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NFPA 1221 Public Fire Service Communications 1988 Edition

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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NATIONAL FIRE PROTECTION ASSOCIATION

NFPA 1221

Standard for the

Installation, Maintenance and Use of Public Fire Service Communication Systems

1988 Edition

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 9-11, 1987 in Portland, Oregon. It was issued by the Standards Council on December 2, 1987, with an effective date of December 22, 1987, and supersedes all previous editions.

The 1988 edition of this standard has been 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, 1980 and 1984.

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James M. Turner, Los Angeles County Fire Dept., CA
Rep. NFPA FSS
Marion J. Varner, Marion J. Varner & Associates

Alternate

Richard A. Rice, Alexandria, VA
(Alternate to E. Stauffer)

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.

Contents

NFPA 1221

Standard for the

Installation, Maintenance and Use of Public Fire Service Communication Systems

1988 Edition

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A or B.
Information on referenced publications can be found in Chapter 5 and Appendix C.

Chapter 1 Fundamentals

1-1 Scope.

1-1.1 This standard covers the installation, maintenance, and use of public fire service communications systems and facilities. This standard is neither 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, 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 the Installation, Maintenance, and Use of Signaling Systems for Central Station Service*; NFPA 72A, *Standard for the Installation, Maintenance, and Use of Local Protective Signaling Systems for Guard's Tour, Fire Alarm, and Supervisory Service*; NFPA 72B, *Standard for the Installation, Maintenance, and Use of Auxiliary Protective Signaling Systems for Fire Alarm Service*; NFPA 72C, *Standard for the Installation, Maintenance, and Use of Remote Station Protective Signaling Systems*; and NFPA 74, *Standard for the Installation, Maintenance, and Use of 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, if found satisfactory, shall be judged the equivalent.

1-2 Management. 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, medical emergency, or other situation that 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 jurisdictions 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."

Baud. Measurement of data transmission rates expressed as "bits per second" or bps.

Box. A device used to send an alarm in event of an emergency (see Auxiliary Box, Master Box, Street Box).

Auxiliary Box. A box that is operated by connection to one or more remote actuating devices.

Master Box. A box that combines the capability of a street box and an auxiliary box.

Street Box. A box configured for manual operation only.

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

CAD (Computer-Aided 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).

Certification. A formal program of related instruction and testing as provided by a recognized organization, or the authority having jurisdiction.

Channel.

(a) *Electric Communication.*

1. a single path for transmitting electric signals, usually as distinct from other parallel paths, or

2. a band of frequencies.

NOTE: The word *path* is to be interpreted in a broad sense to include separations by frequency division or time division. The term *channel* may signify either a one-way path, providing transmission in one direction only, or a two-way path, providing transmission in two directions.

(b) *Data Transmission.* In electric communication,

1. a single path for transmitting electric signals, usually as distinct from other parallel paths, or

2. a band of frequencies.

NOTE: The word *path* is to be interpreted in a broad sense to include separation by frequency division or time division. The term *channel* may signify either one-way path, providing transmission in one direction only, or a two-way path, providing transmission in two directions. See duplex channel; radio channel.

Channel, Radio. See radio channel.

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 that 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 Communication 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. A building or portion of a building specifically configured for the primary purpose of providing emergency communications services to one or more public safety agencies under the authority(ies) having jurisdiction. This facility shall apply to all areas necessary for operation, domicile, and the installation of necessary equipment.

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.

CPU. Central Processing Unit of the computer system. It contains the main storage, arithmetic unit, and special register groups.

Duplex Channel. See duplex operation.

Duplex Operation.

(a) *Data Transmission.*

1. General. The operation of transmitting and receiving apparatus at one location in conjunction with associated transmitting and receiving equipment at another location, the processes of transmission and reception being concurrent.

2. Radio Communication (Two-way Radio Communication Circuit). The operation utilizing two radio-frequency channels, one for each direction of transmission, in such manner that intelligence may be transmitted concurrently in both directions.

(b) Radio Communication (Two-Way Radio Communication Circuit). The operation utilizing two radio-frequency channels, one for each direction of transmission, in such a manner that intelligence may be transmitted concurrently in both directions.

Dynamotor. A machine that combines both motor and generator action in one magnetic field, either with no armatures or with 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 Periodic Function (wherein time is the independent variable).

(a) *General.* The number of periods per unit time.

(b) *Radio Wave Propagation.* Of a periodic wave, the number of identical cycles per second.

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, electromagnetic 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.

Modem (Modulator Demodulator Unit). A device that converts data which is compatible with data-processing equipment to a form that is compatible with transmission facilities, and vice-versa.

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

Municipality. Any government unit, such as a federal agency, state, county, city, town, or fire protection district.

Operator. A person or persons certified to receive and/or retransmit an alarm in the Communication Center.

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

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

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

Power Supply, Uninterruptible (UPS). A system designed to provide power, without delay or transients, during any period when the normal power supply is incapable of performing acceptably.

Protocol.

(a) *Data Communication.* A formal set of conventions governing the format and relative timing of message exchange between two communications terminals. See control procedure.

(b) *Software.*

1. A set of conventions or rules that govern the interactions of processes or applications within a computer system or network.

2. A set of rules that govern the operation of functional units to achieve communication.

Publicly Accessible Box. A street box or master box installed in such a location as to provide immediate access by the general public or on a 24-hour basis.

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 on the type of transmissions and the tolerance for the frequency of emission. Normally allocated for radio transmission in a specified type for service or by a specified transmitter.

Radio Circuit. A means for carrying out one radio communication at a time in either or both directions between two points. See radio channel.

Rectifier. A device without moving parts that 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 amplified, reshaped, or both.

Satellite Communication Center or "Satellite." The building used to house a 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 that 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.

Structured Programming. A modular approach to program development that emphasizes stepwise refinement, simple control structures, and short one-entry point/one-exit point modules.

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

Supervisor. A person or persons certified to manage all operational aspects of a Communication Center.

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 that are 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 that 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 that 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.

UPS (Uninterruptible Power System). See power supply, uninterruptible (UPS).

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

Workmanlike Manner. A journeyman-level of technical performance, as established by a recognized certifying organization and as related to the specific disciplines/trades involved.

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 contructing the roof to resist damage that 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.

2-1.1.3 Each jurisdiction shall maintain an alternate communications facility capable, when staffed, of performing the emergency functions provided at the Communication Center. The facility shall be geographically separated from the primary Communication Center at a distance satisfactory to assure the viability of the alternate facility concept.

2-1.2 Construction.

2-1.2.1 The Communication Center shall be located in buildings classified as being of fire-resistive construction, or protected noncombustible/limited-combustible construction as defined by NFPA 220, *Standard on Types of Building Construction*, if provided with a Class A fire-resistive roof covering and a sprinkler system in all areas of the building excluding the Communication Center and power room. The sprinkler system shall be completely supervised by the Communication Center.

2-1.2.2 A Communication Center located in a building of unprotected noncombustible/limited-combustible or ordinary construction as defined by NFPA 220, *Standard on 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. The sprinkler system shall be completely supervised by the Communication Center. The sprinkler system and its supervisory service shall conform to NFPA 13, *Standard for the Installation of Sprinkler Systems*.

2-1.2.3 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 hours. 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 a 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 conforming to NFPA 72A, *Standard for the Installation, Maintenance, and Use of Local Protective Signaling Systems for Guard's Tour, Fire Alarm, and Supervisory Service*, and NFPA 72E, *Standard on Automatic Fire Detectors*. If the adjoining spaces are occupied by Extra Hazard Occupancies as defined in NFPA 13, *Standard for Installation of Sprinkler Systems*, they shall be provided with an automatic sprinkler system that shall be completely supervised at the Communication Center. The sprinkler system and its supervisory service shall conform to NFPA 13, *Standard for the Installation of Sprinkler Systems*.

2-1.2.4 Interior finish material shall have a flame spread rating of 25 or less, and a smoke development

rating of 50 or less, when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials.*

2-1.2.5 When the design of a new Communication Center or a major remodeling of an existing center requires one or more full-time, on-duty operators, the center shall be equipped with a toilet and lunch area directly accessible to the operations room.

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. The door opening shall be protected by not less than a Class B self-closing fire door assembly.

2-1.2.7 Entry to the Communication Center shall be restricted to authorized persons only. Entryways leading directly from the exterior shall be protected by two doors and a vestibule.

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 utility services shall pass through those portions of the Communication Center where essential equipment is installed and or operational functions are performed.

2-1.4 Fire Protection.

2-1.4.1 The Communication Center shall be provided with fire extinguishers meeting the requirements of NFPA 10, *Standard for Portable Fire Extinguishers*, and not less than two such extinguishers shall be required.

2-1.4.2 The Communication Center, in its entirety, shall be provided with an automatic fire alarm system in accordance with NFPA 72A, *Standard for the Installation, Maintenance, and Use of Local Protective Signaling Systems for Guard's Tour, Fire Alarm, and Supervisory Service*, and NFPA 72E, *Standard on Automatic Fire Detectors*, except that the audible and visual evacuation signals shall not interfere with communications operations. The alarm system shall be monitored in accordance with NFPA 71, *Standard for the Installation, Maintenance, and Use of Signaling Systems for Central Station Service*; NFPA 72B, *Standard for the Installation, Maintenance, and Use of Auxiliary Signal Systems for Fire Alarm Service*; or NFPA 72C, *Standard for the Installation, Maintenance, and Use of Remote Station Protective Signaling Systems.*

2-1.4.3 The Communication Center shall be protected in its entirety with a fixed automatic fire extinguishing system(s) complying with NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*; NFPA 13, *Standard for the Installation of Sprinkler Systems*; and if necessary, NFPA 75, *Standard for the Protection of Electronic Computer/Data Processing Equipment.*

2-1.4.4* In the event of a fire in the Communication Center, the facility shall be capable of continuous operation for sufficient time to enable transfer of operations to any alternate Communication Center capable of continuous operation.

2-1.5 Emergency Lighting.

2-1.5.1 The Communication Center shall be equipped with emergency lighting that shall be immediately placed in service upon a power failure and shall be independent of the power source normally used for lighting purposes. Illuminations shall be great enough to permit all necessary operations (*see Section 700-12(F), NFPA 70, National Electrical Code®*).

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 lights automatically when power is interrupted.

2-1.6 Power.

2-1.6.1 General.

2-1.6.1.1 Under all conditions, two sources of power shall be provided for the operation of the communications network and its 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 installed 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 installed so that it is 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.

2-1.6.1.6 Power supply circuit conductors shall be installed in independent conduits not used for any other circuit conductors, from the disconnect switches to the current-consuming devices. The conductors of this section shall not be routed over any heat-producing equipment, including a distribution transformer, or an engine-driven generator set.

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 that 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 required to operate the essential features of the system shall be supervised.

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

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

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

2-1.6.4.2 Complete, ready-to-use spare units and 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 shall less than one be provided.

2-1.6.4.4 Leads from rectifiers or motor-generators, with storage battery floating, shall have fuses rated at not less than 1 ampere and not more than 200 percent of maximum connected load. Where not provided with battery floating, the fuse shall not be 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 engine-driven generator sets shall conform to the provisions of NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, and NFPA 110, *Standard for Emergency and Standby Power Systems*, except as restricted by the provisions of this section.

2-1.6.5.3 The engine-driven generator set shall be located in an adequately ventilated, cutoff area of the building housing the Communication Center equipment. The area housing the unit 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 hours of operation at full load if a reliable source of fuel supply is available, at any time, on 2 hours 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 hours 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 54, *National Fuel Gas Code*, and NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*.

2-1.6.5.6 The unit, as a minimum, shall be of sufficient capacity to supply power to operate 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 spillproof type, adequately vented and, as applicable, equipped with explosion-inhibiting caps. Lead-acid batteries shall be in jars of glass or other suitable transparent material; 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 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 geographic areas 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 to provide good electrical conductivity and to 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 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 providing 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 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 either in or adjacent to the operations room.

2-1.7.2.8 When signal conductors and electrical 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. Number of operators shall be as follows:

(a) For jurisdictions receiving fewer than 600 alarms per year, alarms not retransmitted automatically shall be received and retransmitted to the fire force by an operator on duty for the purpose, as follows:

1. A specifically designated operator, 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 600 to 2,500 alarms per year, at least one operator shall be on duty in the Communication Center.

(c) For jurisdictions receiving more than 2,500 to 10,000 alarms per year, at least two operators shall be on duty in the Communication Center.

(d) For jurisdictions receiving more than 10,000 alarms per year, additional operators and supervisors shall be required in accordance with the following:

1. One operator in the operations room for 20 incoming alarms per hour.

2. One additional operator in the operations room for transmitting the alarm to fire stations.

3. One additional operator in the Communication Center for tactical radio frequencies used for emergency operations.

4. One supervisor in the Communication Center when there are more than two and fewer than five operators on duty.

5. One supervisor in the operations room when there are five or more operators on duty.

2-1.8.1.1 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 any 911 system, and shall be capable of making the prescribed tests. They shall be familiar with rules and regulations relating to equipment use, including those of the Federal Communications Commission pertaining to emergency services' use of 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 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 (e.g., 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 fires and subsequent alarms, time of acknowledgement 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(s), 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 conditions observed to the Communication Center.

2-1.9.8 Fire communications equipment shall be restored to normal condition as promptly as possible after each alarm for 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, if satisfactory to the authority having jurisdiction, those facilities for systems leased from a nonmunicipal organization, which 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 hour 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 intervals 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)
Maximum	2.25 volts/cell	2.17 volts/cell
Minimum	2.20 volts cell	2.13 volts/cell
High Rate Voltage		2.33 volts cell.

NOTE: High and low gravity voltages are (+)0.07 volts and (−)0.03 volts, respectively.

(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 volts

2-1.11 Maintenance.

2-1.11.1 When maintenance is provided by an organization or person other than the jurisdiction or its employees, a complete written record of the installation, maintenance, test, and extension of the system shall be forwarded to the responsible jurisdiction employee within ten work days subsequent to the time of service.

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 Complete records of 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 shall be kept by the municipality; these records shall include the date and time of all occurrences.

2-1.12.3 When a combination of leased/owned facilities exists, resources 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 used 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 that 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 telephore 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 assigned. The number of lines shall depend upon the traffic handled.

NOTE: Additional telephone lines should be provided for 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 reporting. Where dial system service is used, provisions shall be made for automatic selection of 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 that will automatically record the time of receipt of each alarm.

(h) If an incoming telephone call is not answered within 60 seconds, when only one operator is on duty, 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 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 provision 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 not susceptible to variations in the utility distribution system.

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

NOTE: Form 2B, a rectifier or motor-generator powered from two (2) sources of alternating current, with a floating storage battery having a 4-hour 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 hours 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 only 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 Public Reporting at Fire Stations. A publicly accessible means of communication conforming to this standard shall be provided at fire stations, for the reporting of emergencies at such times that the station is unoccupied.

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 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 Use of a fire alarm dispatching system for the transmission of other signals or calls of a public emergency nature is permissible 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 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 for 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 shall 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 that receive fewer 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(s)] 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 shall be provided for alarms transmitted by voice, separate from those used for recording voice alarms from boxes.

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

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 installed so that it will be accessible only to authorized personnel.

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

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 that 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 electrical service capacity of the equipment required under 2-1.6 is adequate 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.

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 at least 10 percent of the total number of dispatch circuits, but never less than two percent.

3-1.4.3.2.3 If common-current source systems are grounded, the ground shall not exceed 10 percent of the resistance of any connected circuit and shall 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 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*).

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 required to operate the essential features of the system shall be supervised.

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

3-1.4.4 Rectifiers, Converters, Inverters, and 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 shall less than one be provided.

3-1.4.4.4 Leads from rectifiers or motor-generators, with storage battery floating, shall have fuses rated at not 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 the Installation and Use of Stationary Combustion Engines and Gas Turbines*, and NFPA 110, *Standard for Emergency and Standby Power Systems*, except as restricted by the provisions of this section.

3-1.4.5.3 The engine-driven generator set shall be located in an adequately ventilated, cutoff area of the building housing the Communication Center equipment. The area housing the unit 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 hours of operation at full load if a reliable source of supply is available, at any time, on 2 hours 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 hours 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 54, *National Fuel Gas Code*, and NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases.*

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

3-1.4.5.7 When more than one engine-driven generator is provided, each shall be provided with a separate fuel line and transfer pump.

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 spillproof type, adequately vented and, as applicable, equipped with explosion-inhibiting caps. Lead-acid batteries shall be in jars of glass or other suitable transparent material; 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 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 geographic areas 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, if satisfactory to the authority having jurisdiction, those facilities for systems leased from a nonmunicipal organization, which 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 for 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 every 24 hours. Circuits for transmission of graphic signals shall be tested by a message transmission.

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

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

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 hour 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 intervals 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)
Maximum	2.25 volts/cell	2.17 volts/cell
Minimum	2.20 volts/cell	2.13 volts/cell
High Rate Voltage		2.33 volts/cell.

NOTE. High and low gravity voltages are (+)0.07 volts and (−)0.03 volts, respectively.

(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 volts

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 used including trade name, manufacturer, and year of purchase or installation.

3-1.6.3 Operating Practices.

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 Bureau of Standards Handbook H30, *National Electrical Safety Code*, 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 that 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 to provide good electrical conductivity and to 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 their equivalent.

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

3-1.9 Cables.

3-1.9.1 General.

3-1.9.1.1 Cables that 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 the 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 that 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 with permission of the authority having jurisdiction.

3-1.9.1.5 Signaling wires that, 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 cable shall be brought aboveground only at points where

liability of mechanical injury, or 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 made to provide and maintain conductivity, insulation, and protection at least equal to that afforded by the cables that are joined. Cable ends shall be sealed against moisture.

3-1.9.2.6 Direct-burial cable, not enclosed 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 properly protected 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 circuits carrying up to 220 volts for municipal communication use. 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 size No. 20 AWG or larger 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. In all cases, installation shall 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 either in or adjacent to 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 two 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.

(a) Facilities shall be installed to automatically transmit alarms received from any box to all fire stations and, where employed, to outside sounding devices.

(b) Control facilities shall permit any or all circuits to be individually connected to or disconnected from the repeating mechanism.

(c) 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 amps 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 partially or entirely aerial lines 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 amps minimum to 7 amps 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 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 weatherproof lightning arrester or 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 lightning arresters 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, switchboards, 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 designed and installed so 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 that 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 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 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 is to 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, either 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 personnel 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(s)] 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 from 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.** In a Type B System, the requirements in the following paragraphs also apply:

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

(b) In those municipalities that 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 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 requires 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 providing protection against fire and mechanical injury.

3-3.7 **Circuit Protection.**

3-3.7.1 Each conductor entering a fire station from partially or entirely aerial lines 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 amps 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 amps.

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 manual operation is possible within 30 seconds.

3-4.1.3 If both of the dispatch circuits are radio, separate radio frequencies shall be provided.

3-4.1.4 Municipalities shall be permitted to share the same fire frequency(ies) provided that a Continuous Tone Coded Squelch System (CTCSS) or a Continuous Digital Coded Squelch System (CDCSS) is used.

3-4.1.5 Radio dispatch channels shall be separate from radio channels used for routine or fireground 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 designed and installed so that it shall be capable of performing its intended functions in a range of 85 percent through 110 percent of 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 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 continues to operate 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 that 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 used, 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 personnel 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 acknowledgement 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(s)] 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 from 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 fireground communications for jurisdictions or multiple jurisdictions on the same channel receiving 2500 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 jurisdiction 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 an outside contract maintenance service with a maximum response time of 2 hours 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 STD 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 (CTCS), or continuous digital coded squelch (CDCS) 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 fireground operations, are found in 3-10.3.

3-7.1.1 Portable radios shall conform to all FCC standards and be of a 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 STD 810-C, with size and construction making it capable of one-handed 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 the 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 fireground 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 (CTCS), or continuous digital coded squelch (CDCS).

NOTE: If operating in standard squelch systems, continuous coded 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 ensure 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 the 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 amps 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 partially or entirely aerial lines 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 amps minimum to 7 amps 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 two-conductor cable circuits shall be protected by a lightning arrester at intervals of approximately 2000 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 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 continues to operate 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 that 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 personnel 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 automatically provide an audible warning or alerting signal [typically a distinctive tone(s)] over the loudspeaker prior to transmission of an alarm message.

3-9.1.4 The dispatch circuit shall be arranged for acknowledgement 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 only 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 A separate tie circuit shall be provided from the Communication Center to the telephone central office for a telephone group alerting system.

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 a fire alarm 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, the duration of the blast shall be neither 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* Compressors 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 fire alarms, 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 STD 810-C, with size and construction making it capable of one-handed 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 the 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 Computer-Aided Dispatching Systems (CAD) shall have qualified technical assistance available for trouble analysis and repair by in-house personnel or by authorized outside contract maintenance services.

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.

3-12.1.3 Support Dispatch Information. There shall be an up-to-date hard copy file of stored information located on the premises to support the dispatch system should the CAD system fail.

3-12.1.4 Dispatch Capabilities. The installation of a CAD system in fire service dispatching shall not negate the requirements for a second dispatch system. The requirements associated with the type of secondary system selected for use, such as radio, teletype, or wire, shall continue to be met.

3-12.1.5 The CAD Systems shall be dedicated pieces of equipment whose use serves only to enhance fire services dispatching operations. The use of these computer systems to serve unrelated services or other departments shall be prohibited.

Exception: When dispatching operations are of a combined public service nature, the computer system can be used jointly providing that an automatic control function is installed in the dispatching control console positions allowing the operator control override of all agency dispatching for the purpose of dispatching priority traffic. Any emergency that, 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 communications center using a shared computer system.

3-12.2 Classification of Systems. CAD systems in fire communications services shall be categorized as Class 1, Class 2, and Class 3.

3-12.2.1 A Class 1 CAD System shall be one in which computer technology and equipment selects and dispatches fire service personnel and equipment. The system shall be redundant and shall provide automatic switchover in case of failure of the primary operating Central Processing Unit (CPU) and shall transmit and receive data transmissions from fire stations, other administrative sites, and mobile vehicles operated by the fire department.

3-12.2.2 A Class 2 CAD System shall be one in which computer technology and equipment is used in the Communication Center in support of dispatching operations. The system shall be redundant and shall transmit and receive data transmissions from fire stations, other administrative sites, and mobile vehicles operated by the fire department.

3-12.2.3 A Class 3 CAD System shall be one in which computer technology is used as a support function to fire service dispatching and is limited primarily to status and logging information.

3-12.3* Class 1 CAD System.

3-12.3.1 General. The CAD system shall be an integrated system of computers, consoles, CRT keyboard terminals, monitor displays, printers, local and remote administrative terminals, data bases, and computer software. The CAD system shall be capable of interfacing with other related systems (i.e., telephone, 911, fire alarm, etc.).

The function of the Class 1 CAD System is to:

(a) Process emergency calls for service, handle peak call loads, select units for assignment to calls and ensure that the optimum units are selected, provide the initial alerting and dispatch communications to assigned units and provide them with all necessary information, provide unit status monitoring, and support direct entry of status information from the field.

(b) Provide automated support to the monitoring and management of in-process incidents.

(c) Provide detailed and accurate records of all operations in a format suitable for computer analysis.

3-12.3.2 Auxiliary Power.

(a) Computer hardware equipment located at the communications center shall have installed and operational an on-line uninterruptable power supply (UPS) system of sufficient output to provide constant operating power for the computer equipment being used for a period of time sufficient to allow for manual or automatic transfer from the public service AC power to localized auxiliary AC power. Capacity of the UPS system during emergencies shall be consistent with the requirements detailed in 3-1.4. However, in no case shall the capacity be less than four (4) hours.

3-12.3.3 Computer Systems Requirements.

3-12.3.3.1 The following performance requirements are provided as a minimum in equipment selection and system design.

(a) The system shall accommodate the call volumes and other sizing parameters required by the authority having jurisdiction.

(b) The system shall provide the operational capabilities required by the authority having jurisdiction.

(c) The system response time, full load, measured from the time a console operator completes a keyboard entry to the completion of the return of the system

response to the CRT screen, shall not exceed five (5) seconds.

(d) Reliability of the CAD system shall be such that the probability that the system is fully functional shall be not less than 99.9 percent of the time, and that the probability of the system being partially operational 98 percent of the time.

(e) The CAD system hardware shall be configured so that failure of any single device shall not disable the system.

3-12.3.3.2 Computers shall meet applicable approved code requirements such as the Electronics Industries Association (EIA) publications listed in 5-1.2.2 and other such requirements associated with good engineering and manufacturing practices.

3-12.3.4 Applications Software and Data Base Support.

3-12.3.4.1 The CAD system applications shall be written in a structured programming language. The software shall be modular, fully documented in the source code, and shall be designed and implemented in accordance with the accepted standard of software engineering.

3-12.3.4.2 The CAD system applications shall run under the overall control of a standard operating system. The operating system shall include support functions and features as established by the authority having jurisdiction.

3-12.3.4.3 The data files shall be maintained and updated in an on-line interactive mode, generally using administrative CRT terminals. A set of operator commands, data entry screens, and related software shall be provided to support the on-line update transactions for all user-modified files.

3-12.3.5 Computers.

3-12.3.5.1 The CAD system shall be based on two identical CPUs, designated *A* and *B*.

3-12.3.5.2 The mass storage configuration of CPUs *A* and *B* shall maintain redundant copies (mirror images) of all critical CAD on-line files, and shall provide protection from detrimental effect from failure or maintenance outage of any single disk, tape drive, or device controller; shall permit connection of any device to the CPU independently of the other devices; and shall be automatically reconfigurable under software control.

3-12.3.5.3 Central Processing Units (CPUs).

3-12.3.5.4 The two CPUs shall be identical processors. Each processor shall be initially equipped with sufficient real main memory and I/O capacity to support all of the software functions and meet the performance requirements. The processors shall include the following features:

(a) Automatic bootstrap loader

(b) Time and date capability

(c) Programmable interval timer

(d) Power-fail recovery capability.

3-12.3.5.5 The on-line CAD system CPU shall continuously monitor its peripheral devices and interfaces for equipment failures, device exceptions, and timeouts. Upon detection of a failure, the CPU shall perform any appropriate reconfiguration (e.g., bring the back-up disk on-line or transfer control to the back-up CPU) and shall queue notification messages to the supervisor and CPU console terminal.

3-12.3.5.6 The back-up CPU shall continuously monitor the operation of the on-line CPU by means of periodic inquiries requiring positive acknowledgements. In the event of a negative acknowledgement or timeout, the back-up CPU shall immediately seize the on-line disk(s) and peripherals, and assume the operation of the on-line CAD applications.

3-12.3.5.7 In addition to the requirements of 3-12.4.1, the operator shall have the capability to manually initiate CPU switchovers and peripheral device reconfigurations and reassignments by means of operating system commands at the CPU console terminal(s).

3-12.3.5.8 Console Terminal. Each CPU shall have its own dedicated console terminal. The terminal shall include an operator keyboard and a printer for a hardcopy log of computer-operator messages and transactions.

3-12.3.5.9 Storage Network.

3-12.3.5.9.1 Disk Units. The CAD systems shall provide on-line storage for programs and data to meet all of the functional and performance requirements, but in no case shall there be less than one disk unit per CPU.

3-12.3.5.9.2 Mass Storage Unit. Sufficient capacity shall be provided for storage of a minimum of 100 days of history log data.

3-12.3.6 Dispatch Screens and Function Keyboards.

3-12.3.6.1 There shall be not less than one CRT screen and keyboard for each CPU installed.

3-12.3.6.2 There shall be not less than one CRT screen and keyboard for each call taker dispatch position.

3-12.3.6.3 There shall be not less than one spare CRT screen and keyboard available on the premises for immediate change out for every three operator positions, or portion thereof, up to a maximum of three spare CRT screens and keyboards. For the purpose of this section, any additional administrative CRT screens and keyboards over and above those required for dispatching positions and not considered essential to the dispatching of emergencies may be considered as spares.

3-12.3.6.4 CRT Screens.

3-12.3.6.4.1 The CRT display shall have a low-resolution graphics capability, suitable for at least the partitioning of the screen with boundary lines and the display of simple map and floor plan line drawings.

3-12.3.6.4.2 The CRT screen size shall have the capacity to display the information required by the authority having jurisdiction.

3-12.3.6.4.3 Characters shall be displayed in a manner acceptable to the authority having jurisdiction (i.e., bright and dim intensities, blinking, blanking, reverse video, or color). Display intensities shall be operator adjustable from completely dark to maximum CRT brightness. All characters shall be easily visible in a normally lighted room. The CRT display shall be stable and jitter free. Characters shall have a uniform appearance on all parts of the screen.

3-12.3.6.5 Keyboards.

3-12.3.6.5.1 A keyboard shall be provided at each operation position. The keyboard shall be capable of controlling all CAD operational functions as well as all CRT displays associated with the specific operating position.

3-12.3.6.5.2 The keyboard design shall prevent malfunction due to key "bounce," simultaneous closure of multiple keys, or spillage of consumable liquids. The keys shall be formed to prevent dirt and dust from obliterating the legends.

3-12.3.7 Printers.

3-12.3.7.1 The CAD system shall include printers for dispatching, logging, and administrative utility functions.

3-12.3.7.2 All printers shall be interchangeable and logging or utility functions shall be assignable to any printer under system control.

3-12.3.7.3 The authority having jurisdiction shall determine the following minimum characteristics:

(a) Print speed

(b) Maximum adjustable form size

(c) Total number of copies

(d) Weight of paper stock.

3-12.3.8 Information Transmittal. Data communications systems, interfaced with the CAD system, shall provide digital communications between the CAD system remote fire stations, administrative sites, and mobile fire department vehicles, at a rate not less than 600 baud.

3-12.3.8.1 Where RF, 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.

3-12.3.8.2 The transmission of computer information to mobile equipment or fixed locations associated with fire and rescue operations shall be in accordance with Federal Communications Commission (FCC) approved radio frequency channel use for the particular type of service being used.

3-12.3.8.3 The message formats shall be defined by the authority having jurisdiction.

3-12.3.9 Time Synchronization. The CAD system CPU clocks shall be continuously synchronized.

3-12.3.10 Remote Data Terminals (RDTs).

3-12.3.10.1 General.

3-12.3.10.1.1 The CAD system shall initialize the data communications by means of an "all-call" message (or series of messages). The "all-call" shall accomplish at least the following functions:

(a) Display a "system is up" message.

(b) Download forms not permanently stored at all RDTs.

(c) Poll terminals to request current status and update CAD status files and displays accordingly.

3-12.3.10.1.2 CAD system transmissions to RDTs shall be as follows:

(a) Emergency messages shall take priority and be immediately indicated and printed if printers are included in the system.

(b) After transmission of a message, the RDT shall acknowledge by both automatic and manual means. The RDT shall transmit automatic ackowledgement indicating that it has received and stored the message. A manual acknowledgement shall indicate that the field personnel have viewed the message and are taking appropriate action.

(c) Failure to receive an automatic or manual acknowledgement from the RDT shall cause a notification on the originating operator CRT screen in the Communication Center.

(d) RDT display shall not be automatically updated. Displays shall be configured to indicate that a message is waiting. (*See Section 3-12.3.*)

3-12.3.10.2 The RDT terminals shall meet all requirements set forth in the EIA Standard RS-374-A, *Land Mobile Signaling Standard,* dated March 1981.

3-12.3.10.2.1 The RDTs shall be interchangeable, such that any RDT can be installed in any vehicle or fixed location. The RDT shall connect to its associated radio transceiver by a plug-in locking-cable assembly.

3-12.3.10.2.2 The RDT keyboard shall provide the ability to perform all functions as required by the authority having jurisdiction, while keeping keystrokes to a minimum. The terminal shall provide one keystroke operation for unit status reporting functions. The terminal shall display information with minimum use of multipage display.

3-12.3.10.2.3 The RDTs shall have manual controls mounted on the unit for:

(a) Display intensity

(b) Audible alarm volume

(c) Alarm test

(d) Power on/off. The power on/off shall include visual indication that the unit is energized.

3-12.3.10.2.4 The RDTs shall activiate both audible and visual indication of incoming messages. Audio alarm shall be of sufficient volume to overcome ambient noise levels as determined by the authority having jurisdiction.

3-12.3.10.2.5 The RDTs shall have a last in first out feature which shall allow the user to recall the last message transmitted or received.

3-12.3.10.2.6 Each RDT shall have an individual addressing identifier, and shall be capable of receiving single, group, or all-call messages. The RDT terminal address identifier shall be automatically transmitted through the control CPU(s) for each message.

3-12.3.10.2.7 The RDT shall continuously display both current unit and terminal status.

3-12.3.10.2.8 The RDT shall display current unit status as determined by the authority having jurisdiction.

3-12.3.10.2.9 The RDT shall display current status and shall include the following:

(a) *Transmitter Keyed* — Indicates a message sent by the RDT is currently being transmitted.

(b) *Message Received* — Indicates the last transmission has been correctly received by the Communication Center.

(c) *No Ack/Fail* — Indicates a transmission was not received after a predetermined number of retransmissions.

(d) *Channel Busy* — Indicates that the terminal cannot transmit due to other traffic on the frequency, and the message will be sent as soon as the frequency is clear; no manual retransmission is necessary.

(e) *Message Waiting* - Indicates that a new message is waiting to be sent to the terminal and the operator must clear the page to allow the message to be accepted.

(f) *Ack Required* Indicates that a manual acknowledgement by the operator of a received message is required.

3-12.3.10.3 Keyboard Design.

3-12.3.10.3.1 The terminal shall be equipped with an alphanumeric keyboard that meets the requirements of 3-12.3.10.2.

3-12.3.10.3.2 If the keyboard is detachable, the bottom shall have a non-skid surface to prevent the unit from sliding if placed on a slippery surface.

3-12.3.10.4 The RDTs shall not require current to maintain programmed functions when the power to the unit is turned off.

3-12.3.11 Display Functional Requirements.

3-12.3.11.1 The display size shall have the capacity to present the stipulation information as required by the authority having jurisdiction.

3-12.3.11.2 Characters shall be displayed in manner acceptable to the authority having jurisdiction, (i.e., bright and dim intensities, blinking, blanking, reverse video, or color). Display intensities shall be continuously variable by the operator from completely dark to maximum brightness. All characters shall be easily visible in daylight conditions. The display shall be stable and jitter-free. Characters shall have a uniform appearance on all parts of the screen.

3-12.4* Class 2 CAD System.

3-12.4.1 Computers. The minimum standards required in a Class 1 Fire Service CAD system shall apply.

Exception No. 1: The CAD system shall be based on two identical CPUs.

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

Exception No. 3: 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.

3-12.4.2 Console Equipment. The minimum standards contained in 3-12.3.3 for Class 1 fire service CAD systems shall apply.

3-12.4.3 Information Transmittal. The minimum standards contained in Class 1 fire service CAD systems shall apply.

3-12.5* Class 3 CAD System.

NOTE: Computers may be of a microprocessor type, or larger, with limited storage and memory capacity.

3-12.5.1 Redundancy capabilities shall not be required in a Class 3 system.

3-12.5.2 One master hardcopy printer for logging purposes shall be required. Program entry changes shall not be required to have protected command entry code. Priority override shall not be a requirement.

Chapter 4 Public Reporting Systems

4-1 Fundamental Requirements of Public Alarm Reporting Systems.

4-1.1 General.

4-1.1.1 When implemented at the option of the municipality, a fire alarm reporting system shall be designed, installed, operated, and maintained to provide the maximum practicable reliability for transmission and receipt of fire alarms.

4-1.1.2 All signal transmitting and processing equipment installed in accordance with this chapter shall be listed and labeled for the protective signaling purpose for which it is used.

4-1.1.3 Transmission of Other Signals. It is permissible for a public service reporting system to 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.

4-1.1.4 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 is 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 shall be provided to the operators so that manual retransmission and dispatch are instantly available.

4-1.1.5 Any portion(s) of a fire alarm reporting system used to effect the auxiliarized protection of a structure or multiple of structures, shall be listed and labeled as compliant with NFPA 72B, *Standard for the Installation, Maintenance, and Use of Auxiliary Protective Signaling Systems for Fire Alarm Service*. Unless otherwise directed by the authority having jurisdiction, any initiating devices and control units interconnected to the fire alarm reporting system shall be listed and labeled for the protection purposes for which they are used.

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 under the climatic conditions to which they are exposed.

4-1.3.4 Means for transmission of alarms by the public shall be conspicuous and readily accessible for easy operation.

4-1.3.5 Upon completion of a system installation, a functional acceptance test of the entire system shall be made in accordance with the requirements of the authority having jurisdiction. In no case shall operational functions tested be less than those stipulated in the applicable portions of this standard.

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 on noncombustible bases, pedestals, switchboards, 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 is shall be capable of performing its intended functions in a range of 85 percent through 110 percent of rated voltage.

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

4-1.3.11 All ground connections to equipment shall comply with the requirements of NFPA 70, *National Electrical Code*.

4-1.4 Publicly Accessible Fire Alarm Boxes.

4-1.4.1 General.

4-1.4.1.1 Publicly accessible boxes shall be recognizable as such in all municipalities. Boxes shall have instructions for use plainly marked on its 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 Publicly accessible boxes shall be as conspicuous as possible. Their color shall be distinctive.

4-1.4.1.4 A publicly accessible 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 on 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 publicly accessible boxes in mercantile and manufacturing areas. The street light nearest the box, when equipped with a distinctively 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, pedestals, or structural surfaces as directed by the authority having jurisdiction.

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 When publicly accessible boxes are installed, they shall be located to protect areas designated by the authority having jurisdiction.

4-1.4.3.2 In all protected areas, 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 located at or near the main entrance, as directed by the authority having jurisdiction.

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 installed so that it is 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 that 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 the electrical service capacity of the equipment required under 2-1.6 is adequate 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.* A duplicate rectifier or motor-generator powered from two sources of alternating cur-

rent 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 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.

4-1.5.3.1.1.1 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 4-1.5.3.1.2(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 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 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)*].

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 required to operate the essential features of the system 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, and 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 amps.

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 the Installation and Use of Stationary Combustion Engines and Gas Turbines*, and NFPA 110, *Standard for Emergency and Standby Power Systems*, except as restricted by the provisions of this section.

4-1.5.5.3 The engine-driven generator shall be located in an adequately ventilated, cutoff area of the building housing the Communication Center equipment. The area housing the unit 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 fuel 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 54, *National Fuel Gas Code*, and NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases.*

4-1.5.5.6 The unit, as a minimum, shall be of sufficient capacity to supply power to operate 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.

4-1.5.5.8 When more than one engine-driven generator is provided, each shall be provided with a separate fuel line and transfer pump.

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 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 geographic areas 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, 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 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 4-1.6.2.1(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 is to 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)
Maximum	2.25 volts/cell	2.17 volts/cell
Minimum	2.20 volts/cell	2.13 volts/cell
High Rate Voltage		2.33 volts cell.

NOTE: High and low gravity voltages are (+)0.07 volts and (−)0.03 volts, respectively.

(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 volts

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 the 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 used 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 to 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 their equivalent.

4-1.8.1.4 If a municipal box is installed inside a building, it shall be placed as close 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 that 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 an 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 who can interpret the pressure readings and who has authority to have the indicated abnormal condition corrected is in constant attendance.

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 that 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 due to either falling walls or operations in the buildings. Cable joints shall be made to provide and maintain conductivity, insulation, and protection at least equal to that afforded by the cables that 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 circuits carrying up to 220 volts for municipal communication use. 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, in all cases, shall 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 to 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 adjacent to 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 shall be given to liability of mechanical injury; disablement from heat incident to a fire; injury by falling walls; and 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 that 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 close as is 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 circuit. 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 that would be left without box protection in case of disruption of a circuit would 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 amps 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 partially or entirely aerial lines 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 amps minimum to 7 amps 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 is satisfactory to use a common sounding device for more than one circuit and it should be installed at the Communication Center.

NOTE 2: In a Type B system, a sounding device is to 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 that will automatically record the date and time of receipt of each alarm shall be provided.

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 an 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 that 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 The number of boxes permitted on a single frequency shall be goverened by the following:

(a) For systems utilizing one-way transmission in which the individual box automatically initiates the required "test" message (*see 4-3.6.1*) using circuitry integral to the boxes, not more than 500 boxes shall be permitted on a single frequency.

(b) For systems utilizing a two-way concept, in which interrogation signals (*see 4-3.6.1*) are transmitted to the individual boxes from the Communication Center on the same frequency used for receipt of alarms, not more than 250 boxes shall be permitted on a single frequency. If interrogation signals are transmitted on a frequency different from that used for receipt of alarms, not more than 500 boxes shall be permitted on a single frequency.

(c) A specific frequency shall be designated for both fire and other fire-related or public safety alarm signals, and supervisory signals (test and tamper). All acknowledgement and other signals shall utilize a separate frequency.

4-3.1.2 When box message signals to the Communication Center or acknowledgement of message receipt signals from the Communication Center to the box are repeated, associated repeating facilities shall conform to the requirements established in 3-4.1.2.

4-3.1.3 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.

4-3.2 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 multifunction 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 Multifunction 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 battery(ies) adequate in capacity to ensure normal box operation in the event of failure of the local source.

1. Boxes configured to allow auxiliarized service from and for a single structure, and where any and all associated publicly assessible manual initiating devices including those that may be integral to the boxes are installed within the structure, shall contain a battery(ies) adequate in capacity to ensure normal box operation for at least sixty (60) hours.

2. Boxes configured to allow auxiliarized service from and for a single structure, and where any or all associated publicly accessible manual initiating devices including those that may be integral to the boxes are installed on the exterior of the structure, in any common area, public or private, or in the public right of way, shall contain a battery(ies) adequate in capacity to meet the supervisory requirements of 4-3.3.3.2(b).

3. Boxes configured to allow auxiliarized service from and for a multiple of structures shall contain a battery(ies) adequate in capacity to meet the supervisory requirements of 4-3.3.3.2(b).

(b) Except as otherwise permitted under subparagraph a(1) hereto, all boxes operating on a battery(ies) shall provide a specific warning indication as a part of all messages/signals sent, for a period of at least 15 days prior to the time the battery(ies) will fail to operate the box as required.

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 that 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, and shall be installed at the Communication Center. 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, the 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) 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. If the jurisdiction maintains in operation two or more alarm reception points, one receiving network may be at each alarm reception point.

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 the 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 is 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 an 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 that 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, disablement from heat

incident to a fire, injury by falling walls, and 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 in addition 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 that 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 laid out so that the area that 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 NFPA 70, *National Electrical Code*.

4-4.2.1.4 All fuses shall be plainly marked with their rated ampere capacity. All fuses rated over 2 amps 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 partially or entirely aerial lines 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 amps minimum to 7 amps 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 with 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 to eliminate the possibility of interference.

4-4.5.8 Facilities shall be provided that 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), 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 is to 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 an 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 that 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 shall be given to liability of mechanical injury; disablement from heat incident to a fire; injury by falling walls; and 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 that 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 close 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*.

4-5.1.2.2 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 is to be provided for each box.

4-5.1.3 Tie Circuits. 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 are 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 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 NFPA 70, *National Electrical Code*.

4-5.2.1.4 All fuses shall be plainly marked with their rated ampere capacity. All fuses rated over 2 amps 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 partially or entirely aerial lines 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 amps minimum to 7 amps 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 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.

4-5.2.3.2 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).

4-5.2.3.3 Lightning arresters, other than air-gap or self-restoring rare gas type, shall not be installed in fire alarm boxes.

4-5.2.3.4 All protective devices shall be accessible for maintenance inspection.

4-5.3 Power. Power shall be provided in accordance with Section 4-1.5.

4-5.4 Design of Boxes.

4-5.4.1 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.

4-5.4.2 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.

4-5.5 Receiving Equipment — Facilities for Receipt of Box Alarms.

4-5.5.1 The box circuits shall be terminated:

(a) Directly on a console or switchboard located in the Communication Center; or

(b) In concentrator-identifier equipment located in a Satellite Communication Center.

In the latter use, tie circuits from the concentrator shall be terminated on a console or switchboard located in the Communication Center.

4-5.5.2 The box circuits in a direct line system or the tie circuits in a concentrator system shall be grouped on the console or switchboard so that they are readily distinguishable from other circuits also terminated on the console or switchboard.

4-5.5.3 Audible and visual signals shall indicate an incoming call from a telephone box. When the operator answers the call, the audible signal shall cease.

4-5.5.4 Permanent visual recording shall be installed in the Communication Center. A spare recording device shall be provided when the number of boxes exceeds 100.

4-5.5.5 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 with a self-restoring switch.

4-5.5.6 All voice transmissions from boxes for emergencies shall be recorded with the capability of instant playback.

4-5.5.7 A voice recording facility shall be provided for each operator handling incoming alarms to eliminate the possibility of interference.

4-5.5.8 Facilities shall be provided that will automatically record the time of receipt of each alarm.

4-5.6 Testing.

4-5.6.1 Persons testing a voice box shall identify themselves and request the alarm operator to give them the location from which they are calling.

4-5.6.2 The power supply shall be tested in accordance with 4-1.6.2.2 and 4-1.6.2.3.

4-5.7 Supervision.

4-5.7.1 The power supplied to all required circuits and devices of the system shall be supervised.

4-5.7.2 Trouble signals shall actuate a sounding device located where there is always a responsible person on duty.

4-5.7.3 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.

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.

4-5.7.4 The audible signal shall be responsive to faults on any other circuits that may occur prior to restoration of the silencing switch to normal.

4-5.7.5 Either a continuous line test or periodic (up to 6 minutes) automatic line tests shall detect an open, short, ground, or leakage condition. If one of these conditions occurs, a visual and audible trouble signal shall be actuated where there is an operator on duty.

Chapter 5 Referenced Publications

5-1 The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

5-1.1 NFPA Publications. National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 10-1988, *Standard for Portable Fire Extinguishers*

NFPA 12A-1987, *Standard on Halon 1301 Fire Extinguishing Systems*

NFPA 13-1987, *Standard for the Installation of Sprinkler Systems*

NFPA 37-1984, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*

NFPA 54-1984, *National Fuel Gas Code*

NFPA 58-1986, *Standard for the Storage and Handling of Liquefied Petroleum Gases*

NFPA 70-1987, *National Electrical Code*

NFPA 71-1987, *Standard for the Installation, Maintenance, and Use of Signaling Systems for Central Station Service*

NFPA 72A-1987, *Standard for the Installation, Maintenance, and Use of Local Protective Signaling Systems for Guard's Tour, Fire Alarm, and Supervisory Service*

NFPA 72B-1986, *Standard for the Installation, Maintenance, and Use of Auxiliary Protective Signaling Systems for Fire Alarm Service*

NFPA 72C-1986, *Standard for the Installation, Maintenance, and Use of Remote Station Protective Signaling Systems*

NFPA 72D-1986, *Standard for the Installation, Maintenance, and Use of Proprietary Protective Signaling Systems*

NFPA 72E-1987, *Standard on Automatic Fire Detectors*

NFPA 74-1984, *Standard for the Installation, Maintenance, and Use of Household Fire Warning Equipment*

NFPA 75-1987, *Standard for the Protection of Electronic Computer/Data Processing Equipment*

NFPA 110-1988, *Standard for Emergency and Standby Power Systems*

NFPA 220-1985, *Standard Types of Building Construction.*

5-1.2 Other Publications.

5-1.2.1 ANSI Publication. American National Standards Institute, 1430 Broadway, New York, NY 10018.

ANSI C2-1976, *National Electrical Safety Code*, specifically ANSI C2.2-1976, *Safety Rules for the Installation and Maintenance of Overhead Electric Supply and Communication Lines.*

5-1.2.2 EIA Publications. Electronics Industries Association, Engineering Department, 2001 I Street, NW, Washington, DC 20006.

RS-152-B, *Land Mobile Communications* (February 1970)

RS-204-C, *Land Mobile Communications* (January 1982)

RS-316, *Portable Land Mobile Communications* (May 1979)

RS-374-A, *Land Mobile Signaling Standard* (March 1981).

5-1.2.3 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20025.

Federal Communications Commission Rules and Regulations — *Land Mobile Service* (FCC Part 90), November 22, 1978

Federal Communications Commission Rules and Regulations — *Code of Federal Regulations* (Title 47, Part 90), 1979

MIL STD-810-C, U.S. Military Standard (Method 506.1, Procedure 1; Method 509.1, Procedure 1; Method 510, Procedure 1), March 10, 1975.

5-1.2.4 IEEE Publication. Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017.

ANSI/IEEE 100-1977, *IEEE Dictionary of Electrical and Electronics Terms.*

5-1.2.5 IMSA Publication. International Municipal Signal Association, Box 8249, Fort Worth, TX 76112.

IMSA Cable Specifications, 1967 Revision.

5-1.2.6 NBS Publication. National Bureau of Standards, Route 1-270, Quince Orchard Rd., Gaithersburg, MD 20899.

NBS Handbook 30, *National Electrical Safety Code*, 1981.

Appendix A

This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.

A-2-1.4.4 The Communication Center should be provided with self-contained breathing apparatus meeting the requirements of NFPA 1981, *Standard on Open-Circuit, Self-Contained Breathing Apparatus for Fire Fighters*, for all essential operating personnel in the event of a fire in the Communication Center.

A-2-1.10.2.2(b). The following procedure is recommended for checking state of charge:

Switch the battery charger from float to high-rate mode.

The current, as indicated on the charger ammeter, will immediately rise to the maximum output of the charger and the battery voltage, as shown on the charger voltmeter, will start to rise at the same time.

The actual value of the voltage rise is unimportant, since it depends on many variables; the length of time it takes for the voltage to rise is the important factor.

If, for example, the voltage rises rapidly in a few minutes, then holds steady at the new value, the battery was fully charged. At the same time, the current will drop to slightly above its original value.

In contrast, if the voltage rises slowly and the output current remains high, the high-rate charge should be continued until the voltage remains constant. Such a condition is an indication that the battery was not fully charged, and the float voltage should be increased slightly.

A-2-1.13.2 Planning Guidelines for Universal Emergency Calling Code (911) Systems.

This document is intended as a guide to assist those municipalities contemplating or actually planning 911 systems. There are three parts to the document:

I Feature Definitions.

II Municipal Characteristics.

III Feature versus Characteristics Correlation.

In the feature definition section, all known 911 features are described. It should be noted, however, that this is a listing of all features and that not all features are technically compatible with one another. Furthermore, certain features can only be provided if special equipment is available in the telephone company central office. Your local telephone company should be consulted as early as possible when planning a 911 system.

The second section considers various characteristics of municipalities that would influence the feature complement of a 911 system.

A graph is included in the third section that relates municipal characteristics to 911 features.

It must be emphasized that these notes are only a planning guideline. Each municipality has its own unique set of characteristics that must be evaluated and matched to a set of 911 features.

I. Feature Definitions.

Automatic Location Identification (ALI). Displays the calling party's address and other preselected information at the PSAP attendant position.

Automatic Number Identification (ANI). Displays the calling party's telephone number at the PSAP attendant position.

Call Detail Recording (CDR). Provides a hard copy printout after every call of the ANI number, trunk number, and answering attendant number; and the time of seizure, answer, disconnect/transfer.

Called Party Hold. Allows the PSAP attendant to hold the established connection to the station from which the 911 call was originated, regardless of calling party action.

Default Routing. Provides routing of 911 calls to a predetermined PSAP when it is not possible to route a call to its primary PSAP.

Emergency Ringback. Allows the PSAP attendant to ring the calling station regardless of the station switchhook status.

Forced Disconnect. Enables the PSAP attendant to terminate, at any time, an existing 911 call regardless of the action of the calling party.

Idle Tone Application. Gives the PSAP attendant an audible indication if the 911 caller abandons before the attendant answers the call or if the 911 caller terminates the call after the attendant answers the call.

Night Service/Alternate Routing. Calls are routed to an alternate PSAP when:

(a) all trunks are busy to a PSAP; or

(b) a PSAP closes down for a period of time.

Public Safety Answering Point (PSAP). Any facility where 911 calls are answered, either directly or through rerouting.

Selective Routing. Routes a 911 call to the correct PSAP based on the calling party's telephone number, regardless of municipality and telephone company central office boundary mismatches.

Switch-Hook Status. Provides a visual and/or audible indication of whether the originating station on an established 911 call is on-hook or off-hook.

Transfer. Allows an incoming 911 call to be rerouted from one PSAP to another. There are three generic types of transfer:

(a) *Manual.* Voice only is rerouted using a series of operations at the attendant console.

(b) *Fixed.* Voice, ANI and ALI are rerouted to a specific secondary PSAP by pressing a button associated with the desired PSAP.

(c) *Selective.* Voice, ANI and ALI are rerouted to any number of secondary PSAPs based upon the telephone number of the calling party by the operation of a single button.

II. Municipal Characteristics.

Number of 911 Center(s). The number of 911 Emergency Reporting Centers [or Public Safety Answering Points (PSAP)] is one of the key factors that must be considered in planning a 911 system. If multiple answering points are located throughout the system (county or municipality), then there are many factors that will influence the way in which 911 calls are handled. For instance, telephone company and municipal boundaries are rarely coincident. Thus, calls will be routed to improper answering points and time delays will be encountered in handling or rerouting the 911 calls.

On the other hand, having a single answering point minimizes the boundary problem. However, other functions such as dispatch become more difficult.

When planning a 911 system, many factors must be considered. The administrative and operational procedures of the answering bureau and the available 911 system features should be carefully reviewed.

Location of Fire Dispatch Center. If the 911 center (PSAP) is the main dispatch center for fire services, the center should meet the requirements of this standard.

Force Utilization. Both the number and type of personnel that will be handling 911 calls should be considered when planning a 911 system. For instance, if a large percentage of calls must be rerouted (i.e., calls are answered by personnel not affiliated with any particular emergency agency), then 911 features which provide for the expeditious handling of calls should be considered since many calls require rerouting.

If the primary objective is to optimize force, then 911 features that minimize the number of misrouted calls should be considered.

Third-Party Call Handling and Conference Calls. The characteristics of a particular municipality may require the frequent use of interpreters or satellite centers (secondary Public Safety Answering Points). This requires frequent rerouting and conferencing of 911 calls. 911 system features that provide expeditious call handling under these conditions should be considered where this poses a severe problem.

Improper Call Termination by Call Originator. When the calling party does not hang up after a 911 call, whether deliberate or accidental, telephone facilities will be tied up for a time, limiting access to the 911 center by other emergency callers. Where this may be a problem, 911 system features and quantities of telephone access facilities should be reviewed.

Inadequate or Untimely Location Information. In some municipalities or portions thereof, there could be a higher incidence of calls where location information is inadequate or untimely due to such circumstances as inability of the caller to talk, a speech or hearing problem, a prank call, or a false alarm. Where the frequency of such occurrences hampers the effectiveness or costs of the municipalities' emergency services, administrative procedures, operational plans, and 911 system features should be reviewed.

Computer Aided Dispatch (CAD). Many municipalities are considering or are already employing a computer-aided dispatch system. Several 911 system features complement CAD systems and should be very carefully considered when planning a 911 system with a CAD interface.

Fire Emergency Call Handling. In most cases, 911 fire calls will not be routed directly to fire dispatch centers. The first response centers will be required to reroute the calls to the appropriate fire Communication Center. Therefore, 911 features that minimize call han-

dling time (especially rerouting) should be considered when planning a 911 system.

Recommended 911 System Feature Groupings. Forced disconnect and transfer should always be provided – forced disconnect to prevent the system from being tied up, and transfer to ensure expeditious handling of calls.

Either ANI or Called Party Hold, Idle Tone Application, Switchhook Status, and Emergency Ringback should be provided. This will be referred to as basic calling party status identification.

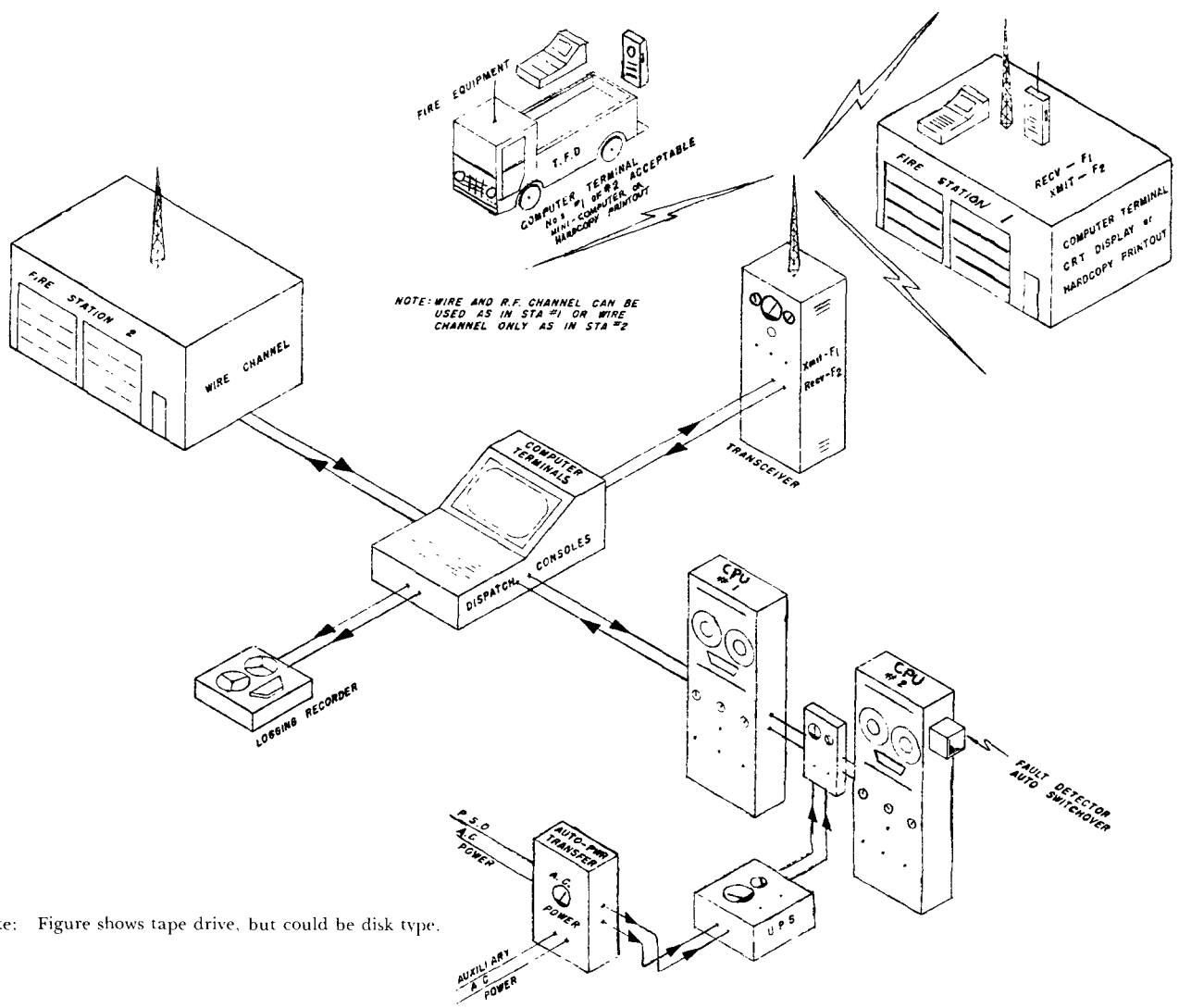
It should be noted that some features are incompatible with one another from a technical point of view (i.e., ANI, SR, ALI are incompatible with Switchhook Status, Emergency Ringback, and Called Party Hold). Also, certain features can only be provided if special equipment is available in the telephone company central office. Your local telephone company should be consulted when planning for a 911 system.

III. Features to Be Considered for Various Municipal Characteristics.

Char. Feature	No. of 911 Centers	Force Utiliz. Calls	3rd Party Conf. Termin.	Improper Call	Loc. Info.	CAD	Fire Call
All					X	X	
CDR					X	X	
Calling Party Status*					X		
Alternate Routing†		X		X			
Forced Disconnect				X			
Selective Routing	X	X					X
Transfer	X	X	X				X

*Called Party Hold, Emergency Ringback, Switch-Hood Status, Idle Tone Application or ANI

†Default Routing and/or Night Transfer and/or Alternate Routing



Note: Figure shows tape drive, but could be disk type.

Figure A-3-12.3 Class I CAD System.

A-3-1.5.3.2(b) See A-2-1.10.2.2(b).

A-3-11.2.7 Facilities should be provided for the auxiliary supply of compressed air in case of compressor or power failure. These facilities may be either manifolds and regulators for connection of high-pressure cylinders, fittings for the supply of compressed air from external self-powered compressors, or supply of air from vehicle air brake compressors.

A-4-1.4.1.5

(a) Current supply for designating lamps at street boxes should preferably be secured at lamp locations from the local electric utility company.

(b) Alternating current power may be superimposed on metallic fire alarm circuits for supplying designating lamps or for control or actuation of equipment devices for fire alarm or other emergency signals, provided:

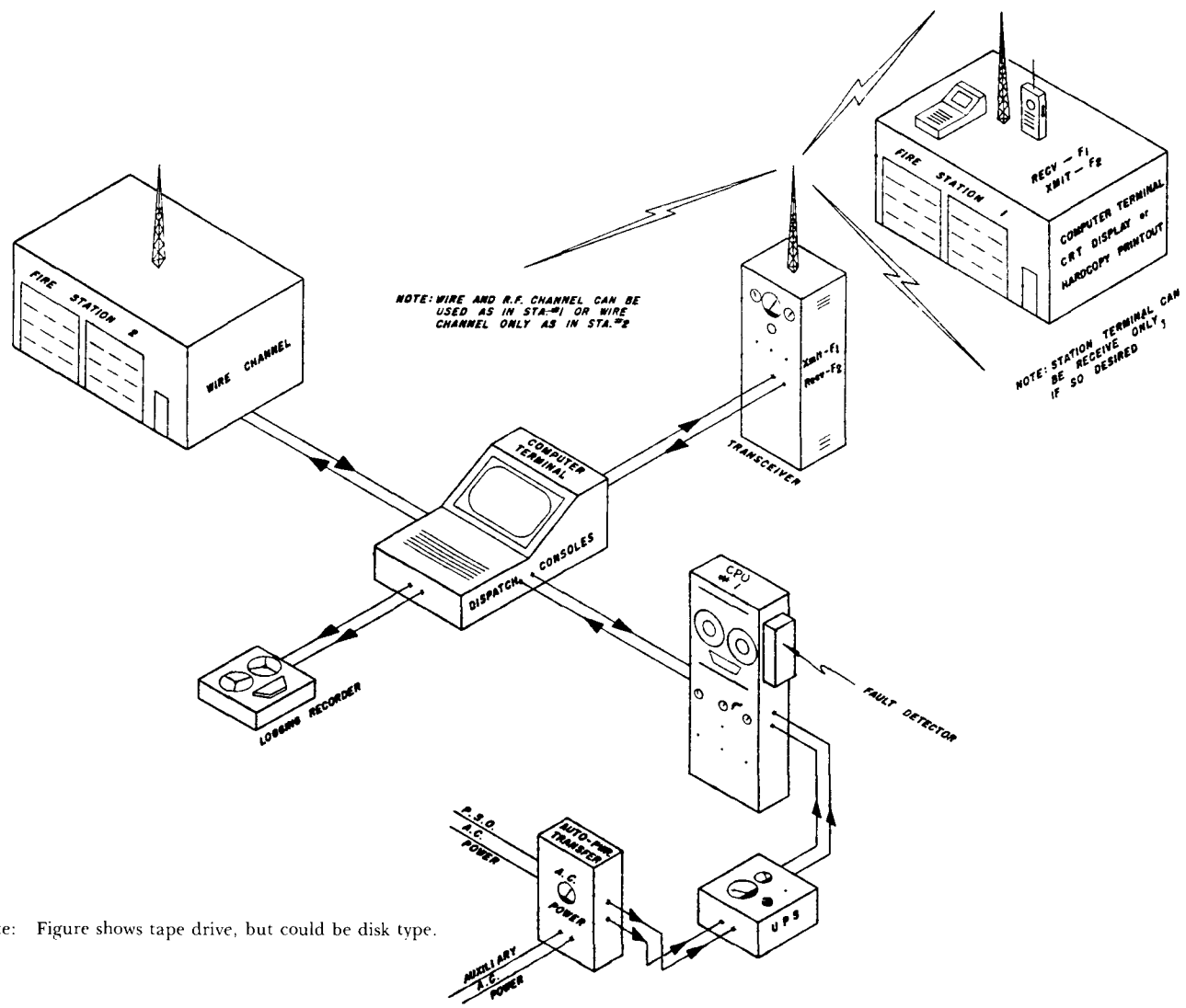
1. Voltage between any wire and ground or between one wire and any other wire of the system shall not exceed 150 volts; the total resultant current in any line circuit shall not exceed ¼ amp.

2. Coupling capacitors, transformers, choke, coils, etc., shall be rated for 600-volt working voltage and have a breakdown voltage of at least twice the working voltage plus 1000 volts.

3. There is no interference with fire alarm service under any conditions.

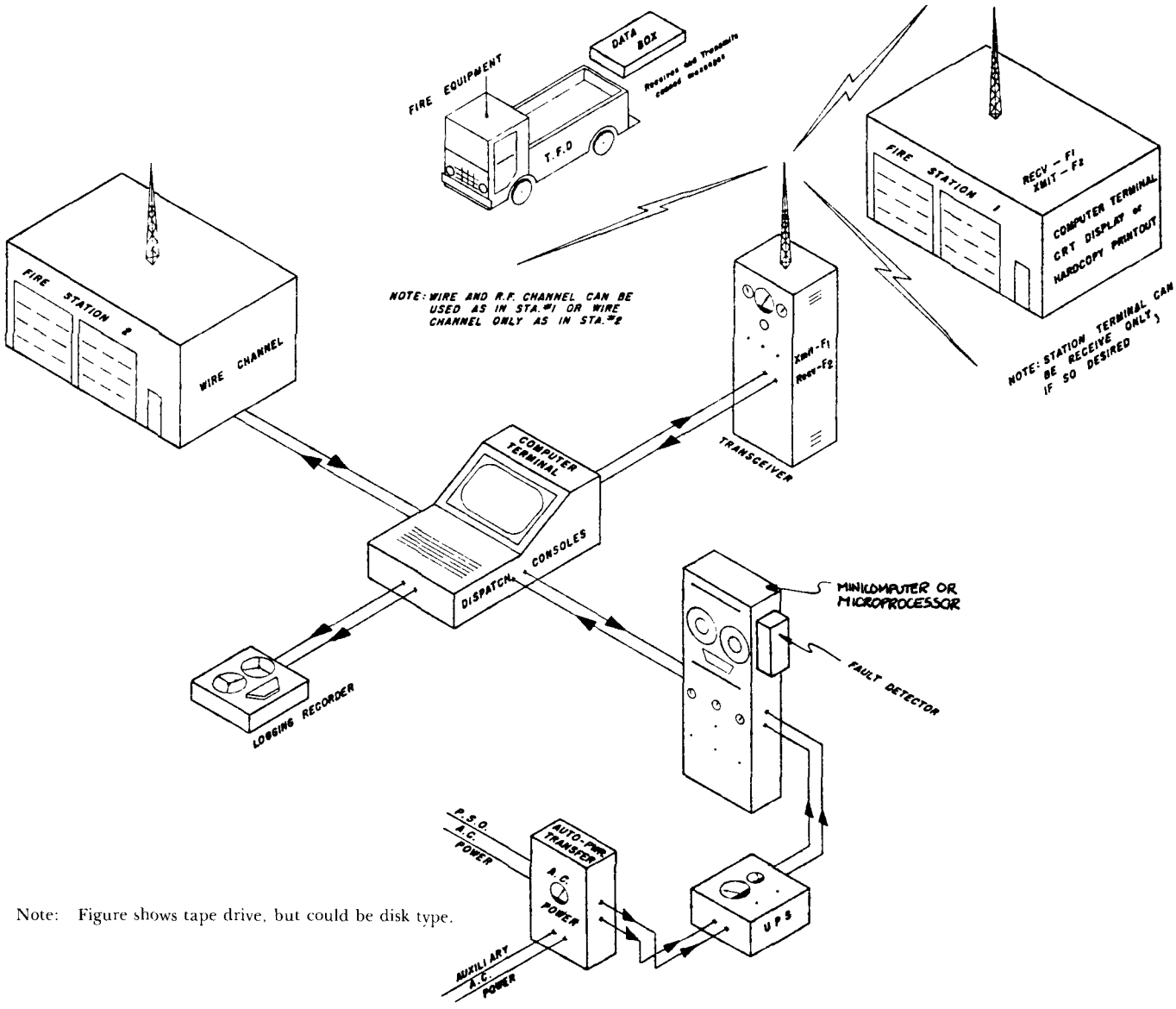
A-4-1.6.2.3(b) See A-2-1.10.2(b).

A-4-3.3.2.2 FCC Rules and Regulations, Vol. V, Part 90, March 1979: "Except for test purposes, each transmission must be limited to a maximum of 2 seconds and may be automatically repeated not more than two times at spaced intervals within the following 30 seconds; thereafter, the authorized cycle may not be reactivated for 1 minute."



Note: Figure shows tape drive, but could be disk type.

Figure A-3-12.4 Class II CAD System.



Note: Figure shows tape drive, but could be disk type.

Figure A-3-12.5 Class III CAD System.