



## 2.2 COMPONENT DESIGN

- 2.2.1 Control Panel
  - 2.2.1.1 Main Annunciator
  - 2.2.1.2 Initiating Zones
  - 2.2.1.3 Remote Annunciator Panel
  - 2.2.1.4 Graphic Annunciator Panel
  - 2.2.1.5 Trouble [Bell] [Buzzer]
- 2.2.2 Manual Pull Stations
- 2.2.3 Heat Detectors
  - 2.2.3.1 Combination Fixed Temperature Rate-Of-Rise Detectors (Spot Type)
  - 2.2.3.2 Rate Compensating Detector (Spot Type)
  - 2.2.3.3 Line-Type Fixed Temperature Detectors
- 2.2.4 Open-Area (Spot-Type) Smoke Detectors
  - 2.2.4.1 4-Wire Smoke Detectors
  - 2.2.4.2 2-Wire Smoke Detectors
  - 2.2.4.3 Ionization Detectors
  - 2.2.4.4 Photoelectric Detectors
  - 2.2.4.5 Detector Spacing and Location
  - 2.2.4.6 [Single] [Multiple]-Station Detectors
- 2.2.5 Duct Smoke Detectors
- 2.2.6 Projected Beam Smoke Detector
- 2.2.7 Notification Appliances
  - 2.2.7.1 Alarm Bells
  - 2.2.7.2 Alarm Horns
  - 2.2.7.3 Visible Appliances
- 2.2.8 Fire Extinguishing Systems
- 2.2.9 Freeze Protection Thermostatic Switch
- 2.2.10 Electro-Magnetic Door Holder-Releases
- 2.2.11 Valve Tamper Switches
- 2.2.12 Off-Premises Fire Alarm
  - 2.2.12.1 Master Fire Alarm Boxes
  - 2.2.12.2 Auxiliary Transmitter
  - 2.2.12.3 Radio Fire Alarm [Master Box] [Auxiliary Transmitter]
  - 2.2.12.4 Grounding
  - 2.2.12.5 Master Box Pedestal
  - 2.2.12.6 Radio Master Box Pedestal
  - 2.2.12.7 [Master Box] [Radio Master Box] Location Light
- 2.2.13 Conduit
  - 2.2.13.1 Rigid Steel Conduit (Zinc-Coated)
  - 2.2.13.2 Intermediate Metal Conduit (IMC)
  - 2.2.13.3 Electrical Metallic Tubing (EMT)
  - 2.2.13.4 Surface Metal Raceway and Fittings
- 2.2.14 Outlet Boxes
- 2.2.15 Fittings for Conduit and Outlet Boxes
- 2.2.16 Wiring
- 2.3 SURGE SUPPRESSION
  - 2.3.1 Line Voltage Surge Suppressor
  - 2.3.2 Low Voltage Surge Suppressor

## PART 3 EXECUTION

- 3.1 INSTALLATION
  - 3.1.1 Additional Installation Requirements
- 3.2 FIELD QUALITY CONTROL
  - 3.2.1 Preliminary Testing
  - 3.2.2 Final Acceptance Testing
    - 3.2.2.1 Entire System
    - 3.2.2.2 Supervisory Systems

### 3.2.3 Additional Tests

-- End of Section Table of Contents --

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USACE / NAVFAC / AFCEC / NASA UFGS-28 31 74.00 20 (February 2010)  
-----  
Preparing Activity: NAVFAC Superseding  
UFGS-28 31 74.00 20 (April 2006)

# UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2020

\*\*\*\*\*

## SECTION 28 31 74.00 20

### INTERIOR FIRE DETECTION AND ALARM SYSTEM 02/10

\*\*\*\*\*

NOTE: This guide specification covers the requirements for manual and automatic, noncoded, interior, Class "B" or Class "A" fire detection and alarm systems.

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).

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NOTE: This system is suitable for use for all occupancies.

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NOTE: For Family Housing projects at NAVFAC NE use regional guide specification section 28 31 46.00 22 (N-13854N) HOUSEHOLD FIRE WARNING EQUIPMENT to specify residential fire warning systems in lieu of this section: 28 31 74.00 20 INTERIOR FIRE DETECTION AND ALARM SYSTEM.

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NOTE: Both 4-wire and 2-wire smoke detectors are specified in this guide specification. For open-area smoke detectors in new systems, edit this

specification to permit the Contractor the option to provide 2-wire detectors. For additions to existing 4-wire systems, or when detector auxiliary contacts are used for critical control functions (such as elevator recall or air handler shutdown) edit this specification to require the Contractor to provide 4-wire detectors only.

For further guidance, consult with the Engineering Field Division (EFD)/Engineering Field Activity (EFA) Fire Protection Engineer.

\*\*\*\*\*

\*\*\*\*\*

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

1. On electrical power or fire protection floor plans show location of control panel, battery and charger, transmitter, remote annunciator, connection to power source, remote trouble device, alarm notification appliances, and each initiating device including fire extinguishing system switches and manual pull stations.

2. For projects at NAVFAC NE do not show open area heat and smoke detectors. For heat and smoke detectors provide a table on the drawings indicating detector types, room locations, and temperature ratings if applicable.

3. On electrical site plan, show location of master fire alarm box, outside annunciator (if required), circuit run to the connection to the base fire alarm circuit (except radio systems), circuit run into the building and connection to control panel, and circuit run for master box marker light. Circuit runs to the base fire alarm (except radio systems) should show conduit size and numbers and size of conductors.

4. Show single line fire alarm riser diagram. Connection of equipment should be indicated by circuit runs and not conduit runs. Do not indicate number and size of conductors for interconnection of fire alarm components.

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NOTE: When an existing system is to be expanded, show the following information:

1. Manufacturer and model of existing control panel.

2. Number of existing initiating circuits (zones), notification appliance circuits, and control circuits served by the control panel.

3. Number of existing alarm notification appliances

on the system.

4. Total calculated current draw of all devices served by the existing standby battery under both supervisory (standby) and alarm conditions.

5. Ampere-hour rating and type of existing battery.

\*\*\*\*\*

## 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.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A17.1/CSA B44 (2016) Safety Code for Elevators and Escalators

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.15 (2011) Release Devices Closer Holder, Electromagnetic and Electromechanical

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

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)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2;  
TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6;  
TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10;  
TIA 17-11; TIA 17-12; TIA 17-13; TIA  
17-14; TIA 17-15; TIA 17-16; TIA 17-17 )  
National Electrical Code

NFPA 72 (2019; TIA 19-1; ERTA 2019) National Fire  
Alarm and Signaling Code

NFPA 90A (2018) Standard for the Installation of  
Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 5 (2016) UL Standard for Safety Surface  
Metal Raceways and Fittings

UL 6 (2007; Reprint Sep 2019) UL Standard for  
Safety Electrical Rigid Metal Conduit-Steel

UL 467 (2013; Reprint Jun 2017) UL Standard for  
Safety Grounding and Bonding Equipment

UL 497B (2004; Reprint Dec 2012) Protectors for  
Data Communication Circuits

UL 514A (2013; Reprint Aug 2017) UL Standard for  
Safety Metallic Outlet Boxes

UL 514B (2012; Reprint Nov 2014) Conduit, Tubing  
and Cable Fittings

UL 797 (2007; Reprint Mar 2017) UL Standard for  
Safety Electrical Metallic Tubing -- Steel

UL 1242 (2006; Reprint Mar 2014) Standard for  
Electrical Intermediate Metal Conduit --  
Steel

UL 1449 (2014; Reprint Jul 2017) UL Standard for  
Safety Surge Protective Devices

UL 1971 (2002; Reprint Oct 2008) Signaling Devices  
for the Hearing Impaired

## 1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

## 1.3 DESCRIPTION OF WORK

\*\*\*\*\*  
NOTE: Edit this paragraph to identify the type of fire alarm system existing at the activity. When the existing base fire alarm system is a radio fire alarm system, identify the manufacturer in the blank space provided.  
\*\*\*\*\*

The work includes [modifying existing] [and] [providing new] interior fire alarm system including material, tools, equipment, installation, and testing necessary for and incidental to the provision of a complete and usable standard system conforming to the applicable requirements of NFPA 70, NFPA 72, and NFPA 90A and this specification. In referenced NFPA publications, the advisory provisions shall 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 [[\_\_\_\_\_] Division] [Engineering Field Activity [\_\_\_\_\_] ], Naval Facilities Engineering Command, Fire Protection Engineer. Equipment and devices shall be compatible and operable in all respects with, and shall in no way impair reliability or operational functions of, the existing [interior fire alarm system and the existing] base fire alarm system. [Existing interior fire alarm system was manufactured by [\_\_\_\_].] Existing base fire alarm system is a [[\_\_\_\_\_] radio] [positive, non-interfering, successive (PNIS) telegraph] [\_\_\_\_\_] system. Materials and equipment to be furnished under this contract shall be essentially the current design products of manufacturers regularly engaged in production of such equipment and shall be listed by the Underwriters' Laboratories, Inc. in the UL Fire Prot Dir, or approved by Factory Mutual System and listed in FM APP GUIDE.

## 1.4 SYSTEM DESCRIPTION

### 1.4.1 Design Requirements

#### 1.4.1.1 Power Calculations

Submit design calculations [for the existing system and new work specified herein] to substantiate that the battery capacity exceeds supervisory and alarm power requirements. Show comparison of the detector power requirements per zone versus the control panel smoke detector power output per zone in both the standby and alarm modes. Show comparison of the notification appliance circuit alarm power requirements with the rated circuit power output.

## 1.5 SUBMITTALS

\*\*\*\*\*  
NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit



the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated 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 submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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" following a submittal item indicates that the submittal is required for the Sustainability eNotebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING. Locate the "S" submittal under the SD number that best describes the submittal item.

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" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

The Naval Facilities Engineering Command, [\_\_\_\_], Fire Protection Engineer will review for approval all submittals required by this section.

\*\*\*\*\*

NOTE: For projects administered by NAVFAC PAC, use "SUBMITTALS" article immediately below in lieu, of above paragraph. Delete the "G" in asterisk tokens after each submittal item, except under "SD-08 Statements."

\*\*\*\*\*

[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 to prior to final inspection.]

#### SD-02 Shop Drawings

System floor plans; G[, [\_\_\_\_\_]]

System wiring diagrams; G[, [\_\_\_\_\_]]

Conductor wire marker schedule; G[, [\_\_\_\_\_]]

#### SD-03 Product Data

\*\*\*\*\*  
**NOTE: Delete equipment not applicable for the  
project and reletter the remaining items.**  
\*\*\*\*\*

Control panel and modules; G[, [\_\_\_\_\_]]

Storage batteries; G[, [\_\_\_\_\_]]

Battery charger; G[, [\_\_\_\_\_]]

Manual pull stations; G[, [\_\_\_\_\_]]

Heat detectors; G[, [\_\_\_\_\_]]

Open-area (spot-type) smoke detectors; G[, [\_\_\_\_\_]]

Duct smoke detectors; G[, [\_\_\_\_\_]]

Alarm bells; G[, [\_\_\_\_\_]]

Alarm horns; G[, [\_\_\_\_\_]]

Visible appliances; G[, [\_\_\_\_\_]]

Main annunciator; G[, [\_\_\_\_\_]]

Remote annunciator panel; G[, [\_\_\_\_\_]]

Graphic annunciator panel; G[, [\_\_\_\_\_]]

[ Master fire alarm boxes; G[, [\_\_\_\_\_]]

[ Auxiliary transmitter; G[, [\_\_\_\_\_]]

[ Master box pedestal; G[, [\_\_\_\_\_]]

[ Radio master box pedestal; G[, [\_\_\_\_\_]]

[ [Master box] [Radio master box] location light; G[, [\_\_\_\_\_]]

[ Radio fire alarm [master box] [auxiliary transmitter]; G[, [\_\_\_\_]] ]

[ Radio fire alarm [master box] [auxiliary transmitter] and interface panel; G[, [\_\_\_\_]] ]

[ Combination auxiliary transmitter and interface panel; G[, [\_\_\_\_]] ]

[ Freeze protection thermostatic switch; G[, [\_\_\_\_]] ]

[ Electro-magnetic door holder-releases; G[, [\_\_\_\_]] ]

[ Valve tamper switches; G[, [\_\_\_\_]] ]

Wiring; G[, [\_\_\_\_]]

Ground rods

Conduit

Outlet boxes

Fittings for conduit and outlet boxes

[ Trouble [bell] [buzzer]; G[, [\_\_\_\_]] ]

[ Projected beam smoke detector; G[, [\_\_\_\_]] ]

[ Surge suppression devices; G[, [\_\_\_\_]] ]

Data which describe more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide. Submit one original for each item and clear, legible, first-generation photocopies for the remainder of the specified copies. Incomplete or illegible photocopies will not be accepted. Partial submittals will not be accepted.

#### SD-05 Design Data

Power calculations; G[, [\_\_\_\_]]

#### SD-06 Test Reports

Open-area (spot-type) 2-wire smoke detectors; G[, [\_\_\_\_]]

Preliminary testing; G[, [\_\_\_\_]]

Final acceptance testing; G[, [\_\_\_\_]]

Submit for all inspections and tests specified under paragraph entitled "Field Quality Control."

#### SD-07 Certificates

Qualifications of installer; G[, [\_\_\_\_]]

\*\*\*\*\*

**NOTE: Include only the item below for projects**

administered by NAVFAC SW and NAVFAC PAC. Delete  
for other projects.

\*\*\*\*\*

[ Qualifications of system technician; G[, [\_\_\_\_]]]

[ SD-08 Manufacturer's Instructions

Projected beam smoke detector; G[, [\_\_\_\_]]]

SD-10 Operation and Maintenance Data

Fire alarm system, Data Package 5; G[, [\_\_\_\_]]

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

SD-11 Closeout Submittals

System as-built drawings; G[, [\_\_\_\_]]

## 1.6 QUALITY ASSURANCE

### 1.6.1 Qualifications of Installer

\*\*\*\*\*

NOTE: For most fire alarm systems the experience  
requirement in this paragraph is adequate. Consult  
with the EFD/EFA Fire Protection Engineer to  
determine whether UL certification is also required  
and edit as appropriate.

For projects administered by NAVFAC SW include  
certification requirement for satisfactory system  
performance for 18 months. Delete for other  
projects.

\*\*\*\*\*

The Contractor or installer shall have satisfactorily installed fire alarm  
systems of the same type and design as specified herein [and shall be UL  
certified for the installation and testing of fire alarm systems].

Prior to commencing fire alarm system work, submit data showing that the  
Contractor or installer has satisfactorily installed three fire alarm  
systems of the same type and design as specified herein within the past  
three years [and certify that each system has performed satisfactorily in  
the manner intended for a period of not less than 18 months]. [Submit  
proof of UL certification and a list of installer's personnel.]

For each system installed, submit the following:

- a. A detailed summary of the type and design of the system;
- b. The contract name or number, completion date of the project and total  
cost of the system;
- c. The name and telephone number of the facility or installation for whom  
the work was performed; and,

- d. The name and telephone number of a supervisory level point of contact at the facility or installation who has knowledge of the performance of the Contractor's or installer's work.

#### 1.6.2 Manufacturer's Representative

Provide the services of a representative or technician from the manufacturer of the system, experienced in the installation and operation of the type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of the system and to provide instruction to Government personnel.

#### 1.6.3 [Qualifications of System Technician

\*\*\*\*\*  
**NOTE: For projects administered by NAVFAC PAC and NAVFAC SW, include the following paragraph requiring the minimum qualification of a NICET Level-III technician for preparation of all fire protection system drawings.**  
\*\*\*\*\*

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 work specified herein, and is currently 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 name and certification of the technician at or prior to submittal of drawings.

#### 1.6.4 Drawing Requirements

##### 1.6.4.1 System Floor Plans

Submit shop drawings of the system floor plans showing locations of initiating and indicating appliances and end-of-line supervisory devices. Show wire color coding, wire counts, and device wiring order. Show candela rating of each visible notification appliance.

##### 1.6.4.2 System Wiring Diagrams

Submit complete wiring diagrams of the system showing points of connection and terminals used for all electrical connections in the system. Show all modules, relays, switches and lamps in the control panel.

##### 1.6.4.3 System As-Built Drawings

\*\*\*\*\*  
**NOTE: Specify one set of as-built drawings unless instructed otherwise by the EFD/EFA Fire Protection Engineer.**  
\*\*\*\*\*

Upon completion, and before final acceptance of the work, furnish to the Contracting Officer [\_\_\_\_\_] complete set[s] of as-built drawings [, including complete as-built circuit diagrams,] of [each] [the] system. The as-built drawings shall be "D" size 850 by 550 mm 34 by 22 inches reproducible drawings on mylar film drawn to the same scale as the

contract drawings and with title block similar to contract drawings. The as-built drawings shall be furnished in addition to the record drawings required by Division 01.

#### 1.6.5 UL Listing or FM Approval

Submit copies of UL listing or FM approval data showing compatibility of the smoke detector model being provided with the control panel being provided, if 2-wire detectors are proposed for use.

### 1.7 MAINTENANCE

#### 1.7.1 Spare Parts

Furnish the following spare parts:

- a. 5 complete sets of system keys
- b. 1 of each type of audible and visual alarm device installed
- c. 2 of each type of fuse required by the system
- [d. [\_\_\_\_\_] spare zone modules for modular type control panels in addition to those installed in the panel]
- [e. 2 of each type of heat detector installed]
- [f. 2 of each type of smoke detector base and head installed]
- [g. 1 smoke detector manufacturer's test screen, card or magnet for each 10 detectors, or fraction thereof, installed in the system]

#### 1.7.2 Manuals

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Inscribe the following identification on the cover: the words OPERATION AND MAINTENANCE MANUAL, the location of the building, the name of the Contractor, system manufacturer and the contract number. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: circuit drawings; wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start-up, operation and shutdown instructions; installation instructions; maintenance instructions; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESIGN

#### 2.1.1 Operation

\*\*\*\*\*  
**NOTE: Shutdown of mechanical (HVAC) systems must be carefully coordinated between this section and mechanical sections. The designer must choose whether to shut down all HVAC systems upon operation of the alarm system or to shut down individual HVAC units separately when smoke is detected in each**

unit's ductwork. Shutdown of all HVAC systems upon any alarm is desirable from a life safety standpoint, but may not be practical in all cases. Consult with the EFA/EFD Fire Protection Engineer for guidance. To shut down all HVAC units from the fire alarm control panel retain the reference to HVAC equipment shutdown in paragraph titled "Operation" and delete reference to shutdown in paragraph titled "Duct Smoke Detectors". If it is desired to shutdown systems on an individual unit basis, delete the reference to HVAC equipment shutdown in paragraph titled "Operation", and retain the reference to shutdown in paragraph titled "Duct Smoke Detectors".

\*\*\*\*\*

Provide a complete, electrically supervised, code 3 temporal common coded, manual [and automatic,] zoned, annunciated, [fire alarm system](#) as described herein, and as shown on the drawings. Provide separate circuits from the control panel to each zone of initiating devices as specified herein. Transmission of signals from more than one zone over a common circuit to the control panel is prohibited.

#### 2.1.1.1 Fire Alarm Signal Initiation

Operation shall be such that actuation of any:

- a. Manual station
- [b. Heat detector]
- [c. Smoke detector]
- [d. Automatic fire sprinkler system]
- [e. Fire extinguishing system]
- [f. Fire standpipe system]
- [g. [\_\_\_\_\_]]

Shall cause all of the following actions:

- a. All building evacuation alarm devices (notification appliances) to operate continuously;
- b. The annunciator(s) to properly register;
- c. A coded signal to be transmitted over the station fire alarm system;
- [d. Heating, ventilating, and air conditioning equipment [Unit Nos. [\_\_\_\_\_]] to shut down;]
- [e. Electro-magnetic door holders to de-energize.]
- [f. [\_\_\_\_\_].]

All operations shall remain in the alarm mode (except alarm notification

appliances if manually silenced) until the system is manually restored to normal.

#### 2.1.1.2 [Supervisory Signal Initiation

\*\*\*\*\*

**NOTE:** Include this paragraph when any of the listed supervisory signal initiating devices are provided by the project or exist in the building and edit accordingly, otherwise delete. Determine if base fire alarm system is capable of transmitting separate supervisory signals to headquarters and edit last sentence accordingly.

\*\*\*\*\*

Operation of a [sprinkler] [or] [standpipe] control valve tamper [or low air pressure supervisory] switch [or fire pump controller remote supervisory contact] [or freeze protection thermostatic switch] shall not cause an alarm, but shall cause operation of common system audible trouble signal, [and] display of a visual indication distinct from that displayed to indicate a fire alarm or a fault in the supervisory circuit [, and transmission of a distinct supervisory signal to fire alarm headquarters].

#### ]2.1.1.3 Monitoring Integrity of Installation Conductors

\*\*\*\*\*

**NOTE:** "Class A" monitoring should be specified for buildings with high life hazard such as hospitals and high rise buildings, and for strategically critical or extremely high monetary value facilities. For all other facilities "Class B" monitoring should usually be specified. (Comply with the limitations contained in NFPA 72 on the number of initiating devices permitted per circuit for both "Class A" and "Class B" circuits.) For all "Class A" circuits, specify separate conduit for return conductors. For additions to existing alarm systems, specify the type of monitoring already in use.

\*\*\*\*\*

All system circuits shall be electrically monitored for integrity including the following:

- a. Initiating circuits.
- b. Evacuation alarm (notification appliance) circuits (including both audible and visual notification appliances).
- c. Battery power supply (low and no voltage across the standby battery terminals and open battery circuit).
- d. [Radio] [Master box] [Auxiliary transmitter] tripping circuits.

Provide [Class B] [Class A] initiating device circuits, and [Class B] [Class A] notification appliance circuits as defined by NFPA 72. [For Class A circuits, provide separate conduits for outgoing and return (redundant) conductors as required by NFPA 72.] A ground fault condition or single break in any other circuit shall cause operation of the system



trouble signals. Loss of AC power, abnormal AC voltage, a break in the standby battery power circuit, or low battery voltage shall also cause operation of system trouble signals. The abnormal position of any switch in the control panel shall also cause operation of the system trouble signals. Audible and visual equipment for supervision of the AC power supply shall be energized from the auxiliary DC power supply and vice versa. Trouble signals shall sound continuously until manually silenced or the system has been restored to normal. [Electrical monitoring for integrity of wiring external of control panel for mechanical equipment shut down and magnetic door holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shutdown.]

#### 2.1.1.4 [Walk-Test Mode

Provide system with walk-test mode to allow one person to test alarm and supervisory features of initiating devices. Walk-test mode shall be enabled from the control panel by authorized service personnel. Control panel shall display a unique visual indication when system is in walk-test mode. If testing ceases while in walk-test mode, after a preset delay system shall automatically return to normal standby mode.

#### ]2.1.1.5 [Alarm Verification Feature

\*\*\*\*\*  
**NOTE: Consult with the EFD/EFA Fire Protection Engineer before specifying an Alarm Verification Feature (AVF). Currently, AVF is not compatible with 4-wire open-area (spot-type) smoke detectors. When AVF is specified, the 2-wire smoke detector option must be included in the paragraph titled "Open Area (Spot-Type) Smoke Detector." Do not specify AVF for duct smoke detectors.**  
\*\*\*\*\*

System shall have a smoke detector alarm verification feature. Upon activation of any area smoke detector, system shall institute an alarm verification process prior to enabling of the alarm functions as specified herein. Activation of any initiating device other than an area smoke detector shall cause immediate enabling of system into alarm mode. If an alarm input from a smoke detector on the initial zone in alarm is present at the end of an initial delay period not exceeding 20 seconds, all alarm functions as specified herein shall be immediately enabled. If a smoke detector alarm input is not present at the end of the initial delay period, a second-stage confirmation period of one minute shall be initiated. If a smoke detector alarm input is received during the second-stage confirmation period, all alarm functions shall be immediately enabled. During the verification process, activation of any area smoke detector on any zone other than the initial zone in alarm shall also cause system to go into alarm mode immediately. If no smoke detector alarm input occurs within the second-stage confirmation period, system shall reset to normal. Any alarm input received from an area smoke detector after the second-stage confirmation period has elapsed shall cause system to institute a new verification process.

#### ]2.1.1.6 [Elevator Recall

\*\*\*\*\*  
**NOTE: Delete this paragraph if no elevator work is**

included in the project.

\*\*\*\*\*

Provide elevator recall system in accordance with ASME A17.1/CSA B44, Section [14 21 13 ELECTRIC TRACTION FREIGHT ELEVATORS][14 21 23 ELECTRIC TRACTION PASSENGER ELEVATORS][14 24 13 HYDRAULIC FREIGHT ELEVATORS][14 24 23 HYDRAULIC PASSENGER ELEVATORS], and as specified herein. Activation of any smoke detector in an elevator shaft, machine room, or lobby (except at designated recall level) shall cause all elevators associated with that shaft, machine room, or lobby to return nonstop to the designated level. Activation of a smoke detector in the lobby or machine room at the designated level shall cause all elevators associated with that lobby to return nonstop to the assigned alternate level. Activation of a detector in an elevator shaft, machine room, or lobby shall also cause complete operation of fire alarm system as specified in paragraph titled "Operation".

#### 12.1.2 Primary Power

\*\*\*\*\*

**NOTE: Consult with the EFD/EFA for guidance on use of safety switch.**

\*\*\*\*\*

Primary power source shall be 120 volts AC service, transformed through a two winding isolation type transformer and rectified to 24 volts DC for operation of all initiating device, notification appliance, signaling line, trouble signal and [master box] [transmitter] tripping circuits. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the rated output of the system power supply module(s). Obtain AC operating power as shown on contract drawings. [Provide an independent properly fused safety switch, with provisions for locking the cover and operating handle in the "POWER ON" position for this connection located adjacent to main distribution panel. Paint the switch box red and identify it by the lettered designation "FIRE ALARM SYSTEM POWER".]

#### 2.1.3 Auxiliary Power

Provide secondary DC power supply for operation of system in the event of failure of the AC source. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and shall not cause transmission of a false alarm. Loss of AC power shall not prevent transmission of a signal to station fire alarm headquarters upon operation of any initiating circuit.

##### 2.1.3.1 Storage Batteries

\*\*\*\*\*

**NOTE: Consult with the Public Works Department for battery preference.**

\*\*\*\*\*

Provide [sealed lead calcium] [or] [sealed lead acid] [or] [vented wet cell pocket plate nickel cadmium] batteries and charger. Drycell batteries are not acceptable. House batteries in the control panel or in a well constructed vented steel cabinet with cylinder lock, non-corrosive base, and louvered vents. Provide batteries of adequate ampere-hour rating to operate the system, including audible trouble signal devices, and [master box] [auxiliary transmitter] tripping circuits under

supervisory conditions for 60 hours, at the end of which time batteries shall be capable of operating the entire system in a full alarm condition for not less than [15] [\_\_\_\_\_] minutes. Provide calculations substantiating the battery capacity. [If calculations required by the paragraph entitled "Power Calculations" show that the total supervisory and alarm power requirements of the modified system exceed the capacity of the existing battery, provide a new battery as specified herein.] Provide reliable separation between cells to prevent contact between terminals of adjacent cells and between battery terminals and other metal parts. When a separate battery cabinet is used, provide a fuse block for battery leads within the cabinet. Finish the cabinet on the inside and outside with enamel paint. Locate the top of the batteries not more than 1.2 m 4 feet above floor level.

#### 2.1.3.2 Battery Charger

\*\*\*\*\*  
**NOTE: Specify ammeter and voltmeter unless directed  
otherwise by the EFD/EFA Fire Protection Engineer.**  
\*\*\*\*\*

Provide completely automatic high/low charging rate type capable of recovery of the batteries from full discharge to full charge in 24 hours or less. [Provide an ammeter to indicate rate of charge and a voltmeter to indicate the state of battery charge under load. Meters shall be factory installed, or factory-supplied plug-in modules. Field installation of meters other than the panel manufacturer's plug-in modules is prohibited.] Provide a trouble light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high-rate switch is provided. House charger in the control panel or battery cabinet.

### 2.2 COMPONENT DESIGN

\*\*\*\*\*  
**NOTE: Delete equipment paragraphs not applicable  
for the project.**  
\*\*\*\*\*

#### 2.2.1 Control Panel

\*\*\*\*\*  
**NOTE: Delete drill switch and master box disconnect  
switch and supervision of set/unset condition of  
master box when connecting to radio transmitter.  
Retain when connecting to telegraphic transmitter or  
master box.**  
\*\*\*\*\*

Provide modular type panel installed in a [flush] [surface] mounted steel cabinet with hinged door and cylinder lock. Mount with panel centerline 1.5 m 5 feet above finished floor elevation. Switches and other controls shall not be accessible without the use of a key. The control panel shall be a neat, compact assembly containing all parts and equipment required to provide specified operating and supervisory functions of the system. Each control panel component shall be UL listed or FM approved and approved by the control panel manufacturer for use in the control panel. Panel cabinet shall be finished on the inside and outside with factory-applied enamel finish. Provide main annunciator located on the exterior of the

cabinet door or visible through the cabinet door. Provide audible trouble signal. Provide permanent engraved rigid plastic or metal identification plates, or silk-screened labels attached to the rear face of the panel viewing window, for all lamps and switches. Provide one set of Form C dry alarm contacts per zone, a common system Form C dry alarm contact, and a common system Form C dry trouble contact. [The set/unset condition of [master box] [auxiliary transmitter] shall be indicated by the control panel.] Permanently label all switches. Provide panel with the following switches:

- a. Trouble silencing switch which silences audible trouble signals (including remote trouble devices, if provided) without extinguishing trouble indicating lamp(s). For non-self-resetting type switch, upon correction of the trouble condition, audible signals will again sound until the switch is returned to its normal position. For silencing switch of the momentary action, self-resetting type, the trouble signal circuit shall be automatically restored to normal upon correction of the trouble condition.
- b. Evacuation alarm silencing switch which when activated will silence all alarm notification appliances without resetting the panel, and cause operation of system trouble signals. Subsequent alarm(s) from additional zone(s) not originally in alarm shall cause activation of the notification appliances even with the alarm silencing switch in the "silenced" position.
- c. Individual zone disconnect switches which when operated will disable only their respective initiating circuit and cause operation of the system and zone trouble signals.
- d. Reset switch which when activated will restore the system to normal standby status after the cause of the alarm has been corrected, and all activated initiating devices reset. Operation of reset switch shall restore activated smoke detectors to normal standby status.
- e. Lamp test switch.
- [f. Drill switch which will enable test of notification appliances and restoration to normal without tripping the master box.]
- [g. Master box disconnect switch which when activated will disconnect the coded device and cause operation of the system trouble signal.]
- [h. HVAC shutdown bypass switch. Operation of the switch shall allow HVAC system to operate with detectors in alarm and shall cause operation of system trouble signals.]

#### 2.2.1.1 Main Annunciator

Provide integral with the control panel. Provide separate alarm and trouble lamps for each zone (initiating circuit) as indicated below and [\_\_\_\_\_] spares, located on the exterior of the cabinet door or visible through the cabinet door. Lamps shall be Light Emitting Diode (LED) type. Zone modules for spare zones shall be provided in the control panel. Supervision will not be required provided a fault in the annunciator circuits results only in loss of annunciation and will not affect the normal functional operation of the remainder of the system. Each lamp shall provide specific identification of the [zone] [area] [device] by means of a permanent label. Provide engraved, silk screened, or

machine-made labels. Handwritten labels are prohibited. In no case shall zone identification consist of the words "Zone 1," "Zone 2," etc., but shall consist of the description of the [zone] [area] [device].

#### 2.2.1.2 Initiating Zones

\*\*\*\*\*  
NOTE: List zones with a brief description of each zone; e.g. "Zone 1: First Floor, West Wing," etc. Expand this list as necessary to identify all the zones required for the building. Provide separate zones for smoke detectors. Always specify separate zones for duct detectors, extinguishing systems, and sprinkler or fire pump supervision (if provided). Do not put devices on different floors on the same zone. When choosing second option, place the following chart on the fire alarm contract drawing.  
\*\*\*\*\*

[Arrange as follows:

| <u>Zone No.</u> | <u>Description</u> |
|-----------------|--------------------|
| [_____]         | [_____]            |
| [_____]         | [_____]            |
| [_____]         | [_____]            |
| [_____]         | [_____]            |
| [_____]         | [_____]            |
| [_____]         | [_____]            |

]

[Arrange as shown.]

#### 2.2.1.3 Remote Annunciator Panel

\*\*\*\*\*  
NOTE: Locate panel at or near the building entrance to allow fire department quick access to panel. When both a remote trouble sounder and remote annunciator are required, specify an annunciator with trouble sounder for dry indoor locations. Where a weatherproof enclosure is required, specify a separate trouble bell.  
\*\*\*\*\*

Provide panel located as shown. Mount with panel centerline 1.5 m 5 feet above finished floor elevation. Panel shall duplicate all requirements specified for the control panel annunciator, except that individual zone trouble lamps are not required. Lamps shall be LED type, except lamps used in backlighted panels shall be LED or neon type. Panel shall have a lamp test switch. Zone identification shall be by means of [permanently attached rigid plastic or metal plate(s)] [or] [silk-screened labels attached to the reverse face of backlighted viewing window(s)]. Panel

shall be of the [interior] [weatherproof] type, [flush] [surface] [pedestal]-mounted. [Provide panel with an integral audible trouble sounder which shall operate in conjunction with control panel audible sounder. Provide panel with trouble silence switch which shall comply with the requirements for a trouble silencing switch as specified in paragraph entitled "Control Panel".]

#### 2.2.1.4 Graphic Annunciator Panel

\*\*\*\*\*

NOTE: Graphic annunciator panels should be provided only when a large number of concealed devices are installed. Normally, exposed devices will be annunciated by zone only on the fire alarm control panel zone annunciator and remote zone annunciator. Edit accordingly. Locate panel(s) at or near building entrance to allow fire department quick access to panel.

\*\*\*\*\*

Provide panel located as shown. Mount with panel centerline 1.5 m 5 feet above finished floor elevation. Panel shall be of the [interior] [weatherproof] type, [flush] [surface] [pedestal]-mounted. Panel shall be provided with the [building] [room] floor plan, drawn to scale, with alarm lamps mounted to represent the location of [each concealed detector] [each initiating device]. Panel graphic shall also show the locations of the annunciator panel and control panel, and shall have a "you are here" arrow showing its location. Orient building floor plan on graphic to location of person viewing the graphic, i.e. the direction the viewer is facing shall be toward the top of the graphic display. Provide a North arrow. [Principal rooms and areas shown shall be labeled with room numbers or titles.] Detectors mounted above ceilings, [on ceilings,] and beneath raised floors and different types of initiating devices shall have different symbols or lamps of different colors for identification. Lamps shall illuminate upon activation of corresponding device and shall remain illuminated until the system is reset. Panel shall have a lamp test switch.

#### 2.2.1.5 [Trouble Bell] [Buzzer]

\*\*\*\*\*

NOTE: Provide a remote trouble bell or buzzer when the control panel is located in a mechanical room, electrical room, or similar space where the possibility of building occupants becoming aware of system trouble is unlikely. Locate remote bell or buzzer in a frequently attended area such as a security/reception desk, office, or main corridor. When a remote annunciator is also specified, specify an annunciator with silenceable trouble sounder.

Provide an external trouble bell or buzzer above the control panel when the control panel is located in a high noise area, such as a machine shop, foundry, printing plant, aircraft hangar bay, etc.

\*\*\*\*\*

[Provide a remote system trouble [ 100 mm 4 inch bell] [buzzer] arranged to operate in conjunction with the panel's integral trouble signal.

Locate remote trouble [bell] [buzzer] as indicated.] [Provide [ 100 mm 4 inch trouble bell] [external trouble buzzer] at the control panel arranged to operate in conjunction with the panel's integral trouble signal.] Provide trouble [bell] [buzzer] with a rigid plastic, white on red engraved identification sign which reads "FIRE ALARM SYSTEM TROUBLE". Lettering on identification sign shall be a minimum 25 mm one inch high.

### 2.2.2 Manual Pull Stations

Provide noncoded [single] [double] action type with mechanical reset features. Stations shall be [surface] [semi-flush] mounted and [interior] [weatherproof] type as indicated. [For surface mounting provide station manufacturer's approved back box. Back box finish shall match station finish.] Equip each station with a terminal strip with contacts of proper number and type to perform functions required. Stations shall be a type not subject to operation by jarring or vibration. Break-glass-front stations are not permitted; however, a pull-lever break-rod type is acceptable provided presence of rod is not required to reset station. Station color shall be red. Station shall provide visible indication of operation. Restoration shall require use of a key. Keys shall be identical throughout the system for all stations and control panel(s). Mount stations with operating lever not more than 1.2 m 4 feet above finished floor. Where weatherproof stations are required, provide stations with cast metal, weatherproof (NEMA 3R) housings with hinged access doors; finish housings with red enamel paint and provide permanently affixed engraved or raised-letter plastic or metal identification signs reading "FIRE ALARM" with white letters a minimum of 19 mm 3/4 inch high.

### 2.2.3 Heat Detectors

\*\*\*\*\*  
**NOTE: Choose the type of heat detector best suited for application or design. Do not use rate-of-rise detectors in areas subject to rapid temperature changes, such as boiler rooms and shower rooms. Line-type detectors should only be used for specialized industrial-type hazards. Consult with the EFD/EFA Fire Protection Engineer.**  
\*\*\*\*\*

Provide detectors designed for detection of fire by [combination fixed temperature rate-of-rise] [rate compensating] [line-type fixed temperature] principle. Locate detectors in accordance with their listing by UL or FM and the requirements of NFPA 72, except provide at least two detectors in all rooms of 54 square meters 600 square feet or larger in area. For mounting heights greater than 3 m 10 feet above floor level, reduce actual detector linear spacing from listed spacing as required by NFPA 72; for heights greater than 9 m 30 feet space detectors no farther apart than 34 percent of their listed spacing. Mount detectors at the underside of ceiling or deck above unless otherwise indicated. Temperature rating of detectors shall be in accordance with NFPA 72. No detector shall be located closer than 300 mm 12 inches to any part of any lighting fixture nor closer than 600 mm 24 inches to any part of an air supply or return diffuser. Detectors, located in areas subject to moisture or exterior atmospheric conditions or hazardous locations as defined by NFPA 70, shall be types approved for such locations. Provide with terminal screw type connections. Removal of detector head from its base shall cause activation of system trouble signals if detectors are

provided with separable heads and bases.

#### 2.2.3.1 Combination Fixed Temperature Rate-Of-Rise Detectors (Spot Type)

Designed for [surface] [semi-flush] outlet box mounting and supported independently of conduit, tubing or wiring connections. Contacts shall be self-resetting after response to rate-of-rise actuation. Operation under fixed temperature actuation shall result in an external indication. Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes shall operate on fixed temperature principle only.

#### 2.2.3.2 Rate Compensating Detector (Spot Type)

Designed for [surface] [flush] [vertical unit] outlet box mounting and supported independently of conduit, tubing or wiring connections. Detectors shall be hermetically sealed and automatically resetting type which will operate when ambient air temperature reaches detector setting regardless of rate of temperature rise. Detector operation shall not be subject to thermal time lag.

#### 2.2.3.3 [Line-Type Fixed Temperature Detectors

\*\*\*\*\*  
NOTE: Specify line-type heat detectors only with  
approval of the EFD/EFA Fire Protection Engineer.  
\*\*\*\*\*

Provide [thermostatic] [or] [thermister] line-type heat detection cable [with weather-resistant outer covering] where indicated. Cable shall be nominally rated for a temperature of [68] [88] [138] degrees C [155] [190] [280] degrees F and shall operate on fixed temperature principle only.

#### ]2.2.4 Open-Area (Spot-Type) Smoke Detectors

\*\*\*\*\*  
NOTE: Choose the type of smoke detector best suited  
for application.  
\*\*\*\*\*

\*\*\*\*\*  
NOTE: Both 4-wire and 2-wire smoke detectors are  
specified in this guide specification. For  
open-area smoke detectors in new systems, edit this  
specification to permit the Contractor the option to  
provide 2-wire detectors. For additions to existing  
4-wire systems, or when detector auxiliary contacts  
are used for critical control functions (such as  
elevator recall or air handler shutdown) edit this  
specification to require the Contractor to provide  
4-wire detectors only.

For further guidance, consult with the EFD/EFA Fire  
Protection Engineer.

\*\*\*\*\*

Provide detectors designed for detection of abnormal smoke densities by the [ionization] [or] [photoelectric] principle. Detectors shall be [4-wire] [or] [2-wire] type. Provide necessary control and power modules



required for operation integral with the control panel. Detectors and associated modules shall be compatible with the control panel and shall be suitable for use in a supervised circuit. Malfunction of the electrical circuits to the detector or its control or power units shall result in the operation of the system trouble signals. Each detector shall contain a visible indicator lamp that shall flash when the detector is in the normal standby mode and shall glow continuously when the detector is activated. [Remote indicator lamp shall be provided for each detector that is located above suspended ceilings, beneath raised floors, or otherwise concealed from view.] Each detector shall be the plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which the detector base contains screw terminals for making all wiring connections. Detector head shall be removable from its base without disconnecting any wires. Removal of detector head from its base shall cause activation of system trouble signals. Each detector shall be screened to prevent the entrance of insects into the detection chamber(s).

#### 2.2.4.1 [4-Wire Smoke Detectors

Detector circuits shall be of the 4-wire type whereby the detector operating power is transmitted over conductors separate from the initiating circuit. Provide a separate, fused, power circuit for each smoke detection initiating circuit (zone). Failure of the power circuit shall be indicated as a trouble condition on the corresponding initiating circuit.

#### ]2.2.4.2 [2-Wire Smoke Detectors

Detector circuits of the 2-wire type whereby the detector operating power is transmitted over the initiating circuit are permitted, provided the detectors used are approved by the control panel manufacturer for use with the control panel provided and are UL listed or FM approved as being compatible with the control panel (copies of the UL or FM listings showing compatibility shall be submitted as specified in paragraph entitled "Submittals"). The total number of detectors on any detection circuit shall not exceed 80 percent of the maximum number of detectors allowed by the control panel manufacturer for that circuit. Additional zones above those specified in the paragraph titled "Initiating Zones" shall be provided if required to meet the above requirements. Calculations showing compliance with the power consumption limitation requirements shall be submitted with the calculations required by the paragraph entitled "Design Data." The manufacturer's data submitted under the paragraph entitled "Manufacturer's Catalog Data" shall clearly indicate the compatibility of the detectors with the control panel provided and the maximum number of detectors permitted per zone.

#### ]2.2.4.3 [Ionization Detectors

Multiple chamber type which is responsive to both invisible and visible particles of combustion. Detectors shall not be susceptible to operation by changes in relative humidity.

#### ]2.2.4.4 [Photoelectric Detectors

Operate on the light scattering principle using a LED light source. Detector shall respond to both flaming and smoldering fires.

#### 2.2.4.5 Detector Spacing and Location

\*\*\*\*\*  
**NOTE: When underfloor detectors are used, the designer must show a mounting detail for underfloor detectors which complies with this paragraph.**  
\*\*\*\*\*

Detector spacing and location shall be in accordance with the manufacturer's recommendations and the requirements of NFPA 72, except provide at least two detectors in all rooms of 54 square meters 600 square feet or larger in area. In no case shall spacing exceed 9 by 9 m 30 by 30 feet per detector, and 9 linear m 30 linear feet per detector along corridors. Detectors shall not be placed closer than [0.9] [1.5] m [3] [5] feet from any air discharge or return grille, nor closer than 300 mm 12 inches to any part of any lighting fixture. In areas without finished ceilings, mount detectors at the underside of deck above unless otherwise indicated. [Detectors installed beneath raised floors shall be mounted with the base within 50 mm 2 inches of the underside of the raised floor, with the detector facing downward. Where the space under the raised floor is less than 300 mm 12 inches in height, detectors shall be mounted with their bases either horizontal or vertical, with the detection chamber(s) located in the upper half of the underfloor space. Under no circumstances shall detectors be mounted facing upward. Detector spacing beneath raised floors shall not exceed [4.5 by 4.5] [6 by 6] m [15 by 15] [20 by 20] feet per detector.]

#### 2.2.4.6 [Single] [Multiple]-Station Detectors

\*\*\*\*\*  
**NOTE: Use the following paragraph for bachelor enlisted/officer quarters, hotels, and similar occupancies as required by MIL-HDBK-1008. For family housing projects at NAVFAC ML use regional guide specification NFGS 28 31 46.00 22 (N-13854N), HOUSEHOLD FIRE WARNING EQUIPMENT to specify residential fire warning systems in lieu of this section: 28 31 74.00 20 INTERIOR FIRE DETECTION AND ALARM SYSTEM.**  
\*\*\*\*\*

Provide a [single] [multiple]-station [photoelectric] [ionization] smoke detector in each sleeping room [and living room and corridor within a suite of sleeping rooms]. Each detector shall contain an 85 dBA minimum alarm sounder, test button, and visible indicating lamp. Lamp shall indicate when the detector is in normal standby mode and provide a different indication when the detector is in alarm. [When more than one detector is installed in a suite of rooms, all detectors within the suite shall be interconnected in multiple-station configuration so that when any detector is activated all alarm sounders shall operate.] Power shall be 120 VAC, obtained from a connection to a lighting circuit serving the room or suite of rooms where the detector is located. Do not obtain power for detectors in more than one room (or suite of rooms) from the same circuit. Connect to the line side of all switches except the overcurrent device protecting the circuit. Detector shall not be susceptible to loss of power by tripping of a Ground Fault Circuit Interrupter (GFCI). Provide detectors with 9-volt alkaline standby battery. Locate and install detector in accordance with NFPA 72.

## 2.2.5 Duct Smoke Detectors

\*\*\*\*\*

NOTE: Shutdown of mechanical (HVAC) systems must be carefully coordinated between this section and mechanical sections. The designer must choose whether to shut down all HVAC systems upon operation of the alarm system or to shut down individual HVAC units separately when smoke is detected in each unit's ductwork. Shutdown of all HVAC systems upon any alarm is desirable from a life safety standpoint, but may not be practical in all cases. Consult with the EFD/EFA Fire Protection Engineer for guidance. To shut down all HVAC units from the fire alarm control panel retain the reference to HVAC equipment shutdown in paragraph titled "Operation" and delete reference to shutdown in paragraph titled "Duct Smoke Detectors". If it is desired to shutdown systems on an individual unit basis, delete the reference to HVAC equipment shutdown in paragraph titled "Operation", and retain the reference to shutdown in paragraph titled "Duct Smoke Detectors".

\*\*\*\*\*

\*\*\*\*\*

NOTE: Choose the type of smoke detector best suited for application or design. Specify duct smoke detectors as required by NFPA 90A. Specify separate zones for duct detectors under paragraph titled "Initiating Zones".

\*\*\*\*\*

Provide detectors installed in ducts of the [ionization] [or] [photoelectric] type and listed by UL or FM for duct installation. Control and power modules required for operation shall be integral with the main control panel. Detectors and associated modules shall be compatible with the main control panel and shall be suitable for use in a supervised circuit. Detector circuits shall be of the 4-wire type whereby the detector operating power is transmitted over conductors separate from the initiating circuit. Malfunction of the electrical circuits to the detector or its control or power modules shall cause operation of the system trouble signals. Provide a separate, fused power circuit for each smoke detection initiating circuit (zone). Failure of the power circuit shall be indicated as a trouble condition on the corresponding initiating circuit. Provide duct detectors in accordance with NFPA 90A. Provide duct detectors with an approved duct housing, mounted exterior to the duct, with perforated sampling tubes extending across the width of the duct. Activation of duct detectors shall cause [shutdown of the associated air handling unit,] annunciation at the control panel, and tripping of the [master box] [transmitter] and sounding of building evacuation alarms. Each detector shall have a visible indicator lamp that shall flash when the detector is in the normal standby mode and shall glow continuously when the detector is activated. Provide remote indicator lamp for each detector. Permanently label remote indicator with description or number of associated air handling unit(s). Provide each detector with a remote test switch. Mount switch not more than 1.8 m 6 feet above finish floor. Permanently label test switch with description or number of associated air handling unit(s).

## 2.2.6 [Projected Beam Smoke Detector

\*\*\*\*\*  
NOTE: Projected beam detectors are specialized devices best suited for use in large open areas such as atriums, high bay buildings, and cathedrals. They also have applications in protection of specialized industrial hazards. Consult with the EFD/EFA Fire Protection Engineer before specifying projected beam detectors. Always specify separate zones for projected beam detectors under paragraph titled "Initiating Zones".  
\*\*\*\*\*

Provide projected beam smoke detectors to protect [the [rooms] [spaces] [hazards] indicated] [\_\_\_\_\_]. Detectors and associated controls shall be compatible with the main control panel and shall be suitable for use in a supervised circuit. Detector circuits shall be of the 4-wire type, whereby the detector operating power is transmitted over conductors separate from the initiating circuit. Provide a separate, fused power circuit for each smoke detection initiating circuit. Failure of the power circuit shall be indicated as a trouble condition on the initiating circuit. Malfunction of the detector or its control unit or blockage of the projected beam shall cause operation of the system trouble signals. Install detectors in accordance with NFPA 72, the manufacturer's instructions, and UL listing or FM approval, with project beams parallel to ceilings. Beam length and distance between adjacent beams, and distance between beams and walls, shall not exceed the maximum permitted by the equipment listing. Do not use mirrors to alter the direction of the projected beam.

## ]2.2.7 Notification Appliances

\*\*\*\*\*  
NOTE: Specify recessed appliances in buildings where tampering is likely (e.g. BEQs).  
\*\*\*\*\*

\*\*\*\*\*  
NOTE: Base-wide uniformity of alarm signals is highly desirable. The designer shall contact the Base Fire Chief to determine which type of alarm device (bell or horn) is most commonly in use. For high noise areas, the designer shall consider increasing the number of devices or the additional use of sirens, high power strobes, etc. as supplemental signal devices. Examples of high noise areas include foundries, machine shops, printing plants, aircraft hangar bays, and in some cases, large computer rooms.  
\*\*\*\*\*

Provide in accordance with NFPA 72 and as indicated. Do not exceed 80 percent of the listed rating in amperes of any notification appliance circuit. Additional circuits above those shown shall be provided if required to meet this requirement. Submit calculations showing compliance with the above power consumption requirements with the calculations required by the paragraph titled "Design Data". Effective sound levels

shall comply with NFPA 72. Provide appliances in addition to those shown if required in order to meet NFPA 72 sound level requirements. Provide appliances specifically listed for outdoor use in locations exposed to weather. Finish appliances in red enamel. [For surface mounting provide appliance manufacturer's approved back box. Back box finish shall match appliance finish.]

#### 2.2.7.1 Alarm Bells

[Surface-mounted] [Recessed], 250 mm 10 inch diameter with matching mounting back box. Bells shall be of the vibrating type suitable for use in an electrically supervised circuit. Bells shall be of the underdome type and produce a sound output rating of at least 90 decibels at 3 m 10 feet.

#### 2.2.7.2 Alarm Horns

[Surface-mounted] [Recessed], [[single] [double] projector,] [grill,] vibrating type suitable for use in an electrically supervised circuit and shall have a sound output rating of at least 90 decibels at 3 m 10 feet.

#### 2.2.7.3 Visible Appliances

\*\*\*\*\*  
NOTE: In accordance with the Uniform Federal  
Accessibility Standards and the Americans With  
Disabilities Act Accessibility Guidelines provide  
visible alarm notification appliances in every  
building subject to civilian occupancy. Determine  
candela rating based on device spacing in accordance  
with Section 6-4 of NFPA 72. Consult the EFD/EFA  
Fire Protection Engineer regarding current  
requirements for synchronization.  
\*\*\*\*\*

[Surface] [Flush]-mounted assembly of the stroboscopic type suitable for use in an electrically supervised circuit and powered from the notification appliance circuit(s). Appliances shall provide a minimum of [15] [30] [75] [110] candela measured in accordance with UL 1971, but in no case less than the effective intensity [required by NFPA 72 for the appliance spacing and location] [shown]. Lamps shall be protected by a thermoplastic lens and labeled "FIRE" in letters at least 12 mm 1/2 inch high. Provide visible appliances within 300 mm 12 inches of each audible appliance [and as indicated]. Visible appliances may be part of an audio-visual assembly. [Where more than two appliances are located in the same room or corridor, provide synchronized operation.]

#### 2.2.8 Fire Extinguishing Systems

Activation shall cause complete functional operation of the control panel. System contacts are specified in other sections.

#### 2.2.9 [Freeze Protection Thermostatic Switch

Provide switch with concealed set point, cover, and allen head screws. Omit temperature indicator or conceal indicator within cover. Switch shall not be adjustable below 4.44 degrees C 40 degrees F. When fire protection equipment room air temperature drops below [4.44] [\_\_\_\_\_] degrees C [40] [\_\_\_\_\_] degrees F, switch contacts shall [transfer]

[close], causing a supervisory signal on fire alarm system. Removal of switch from circuit shall cause a trouble signal on its respective zone. Mount switch with centerline 1.5 m 5 feet above finished floor. Provide with insulating subbase when mounting on exterior wall.

#### ]2.2.10 [Electro-Magnetic Door Holder-Releases

\*\*\*\*\*

NOTE: Where practical, chose first option to close doors upon any alarm. For large buildings with many smoke doors, consult with the EFD/EFA Fire Protection Engineer for guidance on preferred door closing method. Coordinate editing of this paragraph with paragraph titled "Fire Alarm Signal Initiation".

\*\*\*\*\*

BHMA A156.15. Provide where shown. The armature portion shall be mounted on the door and shall have an adjusting screw for setting the angle of the contact plate. Mount the electro-magnetic release on the wall or in a wall recess behind the door. The activation of the [fire alarm system] [any smoke detector] [a smoke detector designated for door release service] shall release all doors on the circuit to close. Total projection of the door holder-release shall not exceed 100 mm 4 inches. Door holders shall not require battery backup power.

#### ]2.2.11 [Valve Tamper Switches

Provide switches to monitor the open position of valves controlling water supply to sprinkler systems. Switch contacts shall transfer from the normal position to the off-normal position during the first two revolutions of the hand wheel or when the stem of the valve has moved not more than one-fifth of the distance from its normal position. Provide switch with tamper resistant cover. Removal of the cover shall cause switch to operate into the off-normal position.

#### ]2.2.12 Off-Premises Fire Alarm

\*\*\*\*\*

##### NOTE:

1. Telegraphic and radio master boxes shall be placed in readily visible, accessible locations, preferably on poles or pedestals between the front of the building and the street. In mercantile, manufacturing, and industrial districts it shall not be necessary to travel in excess of one block or 152 m 500 feet to reach an exterior fire alarm box. In residential areas it shall not be necessary to travel in excess of two blocks or 244 m 800 feet to reach an exterior fire alarm box. Schools, hospitals, nursing homes and places of assembly shall have an exterior alarm box at or near the main entrance.

2. For connection to telegraphic positive non-interfering successive type (PNIS) base fire alarm system, specify a master fire alarm box when there is also a need for a new exterior coded fire

alarm box. Specify an auxiliary transmitter when there is no requirement for a new exterior fire alarm box. Use local energy tripping devices unless approved otherwise by the EFD/EFA Fire Protection Engineer.

3. For connection to radio fire alarm systems, specify a radio fire alarm master box when there is a requirement for an exterior fire alarm box, otherwise specify an auxiliary transmitter.

\*\*\*\*\*

Provide auxiliary connection to the base fire alarm system in accordance with NFPA 72, except as modified herein.

#### 2.2.12.1 [Master Fire Alarm Boxes

Provide master fire alarm boxes of the coded, positive non-interfering type with succession features having a local energy type auxiliary tripping device. Boxes shall be of the prewound, open-door pull-lever type. Mechanism shall be housed in a weatherproof cottage shell housing with metallic bronze or nickel-alloy or rigid plastic code number plate mounted on the exterior face of the cottage shell. Operation of the actuating pull-lever shall cause the box to transmit four complete rounds of code. Driving springs shall have the capability to transmit not less than 8 complete four round groups of code before being rewound. Boxes shall be designed for operation at 100 milliamperes and shall be capable of full operation between 70 and 120 milliamperes DC line current. Boxes shall have the ability to transmit signals through ground to overcome an open circuit. Activation of box when a single open fault is present on exterior fire alarm circuit shall cause box to transmit four complete code rounds via box earth ground connection. 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. Each box shall have a manual signaling key, telephone jack, silent test device and box shunt device. Box code shall be as directed by the Contracting Officer. Box shall be [wall] [pole] [pedestal]-mounted with center of box 1.5 m 5 feet above grade. Mounting bolts, brackets, and fastenings shall be copper alloy or cadmium or zinc-coated steel. Transmitter housing shall be finished in gloss red enamel. Housing shall have a reflective, highly visible label imprinted with the word "FIRE" in minimum 50 mm 2 inch block characters on both sides of the box.

#### ]2.2.12.2 [Auxiliary Transmitter

Provide auxiliary transmitters of the coded, positive non-interfering type with succession features. Transmitters shall be [prewound spring mechanism type having a local energy type auxiliary tripping device] [or] [solid state electronic type utilizing form "A" or form "C" dry contacts] which, when activated by the fire alarm control panel, will transmit four rounds of code. [Driving springs shall have the capability to transmit not less than 8 complete four-round groups of code before being rewound.] [Electronic transmitters shall have a standby battery with the capacity to power the transmitter in a standby status for 60 hours and then transmit not less than 8 complete four-round groups of code. Transmitter primary and standby power shall be supervised in accordance with the paragraph titled "Supervision".] Transmitters shall be designed for operation at 100 milliamperes and shall be capable of full operation between 70 and 120

milliamperes DC line current. Transmitters shall have the ability to transmit signals through ground to overcome an open circuit. Activation of transmitter when a single open fault is present on exterior fire alarm circuit shall cause transmitter to transmit four complete code rounds via transmitter earth ground connection. Transmitters shall have a device to disconnect the transmitter for maintenance purposes. Transmitter code shall be as directed by the Contracting Officer. The transmitter 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. Mechanism shall be housed in a wall mounted locked metal cabinet. Cabinet shall be finished in gloss red enamel. Provide engraved metallic bronze or nickel-alloy or rigid plastic code number plate mounted on face of transmitter housing.

#### 12.2.12.3 [Radio Fire Alarm [Master Box] [Auxiliary Transmitter]

\*\*\*\*\*  
**NOTE: Use this paragraph for bases having radio alarm systems. Transmitters must be obtained from the manufacturer of the base system. Provide model, style, color and frequency or frequencies to match existing. Interface panels are required by some manufacturer's systems (for supervision of wiring between the control panel and the radio transmitter), whereas with other manufacturer's systems all required functions are contained within the transmitter enclosure. Edit accordingly. The wording of this paragraph has been approved by a Level III Contracting Officer. The Contracting Officer, Code 02 must be notified when this paragraph is included in a project specification.**  
\*\*\*\*\*

Provide a [\_\_\_\_\_] model [\_\_\_\_\_] radio fire alarm [master box] [auxiliary transmitter] [and model [\_\_\_\_\_] interface panel] [combination auxiliary transmitter and interface panel] to be compatible with the existing base system. Notwithstanding any other provisions of this contract, no other product will be acceptable. Transmitter shall operate on a frequency of [\_\_\_\_\_] MHz [AM] [FM]. Transmitter code number(s) shall be as specified by the Contracting Officer. Transmitter [and interface] shall operate on 120 VAC and shall also be provided with the manufacturer's approved battery charger and standby battery adequate to supply standby power for at least 60 hours. Transmitter housing shall be [red] [lime yellow] in color. Mounting shall be [wall] [pole] [pedestal], 1.5 m 5 feet above grade. [Arrange the transmitter(s) to send a separate alarm signal for each alarm and supervisory zone on the fire alarm control panel as specified in the paragraph entitled "Initiating Zones," and a common trouble signal for any trouble condition on the control panel.] Provide [exterior] antenna as recommended by the transmitter manufacturer. Provide engraved metallic bronze or nickel-alloy or rigid plastic code number plate mounted on face of housing.

#### 12.2.12.4 Grounding

Ground each [master box] [transmitter] by 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 10 ohms. Ground rods shall be the sectional type, copper-encased steel, with a



minimum diameter of 19 mm 3/4 inch and a total length of 3 m 10 feet conforming to UL 467. The rods shall have a hard, clean, smooth, continuous copper surface throughout the length of the rod. The copper shall have a minimum wall thickness of 0.325 mm 0.013 inch at any point on the rod. Ground rods shall not protrude [more than 75 mm 3 inches] above grade.

#### 2.2.12.5 [Master Box Pedestal]

\*\*\*\*\*  
**NOTE: Select this paragraph for pedestal mounted telegraphic master boxes.**  
\*\*\*\*\*

Provide pedestal constructed of galvanized sheet metal with heavy cast iron base, designed to support the fire alarm box and location light. The shaft shall be rectangular in cross section with a hollow compartment inside, readily accessible and containing facilities for installing cable terminals. Such facilities shall be capable of mounting no less than ten two-point terminals. The pedestal shall have a suitable red and white finish of the same shades as those used for the fire alarm boxes.

#### ]2.2.12.6 [Radio Master Box Pedestal

\*\*\*\*\*  
**NOTE: Select this paragraph for pedestal mounted radio master boxes.**  
\*\*\*\*\*

Provide pedestal having a round aluminum barrel with a bell base, designed to support the radio transmitter, location light, and antenna. The bell base shall contain a compartment with access plate to permit pulling and splicing of cables in the base.

#### ]2.2.12.7 [[Master Box] [Radio Master Box] Location Light

Provide a vaportight type fixture constructed of a cast aluminum housing and unbreakable, heat resistant, threaded ruby globe. Support light with 12 mm 1/2 inch minimum galvanized steel conduit screwed into the hub on the top of the master box. Locate light approximately 300 mm one foot above the master box. Mount light in pendant position. Provide light with a screw-in, 9-watt minimum compact fluorescent lamp with integral ballast.

#### ]2.2.13 Conduit

##### 2.2.13.1 Rigid Steel Conduit (Zinc-Coated)

ANSI C80.1 or UL 6.

##### 2.2.13.2 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

##### 2.2.13.3 Electrical Metallic Tubing (EMT)

ANSI C80.3 or UL 797.

#### 2.2.13.4 Surface Metal Raceway and Fittings

\*\*\*\*\*  
**NOTE: Specify surface raceways only for retrofit projects where concealment of wire is impractical and wiring is not subject to physical abuse.**  
\*\*\*\*\*

UL 5, two-piece painted steel, totally enclosed snap-cover type.

#### 2.2.14 Outlet Boxes

UL 514A, zinc-coated steel.

#### 2.2.15 Fittings for Conduit and Outlet Boxes

UL 514B, zinc-coated steel.

#### 2.2.16 Wiring

NFPA 70 and NFPA 72. Wire for 120V circuits shall be No. 12 AWG minimum solid copper conductor. Wire for low voltage DC circuits shall be No. 14 AWG minimum solid copper conductor [except wire to remote annunciators, if provided, shall be No. 18 AWG minimum solid copper conductor]. Wire for connection to base telegraphic alarm loop, if provided, shall be No. [10] [12] AWG minimum solid copper conductor. Insulation shall be 75 degree C minimum with nylon jacket. [Cable from control panel to [master box] [auxiliary transmitter] and to telegraphic loop shall be Type UF if underground or in wet location.] Color code all wiring.

### 2.3 [SURGE SUPPRESSION

\*\*\*\*\*  
**NOTE: Specify surge suppression for projects administered by NAVFAC SE and for high lightning damage areas as directed by the EFD/EFA Fire Protection Engineer.**  
\*\*\*\*\*

Provide [line voltage] [and] [low voltage] surge suppression devices to suppress all voltage transients which might damage the control panel [and transmitter] components. Mount suppressors in separate enclosure(s) adjacent to control panel [and transmitter] unless suppressors are specifically UL listed or FM approved for mounting inside the control panel [and transmitter] provided and approved for such use by the control panel [and transmitter] manufacturer[s].

#### 2.3.1 [Line Voltage Surge Suppressor

Suppressor shall be UL 1449 listed with a maximum 330 volt clamping level and a maximum response time of 5 nanoseconds. Suppressor shall also meet IEEE C62.41.1 and IEEE C62.41.2 category B tests for surge capacity. Suppressor shall be a multi-stage construction which includes inductors and silicon avalanche zener diodes. Suppressor shall have a long-life indicating lamp (light emitting diode or neon lamp) which extinguishes upon failure of protection components. Fuses shall be externally accessible. Wire in series with the incoming power source to the protected equipment using screw terminations.

### 12.3.2 [Low Voltage Surge Suppressor

Provide for all circuits which leave the building shell and as shown on the contract drawings. When circuits interconnect two or more buildings, provide an arrestor at the circuit entrance to each building. Suppressor shall be **UL 497B** listed with a maximum 30 volt clamping level and a maximum response time of 5 nanoseconds. Suppressor shall have multi-stage construction and both differential/common mode protection.

## ]PART 3 EXECUTION

### 3.1 INSTALLATION

\*\*\*\*\*  
**NOTE: Specify surface raceways only for retrofit projects where concealment of wire is impractical and wiring is not subject to physical abuse.**  
\*\*\*\*\*

Installation shall be in accordance with the requirements of **NFPA 70**, **NFPA 72** and **NFPA 90A**. Each conductor used for the same specific function shall be distinctively color coded. Each function color code shall remain consistent throughout the system. Use colors as directed by the Contracting Officer to match existing base color coding scheme. All wiring shall be in steel conduit or electrical metallic tubing [, except surface mounted wiring may be in surface mounted metal raceway in finished areas]. All circuit conductors shall be identified within each enclosure where a tap, splice or termination is made. Conductor identification shall be by plastic coated self sticking printed markers or by heat-shrink type sleeves. The markers shall be attached in a manner that will not permit accidental detachment. Control circuit terminations shall be properly identified. Wire devices so that their removal will activate system trouble signals. Pigtail or "T" tap connections are prohibited. Wiring for DC circuits shall not be permitted in the same conduit or tubing as wiring for AC circuits. Paint all junction box covers red or provide them with permanent labels reading "FIRE ALARM CIRCUIT." Electrical metallic tubing shall not be installed in exterior or wet locations and shall not be imbedded in masonry or concrete. Provide a written schedule of conductor markings identifying each wire marker, the purpose, the origin, and termination point of each conductor. The **conductor wire marker schedule** shall be turned over to the Contracting Officer at the time of preliminary testing with as built drawings.

#### 3.1.1 [Additional Installation Requirements

\*\*\*\*\*  
**NOTE: Include this paragraph in projects administered by NAVFAC SE.**  
\*\*\*\*\*

Pull all conductors splice free. Make all conductor connections under screw terminals. Provide insulated barrier type terminal strips at junction points. Use of wire nuts, crimped connectors, or twisting of conductors is prohibited. All control panels shall be dressed out in a professional manner with all wires running in the vertical or horizontal plane, cut to exact length, making all turns at 90 degree angles, and tightly bundled and wire wrapped. Conduit may not enter the top of control panel cabinet. Provide panel in the manufacturer's NEMA 4 enclosure for panels subject to water spray/runoff and/or located in

damp/dirty locations or relocate to a suitable dry location at the direction of the Contracting Officer. Provide conduit seals for all raceway terminating at the control panel cabinet.

### 13.2 FIELD QUALITY CONTROL

#### 3.2.1 Preliminary Testing

Notify Contracting Officer prior to performing preliminary testing. Contractor shall conduct the following tests during installation of wiring and system components. Any deficiency pertaining to these requirements shall be corrected by the Contractor prior to final acceptance testing of the system. Record results of testing. Submit all test results to the Contracting Officer.

\*\*\*\*\*  
**NOTE: Delete the first testing method for projects  
administered by NAVFAC SE.**  
\*\*\*\*\*

- a. Ground Resistance: [Prior to connecting control panel [and transmitter], test grounds for ground resistance value. Use a portable ground testing megger to test each ground or group of grounds. Make ground resistance measurements in normally dry weather, not less than 48 hours after a rainfall. Follow the directions provided by the equipment manufacturer for proper use of the equipment.] [Measure resistance of each connection to ground.] Resistance of each connection to ground shall not exceed 10 ohms.
- b. Operation of Entire System. Operate all initiating and indicating devices.
- c. Operation of Supervisory Systems: Operate all portions to demonstrate correctness of installation.

\*\*\*\*\*  
**NOTE: Include the bracketed text for sensitivity  
testing when 2-wire smoke detectors are specified.**  
\*\*\*\*\*

- d. Smoke Detector Test: Clean the smoke detectors in accordance with the manufacturer's recommended procedures. Test smoke detectors using magnet-activated test switch, manufacturer-provided test card, or smoke. Use of aerosol sprays to test smoke detectors is prohibited. [When 2-wire smoke detectors are provided, prior to formal inspection and tests, perform sensitivity tests on each smoke detector. Perform voltage activation sensitivity test on each detector and record the results. Remove detectors with a sensitivity level above or below the UL accepted sensitivity range for that detector and replace with new detectors having the UL accepted sensitivity range. Present recorded data at the formal inspection for verification. Approved copies shall become part of the operation and maintenance manual for the fire alarm system.]
- [e. Duct Detector Differential Pressure Test: Measure and record the observed differential pressure between sampling tubes with completed HVAC system operating normally to verify airflow requirements through detector housing. Perform test on smoke detector heads as specified above for smoke detectors.]

### 3.2.2 Final Acceptance Testing

The Contractor shall notify the Contracting Officer when the system is ready for final acceptance testing. Request scheduling for final acceptance testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative and the Contracting Officer, and written certification to this effect has been received by the [EFD] [EFA] Fire Protection Engineer. The system shall be in service at least 15 calendar days prior to final acceptance testing. The Contractor shall allow at least [15] [\_\_\_\_\_] calendar days between the date final testing is requested and the date the final acceptance testing takes place. The Contractor shall furnish all appliances, equipment, instruments, devices and personnel for this test. Furnish a minimum of three two-way radios plus one additional radio for each remote annunciator, all operating on the same frequency. The system shall be tested for approval in the presence of representatives of the manufacturer, the Contracting Officer, and the [EFD] [EFA] Fire Protection Engineer. All necessary tests shall be made including the following, and any deficiency found shall be corrected and the system retested.

#### 3.2.2.1 Entire System

Test the entire system by operating all fire alarm initiating, notification, and signaling devices. Perform tests with the system operating on primary power and repeat the test with the system operating on battery power only. Provide necessary equipment to test smoke detectors and heat detectors.

#### 3.2.2.2 Supervisory Systems

All aspects of the supervisory functions of the systems shall be operated. Introduce faults in each circuit at random locations as directed by the [EFD] [EFA] Fire Protection Engineer. Verify proper trouble annunciation at the control panel.

#### 3.2.3 Additional Tests

When deficiencies, defects or malfunctions develop during the tests required, all further testing of the system shall be suspended until proper adjustments, corrections or revisions have been made to assure proper performance of the system. If these revisions require more than a nominal delay, the Contracting Officer shall be notified when the additional work has been completed, to arrange a new inspection and test of the fire alarm system. All tests required shall be repeated prior to final acceptance, unless directed otherwise.

-- End of Section --