged to permit inspection and repair.

3-11.3 Miscellaneous Radio Devices.

3-11.3.1 When radio home alerting receivers, handheld units, pocket pagers, and similar radio devices are used to receive alarms of fire, or are used on the fireground, they shall conform to the following requirements:

3-11.3.2 Fire portable radio equipment shall be manufactured for the environment in which it will be used. Equipment shall be water resistant in accordance with mil-spec 810-C, with size and construction making it capable of one-hand operation.

3-11.3.3 Fire portable radio transceivers shall not be placed into transmit mode except by operator action on a mechanically guarded switch.

3-11.3.4 Multiple frequency fire radio transceivers shall be capable of changing channels while operators are wearing gloves.

3-11.3.5 Single unit chargers for fire portable radios shall be capable of charging fully while the radio is in the receiving mode.

3-11.3.6 Radio pocket pagers powered by replaceable batteries shall indicate audibly before battery is incapable of operating the pager for alerting purposes.

3-12 Computer Aided Dispatch Systems (CAD).

3-12.1 General.

3-12.1.1 Fire service dispatching entities employing CAD systems shall have qualified technical assistance available for trouble analysis and repair by in-house personnel or by outside contract maintenance services with a maximum response time of 2 hrs from time of notification.

3-12.1.2 Where a CAD system is used for fire service dispatch operations, manual back-up facilities shall be provided and readily available for use in the event of problems with or failure of the CAD system.

3-12.2 Classification of Systems. Computer Aided Dispatch Systems in Fire Communications Services shall be categorized in three major classes.

Class 1 Computer Aided Dispatching System
Class 2 Computer Aided Dispatching System
Class 3 Computer Aided Dispatching System

For the purpose of brevity Computer Aided Dispatching hereafter will be referred to as CAD.

3-12.3* Class 1 CAD System.

3-12.3.1 General. A Class 1 CAD system shall be one in which computer technology and equipment selects and dispatches fire service personnel and equipment for the purpose of serving the public in the area of fire and rescue emergency service assistance, and any other such emergency services in the public interest which are deemed necessary and appropriate by the proper fire service officials.

3-12.3.2 Computers.

3-12.3.2.1 Computers shall meet all applicable approved code requirements such as EIA standards and other such requirements associated with good engineering and manufacturing practices.

3-12.3.2.2 Computers shall have complete redundancy. A computer fault-detection system shall be employed to detect computer failure and subsequently alert the control position that a failure has occurred. This alerting shall be by visual and audible means.

3-12.3.3 Console Equipment.

3-12.3.3.1 Console equipment shall consist of one computer terminal and CRT for each operator position.

3-12.3.3.2 The number of computer terminal and CRT positions shall be consistent with departmental work loads to produce a minimum delay in emergency dispatch time.

3-12.3.3.3 A minimum of one computer terminal and CRT shall be available on the premises for immediate change out for every two positions in operation, up to a maximum of three complete spares.

3-12.3.3.4 Interchangeability of these units shall be of a nontechnical nature so as to be accomplished by a trained fire operator.

3-12.3.3.5 Every operator position shall be supported by one hard copy printer at each operator position, or in lieu of this, one master hard copy printer with entry memory capability can be used, provided any operator retrieval of hard copy printout of the last operator entry information does not exceed 3-minute retrieval time under maximum load conditions.

3-12.3.3.6 One operator position shall be designated as a control position and shall have take-over capabilities of any or all of the other terminals, thus allowing for priority interruptions without loss of computer information to the other terminals for the purpose of transmitting priority emergency traffic.

3-12.3.3.7 The control position shall have the capabilities to make minor program entry changes by command entry from the keyboard terminal by use of a protected computer entry code. This program entry change shall be limited to vehicular assignment information to allow for temporary vehicular deployment in emergency overload conditions or temporary vehicular or station assignment to allow for normal vehicular service.

3-12.3.3.8 Hardware equipment associated with the operator work position and including the keyboard terminal shall be so designed that operator error due to accidental triggering of an electronic switch, key, light, or other electronic functions shall be highly improbable. Operator displays and indicator lights shall be clearly identifiable under extreme conditions such as glare, bright sunlight, or other adverse conditions.

3-12.3.3.9 The computers shall be dedicated pieces of equipment whose use serves only to enhance fire service dispatching operations. The use of these computers to serve unrelated services or other departments shall be prohibited.

Exception: When dispatch operations are of a combined public safety nature, these computers may be used jointly providing that a control function is installed in the control console position allowing operator control override of all agency dispatching for the purpose of dispatching priority traffic. Any emergency which, in the judgment of the operator in charge, is categorized to be life-threatening shall take precedence over all other traffic in a combined dispatch center using a shared computer.

3-12.3.4 Information Transmittal.

3-12.3.4.1 The transmission of computer information shall be by either radio frequency (RF) or via wired circuits to fixed locations, or a combination of both.

3-12.3.4.2 In each case where RF is used or wired circuitry or a combination thereof is used, each method used must meet all applicable requirements in this standard for the use of RF transmission or wired circuitry as a primary method of fire service dispatching.

3-12.3.4.3 The transmission of computer information to vehicular equipment or portable equipment associated with fire and rescue operations shall be on any Federal Communications Commission (FCC) approved radio frequency channel for the particular type of service being used.

3-12.3.4.4 All NFPA standards presently associated with the type of transmission selected for use shall remain in effect as a standard for the operation.

3-12.3.5 Auxiliary Power.

3-12.3.5.1 Computer hardware equipment located at the Communication Center shall have installed and operational an on-line uninterruptible power supply (UPS) system of sufficient power handling capabilities to provide constant operating capabilities of the computer equipment being used for a period of time allowing for manual or automatic transfer from public service AC power to localized auxiliary AC power.

3-12.3.5.2 Operational time of the UPS system during emergencies shall be consistent with present standard requirements detailed in the power section pertaining to battery-powered inverters used in a Type A fire dispatch system. AC power requirements shall be applicable to AC power requirements detailed in this standard under the power section.

3-12.3.6 Dispatch Capabilities.

3-12.3.6.1 The installation of a Class 1 CAD system in fire service dispatching shall not negate the requirements for a "second" dispatch system.

NOTE: All requirements associated with the type of secondary system selected for use such as radio, teletype, or wire shall continue to be met.

3-12.3.7 Support Dispatch Information. There shall be an up-to-date hard copy file of all stored information located on the premises to support the second dispatch system should the primary CAD system fail.

3-12.3.8 Fire Station and Vehicle Equipment.

3-12.3.8.1 Fire Stations.

(a) Each fire station shall have a computer terminal consistent in design and compatible with its counterpart located at the Communication Center. This equipment shall be capable of transmitting data to and receiving data from the Communication Center.

(b) Design characteristics applicable to Communication Center computer equipment shall apply to fire station equipment.

NOTE: Departments desiring to utilize hard copy printout equipment in lieu of CRT display may do so.

3-12.3.8.2 Vehicles.

(a) Computerized equipment such as terminals, CRT's, etc. installed in fire apparatus and other fire department emergency vehicles shall be manufactured in accordance with all applicable FCC rules, EIA codes, and good engineering practices consistent with the manufacturing of electronic equipment for use in a vehicular mobile environment.

(b) The equipment shall be so designed as to require the least amount of human contact possible for efficient operation of the system.

NOTE: Departments desiring to utilize hard copy printout equipment in lieu of CRT display may do so.

(c) Where human contact is required, the utmost attention should be given to simplicity of operation. Contact devices, such as switches and keyboard, shall be so designed to minimize the possibility of accidental triggering by an inexperienced operator.

3-12.4* Class 2 CAD System.

3-12.4.1 General. A Class 2 CAD system shall be one in which computerized technology and equipment is used in the Communication Center and other fixed locations as a support dispatch operation to voice or graphic type operated dispatch systems, for the purpose of serving the public in the area of fire and rescue emergency service assistance, and any other such emergency services in the public interest which are deemed necessary and appropriate by the proper fire service officials.

3-12.4.2 Computers. The minimum standards required in a Class 1 fire service CAD system shall apply.

Exception No. 1: Computers used in a Class 2 system shall not be required to have complete redundancy.

Exception No. 2: Automatic switchover shall not be required as a standard; however, a fault detection system shall be employed to detect computer failure and to subsequently alert the control console by visual and audio means.

3-12.4.3 Console Equipment. The minimum standards contained in 3-12.3.3 shall apply.

3-12.4.4 Information Transmittal. The minimum standards contained in 3-12.3.4 shall apply.

3-12.4.5 Auxiliary Power. Requirements shall be consistent with a Class 1 CAD system.

Exception: The UPS in a Class 2 CAD system shall only be required to be of sufficient power handling capabilities to supply power to the main computer section to prevent memory damage, failure, and loss during an AC power failure or transfer from public service AC to locally supplied auxiliary AC.

3-12.4.6 Dispatch Capabilities. The requirements as outlined for a Class 1 CAD system in fire service dispatching shall apply.

3-12.4.7 Fire Station and Vehicle Equipment.

3-12.4.7.1 Fire Stations. Standard requirements for a Class 1 CAD system shall apply.

3-12.5* Class 3 CAD System.

3-12.5.1 General. A Class 3 CAD system shall be one in which computerized technology is used as a support function to fire service dispatching and is limited primarily to status and logging information.

3-12.5.2 Computers.

NOTE: Computers may be of a microprocessor type with limited storage and memory capabilities.

3-12.5.2.1 Redundancy capabilities shall not be required in a Class 3 system. All other computer requirements as listed in a Class 1 fire service CAD system shall apply.

3-12.5.3 Console Equipment. The minimum system requirements that apply to a Class 1 fire service CAD system shall apply.

NOTE: Computers may be of a microprocessor type with limited storage capability.

Exception: One master hard copy printer for logging purposes shall be acceptable. Program entry changes shall not be required to have a protected command entry code. Priority override shall not be a requirement.

3-12.5.4 Information Transmittal. The minimum standards as required in a Class 1 fire service CAD system shall apply.

3-12.5.5 Auxiliary Power. The standard auxiliary power requirements as outlined for a fire service Communication Center shall be acceptable.

3-12.5.6 Dispatch Capabilities. The requirements as outlined for a Class 1 CAD system in fire service dispatching shall apply.

3-12.5.7 Fire Station and Vehicle Equipment. Station and vehicular equipment shall consist of the following:

3-12.5.7.1 Fire Stations.

(a) Each fire station shall be equipped with a computer type piece of equipment capable of receiving a message from a microprocessor or other computer type device located at the Communication Center.

(b) Information shall consist of a data message causing the station equipment to perform a given function in the form of a contact closure or multiple closures to trigger peripheral equipment such as a siren or station public address equipment for the purpose of alerting the station.

(c) Station equipment shall be capable of sending a data message to the Communication Center microprocessor or other computer type device for the purpose of station acknowledgment.

3-12.5.7.2 Vehicles.

(a) Computer-type equipment shall be installed in each vehicular-type piece of fire fighting equipment, excluding administrative-type vehicles, which shall be subject to the discretion of the fire chief.

(b) Equipment shall be capable of sending and receiving data-type information for the purpose of alerting the vehicle that headquarters is trying to establish contact.

(c) Equipment shall be capable of sending single or multiple data-type messages to the microprocessor or other computer-type device located at the Communication Center for the purpose of status update in lieu of voice traffic for routine information such as "arrived at scene," "10-4," etc.

Chapter 4 Public Reporting Systems

4-1 Fundamental Requirements of Public Alarm Reporting Systems.

4-1.1 General.

4-1.1.1 A fire alarm reporting system shall be designed, installed, operated and maintained so as to provide the maximum practicable reliability for transmission and receipt of fire alarms.

4-1.1.2 Transmission of Other Signals. A public reporting system may be used for the transmission of other signals or calls of a public emergency nature, provided such transmission does not interfere with the transmission and receipt of fire alarms.

4-1.1.3 Type A Alarm System. A Type A System is permissible in any size municipality or area. A Type A System shall be provided when the number of emergency calls from boxes exceeds 2500 per year; or where the number of all alarms required to be retransmitted over the dispatch circuits exceeds 2500 per year.

NOTE: When a Type A System is required, automatic retransmission of alarms from boxes by use of electronic equipment shall be permissible, only if the following requirements are satisfied:

(a) Reliable facilities are provided for the automatic receipt, storage, retrieval and retransmission of alarms in the order received, and

(b) Override capability is provided to the operators so that manual retransmission and dispatch shall be instantly available.

4-1.2 Management and Maintenance.

4-1.2.1 The system shall be under the control of a responsible municipal employee.

4-1.2.2 A complete record shall be kept by the municipality of all test and alarm signals, all circuit interruptions and observations or reports of apparatus failures or derangements, and all seriously abnormal or defective circuit conditions indicated by test or inspection; these records shall include the date and time of all occurrences.

4-1.2.3 When maintenance is provided by an organization or person other than the municipality or its employees, complete written records of the installation, maintenance, test, and extension of the system shall be forwarded to the responsible municipal employee as soon as possible. Notice of failure and restoration of service shall be made immediately to the responsible municipal employee.

4-1.2.4 Maintenance by an organization or person other than the municipality or a municipal employee shall be by written contract, guaranteeing performance acceptable to the authority having jurisdiction.

4-1.3 Equipment and Installation.

4-1.3.1 All devices and equipment constructed and installed under this standard shall be suitable for the purpose for which they are intended.

4-1.3.2 All systems shall be installed in a workmanlike manner in accordance with the established practices and applicable requirements of this standard.

4-1.3.3 All the devices shall be designed to function satisfactorily under the climatic conditions to which they will be exposed.

4-1.3.4 Means for transmission of alarms by the public shall be available on the street and at each fire station and shall be conspicuous and readily accessible for easy operation.

4-1.3.5 Upon completion of a system installation, a satisfactory test of the entire equipment shall be made in the presence of the authorized representative of the purchaser and, if required by the authority having jurisdiction, in the presence of its representative.

4-1.3.6 All apparatus shall be restored to normal condition as promptly as possible after each test or alarm in which the apparatus functioned.

4-1.3.7 All devices and instruments, the failure of which would adversely affect the operation of the system, shall be mounted upon noncombustible bases, pedestals, swithboards, panels or cabinets. All mounting shall be of such design and construction that all components will be readily accessible.

4-1.3.8 Wires on switchboards shall not be smaller than No. 24 AWG. Unsupported wires and wires subject to vibration shall be not less than No. 18 AWG. The outer covering over the insulation of such wires, or the insulation itself if no outer covering is present, shall be flame-retardant and moisture-resistant.

4-1.3.9 Equipment shall be so designed and installed that it shall be capable of performing its intended function at 85 percent and at 110 percent of the rated voltage.

4-1.3.10 The normal operation of the system shall not require the use of a ground to secure any essential function. Circuits extending outside the Communication Center shall normally test free of grounds. This shall not prohibit the use of the ground to secure functioning under abnormal line conditions, provided such use would not prevent reception or transmission of a signal under normal conditions if the circuit were accidentally grounded.

4-1.4 Fire Alarm Boxes.

4-1.4.1 General.

4-1.4.1.1 Boxes shall be recognizable as such in all municipalities. Boxes shall have instructions for use plainly marked on the exterior surface.

4-1.4.1.2 The operating device shall be readily available and of such design and so located as to make the method of its use apparent.

4-1.4.1.3 Boxes shall be as conspicuous as possible. The color shall be distinctive.

4-1.4.1.4 A box shall be visible from all directions insofar as is possible. A wide band of distinctive colors visible over the tops of parked cars, or adequate signs when completely visible from all directions, shall be applied to supporting poles.

4-1.4.1.5* Indicating lights of a distinctive color, visible for at least 1,500 ft (460 m) in all directions, shall be installed over boxes in mercantile and manufacturing areas. The street light nearest the box when equipped with a distinctive colored light shall be acceptable.

4-1.4.1.6 Box cases and parts at any time accessible to users shall be of insulating materials or permanently and effectively grounded.

4-1.4.1.7 All ground connections to boxes shall comply with the requirements of NFPA 70, *National Electrical Code*.

4-1.4.1.8 Boxes shall be securely mounted on poles or pedestals.

4-1.4.2 Design of Boxes.

4-1.4.2.1 Boxes when in an abnormal condition shall leave the circuit usable.

4-1.4.2.2 Boxes shall be designed so that recycling will not occur if a box actuating device is held in the actuating position and will be ready to accept a new signal as soon as the actuating device is released.

4-1.4.2.3 Boxes when actuated shall give a visible or audible indication to the user that the box is operating or that the signal has been received by the Communication Center.

NOTE: When the operating mechanism of a box creates sufficient sound to be heard by the user, the requirements are satisfied.

4-1.4.2.4 Concurrent operation of at least four boxes shall not result in the loss of an alarm.

4-1.4.2.5 The box housing shall protect the internal components from weather.

4-1.4.2.6 Doors on boxes shall remain operable under adverse climatic conditions, including icing and salt spray.

4-1.4.3 Location of Boxes.

4-1.4.3.1 Where boxes are installed, they shall be located as to protect all built-up areas.

Exception: Boxes are not required in residential (one- and two-family detached dwellings) areas.

4-1.4.3.2 In all built-up districts, except residential, it shall not be necessary to travel in excess of one block or 500 ft (150 m) to reach a box. In residential areas, it shall not be necessary to travel in excess of two blocks or 800 ft (240 m) to reach a box.

4-1.4.3.3 Schools, hospitals, nursing homes and places of public assembly shall have a box at or near the main entrance.

4-1.5 Power.

4-1.5.1 General.

4-1.5.1.1 Power circuits, together with their associated motors, generators, rectifiers, transformers, fuses and controlling devices, shall be in accordance with the requirements of NFPA 70, *National Electrical Code*.

4-1.5.1.2 The conductors of the power supply circuit shall be connected to the line side of the main service of a commercial light or power supply circuit or to the main conductors of an isolated power plant located on the premises except as permitted in 4-1.5.1.3. The circuit disconnecting means shall be so installed that it would be accessible only to authorized personnel.

4-1.5.1.3 Power may be obtained from the load side of the main disconnect switch only when buildings are for the exclusive housing of fire alarm and other emergency facilities.

4-1.5.1.4 Circuit protection enclosed in a locked or sealed cabinet located immediately adjacent to the point of connection to the light and power conductors shall be provided in series with each ungrounded conductor.

4-1.5.2 Power Source. Each box circuit, except as permitted by 4-3.3.3.2, and related alarm receiving devices, including equipment at fire stations needing local power for operation and all coded radio receiving devices, shall be provided with two sources of power. The two sources of power considered acceptable are:

(a)* One circuit from a utility distribution system and a second from an engine-driven generator and a standby battery having a 4-hr capacity.

(b)* Two circuits from separate utility distribution systems, so serviced or connected that normal supply to one will not be affected by trouble which would put the other out of service. This would require supply from two building services on entirely separate distribution networks from independent generating stations.

(c)* Two engine-driven generators with one unit supplying normal system power and the other unit serving as standby with facilities to apply its power to the line within 30 seconds. A standby, storage battery having a 4-hr capacity shall be provided. If two engine-driven generators are used as a second source of power, the fire alarm system 4-hr battery may be omitted.

4-1.5.3 Power Supply.

4-1.5.3.1 The forms and arrangements of power supply shall be classified as described in the paragraphs below.

NOTE: If equipment required under 2-1.6.3 is adequate with regard to electrical service/capacity to satisfy the needs of equipment in this section, said equipment need not be duplicated.

4-1.5.3.1.1 Form 2. Permissible for Type A systems only. Box circuits served in multiple by:

(a)* *Form 2A.* A rectifier or motor-generator powered from a single source of alternating current, with a floating storage battery having a 24-hr standby capacity.

(b)* *Form 2B.* A rectifier or motor-generator powered from two sources of alternating current, with a floating storage battery having a 4-hr standby capacity.

(c)* *Form 2C.* Duplicate rectifier or motor-generator powered from two sources of alternating current with transfer facilities to apply power from the secondary source to the system within 30 seconds [*see 3-1.4.2(c)*]. Each rectifier or motor-generator shall be capable of powering the entire system.

NOTE: For Form 2A, 2B and 2C, these arrangements are permissible but are not recommended where circuits are wholly or partly open-wire because of the possibility of trouble from multiple grounds.

4-1.5.3.1.1.1 Batteries, motor-generator or rectifiers shall be sufficient to supply all connected circuits without exceeding the capacity of any battery or overloading any generator or rectifier, so that circuits developing grounds or crosses with other circuits may be supplied each by an independent source to the extent required by (b) below.

4-1.5.3.1.1.2 Provision shall be made in the operating room for supplying any circuit from any battery, generator or rectifier. Enclosed fuses shall be provided at points where supplies for individual circuits are taken from common leads. Necessary switches, testing and signal transmitting and receiving devices shall be provided to permit the isolation, control and test of each circuit, to the extent of at least 10 percent of the total number of box and dispatch circuits, but never less than two.

4-1.5.3.1.1.3 If common-current source systems are grounded, the ground shall not exceed 10 percent of resistance of any connected circuit and be located at one side of the battery. Visual and audible indicating devices shall be provided for each box and dispatch circuit to give immediate warning of ground leakage endangering operability.

4-1.5.3.1.2 Form 3. Each box circuit or coded radio receiving system served by:

(a)* *Form 3A.* A rectifier or motor-generator powered from a single source of alternating current with a floating storage battery having a 60-hr standby capacity.

(b)* *Form 3B.* A rectifier or motor-generator powered from two sources of alternating current with a floating storage battery having a 24-hr standby capacity.

4-1.5.3.1.3 Form 4. Each box circuit or coded radio receiving system served by:

(a)* *Form 4A.* An inverter powered from a common rectifier powered by a single source of alternating current, with a floating storage battery having a 24-hr standby capacity.

(b)* *Form 4B.* An inverter powered from a common rectifier receiving power from two sources of alternating current, with a floating storage battery having a 4-hr standby capacity.

NOTE: For Form 4A and Form 4B, it is permissible to distribute the system load between two or more common rectifiers and batteries.

(c)* *Form 4C.* A rectifier, converter or motor-generator receiving power by two sources of alternating current with transfer facilities to apply power from the secondary source to the system within 30 seconds [*see 3-1.4.2(c)*].

4-1.5.3.2 Local circuits at Communication Centers shall be supplied either in common with box circuits or coded radio receiving system circuits or by a separate power source. The source of power for local circuits on

which the operation of essential features of the system depends shall be supervised.

4-1.5.3.3 Visual and audible means to indicate a 15 percent or greater reduction of normal power supply (rated voltage) shall be provided.

4-1.5.4 Rectifiers, Converters, Inverters, Motor-Generators.

4-1.5.4.1 Rectifiers shall be supplied through an isolating transformer taking energy from a circuit not to exceed 250 volts.

4-1.5.4.2 Complete, ready-to-use spare units, or spare parts, shall be available in reserve.

4-1.5.4.3 One spare rectifier shall be provided for each ten required for operation but in no case less than one.

4-1.5.4.4 Leads from rectifiers or motor-generators, with storage battery floating, shall have fuses rated at not less than 1 amp and not more than 200 percent of maximum connected load. Where not provided with battery floating, the fuse shall be not less than 3 amp.

4-1.5.5 Engine-Driven Generator Sets.

4-1.5.5.1 The provisions of this section shall apply to generators driven by internal combustion engines.

4-1.5.5.2 The installation of such units shall conform to the provisions of NFPA 37, *Standard for Stationary Combustion Engines and Gas Turbines*, except as restricted by the provisions of this section.

4-1.5.5.3 The unit shall be located in an adequately ventilated, cutoff area of the building housing the Communication Center equipment; the room shall be used for no other purpose except storage of spare parts or equipment. Exhaust fumes shall be discharged directly outside the building.

4-1.5.5.4 Liquid fuel shall be stored in outside underground tanks and gravity feed shall not be used. Sufficient fuel shall be available for 12 hrs of operation at full load if a reliable source of supply is available, at any time on 2 hrs' notice. If a source of supply is not reliable or readily available, or if special arrangements must be made for refueling as necessary, a supply sufficient for 24 hrs of operation at full load shall be maintained.

4-1.5.5.5 Liquefied petroleum gas and natural gas installations shall meet the requirements of NFPA 58, *Standard on Liquefied Petroleum Gases*, and NFPA 54, *National Fuel Gas Code*.

4-1.5.5.6 The unit shall be of sufficient capacity to supply power at least for operating all fire alarm facilities and emergency lighting of the operating rooms or communications building.

4-1.5.5.7 A separate storage battery on automatic float charger shall be provided for starting the engine-driven generator.

4-1.5.6 Batteries — Communication Center.

4-1.5.6.1 Batteries shall be of the storage type; primary batteries (dry cells) shall not be used. All cells shall be of the sealed type; lead-acid batteries shall be in jars of glass or other suitable transparent materials; other types of batteries shall be in containers suitable for the purpose.

4-1.5.6.2 Batteries shall be located in the same building as the operating equipment, preferably on the same floor, readily accessible for maintenance and inspection. The battery room shall be aboveground except as permitted by 2-1.1.2, and shall be ventilated to prevent accumulation of explosive gas mixtures; special ventilation is required only for unsealed cells.

4-1.5.6.3 Batteries shall be mounted in such a manner as to provide effective insulation from the ground and from other batteries. The mounting shall be suitably protected against deterioration and consideration shall be given to stability, especially in territory subject to seismic disturbance.

4-1.6 Testing.

4-1.6.1 General.

4-1.6.1.1 Tests and inspections shall be made at intervals not less frequent than those specified in this standard.

4-1.6.1.2 Testing facilities shall be installed at the Communication Center and the Satellite Communication Center, if used, except that, if satisfactory to the authority having jurisdiction, those facilities for systems leased from a nonmunicipal organization may be located elsewhere.

4-1.6.2 Power.

4-1.6.2.1 Manual tests of the power supply for telegraph and telephone (parallel) box circuits shall be made and recorded at least once in each 24 hrs. Such tests shall include:

(a) Current strength of each circuit. Changes in current of any circuit, amounting to 10 percent of normal current, shall be investigated immediately.

(b) Voltage across terminals of each circuit, inside of terminals of protective devices. Changes in voltage of any circuit, amounting to 10 percent of normal voltage, shall be investigated immediately.

(c) Voltage between ground and circuits. When this test shows a reading in excess of 50 percent of that shown in test 4-1.6.2.1(b) above, the trouble shall be immediately located and cleared; readings in excess of 25 percent shall be given early attention. These readings shall be taken with a voltmeter of not more than 100 ohms resistance per volt.

NOTE 1: The voltmeter sensitivity has been changed from 1,000 ohms per volt to 100 ohms per volt so that false ground readings (caused by induced voltages) will be minimized.

NOTE 2: Systems in which each circuit is supplied by an independent current source (Forms 3 and 4) will require tests between ground and each side of each circuit. Common current source systems (Form 2) will require voltage tests between ground and each terminal of each battery and other current source.

(d) A ground current reading shall be acceptable in lieu of 4-1.6.2(c) above. When this method of testing is used, all grounds showing a current reading in excess of 5 percent of the normal line current shall be given immediate attention.

(e) Voltage across terminals of common battery, on switchboard side of fuses.

(f) Voltage between common battery terminals and ground. Abnormal ground readings shall be investigated immediately.

NOTE: Tests (e) and (f) apply only to those systems using a common battery. If more than one common battery is used, each common battery shall be tested.

4-1.6.2.2 An emergency power source other than batteries shall be operated to supply the system for a continuous period of 1 hr at least weekly. This test shall require simulated failure of the normal power source.

4-1.6.2.3 Periodic tests shall be performed to ensure that the batteries are capable of supplying the system with power when required to do so. The required tests and the maximum interval at which they are to be performed are as follows:

(a) For lead acid batteries:

	Maximum Interval
Measure Float Voltage	
Of entire battery or a pilot cell	1 week
Of each cell	3 months
Measure Specific Gravity	
Of a pilot cell	6 weeks
Of each cell	6 months
Discharge for 2 hours	1 year
Clean and Inspect	3 months
Calibrate Meters	1 year

To maximize battery life the battery voltage for lead acid cells shall be maintained within the limits shown in the table below:

Float Voltage	High Gravity Battery (Lead Calcium)	Low Gravity Battery (Lead Antimony)
Max.	2.25 volts/cell	2.17 volts/cell
Min.	2.20 volts/cell	2.13 volts/cell

High rate voltage 2.33 volts/cell.

NOTE: Both high and low gravity voltage is (+)0.07 volts and (-)0.03 volts.

(b)* For nickel cadmium batteries:

	Maximum Interval
Measure Float Voltage (1.42 volts per cell nominal)	
Of entire battery	3 months
Of each cell	1 year
Check State of Charge	6 months
Discharge for 2 hours	1 year
Clean and Inspect	3 months
Calibrate Meters	1 year

To maximize battery life the battery shall be charged as follows:

Float Voltage	1.42 volts/cell ± .01 volts
High Rate Voltage	1.58 volts/cell + .07 - 0.00

4-1.6.3 Control Equipment. Manual tests of box circuit instruments shall be made and recorded at least once each 24 hrs. Where applicable, all box circuit instruments shall be tested by use of operators' keys.

4-1.6.4 Boxes.

4-1.6.4.1 Where repeating facilities are depended upon, the test of one box from every circuit from which no alarm was transmitted during the past month shall be transmitted over the entire system.

4-1.6.4.2 Boxes shall be tested by operation under conditions simulating actual use and test signals shall be transmitted and recorded at the Communication Center.

4-1.6.4.3 A periodic test shall be performed on all fire alarm boxes at least once in each 60 day period, and at that time said boxes shall be examined, cleaned and all functions tested.

4-1.7 Records.

4-1.7.1 General.

4-1.7.1.1 Complete records, sufficient to assure reliable operation of all alarm system functions, shall be maintained in a satisfactory manner.

4-1.7.1.2 When a combination of leased/owned facilities exists, records required to be maintained by the lessor for the municipality shall be specified.

4-1.7.1.3 A report of operations summarizing important statistics shall be prepared annually.

4-1.7.1.4 Circuits. Records of wired box circuits shall include: outline plans showing terminals and box sequence; diagrams of office wiring; materials including trade name, manufacturer and year of purchase or installation.

4-1.7.2 Boxes.

4-1.7.2.1 Records of boxes shall include: box identification; location address; circuit number (if applicable); physical mounting; description by manufacturer, model number; date of installation and power source (radio); test dates and time.

4-1.7.2.2 Field inspection forms shall include:

(a) Physical condition, paint, mounting, door function, drop wire or antenna,

(b) Tests of all box functions, and

(c) Maintenance.

4-1.7.3 Operations. Emergency calls, however received, shall be appropriately recorded and tabulated to indicate the origin of the call.

4-1.7.4 Emergency Generating Equipment. Emergency generating equipment periodic test records shall include: date and time; fuel, electrical, coolant and exhaust system conditions; operating time.

4-1.8 Requirements for Metallic Systems and Metallic Interconnections.

4-1.8.1 Circuit Conductors — General.

4-1.8.1.1 Wires shall be terminated so as to provide good electrical conductivity and prevent breaking from vibration or stress.

4-1.8.1.2 Circuit conductors on terminal racks shall be identified and isolated from conductors of other systems whenever possible and shall be suitably protected from mechanical injury.

4-1.8.1.3 Except as otherwise provided herein, exterior cable and wire shall conform to International Municipal Signal Association specifications or equal.

4-1.8.1.4 If a municipal box is installed inside a building, it shall be placed as near as practical to the point of entrance of the circuit, and the exterior wire shall be installed in conduit or electrical metallic tubing, in accordance with Chapter 3 of NFPA 70, *National Electrical Code*.

Exception: This requirement shall not apply to coded radio box systems.

4-1.8.2 Cables.

4-1.8.2.1 General.

4-1.8.2.1.1 Cables which meet the requirements of Article 310, NFPA 70, *National Electrical Code*, for installation in wet locations are satisfactory for overhead or underground installation except that direct-burial cable shall be specifically approved for the purpose.

4-1.8.2.1.2 Paper or pressed pulp insulation is not considered satisfactory for emergency service such as a fire alarm system, except that cables containing conductors with such insulation may be acceptable if pressurized with dry air or nitrogen. Loss of pressure in cables shall be indicated by a visual or audible warning system located where someone is in constant attendance who can interpret the pressure readings and who has authority to have the indicated abnormal condition corrected.

4-1.8.2.1.3 Natural rubber-sheathed cable shall not be used where it may be exposed to oil, grease, or other substances or conditions which may tend to deteriorate the cable sheath. Braided-sheathed cable shall be used only inside of buildings when run in conduit or metal raceways.

4-1.8.2.1.4 Other municipally controlled signal wires may be installed in the same cable with fire alarm wires. Cables controlled by, or containing wires of, private signaling organizations can be used for fire alarm purposes only by permission of the authority having jurisdiction.

4-1.8.2.1.5 Signaling wires which, because of the source of current supply, might introduce a hazard shall be protected and supplied as required for lighting circuits.

4-1.8.2.1.6 All cables, when installed, with all taps and splices made, but before connection to terminals, shall be tested for insulation resistance. Such tests shall indicate an insulation resistance of at least 200 megohms per mile between any one conductor and all others, the sheath, and ground.

4-1.8.2.2 Underground Cables.

4-1.8.2.2.1 Underground cables in duct or direct burial shall be brought aboveground only at points where liability of mechanical injury, or of disablement from heat incident to fires in adjacent buildings, is minimized.

4-1.8.2.2.2 Cables shall be in duct systems and manholes containing low-tension signaling system conductors only, except low-tension secondary power cables may be permitted. If in duct systems or manholes containing power circuit conductors in excess of 250 volts to ground, fire alarm cables shall be located as far as possible from such power cables and shall be separated from them by a noncombustible barrier or by such other means as may be practicable to protect the fire alarm cables from injury.

4-1.8.2.2.3 All cables installed in manholes shall be properly racked and marked for identification.

4-1.8.2.2.4 All conduits or ducts entering buildings from underground duct systems shall be effectively sealed against moisture or gases entering the building.

4-1.8.2.2.5 Cable joints shall be located only in manholes, fire stations, and other locations where proper accessibility is provided and where there is little liability of injury to the cable by falling walls or by operations in the buildings. Cable joints shall be so made as to provide and maintain conductivity, insulation and protection at least equal to that afforded by the cables which are joined. Cable ends shall be sealed against moisture.

4-1.8.2.2.6 Direct burial cable, without enclosure in ducts, shall be laid in grass plots, under sidewalks or in other places where the ground is not apt to be opened for other underground construction. If splices are made, such splices shall, where practicable, be accessible for inspection and tests. Such cables shall be buried at least 18 in. (0.5 m) deep and, where crossing streets or other areas likely to be opened for other underground construction, shall be in duct or conduit, or be covered by creosoted planking of at least 2-in. (50-mm) by 4-in. (100-mm) planks with half-round grooves, spiked or banded together after the cable is installed.

4-1.8.3 Aerial Construction.

4-1.8.3.1 Fire alarm wires shall be run under all other wires except communication wires. Suitable precautions shall be provided where passing through trees, under bridges, over railroads and at other places where injury or deterioration is possible. Wires and cables shall not be attached to a crossarm carrying electric light and power

wires, except that circuits carrying up to 220 volts for municipal communication use are permitted. Such 220-volt circuits shall be tagged or otherwise identified.

4-1.8.3.2 Aerial cable shall be supported by messenger wire of adequate tensile strength, except as permitted in 4-1.8.3.3.

4-1.8.3.3 Two-conductor cable shall be messenger-supported unless it has conductors of No. 20 AWG or larger size and has mechanical strength equivalent to No. 10 AWG hard-drawn copper.

4-1.8.3.4 Single wire shall meet International Municipal Signal Association specifications and shall not be smaller than No. 10 Roebling gage if of galvanized iron or steel, No. 10 AWG if of hard-drawn copper, No. 12 AWG if of approved copper-covered steel, or No. 6 AWG aluminum. Span lengths shall not exceed manufacturers' recommendations.

4-1.8.3.5 Wires to buildings shall contact only intended supports and shall enter through an approved weatherhead or suitable sleeves slanting upward and inward. Drip loops shall be formed on wires outside of buildings.

4-1.8.4 Leads Down Poles.

4-1.8.4.1 Leads down poles shall be protected against mechanical injury. Any metallic covering shall form a continuous conducting path to ground. Installation shall in all cases be such as to prevent water from entering the conduit or box.

4-1.8.4.2 Leads to boxes shall have 600-volt insulation approved for wet locations, as defined in NFPA 70, *National Electrical Code*.

4-1.8.5 Wiring Inside Buildings.

4-1.8.5.1 At the Communication Center, conductors shall extend as directly as possible to the operating room in conduits, ducts, shafts, raceways or overhead racks and troughs of a type of construction affording protection against fire and mechanical injury.

4-1.8.5.2 All conductors inside buildings shall be in conduit, electrical metallic tubing, metal molding, or raceways. Installation shall be in accordance with NFPA 70, *National Electrical Code*.

4-1.8.5.3 Conductors shall have an approved insulation; the insulation or other outer covering shall be flame-retardant and moisture-resistant.

4-1.8.5.4 Conductors shall be installed as far as possible without joints. Splices will be permitted only in junction or terminal boxes. Wire terminals, splices and joints shall conform with NFPA 70, *National Electrical Code*.

4-1.8.5.5 Conductors bunched together in a vertical run connecting two or more floors shall have a flame-retardant covering sufficient to prevent the carrying of fire from floor to floor. This requirement shall not apply if the conductors are encased in a metallic conduit, or located in a fire-resistive shaft having fire stops at each floor.

4-1.8.5.6 Where cables or wirings are exposed to unusual fire hazards, they shall be properly protected.

4-1.8.5.7 Cable terminals and cross-connecting facilities shall be located in or adjoining the operations room.

4-1.8.5.8 When signal conductors and electric light and power wires are run in the same shaft, they shall be separated by at least 2 in. (50 mm), or either system shall be encased in a noncombustible enclosure.

4-2 Coded Wired Reporting Systems.

4-2.1 Circuits.

4-2.1.1 General.

4-2.1.1.1 The National Electrical Safety Code, National Bureau of Standards Handbook H30, shall be used as a guide for the installation of outdoor circuitry.

4-2.1.1.2 In all installations first consideration shall be given to continuity of service; particular attention given to liability of mechanical injury, to disablement from heat incident to a fire, to injury by falling walls, and to damage by floods, corrosive vapors, or other causes.

4-2.1.1.3 Open local circuits within single buildings are permitted for the operation of alerting devices and alarm equipment additional to that required by the standard.

4-2.1.1.4 All circuits shall be so routed as to permit ready tracing of circuits for trouble.

4-2.1.1.5 Circuits shall not pass over, under, through, or be attached to buildings or property which is not owned by, or under the control of, the municipality or the agency responsible for maintaining the system.

4-2.1.1.6 Alarm instruments installed in private buildings shall be on circuits separate from box and dispatch circuits.

4-2.1.2 Box Circuits.

4-2.1.2.1 If a municipal box is installed inside a building, it shall be placed as near as practical to the point of entrance of the circuit, and the exterior wire shall be installed in conduit or electrical metallic tubing, in accordance with Chapter 3 of NFPA 70, *National Electrical Code*.

4-2.1.2.2 Accessible and reliable means, available only to the authority in control of the municipal system, shall be provided for disconnecting the loop to the box(es) inside the building, and definite notification shall be given to occupants of the building when the interior box(es) is not in service.

4-2.1.2.3 For a Type B system the effectiveness of noninterference and succession functions between box circuits shall be no less than between boxes in any one cir-

cuit. The disablement of any metallic box circuit shall cause a warning signal in all other circuits and, thereafter, the circuit or circuits not otherwise broken shall be automatically restored to operative condition.

4-2.1.2.4 Box circuits shall be sufficient in number and so laid out that the areas which would be left without box protection in case of disruption of a circuit will not exceed that covered by 20 properly spaced boxes where all or any part of the circuit is of aerial open-wire, or 30 properly spaced boxes where the circuit is entirely in underground or messenger-supported cable.

4-2.1.2.5 When all boxes on any individual circuit and associated equipment are designed and installed to provide for receipt of alarms through the ground in event of a break in the circuit, it is permissible for the circuit to serve twice the above figures for aerial open wire and cable circuits, respectively.

4-2.1.2.6 The installation of additional boxes in an area served by the number of properly spaced boxes indicated above does not constitute geographical overloading of a circuit.

4-2.1.3 Tie Circuits.

4-2.1.3.1 A separate tie circuit shall be provided from the Communication Center to each Satellite Communication Center.

4-2.1.3.2 In a Type B system, when all boxes in the system are of succession type, it is permissible to use the tie circuit as a dispatch circuit.

4-2.2 Circuit Protection.

4-2.2.1 General.

4-2.2.1.1 The protective devices shall be located close to, or be combined with, the cable terminals.

4-2.2.1.2 Lightning arresters suitable for the purpose shall be provided. Lightning arresters shall be marked with the name of the manufacturer and model designation.

4-2.2.1.3 All lightning arresters shall be connected to a suitable ground in accordance with NFPA 70, *National Electrical Code*.

4-2.2.1.4 All fuses shall be plainly marked with their rated ampere capacity. All fuses rated over 2 amp shall be of the enclosed type.

4-2.2.1.5 Circuit protection required at the Communication Center shall be provided in every building housing Communication Center equipment.

4-2.2.1.6 Each conductor entering a fire station from lines partially or entirely aerial shall be protected by a lightning arrester.

4-2.2.2 Communication Center.

4-2.2.2.1 All conductors entering the Communication Center shall be protected by the following devices, in the order named, starting from the exterior circuit:

(a) A fuse rated at 3 amp minimum to 7 amp maximum and not less than 2000 volts;

(b) A lightning arrester;

(c) A fuse or circuit breaker, rated at ½ amp.

4-2.2.2.2 The ½ amp protection on the tie circuits shall be omitted at Satellite Communication Centers.

4-2.2.3 Protection on Aerial Construction.

4-2.2.3.1 At junction points of open aerial conductors and cable, each conductor shall be protected by a lightning arrester of weatherproof type, or be suitably protected from the weather. There shall also be a connection between the lightning arrester ground and any metallic sheath and messenger wire.

4-2.2.3.2 Aerial open wire and nonmessenger supported 2-conductor cable circuits shall be protected by a lightning arrester at intervals of approximately 2,000 ft (610 m).

4-2.2.3.3 Lightning arresters, other than air-gap or self-restoring, rare gas type, shall not be installed in fire alarm boxes.

4-2.2.3.4 All protective devices shall be accessible for maintenance and inspection.

4-2.3 Power.

4-2.3.1 Requirements for Constant-Current Systems.

4-2.3.1.1 Means shall be provided for manually regulating current in box circuits so that operating current is maintained within 10 percent of normal throughout changes in external circuit resistance from 20 percent above to 50 percent below normal.

4-2.3.1.2 The voltage supplied to maintain normal line current on box circuits shall not exceed 150 volts, measured under "no load" conditions and shall be such that the line current will not be reduced below safe operating value by the simultaneous operation of four boxes.

4-2.3.1.3 Visual and audible means to indicate a 20 percent or greater reduction in the normal current in any box circuit shall be provided. All devices connected in series with any box circuit shall function properly when the box circuit current is reduced to 70 percent of normal.

4-2.3.1.4 Sufficient meters shall be provided to indicate the current in any box circuit and the voltage of any power source. Meters used in common for several circuits shall be provided with cut-in devices designed to reduce the probability of cross-connecting circuits.

4-2.4 Receiving Equipment — Facilities for Receipt of Box Alarms.

4-2.4.1 Visual Recording Devices.

4-2.4.1.1 A device for producing a permanent visual record shall be provided at each Communication Center

for each box circuit and each tie circuit. A reserve recording device shall be provided where there are five or more box circuits.

4-2.4.1.2 In a Type B system, one such device shall be installed in each fire station and at least one in the Communication Center.

4-2.4.2 Sounding Devices.

4-2.4.2.1 Sounding devices for signals shall be provided for box circuits.

NOTE 1: In a Type A system, it shall be satisfactory to use a common sounding device for more than one circuit and it shall be installed at the Communication Center.

NOTE 2: In a Type B system, a sounding device shall be installed in each fire station at the same location as the recording device for that circuit, except that at the Communication Center a common sounding device is permitted.

4-2.4.3 General.

4-2.4.3.1 Alarms from boxes shall be automatically received and recorded at the Communication Center.

4-2.4.3.2 A permanent visual record and an audible signal are required to indicate the receipt of an alarm. The permanent record shall indicate the exact location from which the alarm is being transmitted.

NOTE: The audible signal device may be common to several box circuits and arranged so that the fire alarm operator can manually silence the signal temporarily by a self-restoring switch.

4-2.4.3.3 Facilities shall be provided which will automatically record the date and time of receipt of each alarm.

4-2.5 Supervision.

4-2.5.1 To assure reliability, wired circuits upon which transmission and receipt of alarms depend shall be under constant electrical supervision to give prompt warning of conditions adversely affecting reliability.

4-2.5.2 The power supplied to all required circuits and devices of the system shall be supervised.

4-2.5.3 Trouble signals shall actuate a sounding device located where there is always a responsible person on duty.

4-2.5.4 Trouble signals shall be distinct from alarm signals and shall be indicated by both a visual light and audible signal.

NOTE 1: The audible signal may be common to several supervised circuits.

NOTE 2: A switch for silencing the audible trouble signal is permitted if the visual signal remains operated until the silencing switch is restored to its normal position.

4-2.5.5 The audible signal shall be responsive to faults on any other circuits which may occur prior to restoration of the silencing switch to normal.

4-3 Coded Radio Reporting Systems.

4-3.1 Radio Box Channel (Frequency).

4-3.1.1 Not more than 500 boxes shall be permitted on a single channel.

4-3.1.2 All coded radio box systems shall provide constant monitoring of the frequency(ies) in use. Both an audible and visual indication of any sustained carrier signal (when in excess of 15 seconds duration) shall be provided for each receiving system at the Communication Center.

4-3.1.3 When box message signals to the Communication Center or acknowledgment of message receipt signal from the Communication Center to the box are repeated, associated repeating facilities shall conform to the requirements established in 3-4.1.2.

4-3.2 Metallic Interconnections.

4-3.2.1 General. The National Electrical Safety Code, National Bureau of Standards Handbook H30, shall be used as a guide for the installation of outdoor circuitry.

All installations shall be protected against damage due to mechanical injury, fire, falling walls, floods, corrosive vapors or other causes.

4-3.2.2 Box Circuits. Accessible and reliable means, available only to the authority in control of the municipal system, shall be provided for disconnecting the loop to the box(es) inside the building, and definite notification shall be given to occupants of the building when the interior box(es) is not in service.

4-3.3 Boxes.

4-3.3.1 General. Coded radio fire alarm boxes shall be designed and operated in compliance with all applicable rules and regulations of the Federal Communications Commission, as well as the requirements established herein.

4-3.3.2 Design of Boxes.

4-3.3.2.1 Boxes shall provide no less than three specific and individually identifiable functions to the Communication Center in addition to the box number and they shall be "Test," "Tamper," and "Fire."

4-3.3.2.2* Boxes shall transmit to the Communication Center no less than one round for "Test," no less than one round for "Tamper," and no less than three rounds for "Fire."

4-3.3.2.3 When multi-function boxes are used to transmit to the Communication Center request(s) for emergency service or assistance in addition to those stipulated in 4-3.3.2.1, each such additional message function shall be individually identifiable.

4-3.3.2.4 Multi-function boxes shall be so designed as to prevent the loss of supplemental or concurrently actuated messages.

4-3.3.2.5 An actuating device held or locked in the activating position shall not prevent the activation of other messages.

4-3.3.3 Power Source.

4-3.3.3.1 Self-powered boxes shall provide satisfactory service for normal signaling and transmission, including testing, for a period of at least 6 months.

4-3.3.3.2 Boxes operating from a local source, stored energy or battery are permitted. Batteries used to power the individual box shall meet the following requirements:

(a) When operating from a local AC/DC energy source, each box shall contain a battery to ensure normal box operation in the event of failure of the local source.

(b) When operating from a battery and the battery voltage decreases to 85 percent or less of its rated voltage (measured under load condition), a specific warning indication shall be contained in all messages. The warning indication shall be part of all messages for no less than 15 days prior to the time the battery will become nonoperational.

(c) Battery operating characteristics shall be suitable for local temperature extremes.

4-3.3.3.3 Solar charging is permissible.

4-3.4 Receiving Equipment — Facilities for Receipt of Box Alarms.

4-3.4.1 General.

4-3.4.1.1 Alarms from boxes shall be automatically received and recorded at the Communication Center.

4-3.4.1.2 A permanent visual record and an audible signal are required to indicate the receipt of an alarm. The permanent record shall indicate the exact location from which the alarm is being transmitted.

4-3.4.1.3 Facilities shall be provided which will automatically record the date and time of receipt of each alarm.

4-3.4.2 Type A System.

4-3.4.2.1* For each frequency used, two separate receiving networks, each including an antenna, audible alerting device, receiver, power supply, signal processing equipment, a means of providing a permanent graphic recording of the incoming message that is both timed and dated, and other associated equipment shall be provided. Both systems and associated equipment shall be in operation simultaneously. Facilities shall be so arranged that a failure of either receiving network will not affect the receipt of messages from boxes.

4-3.4.2.2 When the system configuration is such that a polling device is incorporated into the receiving network to allow remote/selective initiation of box tests (*see 4-3.6.1*), a separate such device must be included in each of the two required receiving networks. Further, said polling devices shall be configured for automatic cycle initiation in their primary operating mode; capable of continuous self monitoring; and integrated into the network(s) in such a manner as to provide automatic switchover and operational continuity in the event of failure of either device.

4-3.4.2.3 "Test" signals from boxes need not include the date as part of their permanent recording, providing that the date is automatically printed on the recording tape at the beginning of each calendar day.

4-3.4.3 Type B System.

4-3.4.3.1 For each frequency used, a single complete receiving network shall be permitted in each fire station, providing the Communication Center conforms to 4-3.4.2.1.

4-3.4.3.2 If alarm signals are transmitted to a fire station from the Communication Center using the coded radio-type receiving equipment in the fire station to receive and record the alarm message, a second receiving network conforming to 4-3.4.3.1 shall be provided at each fire station and that receiving network shall employ a frequency other than that used for the receipt of box messages.

4-3.5 Power. Power shall be provided in accordance with 4-1.5.3.1.2 or 4-1.5.3.1.3.

4-3.6 Box Testing.

4-3.6.1 Each coded radio box shall automatically transmit a "Test" message at least once in each 24-hour period.

4-3.6.2 Periodic Test. The test (*see 4-1.6.4.3*) shall include the operation of all message functions associated with each box tested and such message functions shall be transmitted to the respective Communication Center, received and permanently recorded.

4-3.6.3 When solar charging of box battery(ies) is utilized, the solar cell associated with each box in the system shall be examined and cleaned no less than once in each 60-day period.

4-3.6.4 Receiving Equipment. Receiving equipment associated with coded radio-type systems shall be tested at least once each hour. The receipt of "Test" messages will be considered sufficient to comply with this requirement, providing at least one such message is received each hour.

4-3.7 Supervision.

4-3.7.1 Radio repeaters upon which receipt of alarms depend shall be provided with dual receivers and transmitters. Failure of the primary transmitter or receiver shall cause an automatic switchover to the secondary receiver and transmitter. However, if the repeater controls are located where someone is always on duty, manual switchover facilities are permitted if it can be done within 30 seconds.

4-3.7.2 The power supplied to all required circuits and devices of the system shall be supervised.

4-3.7.3 Trouble signals shall actuate a sounding device located where there is always a responsible person on duty.

4-3.7.4 Trouble signals shall be distinct from alarm signals and shall be indicated by both a visual light and audible signal.

NOTE 1: The audible signal may be common to several supervised circuits.

NOTE 2: A switch for silencing the audible trouble signal is permitted if the visual signal remains operated until the silencing switch is restored to its normal position.

4-3.7.5 The audible signal shall be responsive to faults on any other circuits which may occur prior to restoration of the silencing switch to normal.

4-4 Telephone (Series) Reporting Systems.

4-4.1 Circuits.

4-4.1.1 General.

4-4.1.1.1 The National Electrical Safety Code, National Bureau of Standards Handbook H30, shall be used as a guide for the installation of outdoor circuitry.

4-4.1.1.2 In all installations first consideration shall be given to continuity of service; particular attention given to liability of mechanical injury, to disablement from heat incident to a fire, to injury by falling walls, and to damage by floods, corrosive vapors or other causes.

4-4.1.1.3 Open local circuits within single buildings are permitted for the operation of alerting devices and alarm equipment additional to that required by the standard.

4-4.1.1.4 All circuits shall be so routed as to permit ready tracing of circuits for trouble.

4-4.1.1.5 Circuits shall not pass over, under, through, or be attached to buildings or property which are not owned by, or under the control of, the municipality or the agency responsible for maintaining the system.

4-4.1.1.6 Alarm instruments installed in private buildings shall be on circuits separate from box and dispatch circuits.

4-4.1.2 Box Circuits.

4-4.1.2.1 Box circuits shall be sufficient in number and so laid out that the area which would be left without box protection in case of disruption of a circuit will not exceed that covered by 20 properly spaced boxes where all or any part of the circuit is of aerial open-wire, or 30 properly spaced boxes where the circuit is entirely in underground or messenger-supported cable.

4-4.1.2.2 When all boxes on any individual circuit and associated equipment are designed and installed to provide for receipt of alarms through the ground in event of a break in the circuit, it is permissible for the circuit to serve twice the above figures for aerial open-wire and cable circuits, respectively.

4-4.1.2.3 The installation of additional boxes in an area served by the number of properly spaced boxes indicated above does not constitute geographical overloading of a circuit.

4-4.1.3 Tie Circuits.

4-4.1.3.1 A separate tie circuit shall be provided from the Communication Center to each Satellite Communication Center.

4-4.1.3.2 The tie circuit between the Center and Satellite shall not be used for any other purpose.

4-4.2 Circuit Protection.

4-4.2.1 General.

4-4.2.1.1 The protective devices shall be located close to, or be combined with, the cable terminals.

4-4.2.1.2 Lightning arresters suitable for the purpose shall be provided. Lightning arresters shall be marked with the name of the manufacturer and model designation.

4-4.2.1.3 All lightning arresters shall be connected to a suitable ground in accordance with the *National Electrical Code*, NFPA 70.

4-4.2.1.4 All fuses shall be plainly marked with their rated ampere capacity. All fuses rated over 2 amp shall be of the enclosed type.

4-4.2.1.5 Circuit protection required at the Communication Center shall be provided in every building housing Communication Center equipment.

4-4.2.1.6 Each conductor entering a fire station from lines partially or entirely aerial shall be protected by a lightning arrester.

4-4.2.2 Protection at Communication Center.

4-4.2.2.1 All conductors entering Communication Centers shall be protected by the following devices, in the order named, starting from the exterior circuit:

(a) A fuse rated at 3 amp minimum to 7 amp maximum and not less than 2000 volts;

(b) A lightning arrester;

(c) A fuse or circuit breaker, rated at ½ ampere.

4-4.2.2.2 The ½ amp protection on the tie circuits shall be omitted at Satellite Communication Centers.

4-4.2.3 Protection on Aerial Construction.

4-4.2.3.1 At junction points of open aerial conductors and cable, each conductor shall be protected by a lightning arrester of weatherproof type, or be suitably protected from the weather. There shall also be a connection between the lightning arrester ground and any metallic sheath and messenger wire.

4-4.2.3.2 Aerial open-wire and nonmessenger supported 2-conductor cable circuits shall be protected by a lightning arrester at intervals of approximately 2,000 ft (610 m).

4-4.2.3.3 Lightning arresters, other than air-gap or self-restoring, rare gas type, shall not be installed in fire alarm boxes.

4-4.2.3.4 All protective devices shall be accessible for maintenance and inspection.

4-4.3 Power.

4-4.3.1 Requirements for Constant-Current Systems.

4-4.3.1.1 Means shall be provided for manually regulating current in box circuits so that operating current is maintained within 10 percent of normal throughout changes in external circuit resistance from 20 percent above to 50 percent below normal.

4-4.3.1.2 The voltage supplied to maintain normal line current on box circuits shall not exceed 150 volts, measured under "no load" conditions, and shall be such that the line current will not be reduced below safe operating value during the simultaneous operation of four boxes.

4-4.3.1.3 Visual and audible means to indicate a 20 percent or greater reduction in the normal current in any box circuit shall be provided. All devices connected in series with any box circuit shall function properly when the box circuit current is reduced to 70 percent of normal.

4-4.3.1.4 Sufficient meters shall be provided to indicate the current in any box circuit and the voltage of any power source. Meters used in common for several circuits shall be provided with cut-in devices designed to reduce the probability of cross-connecting circuits.

4-4.4 Design of Boxes.

4-4.4.1 If a handset is used, the caps on the transmitter and receiver shall be secured to reduce the probability of the box being disabled due to vandalism.

4-4.4.2 Boxes shall be designed to permit the Communication Center operator to determine whether or not the box has been restored to normal condition after use.

4-4.5 Receiving Equipment — Facilities for Receipt of Box Alarms.

4-4.5.1 A permanent visual recording device installed in the Communication Center shall be provided to record all incoming box signals. A spare recording device shall be provided for five or more box circuits.

4-4.5.2 A second visual means of identifying the calling box shall be provided.

4-4.5.3 Audible signals shall indicate all incoming calls from box circuits.

4-4.5.4 Alarms from boxes shall be automatically received and recorded at the Communication Center.

4-4.5.5 A permanent visual record and an audible signal are required to indicate the receipt of an alarm. The permanent record shall indicate the exact location from which the alarm is being transmitted.

NOTE: The audible signal device may be common to several box circuits and arranged so that the fire alarm operator can manually silence the signal temporarily by a self-restoring switch.

4-4.5.6 All voice transmissions from boxes for emergencies shall be recorded with the capability of instant playback.

4-4.5.7 A voice recording facility shall be provided for each operator handling incoming alarms in order to eliminate the possibility of interference.

4-4.5.8 Facilities shall be provided which will automatically record the date and time of receipt of each alarm, except that time only is acceptable in voice recordings.

4-4.6 Testing.

4-4.6.1 Power Supply. Manual tests of the power supply for box circuits shall be made and recorded at least once each 24 hours. Such tests shall include:

(a) Current strength of each circuit. Changes in current of any circuit, amounting to 10 percent of normal current, shall be investigated immediately.

(b) Voltage across terminals of each circuit, inside of terminals of protective devices. Changes in voltage of any circuit, amounting to 10 percent of normal voltage, shall be investigated immediately.

(c) Voltage between ground and circuits. When this test shows a reading in excess of 50 percent of that shown in test 4-4.6.1(b) above, the trouble shall be immediately located and cleared; readings in excess of 25 percent shall be given early attention. These readings shall be taken with a voltmeter of not more than 100 ohms resistance per volt.

NOTE 1: The voltmeter sensitivity has been changed from 1,000 ohms per volt to 100 ohms per volt so that false ground readings (caused by induced voltages) will be minimized.

NOTE 2: Systems in which each circuit is supplied by an independent current source (Forms 3 and 4) will require tests between ground and each side of each circuit. Common current source systems (Form 2) will require voltage tests between ground and each terminal of each battery and other current source.

(d) A ground current reading shall be acceptable in lieu of 4-4.6.1(c). When this method of testing is used, all grounds showing a current reading in excess of 5 percent of the normal line current shall be given immediate attention.

(e) Voltage across terminals of common battery, on switchboard side of fuses.

(f) Voltage between common battery terminals and ground. Abnormal ground readings shall be investigated immediately.

NOTE: Tests (e) and (f) apply only to those systems using a common battery. If more than one common battery is used, each common battery shall be tested.

4-4.6.2 Control Equipment. Manual tests of box and dispatch circuit instruments shall be made and recorded at least once each 24 hrs.

4-4.7 Supervision.

4-4.7.1 To assure reliability, wired circuits upon which transmission and receipt of alarms depend shall be under constant electrical supervision to give prompt warning of conditions adversely affecting reliability.

4-4.7.2 The power supplied to all required circuits and devices of the system shall be supervised.

4-4.7.3 Trouble signals shall actuate a sounding device located where there is always a responsible person on duty.

4-4.7.4 Trouble signals shall be distinct from alarm signals and shall be indicated by both a visual light and audible signal.

NOTE 1: The audible signal may be common to several supervised circuits.

NOTE 2: A switch for silencing the audible trouble signal is permitted if the visual signal remains operated until the silencing switch is restored to its normal position.

4-4.7.5 The audible signal shall be responsive to faults on any other circuits which may occur prior to restoration of the silencing switch to normal.

4-5 Telephone (Parallel) Reporting Systems.

4-5.1 Circuits.

4-5.1.1 General.

4-5.1.1.1 The National Electrical Safety Code, National Bureau of Standards Handbook H30, shall be used as a guide for the installation of outdoor circuitry.

4-5.1.1.2 In all installations first consideration shall be given to continuity of service; particular attention given to liability of mechanical injury, to disablement from heat incident to a fire, to injury by falling walls, and to damage by floods, corrosive vapors or other causes.

4-5.1.1.3 Open local circuits within single buildings are permitted for the operation of alerting devices and alarm equipment additional to that required by the standard.

4-5.1.1.4 All circuits shall be so routed as to permit ready tracing of circuits for trouble.

4-5.1.1.5 Circuits shall not pass over, under, through, or be attached to buildings or property which are not owned by, or under the control of, the municipality or the agency responsible for maintaining the system.

4-5.1.1.6 Alarm instruments installed in private buildings shall be on circuits separate from box and dispatch circuits.

4-5.1.2 Box Circuits.

4-5.1.2.1 If a municipal box is installed inside a building, it shall be placed as near as practical to the point of entrance of the circuit, and the exterior wire shall be installed in conduit or electrical metallic tubing, in accordance with Chapter 3 of the *National Electrical Code*, NFPA 70.

4-5.1.2.2 Accessible and reliable means, available only to the authority in control of the municipal system, shall be provided for disconnecting the loop to the box(es) inside the building, and definite notification shall be given to occupants of the building when the interior box(es) is not in service.

4-5.1.2.3 A separate circuit shall be provided for each box.

4-5.1.3 Tie Circuits.

4-5.1.3.1 Where a concentrator-identifier or similar device is employed, at least two tie circuits for the first 40 boxes connected shall be provided to the Communication Center. A tie circuit shall be provided for each 40 or fraction thereof of additional boxes connected to the above named device.

NOTE: These tie circuits shall not be used for any other purpose or function.

4-5.2 Circuit Protection.

4-5.2.1 General.

4-5.2.1.1 The protective devices shall be located close to, or be combined with, the cable terminals.

4-5.2.1.2 Lightning arresters suitable for the purpose shall be provided. Lightning arresters shall be marked with the name of the manufacturer and model designation.

4-5.2.1.3 All lightning arresters shall be connected to a suitable ground in accordance with the *National Electrical Code*, NFPA 70.

4-5.2.1.4 All fuses shall be plainly marked with their rated ampere capacity. All fuses rated over 2 amp shall be of the enclosed type.

4-5.2.1.5 Circuit protection required at the Communication Center shall be provided in every building housing Communication Center equipment.

4-5.2.1.6 Each conductor entering a fire station from lines partially or entirely aerial shall be protected by a lightning arrester.

4-5.2.2 Protection at Communication Center. All conductors entering the Communication Center shall be protected with devices, in the order named, starting from the exterior circuit as follows:

(a) A fuse rated at 3 amp minimum to 7 amp maximum and not less than 2000 volts;

(b) A lightning arrester;

(c) A fuse or other device, such as a heat coil, rated at not more than ½ ampere; or

(d) Where the design of the system is such that other type protection is necessary, the recommendation of the manufacturer shall be followed.

4-5.2.3 Protection on Aerial Construction.

4-5.2.3.1 At junction points of open aerial conductors and cable, each conductor shall be protected by a light-