UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

SECTION 28 31 73.00 20

EXTERIOR FIRE ALARM SYSTEM, CLOSED CIRCUIT TELEGRAPHIC TYPE

02/10

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USACE / NAVFAC / AFCEC / NASA	**UFGS-28 31 73.00 20 (February 2010)**

Preparing Activity: NAVFAC	**Superseding**
	UFGS-28 31 73.00 20 (February 2003)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

****

SECTION 28 31 73.00 20

EXTERIOR FIRE ALARM SYSTEM, CLOSED CIRCUIT TELEGRAPHIC TYPE
02/10

****

NOTE: This guide specification covers the requirements for exterior fire alarm reporting and receiving system of the closed circuit telegraphic type.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

****

NOTE: System requirements must conform to UFC 3-600-01, "Fire Protection Engineering for Facilities".

****

****

NOTE: The following information shall be shown on the project drawings:

1. Location of Decoding/receiving console.

2. Locations where recording equipment should be installed.

3. Dimensions of cabinets and whether flush or surface mounted.

4. Location of the panel, bells, and other equipment.

5. Location of the alarm gongs and bells.

6. Location of all boxes.

7. All portions of the system that will be underground and any portion that will be installed in an outside overhead system.

8. Cables that are to be installed in the duct-and-manhole system, the design of the system, the location of the cables, and the number of conductors in each cable.

9. Cables that are to be installed in outside overhead systems, the design of the system, the location of the cables, and the number of conductors in each cable.

10. Cables that are to be buried directly in earth, their location, where cables pass under roadways or paved areas, and the ducts or conduits used, and the number and AWG size of conductors in each cable.

11. Locations of the branch or "Y" connections and the necessary related details.

12. Ground connections that should be welded or brazed, if any.

13. Lightning arrester locations and detail arrangement.

14. System timing.

15. Code Numbers of Fire Alarm Boxes: Coding shall be an integrated four-digit code. Code numbers should not contain any digit larger than 6, shall not have succeeding digits of the number "1" or "0." (Example: 1-1-3-4.) A table should indicate location of all boxes with respective code numbers.

****

PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of

the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A475	(2003; R 2020) Standard Specification for Zinc-Coated Steel Wire Strand

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

INTERNATIONAL MUNICIPAL SIGNAL ASSOCIATION (IMSA)

IMSA 32	(1997) Copper-Covered Steel Messenger Strand, 30 Percent or 40 Percent Conductivity

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C80.1	(2005) American National Standard for Electrical Rigid Steel Conduit (ERSC)
ANSI C80.3	(2015) American National Standard for Electrical Metallic Tubing (EMT)
ANSI/NEMA WC 71/ICEA S-96-659	(2014) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA WC 3	(1992; Rev 1 1994) Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 70	(2009) Power Cable Rated 2000 V or Less for the Distribution of Electrical

Energy--S95-658

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 72	(2019; TIA 19-1; ERTA 1 2019) National Fire Alarm and Signaling Code
NFPA 1221	(2019) Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems

UNDERWRITERS LABORATORIES (UL)

UL 38	(2008; Reprint Nov 2013) Manual Signaling Boxes for Fire Alarm Systems
UL 83	(2017; Reprint Mar 2020) UL Standard for Safety Thermoplastic-Insulated Wires and Cables
UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 514A	(2013; Reprint Aug 2017) UL Standard for Safety Metallic Outlet Boxes
UL 514B	(2012; Reprint May 2020) Conduit, Tubing and Cable Fittings
UL 864	(2014; Reprint May 2020) UL Standard for Safety Control Units and Accessories for Fire Alarm Systems
UL 1242	(2006; Reprint Aug 2020) Standard for Electrical Intermediate Metal Conduit -- Steel
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 RELATED REQUIREMENTS

[Sections 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION; 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION; and 26 20 00 INTERIOR DISTRIBUTION SYSTEM] [applies] [apply] to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Installer

The installer of the exterior fire alarm system; either the Contractor or subcontractor proposed by the Contractor to perform the work and with whom the Contractor has a firm contractual agreement.

1.4 SYSTEM DESCRIPTION

****
NOTE: The manufacturer and type of station fire alarm system should be indicated.
****

****
NOTE: Design and specify emergency lighting system where required.
****

Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with [NFPA 72] [and] [NFPA 1221], except as modified herein. Except as modified herein, the exterior fire alarm reporting and receiving system shall comply with [NFPA 72 Style B for initiating circuits, Style 2 for signaling circuit] [and] [NFPA 1221 for a [Type A] [Type B] system]. Design the system to operate on direct current supplied from a rectifier and storage batteries. The exterior fire alarm reporting and receiving system shall include the following features:

a. A complete, electrically supervised, normally-closed series, coded, positive noninterfering type of circuit.

b. Succession features, whereby alarms from coded boxes [and transmitters] are transmitted over box circuits to [the central fire station] [fire alarm headquarters].

   (1) Alarms that are [manually][automatically] retransmitted to each branch fire station and to recording and sounding devices in the system.

   (2) Regardless of location, the first coded box operated shall transmit four complete rounds of code without interference from any other box.

   (3) Other coded boxes that may have been operated during this period and that shall then transmit one at a time as the circuit becomes available until all boxes in an alarm condition have completed four rounds of code.

c. [_____] box circuits terminating in box circuit panels and alarm panels arranged to automatically sound and record alarms from each box circuit.

The central [fire station] [fire alarm headquarters] watch position shall include [a desk and table,] receiving console with all associated switches, printer, coupling units, alarm gongs, and other equipment.

1.4.1 Design Requirements

1.4.1.1 Supervisory and Alarm Power Requirements

Submit calculations substantiating battery capacity. Include ampere-hour requirements for each system component and each panel component with the calculations. Include battery recharging period with the calculations.

1.5 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

The fire protection engineer, [_____] Division, Naval Facilities Engineering Command will review and approve all submittals in this section requiring Government approval.

****

NOTE: For projects administered by Pacific Division, NAVFACENGCOM, use the submittal paragraph below in lieu of the above paragraph. Delete the "G" after each submittal item, except under "SD-08 Statement."

****

The Pacific Division, Naval Facilities Engineer delegates the authority

for review and approval of all submittals required by this section to the U.S. Registered Fire Protection Engineer employed in the Quality Control (QC) Organization, specified under Section 01 45 00.00 20 QUALITY CONTROL. Submit to the Pacific Division, Naval Facilities Engineering Command, Fire Protection Engineer two sets of all approved submittals and drawings immediately after approval but no later than 15 working days prior to final inspection.

SD-02 Shop Drawings

[Fire station; G[, [_____]]]

[Fire alarm headquarters; G[, [_____]]]

[Exterior fire alarm reporting and receiving system; G[, [_____]]]

Submit detail plan showing the location of fire alarm equipment and devices with complete point to point wiring diagrams. Wiring diagrams shall show points of connection and terminals to be used, and interior wiring diagrams of each component. Clearly and completely indicate the function of the control panel and devices connected thereto. Drawings should be [1189 by 841 mm] [30 by 42 inches] [_____].

SD-03 Product Data

****
NOTE: Delete equipment which is not applicable. Letter-designate, in alphabetical order, items required.
****

Alarm receiving and decoding console; G[, [_____]]

Variable code transmitter; G[, [_____]]

Printers; G[, [_____]]

Sounding Devices; G[, [_____]]

Rectifier/Charger; G[, [_____]]

Batteries; G[, [_____]]

Audible alarm; G[, [_____]]

Testing instruments; G[, [_____]]

Fire alarm boxes; G[, [_____]]

Pedestal; G[, [_____]]

Circuit protection devices; G[, [_____]]

Tie-line repeater; G[, [_____]]

Wires and cables; G[, [_____]]

SD-05 Design Data

Supervisory and alarm power requirements; G[, [_____]]

SD-06 Test Reports

Ground resistance tests; G[, [_____]]

Dielectric strength and insulation resistance tests; G[, [_____]]

Power supply tests; G[, [_____]]

Supervisory features and trouble alarm circuit test; G[, [_____]]

Box and transmitter tests; G[, [_____]]

Signal transmission and recording tests; G[, [_____]]

Trouble line operation tests; G[, [_____]]

Final performance and acceptance tests; G[, [_____]]

After successful completion of the final acceptance tests, submit test results in booklet form showing field tests performed were in compliance with the specified performance criteria. In each test report, indicate the final position of controls.

SD-07 Certificates

Parts reliability; G[, [_____]]

Installer qualifications; G[, [_____]]

Test procedures; G[, [_____]]

Installation certificate; G[, [_____]]

Installation personnel; G[, [_____]]

Current UL listings or FM approvals; G[, [_____]]

SD-10 Operation and Maintenance Data

Alarm receiving and decoding console, Data Package 5; G[, [_____]]

[Auxiliary transmitter, Data Package 5; G[, [_____]]

] Rectifier/Charger, Data Package 5; G[, [_____]]

Fire alarm boxes, Data Package 5; G[, [_____]]

Variable code transmitter, Data Package 5; G[, [_____]]

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Record wiring diagrams; G[, [_____]]

1.6 QUALITY ASSURANCE

1.6.1 Qualifications

1.6.1.1 Installer Qualifications

Prior to installation, submit evidence including system type and design showing that the installer has successfully installed at least two exterior fire reporting and receiving alarm systems conforming to the requirements of the NFPA and of the same type and design specified herein. Include the names and locations of the installations and written certification from the users that the systems have performed satisfactorily for a period of not less than 18 months. Ensure the installer is UL certified for the installation and testing of Fire Alarm Systems. Provide proof of this listing. A list of installer's personnel shall be provided as part of the submittal package.

1.6.1.2 Installation Personnel

Submit names of personnel who will supervise installation and testing of the system, and who will furnish instruction to Government personnel, along with the manufacturer's certification of the qualifications of the named individuals.

1.6.1.3 Fire Alarm System Technician or Engineer

Make installation, adjustments, and tests under the supervision of a technician or engineer retained by the Contractor who is qualified with at least 2 years' experience in the installation and operation of exterior fire alarm systems of the type specified.

****

NOTE: For projects administered by NAVFAC PAC, include the following paragraph requiring the minimum qualification of a NICET Level-III technician for preparation of all fire protection system drawings. Delete for projects administered by NAVFAC ML. For projects administered by other EFDs, consult with the EFD's Fire Protection Engineer for further guidance before using the paragraph.

****

Qualification of technician:

Installation drawings, shop drawings and as-built drawings shall be prepared by, or under the supervision of, a qualified technician. Qualified technician shall be an individual who is experienced with the types of works specified herein, and is certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with minimum Level-III certification in fire alarm system program. Contractor shall submit data showing the names and certification of the technician at or prior to submittal of drawings.

1.6.2 Modification of References

In the NFPA publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority

having jurisdiction" shall be interpreted to mean the Engineering Field Division Fire Protection Engineer.

1.6.3 Regulatory Requirements

Materials and equipment for fire alarm service shall be listed by UL Fire Prot Dir or approved by FM APP GUIDE. Provide current materials and equipment of one manufacturer regularly engaged in production of such equipment, and provide items that have performed satisfactorily for at least 2 years prior to bid opening.

1.6.3.1 Installation Certificate

Upon completion of construction, submit an installation certificate issued by a service company listed in UL Fire Prot Dir, under "Protection Signaling Services - Local, Auxiliary, Remote Station Proprietary."

1.6.3.2 UL Listings/FM Approvals

Submit copies of current UL listings or FM approvals for the system in configurations offered, with copies of the actual UL or FM test results.

1.6.4 Parts Reliability

Certify that materials and equipment furnished are identical to items that have been in satisfactory use for at least two years prior to bid opening.

1.6.5 Test Procedures

Submit detailed test procedures for the fire alarm system 60 [_____] calendar days prior to performing system tests.

1.7 DELIVERY, STORAGE AND HANDLING

Store and protect equipment from the weather, humidity and temperature variation, dirt and dust, and other contaminants.

1.8 [EXISTING CONDITIONS

Existing system was manufactured by [_____], and new equipment shall be compatible with and not reduce existing system operations and reliability.]

1.9 MAINTENANCE

1.9.1 Special Tools

Furnish a suitable testing instruments, metal tool box and special tools required for the maintenance of the equipment to the Contracting Officer.

1.9.2 Spare Parts

****
NOTE: Delete equipment which is not applicable. Letter-designate, in alphabetical order, items required.
****

a. Three sets of fuses of each type and size;

b. Five spare lamps of each type;

c. Two fire alarm box mechanisms;

d. Two complete printed circuit modules for each recording device console control unit;

e. One suitable metal storage cabinet unless the fire alarm control console is suitable;

f. Five boxes of continuous feed printout paper;

g. Two ink ribbons or cartridges for the printer; and

h. One rectifier/charger at each location indicated.

1.9.3 Record Wiring Diagrams

Submit diagrams prior to final testing of the system.

PART 2 PRODUCTS

2.1 ALARM RECEIVING AND DECODING CONSOLE

****

NOTE: Wherever there are five or more box circuits, a reserve recorder, or recorders as necessary, shall be provided at the alarm receiving center. One or more recorders (depending upon number of box circuits and recorder capacity) shall be provided in each fire station whenever signals are to be transmitted to fire stations either automatically or manually. Provide illumination of console where lighting is inadequate.

****

Provide console in the main fire alarm watch office that conforms with the applicable requirements of UL 864 and includes the following features:

a. Completely assembled, wired, and tested at the factory, and delivered ready for installation and operation.

b. Performs the receipt, processing, and display of alarms transmitted by the transmitters specified herein.

c. A complete receiving system consisting of a decoder, audio devices, visual display, digital clock, printer, primary and emergency power supplies, power supply monitors, memory device, and necessary interconnecting cables.

d. Cabinet storage space of at least three shelves unless a separate metal storage cabinet with door, tumbler-type lock, and two keys are provided for storage of repair parts.

e. Powers and supervises each initiating circuit so that a signal on one zone does not prevent receipt of signals from other zones.

f. Mounts so that no part of the enclosing cabinet is less than 305 mm 12 inches above the finished floor nor more than 1980 mm 78 inches above

the finished floor. Mount manually operated controls at least 915 mm 3 feet and less than 1525 mm 5 feet above the finished floor.

2.1.1 Display

Each console shall conform to the following:

a. Display incoming alarms in alphanumeric format, by means of a light emitting diode, illuminated dot matrix, or cathode ray tube.

(1) Indicate the identity with a minimum of four digit 0002-9999, time, date, and type of signal (alarm, trouble) code number assigned to the originating transmitter.

(2) Include a message of a minimum of 3 lines of 20 characters each for each transmission (minimum 500 transmitter capacity). The message shall be [pre-programmed into the memory as directed by the Contracting Officer] [operator-programmable into the memory through a keyboard which shall be provided].

b. Include a means to manually clear and reset the display. If the display is not reset at the time additional alarms are received, the additional alarms shall be retained in memory and a distinctive audible or visual indication given to the operator that additional alarms are waiting to be acknowledged.

(1) A minimum of 16 such alarms shall be retained for display and acknowledgement.

(2) Alarms shall be printed immediately upon receipt.

2.1.2 Memory

Provide each console with a [programmable] memory capable of retaining at least [_____] [500] transmitter codes, together with specific messages, total number of zones possible, and related information associated with each of the [_____] [500] transmitters. If memory is operator-programmable, restrict access into the memory for the purpose of making additions or deletions by the use of a key switch or access code to prevent unauthorized changes. Memory shall not be lost in the event of a total loss of primary and emergency power supplies.

2.1.3 Digital Clock

Each console shall incorporate an electronic digital clock. Clock shall display the current time expressed in 24-hour time and date (day and month) and shall transmit to each interconnected printer the time and date that signals are received. Provide manual means of resetting the clock.

2.1.4 Printers

Provide printers of high speed, computer compatible, low noise design, capable of printing incoming messages with no messages being lost. Upon reception of an alarm, each printer shall print on paper the required visually displayed data, including the date and time received. Provide standard size paper for recording messages, commercially available from three or more manufacturers, usable on a computer printer or adding machine, and continuous feed. Include paper take-up devices for storing printouts. Print alarms in a manner to make them readily distinguishable

from acknowledgements and routine messages, by use of a different color, typeface, type size, or other distinguishable means.

2.1.5 Audible Trouble and Alarm Devices

The audible alarm device used to indicate the receipt of alarms shall produce a sound distinct from other audible trouble signals. The device shall be internally mounted in the console, and activated upon receipt of an alarm. The audible sounds used to indicate trouble messages, shall be separate and distinct from the sound used to denote receipt of alarm messages.

2.1.6 Power Supply

Provide 120-volt, 60 Hz ac primary power for each console. Supply emergency backup power by batteries capable of powering the system for a minimum of 24 hours. Obtain the 120-volt, 60 Hz ac power supply for each console [through a single connection into the line side of the building's regular ac service circuit] [from the building emergency service circuit as shown] through a lockable fused disconnect switch. Provide a separate disconnect switch for each console.

2.1.7 Emergency Power

Supply emergency power by [lead acid] [_____] type batteries having plastic cases and explosion-proof vents. Provide batteries of sufficient capacity to operate functions of the console for no less than 24 continuous hours, in the event of loss of ac power. Following 24 continuous hours of operation by batteries, batteries shall have ample capacity to operate all components of the system, including alarm signaling devices in the total alarm mode for a period of 10 minutes. Size batteries to deliver 50 percent more ampere/hour than required for the calculated capacities. Mount batteries on racks designed for mounting batteries. Provide a termination cabinet as part of the required rack. Locate battery racks where shown.

2.1.7.1 Emergency Power Switchover

In the event of loss of normal ac power, provide automatic transfer to the emergency power mode, without interruption or loss of console memory. When ac power is restored, provide automatic transfer back to normal mode.

2.1.7.2 Console Battery Charger

Each self-regulating charger shall have the capacity to completely recharge its associated batteries from full discharge within 24 hours with the console fully operational on primary ac power. The console shall remain operational on ac power with the batteries removed.

2.1.8 Console Supervision

The supervisory controls shall provide constant supervision of the operating condition of the console. Provide individual indicators for each major component, and produce an audible signal in the event of failure of a major component. Provide an audible signal distinctly different from the signal used to annunciate alarms. Provide a switch to silence the audible trouble signal. Provide separate alarm trouble lamps for each zone alarm initiating circuit, located on exterior of cabinet door or visible through the door. Provide a suitable means for testing

the control panel meter or lamp visual indicating devices.

2.1.9 Tie-Line Repeater

****

NOTE: Tie-line repeaters are required only where signals are to be repeated or retransmitted to other fire stations. Where Type A central system is provided, a one-way repeater is required. Type B systems require a two-way repeater.

****

Provide a [one-way] [two-way] tie-line repeater with the control unit.

2.1.10 Variable Code Transmitter

****

NOTE: This device is required in only Type A systems where a telegraphic (coded) circuit is one of the two dispatch circuits required by NFPA 1221, but may be provided on Type B systems. Wherever more than five circuits are provided on a Type A system a reserve variable code transmitter shall also be provided.

****

Provide for transmitting a manually selected code to fire stations from alarm receiving headquarters. Provide a momentary-contact "Start" push button on the face of the transmitter to set the transmitter into operation. Provide a separate push button "Restore" switch to permit the operator to instantly clear the transmitter for another alarm and to restore all numerical selectors to the unset position. Provide transmitter capable of the following:

a. Being set to transmit any combination of codes up to and including 9-9-9-9.

b. Transmitting from one to four complete rounds of the selected code number.

c. Transmitting signal at rates varying from 1/4 second to 3 1/4 second impulses.

2.2 AUDIBLE ALARM

****

NOTE: Provide a remote trouble device when the control panel is located in an area where the control panel integral trouble signal normally cannot be heard.

****

Provide an audible alarm device arranged to sound whenever an abnormal condition exists, such as box or alarm circuit trouble, low battery voltage, or low supervisory current. Provide distinctive trouble indication for each type of trouble condition and an audible alarm silencing switch. Operation of the silencing switch shall not delete the activated trouble indicator. With the switch in the "silence" position, the audible signal shall re-sound when the trouble condition is corrected.

The control unit shall automatically prevent interference between circuits to the same degree as the noninterference feature between boxes on the same circuit. Mount unit in a compact [free-standing floor] [desk-top] cabinet. Provide voltmeters and millimeters on the face of each unit. Provide a rigid plastic or metal identification sign which reads "Fire Alarm System Trouble" at the device.

2.3 SOUNDING DEVICES

****

NOTE: In a Type B system a single gong located in the alarm receiving center is permitted as a common sounding device for more than one circuit. In a Type A system a separate sounding device shall be provided on each box circuit and shall be installed at the same location as the recording device for that circuit.

****

Provide a 255 mm 10 inch diameter single-stroke [electric] [mechanical] operated gong at locations indicated. Connect gong to the control unit so that gong sounds the code of each operated fire alarm box.

2.4 CIRCUIT PROTECTION DEVICES

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NOTE: The one-half ampere protection on tie-line circuits shall be omitted at all stations other than the alarm control center.

****

Protect box circuit and tie-line conductors entering the alarm control center by the following devices, in the order named, starting from the exterior circuit. Provide lightning arresters at locations on the system [as required by NFPA 1221.] [and as indicated.]

a. A fuse rated at 7 amperes and not less than 2000 volts.

b. A lightning arrestor.

c. A fuse, or circuit breaker, rated at one-half ampere, fast-blow for solid state circuits.

2.5 STANDARD FIRE ALARM BOXES

Connect manual stations into alarm initiating circuit. Provide coded, positive, noninterfering type with succession features. Provide boxes capable of transmitting through ground in the event of a single open in the circuit. Provide pre-wound, open-door-pull-lever type boxes that conform to applicable requirements of UL 38. The house mechanism shall be in a weatherproof cottage-shell type of housing with metallic bronze or nickel-alloy or rigid plastic code number plate mounted on the exterior face of the cottage shell. Stations requiring breaking of glass or plastic panels for operation are not acceptable; however, stations employing glass rods are acceptable. Gravity or mercury switches are not acceptable. Finish the housing in gloss [red] [yellow] enamel with a reflective, highly visible label imprinted with the word "FIRE" in minimum 50 mm 2 inch block characters on both sides of the box. Code wheel shall be metallic [or nylon derivative] and code shall be as developed by the

coding plan for the code wheel location. Operation of the actuating pull lever shall cause the box to transmit 4 complete round groups of code to all gongs, recorders, and other devices on the circuit to which the pull lever is connected. Driving springs shall have the capability to transmit not less than 8 complete 4-round groups of code before being rewound. Design boxes for operation on 100 milliamperes dc, but with capability of full operation at 70 milliamperes and up to 120 milliamperes. Box mechanism shall be capable of transmitting signals at varying rates of speed ranging from electrical impulses at 3 1/4 second intervals to 1/4 second intervals and shall be field adjustable to any speed within this range. Equip each box with manual signaling key, silent test device, and box shunt device.

2.5.1 Master Fire Alarm Boxes

Provide type identical to standard boxes except that, in addition, equip each master box with a [shunt] [local-energy] type auxiliary tripping coil for connection to building protective or alarm system devices.

2.5.2 Fire Alarm Box Mounting

Provide [wall] [pole] [or] [pedestal] mounting [as indicated] with box center 1525 mm 5 feet above grade. Mounting bolts, brackets, fastenings, and conduit shall be copper-alloy, cadmium, or zinc-coated steel. Provide a ruby-globe marker lamp in a weatherproof gasketed cast aluminum housing at each fire alarm box. Locate marker lamp housing above the box, and arranged so that moisture cannot collect at the junction of globe and fixture. Marker lamp shall be a 130 volt, 25 watt, extended service lamp. Provide zinc-coated steel pedestal and finished in at least two coats of red enamel. Pedestal shall include box mounting assembly, terminal strip, and terminal strip access door.

2.5.3 Fire Alarm Box Grounding

Provide connection from the grounding terminal connection of the box to either a driven ground rod or a buried, metallic water pipe. Resistance to ground shall not exceed 5 ohms. Do not consider the grounded neutral connection of a three-phase or single-phase power supply as an adequate ground for the fire alarm box ground.

[2.5.4 Auxiliary Transmitter

Configure auxiliary transmitter for automatic actuation through auxiliary connections to local protective signaling systems [and initiating devices]. Auxiliary transmitters shall comply with the paragraph entitled "Master Fire Alarm Boxes" but are not fitted with a pull lever [and may be housed in noncottage-shells type enclosures].

]2.6 OVERVOLTAGE AND SURGE PROTECTION

2.6.1 Power Line Surge Protection

Protect equipment connected to ac circuits from power line surges. Equipment shall meet requirements of IEEE C62.41.1 and IEEE C62.41.2. Do not use fuses for surge protection.

2.6.2 Communications Link Surge Protection

Protect communications equipment against surges induced on communications

links. Install surge protection circuits at each end of cables and conductors, except fiber optics, which serve as communications links, to meet the following two waveforms:

a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Provide protection at the equipment. Install additional triple electrode gas surge protectors, rated for the applications, on each wireline circuit within three feet of the building entrance. Do not use fuses for surge protection.

2.6.3 Sensor Wiring Surge Protection

Protect digital and analog inputs and outputs against surges induced by sensor wiring installed outdoors and as shown. Test inputs and outputs with the following two waveforms:

a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond by 20 microsecond wave form with a peak voltage of 1000 volts and a peak current of 500 amperes. Do not use fuses for surge protection.

2.7 FIRE ALARM SYSTEM POWER SUPPLY

Provide dc power supply consisting of rectifier/battery charger, battery power supply, necessary transformers, and inverters, in the central alarm receiving location [and in each fire station] as indicated. Provide two sources of electrical power for each box circuit, [dispatch circuit,] and alarm transmitting or receiving device, including fire station equipment requiring local power for operation. Power supply shall conform to [NFPA 1221 for Form 4A] [NFPA 72 for primary and secondary power supplies for Central Supervising Station].

2.7.1 AC Power

Obtain power from the line side of the main electrical service to each building. At the location indicated, provide a circuit disconnecting means in a locked cabinet with the function clearly and permanently identified. Provide circuit protection in each ungrounded conductor located in a locked cabinet immediately adjacent to the point of connection to light and power conductors.

2.7.2 Rectifier/Charger

Supply each rectifier/charger through an isolating transformer taking energy from a circuit not exceeding 240 volts. Rectifier/charger leads shall fuse at not less than one ampere and at not more than 200 percent of the maximum connected load. Rectifier/charger shall be a fully automatic, variable rate, filtered battery charger capable of providing 150 percent of the connected battery load. Adjust charger in accordance with the battery manufacturer's recommendations to provide full "float" voltage to compensate for the load and maintain the batteries at full voltage. Charger shall be properly fused and shall incorporate a dc voltmeter and dc ammeter. [Provide a manual high-rate-of-charge switch together with a

red pilot light to indicate when batteries have been manually placed on high charging rate.]

2.7.3 Batteries

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NOTE: Nickel-cadmium batteries should not be specified over lead-calcium type unless some unusual environmental or operational condition warrants the additional cost of nickel-cadmium. For normal installations, battery selection may be left as a contractor's option. Ensure battery room or location has adequate ventilation to keep hydrogen concentrations below 3 percent.

****

Provide [sealed,] wet-cell, [lead-acid (lead antimony)] [or] [lead-calcium] type, adequate to provide each transmitter with a minimum of 24-hour standby capacity. Mount batteries [on racks] [in cabinets] designed for mounting batteries. Provide reliable separation between cells and from ground. Connect batteries to "float" on the exterior fire alarm reporting and receiving system circuits.

2.7.4 Electronic Inverters

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NOTE: Nickel-cadmium batteries should not be specified over lead-calcium type unless some unusual environmental or operational condition warrants the additional cost of nickel-cadmium. For normal installations, battery selection may be left as a contractor's option. Ensure battery room or location has adequate ventilation to keep hydrogen concentrations below 3 percent.

****

Provide units capable of 115-volt 60-Hz ac output in alarm receiving headquarters [and in each fire station] for operating alarm receiving, alarm transmitting, recording and signaling devices, or components requiring 115 Vac. Inverters shall be battery powered and arranged to operate automatically in the event of loss of normal ac power. Provide battery power supply from either the main alarm system standby battery or from separate [sealed,] wet-cell, [lead-acid (lead antimony)] [or] [lead-calcium] batteries and charger. Provide battery power supply to sustain the connected devices under normal operating load for a minimum of 24 hours. If supplied from the main alarm system, provide alarm system batteries to sustain connected loads for the full 24-hour period.

2.7.5 Transformers

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NOTE: Detail transformers on drawings.

****

Provide isolation and step-down transformers for proper operation of the various components of the system.

2.8 WIRING

Provide color coded wires and cables.

2.8.1 Wiring Within Buildings

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NOTE: Type THW insulation can only be obtained in large quantity. Use of this type insulation is not recommended for small projects.

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Provide in conduit or electrical metallic tubing, except wiring within cabinets and other components of the system. Wiring for 120-volt circuits shall be not less than No. [12] [_____] AWG. Wiring shall comply with NFPA 70 and NFPA 1221. Conductors shall be copper, Type [THW] or [THWN] conforming to UL 83. Color code conductors. Distinctly color code conductors used for the same functions. Use two different color codes for each alarm circuit; one for each loop. Wiring color code shall remain uniform throughout the circuit.

2.8.2 Cables for Fire Alarm Service

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NOTE: Whenever cables enter the fire station or fire alarm headquarters or emerge from direct burial or underground duct locations and continue aboveground as aerial messenger cables or open wire aerial loops they shall be protected by lightning arresters. These must be indicated on the drawings.

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2.8.2.1 Underground Cables

Cables [provided in duct-and-manhole systems] [buried directly in earth] shall be in accordance with Sections 31 00 00 EARTHWORK and 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Concrete work for underground distribution system and appurtenances shall be in accordance with Sections [03 30 00 CAST-IN-PLACE CONCRETE] [33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION]. Power wiring shall be copper Type USE conductors not less than No. [_____] AWG in size conforming to NFPA 70. Exterior fire alarm reporting and receiving system cable shall consist of individually insulated conductors and double polyethylene outer jacket [and copper tape shield between jackets for direct burial] not less than No. [_____] AWG in size. Wires and cables shall be one piece without splices between connections except where the distance exceeds the lengths in which cable is manufactured. Make splices only in manholes, handholes, or other protected and accessible space.

2.8.2.2 Cables Provided in an Exterior Overhead System

Cables shall be in accordance with Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION. Cables shall be copper not less than No. [_____] AWG in size and shall conform to NEMA WC 3 or NEMA WC 70 or ANSI/NEMA WC 71/ICEA S-96-659. Cables shall be in one piece without splices between connections except where the distance exceeds the lengths in which the cable is manufactured. Support cables from copper-encased steel or galvanized messenger wire or strand by a continuous spirally wrapped lashing wire of copper-encased steel, galvanized steel, or

stainless steel. Messenger wire or strand shall conform to IMSA 32, [30] [40] percent conductivity or ASTM A475, Siemens-Martin Utilities or HIGH Strength with Class A or B galvanizing.

2.8.2.3 Identification Slabs (Markers)

Provide markers in accordance with Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION, and provide at each change of direction of cable, over the ends of ducts or conduits that are provided under paved areas and roadways, and over each splice.

2.8.3 Wire Markers

Provide markers at both ends of each wire connected to the control board. Provide taped-band type markers, of permanent material, permanently stamped with the proper identification. The taped band shall be white and the markings black in color so that the identification can be easily read. Attach the markers to the wires in a manner that will not permit accidental detachment.

2.9 CONDUIT

2.9.1 Rigid Steel Conduit Zinc-Coated

ANSI C80.1.

2.9.2 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.9.3 Electrical Metallic Tubing (EMT)

ANSI C80.3.

2.10 OUTLET BOXES

UL 514A, zinc-coated steel.

2.11 FITTINGS FOR CONDUIT AND OUTLET BOXES

UL 514B, zinc-coated steel.

2.12 GROUND RODS

Rods shall be the sectional type, copper-encased steel, with a minimum diameter of 19 mm 3/4 inch and a minimum length of 3045 mm 10 feet. The rods shall have a hard, clean, smooth, continuous copper surface, and the proportion of copper shall be uniform throughout the length of the rod. Copper shall have a minimum wall thickness of 0.33 mm 0.013 inch at any point on the rod. Rods shall comply with the UL 467 requirements.

2.13 KEYS AND LOCKS

Key locks alike. Furnish tags with stamped identification number for keys and locks.

2.14 NAMEPLATES

Securely attach to each major component of equipment a noncorrosive and

nonheat sensitive plate indicating the manufacturer's name, address, type or style, voltage and current and current rating, and catalog number.

2.15 PAINTING

Factory paint switch boxes, fire alarm boxes, transmitters, and gongs with a priming coat and not less than two coats of a hard, durable weatherproof enamel. The finish color shall be [red] [_____] gloss. Treat and paint control boards in accordance with the manufacturer's standard practice. Steel pedestals and other exterior work shall have a suitable priming coat and not less than two coats of approved enamel with finish color as selected by the Contracting Officer. Repaint painted surfaces damaged during installation of the exterior fire alarm reporting and receiving system with color to match existing paint.

PART 3 EXECUTION

3.1 INSTALLATION

Install the exterior fire alarm reporting and receiving system in accordance with NFPA requirements, the manufacturer's diagrams and recommendations, and this section.

3.2 VERIFICATION OF CONDITIONS

Become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of discrepancies before performing the work.

3.3 WIRING

Wiring shall be in rigid steel conduit, intermediate metal conduit or electrical metallic tubing. Identify circuit conductors within each enclosure where a tap, splice, or termination is made. Attach markers in a manner that will not permit accidental detachment. Identify control circuit terminations. Unless otherwise indicated, wiring and conduit will be new. Do not run fire alarm circuits in the same conduit with non-fire alarm circuits. Do not run ac circuits in the same conduit with dc circuits.

3.4 GROUNDING

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NOTE: Connections subject to moisture or corrosive influences should be welded or brazed.

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Ground equipment in accordance with NFPA 70. Measure the resistance of each connection to ground. Ground resistance shall not exceed 5 ohms.

3.5 CABLE SPLICES

Make splices only where the distance between connections exceeds the length in which the cable is manufactured. Splices shall conform to Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION, and the cable manufacturer's recommendations.

3.6 SPECIAL CONNECTIONS

3.6.1 Branch or "Y" Connections for Cables

Make these connections only aboveground at fire alarm stations, on structures, or in manholes and handholes as approved. Provide cable terminations in fire alarm station enclosures or in boxes or cabinets equipped with telephone-type terminal boards. Provide weatherproof enclosures in exterior or wet locations and watertight in manholes and handholes.

3.6.2 Welded and Brazed Connections

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NOTE: When welded or brazed connections are not indicated or specified, delete this paragraph.
****

Welding or brazing process shall not weaken the parts joined and shall join strands. Provide welding process so that the completed joint or connection will be one homogeneous mass equal to or larger in size than the cables and wires joined. An exothermic type welding method may be used, employing a measured heat supply and molds designed for the conductors joined. Perform brazing process with operators experienced in work of a similar character and in a manner that will not damage the parts joined. [Approved splice cap swaged spike terminations, insulation wrapped and epoxy potted, may be substituted for welded and brazed connections.]

3.7 CORROSION AND FUNGUS PREVENTION

Protect metallic materials against corrosion. Coat outdoor equipment with a rust inhibiting treatment and standard finish by the manufacturer. Do not use aluminum in contact with the earth. Protect dissimilar metals with approved fittings and treatment. Coat steel conduits installed underground with an approved asphaltic paint or plastic coating, or wrap with a single layer of a pressure sensitive plastic tape, half-lapped. Protect components against corrosion and fungus. Coat printed circuit board with epoxy.

3.8 FIELD QUALITY CONTROL

3.8.1 Tests During Installation

Conduct the following tests during installation of wiring and system components. Correct deficiencies prior to formal functional and operational tests of the system. Tests shall include meggering system conductors to determine that system is free from grounded or open circuits. Complete the megger test prior to installation of fire alarm equipment.

3.8.1.1 Ground Resistance Tests

Resistance of each connection to ground shall be measured and not exceed 5 ohms.

3.8.1.2 Dielectric Strength and Insulation Resistance Tests

Test dielectric strength and insulation resistance of the system

interconnecting wiring by means of an instrument capable of generating 500 V dc and equipped to indicate leakage current in terms of resistance. Provide test instrument capable of indicating 1000 megohms. For the purpose of this test, connect the instrument between each conductor on the line and between each conductor and ground at the control panel end of the line, with the other extremity open-circuited and series-connected devices in place. The system shall withstand the test without breakdown and indicate a resistance of not less than 500,000 ohms, the measurement being taken after an electrification of not more than one minute with a dc potential of not less than 100 volts nor more than 550 V dc.

3.8.1.3 Power Supply Tests

Conduct a complete test of the power supply including rectifier, charging rates, and automatic controls. Record operating input and output line voltages and current (load) at the time of the tests.

3.8.1.4 Supervisory Features and Trouble Alarm Circuit Test

Make detailed tests of supervisory features and trouble alarm circuits and relays.

3.8.1.5 Box and Transmitter Tests

Prior to commencement of tests, prepare sketches on letter-size sheets indicating electrical sequence from the control panel of manual boxes and transmitters. Test each box on each box circuit as follows: Electrically operate the farthest box from the fire station first. Examine the printout to determine if the code contacts cause a uniform signal to be transmitted through each of the four rounds. This test will provide a check on the box operation and code contacts. Test the succeeding boxes or transmitters successively until each box in the box circuit has been tested as specified. Test each box circuit separately to determine that, should two or more devices be operated at or near the same time, the device first securing the line shall continue to transmit its code without interference from other devices [, and that the remaining actuated devices shall similarly and subsequently transmit their codes without interference as the line becomes available].

3.8.1.6 Signal Transmission and Recording Tests

Test each fire alarm box for signal transmission and recording, including fidelity of repeated signals on gong circuits under normal circuit conditions with the maximum allowable current. Repeat test at 70 milliamperes. Test alarm relays at the same time at upper and lower current limits.

3.8.1.7 Trouble Line Operation Tests

Repeat the foregoing operational test for the conditions of trouble line operation, except test relays only at minimum current flow. Accomplish test for box circuit relays by adjusting the normal line current to 100 milliamperes before simulating trouble line condition.

Simulating line trouble: Simulate line trouble by removing circuit wires from terminals or applying grounds to these terminals in each fire alarm box. Subject each box on each circuit to the following tests.

a. First test for trouble line operation: Remove one or the other of the

circuit wires from the terminal of the box being tested. After waiting for the timing interval of the automatic conditioning relay, operate the box. The signal shall be received and recorded by the recorder and repeated in each of the gong circuits. Following this test replace the removed conductor, remove the remaining conductor, and repeat the test.

b. Manual-set transmitter test: Set up the complete four-digit numbers (1-1-1-1, 2-2-2-2, through 9-9-9-9) operating the transmitter each time for full four rounds.

3.8.2 Complete Printout Documentation

Mark printouts for operational tests to identify each test.

3.8.3 Final Performance and Acceptance Tests

After the system has been in service for at least 30 calendar days, notify the Contracting Officer in writing that the system is ready for final acceptance tests. Provide notification at least 15 calendar days prior to the date of the final acceptance test. Submit with this notification a certificate from a service company listed in the UL Fire Prot Dir, under "Protective Signaling - Local, Auxiliary-Remote Station and Proprietary," which includes tests specified in paragraphs entitled "Ground Resistance," "Dielectric Strength and Insulation Resistance," "Power Supply," "Supervisory Features and Trouble Alarm Circuits," "Box and Transmitter Test," "Signal Transmission and Recording," and "Trouble Line Operation." Consider the system ready for testing after necessary preliminary tests have been made and deficiencies have been corrected to the satisfaction of the equipment manufacturer's technical representative and the Engineering Field Division Fire Protection Engineer.

3.8.3.1 Acceptance Testing

Furnish proposed test procedures for approval at least 60 calendar days prior to commencement of acceptance testing. Perform the tests in the presence of the [Engineering Field Division Fire Protection Engineer] [Contracting Officer] or authorized representative under the supervision of the fire alarm reporting system manufacturer's qualified representative. Furnish instruments, labor, and materials required for the tests. Arrange for the technician who supervised the installation to conduct the tests. Correct deficiencies found and retest the system. Repeat tests specified in paragraph entitled "Tests During Installation" as directed by the Engineering Field Division Fire Protection Engineer during final acceptance tests.

3.8.4 Additional Tests

When deficiencies, defects, or malfunctions develop during the tests required, suspend further testing of the system until proper adjustments, corrections, or revisions have been made to ensure proper performance of the system. If these revisions require more than a nominal delay, notify the Contracting Officer when the additional work has been completed to arrange a new inspection and test of the exterior fire alarm reporting and receiving system. Repeat tests required prior to final acceptance, unless directed otherwise.

3.8.5 Manufacturer's Field Service

3.8.5.1 Manufacturer's Representative

Furnish the services of a qualified representative or technician of the system manufacturer, experienced in the installation and operation of the type of system being provided to supervise testing, including final testing, and adjustment of the system.

3.8.5.2 Instruction for Government Personnel

Conduct a training course for operating staff as designated by the Contracting Officer. The training period shall consist of [3] [_____] training days, 8 hours per day, and shall start after the system is functionally complete but prior to final acceptance tests. The field instructions shall cover items contained in the operating and maintenance instructions.

3.9 CONTINUITY OF PROTECTION

During installation of the system, there shall be no loss of function of the existing base fire alarm system, or of the local building alarm systems connected thereto. Transfer of local alarm system connections from the existing base alarm system shall not result in loss of alarm transmitting or receiving capability. Temporary interruption of individual building alarm connections, not to exceed 8 hours duration, will be permitted at the discretion of the Contracting Officer. Interruption of alarm or communications functions at the fire alarm watch office is prohibited.

-- End of Section --