

**FIRE ALARM AND DETECTION SYSTEM
DESIGN AND INSTALLATION**

UNIVERSITY CONTACT:

Fire Marshal, Environmental Health & Safety
(302) 831-8475

This document identifies the minimum design, installation, testing and quality levels for new fire alarm and detection systems being supplied to any University of Delaware facility. The Architect/Engineer shall include all of these minimum requirements within the content of the bidding documents and ensure that all minimum requirements are complied with through completion of the project.

Part 1 General

- A. The intent of the system shall meet the minimum code requirements as specified, but in addition, shall meet the specific level of life safety and protection as required by the University of Delaware in these minimum requirements. In almost all cases, these minimum requirements will require a higher degree of protection and workmanship than that specified by the referenced codes.
- B. The system shall be designed in a modular fashion to insure future expansion capability. Furthermore, it shall be the intent of the system to monitor all fire suppression systems, fire extinguishing systems and building services as designated. The fire alarm and detection system is the centerpiece of the University of Delaware's life safety systems and is intended to provide a high degree of alarm notification, detection critical system monitoring and selected control outputs. Currently, this design is intended to provide the University of Delaware with a high degree of reliability and NO unwanted alarms.
- C. In large and intricate facilities the University would prefer to have a single point addressable system. In smaller less intricate facilities the University will consider a standard zoned fire alarm and detection system, however; the single point addressable system is preferred. The designer of the system shall consult with the Department of Environmental Health and Safety and the University's liaison representative, when applicable, to identify the specific type of system being proposed. Types of signaling systems and method of occupant notification will be determined at the time of consultation with the Department of Environmental Health and Safety and the University Liaison Representative.
- D. The design, installation, workmanship, testing and documentation of the system must be of the highest quality. The design team includes the Department of Environmental Health Fire Marshal, Manager Electronics Services and the University Liaison Representative shall be the final judge of quality issues and their decision is final. If bidders or any interested parties have a concern with these conditions, they shall note their concerns in writing at the time of pre-bid meetings and at the time of bid submission.
- E. The fire alarm system shall be a stand-alone fire alarm system. The building shall be interconnected to the University of Delaware's Remote Signal alarm receiving station located at the Department of Public Safety, 413 Academy Street, Newark, Delaware. All proposed fire alarm systems shall be equipped with RS232 cards and ports for interface with, **and fully compatible with** Keltron LS 922 IP Transceiver for fire alarm signal transmission to UD Public Safety via Keltron LS 7000 IP Alarm Receiver. The Manager of Electronic Services will coordinate all Keltron System programming.

- F. The fire alarm system shall be complete in all respects for operation and interface with building equipment related to or desired to be controlled by the fire alarm system. All work shall be coordinated with the University of Delaware's Department of Facilities Management. The fire alarm contractor/designer shall include in his/her design all work necessary to interface Heating, Ventilation and Air Conditioning shut-down, sprinkler monitoring and control, building systems monitoring, smoke management and other code specified supervisory functions. Any equipment, wiring, installation or other work necessary to finish all interface and output wiring or equipment shall be included in the design and subsequent bid packages.
- G. Prior to the start of any design or installation, the Contractor and Vendor shall have a "kick off" meeting with the following in attendance:
1. Contractor's actual wire and device installer(s) for the project. This is the actual mechanic(s) that will be performing the work.
 2. Actual Vendor tech that will be doing all end point connections and testing.
 3. Actual Vendor designer and NICET Level IV holder.
 4. University Representative of their choice

1.2 Definitions

- A. ASME: American Society of Mechanical Engineers
- B. FACP: Fire alarm control panel.
- C. FM: FM Global (Factory Mutual)
- D. NFPA: National Fire Protection Association. Definitions in NFPA 72 apply to fire alarm terms used in this Section.
- E. NICET: National Institute for Certification in Engineering Technologies.
- F. UL: Underwriters Laboratories

1.3 References/Required Code Compliance – (Most current editions)

- A. NFPA 72 – National Fire Alarm Code, Currently Adopted Edition by DE State Fire Prevention Regulation
- B. NFPA 25 – Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Currently Adopted Edition by DE State Fire Prevention Regulation
- C. NFPA 101 - Life Safety Code, Currently Adopted Edition by DE State Fire Prevention Regulation
- D. International Building Code, Current Edition Adopted by City of Newark or County Building Department
- E. International Fire Code, Current Edition Adopted by City of Newark
- F. Underwriters' Laboratories fire alarm and fire alarm equipment listings, approvals and standards.
- G. Factory Mutual fire alarm approvals and standards.
- H. NFPA 70 - National Electric Code, , Currently Adopted Edition by DE State Fire Prevention Regulation

- I. Americans with Disabilities Act, (except as modified per these specifications).
 - J. NFPA 90A – Installation of Air Condition and Ventilating Systems, , Currently Adopted Edition by DE State Fire Prevention Regulation.
 - K. Delaware State Fire Prevention Regulations, Current Edition
- 1.4 Requirements of Regulatory Agencies
- A. All equipment, components, wiring, design and the installation of all items as described or implied in this document shall meet all of the appropriate requirements in the codes, standards and guidelines as listed.
 - B. All equipment, components, wiring, design and installation of all items as described or implied in this document shall be UL listed and approved for the use intended.
 - C. All equipment, components, wiring, design and installation of all items as described or implied in this document shall be reviewed and approved by listed code authorities. The Contractor shall be responsible to submit all design documents and obtain all approvals from each listed code authority only after the submissions have been reviewed and approved by the Owner. No submission will be made to a code official until the Owner has approved the shop drawings.

Code Authority review required for this project is as follows:

- 1. Appropriate AHJ; City of Newark Fire Marshal's Office, State Fire Marshal's Office or City Wilmington/Dover Fire Marshal's Office.
 - 2. Factory Mutual Global Company
 - 3. University of Delaware Department of Environmental Health and Safety and Manager of Electronic Services
 - 4. University Liaison Representative
- D. The Contractor shall be responsible for all submission costs and the Contractor shall be responsible for obtaining all required approvals, permits, and acceptance inspections/approvals from all legal and/or required agencies, inspection organizations and insurance groups as listed in these specifications.
- 1.5 Coordination
- A. The Contractor shall fully coordinate the design, equipment, devices, installation, wiring and connection of all fire alarm systems with the Owner and/or their authorized representative and all other related contractors throughout each developmental stage of the project.
 - B. Fully coordinate the installation of all systems with other contractors and other work in progress or proposed progress at the time of Contractors design and installation. It shall be the Contractor's responsibility to communicate with the Owner's on-site representatives and identify all other work or trades which will require coordination with the fire alarm system design and installation.
 - C. The Contractor shall include in his schedule key times to notify the University Liaison Representative for periodic inspection of the system installation. The University requires an inspection of the installation at the following points of:
 - 1. Shop drawing development
 - 2. 25% of rough in wiring installation

3. Device and panel installation
4. Pre-acceptance inspection by Department of Environmental Health and Safety (Fire Protection), Department of Operations and Maintenance Electronics Manager, and other representatives as necessary
5. Final acceptance testing

1.6 Submittals

1.6.1 Submittals at Time of Shop Drawings and Shop Drawing Format

- A. All shop drawings shall be approved by University Fire Marshal and when applicable Owner Representative prior to installation. Submit two copies of all shop drawings prior to equipment delivery and installation of wiring. Each shop drawing must be approved by the University Fire Marshal and when applicable, the Owner Representative prior to equipment delivery and installation.
- B. The bid drawings as provided are supplied in scale. The contractor shall be responsible to submit all approval drawings, shop drawings, and as-built drawings in a scale no smaller than 1/8 inch scale.
- C. All shop drawings shall show proposed wiring diagrams point-to-point with labeled terminal and splice points, data sheets, equipment ratings, layout, dimensions, conduit, wire mold, material type and finishes.
- D. Submit material list indicating proposed manufacturer's name and design/installation data for all systems and materials listed, specified or intended for use by the Contractor.
- F. The Contractor shall be required to submit the following series of drawings:
 1. Shop drawings
 2. Panel drawings
 3. Schematics of all auxiliary devices and auxiliary system connections such as HVAC, etc.
- G. Contractor shall be responsible to provide all shop, panel, schematic and as-built drawings in a CAD format. Drawings shall be multiple-colored ink on high quality, white bond plotting paper of a standard size sheet as agreed upon with the Owner and shall include the following parameters:
 1. CAD (Computer aided drafting) form using an acceptable CAD system capable of producing the electronic media in an AutoCAD 2010 or greater version format.
- G. The Owner shall own all electronic media and original drawings addressed under this specification. The Owner shall have the right to modify, reproduce, distribute and use the electronic media and original drawings in any fashion or for any use that the Owner may desire.
- H. The Contractor and manufacturer shall retain a copy of all as-built drawings and documentation as discussed in these specifications. The Contractor and manufacturer shall not have the right to use any digital media, drawings, documentation or other material describing or relating to the fire alarm system without the express written permission of the Owner.
- I. All drawings shall show building background features in "green" ink with single narrow pen width. Panel drawings shall show panel box and chassis in green.
- J. All drawings shall show fire alarm and detection features in "black" ink with varying pen widths. Separate pen widths shall demarcate devices, point-to-point wiring, device labels, and notes.

- K. All drawings shall show underfloor fire alarm and detection features in “red” ink with varying pen widths. Separate pen widths shall demarcate devices, point-to-point wiring, devices labels, and notes.
- L. All drawings shall show labels, wire sizes and other similar information in “blue” ink.
- M. Contractor shall show exposed conduit or surface mounted devices or surface mounted Wiremold in “orange” with a heavy pen width. Contractor may use other colors to demarcate other features of information on the drawings, but such colors shall be consistent from drawing to drawing and legible.
- N. Match wiring details, including number of wires per initiating and signal circuit, and location and type of end-of-line device to type of supervision specified.
- O. Show locations of fire alarm control panels, NAC panels, surge suppression enclosures and documentation cabinets on drawings to ensure adequate space is available.
- P. Ensure drawings and specifications agree with respect to type of cable specified and that cable specified is suitable for the environment of the specific project.
- Q. Contractor shall produce and provide electrical schematic diagrams of any electrical connections between the fire alarm system and building equipment. These drawings shall be submitted at the time of shop drawings and as-built drawing submission.
- R. As part of this project and included within the base bid cost, the Contractor shall provide the Owner with “as-built” drawings for the entire fire alarm system showing all features as described in these specifications in their entirety, in an “as-built” status. All changes and/or corrections to the approved shop drawings made during installation and testing shall be documented and shown on the final as-built documents.
- S. Along with the as-built drawing submission, the Contractor shall supply three complete sets of AutoCAD files of all drawings including the panel drawings.
- T. The Contractor shall provide one complete set of documentation for onsite use. The Owner will return one of the three sets of documentation that are required by Part 5, back to the Contractor for installation into the documentation cabinet.
- Note: It is the intent of this section to ensure that a complete and adequate set of documentation exists on-site and is available to service technicians, inspectors, and fire department. No documents or other items will be permitted to be stored inside of any fire alarm control equipment or other enclosure.
- U. All shop drawing submissions shall include the following:
1. A narrative description of the fire alarm system. The narrative description shall include an exact English description of all signaling arrangements, detection arrangements, output and supervisory functions.
 2. All panel drawings shall show power and battery calculations for the system. Panel drawings shall show all wiring, ribbon and other cable point connections. Show any field or manufacturer modifications to include dip switch set-up positions, jumpers and snipped components including wire color coding and labeling.
 3. The system drawings shall have a plan view of each floor and a detailed riser diagram.

4. Actual wire, wire mold and conduit runs with anticipated methods of matching backgrounds or concealment of wire and conduit. Conduit and wire mold placement must be approved by the Owner.
5. System annunciation descriptors for each alarm, trouble and supervisory output signal. Such descriptors shall be in "plain English" for each alarm, trouble and supervisory output signal. The English annunciation descriptors shall use actual terminology used at the project building to include floor names and point of compass designations un-coded. Contractor shall confirm descriptors with the Owner's on-site representative prior to shop drawing submission.

Note: Code numbers, zone numbers or abbreviated text will not be approved without exception. Submission of coded, zoned or abbreviated text will be rejected at the time of shop drawing submission without cause or comment! If bidder does not understand this requirement, seek clarification from the Owner prior to bid submission. Only complete and understandable English descriptors for fire alarm point and trouble annunciation will be approved.

6. Contractor shall show all exposed conduit (if any) at the time of shop drawings and received approval of the Owner. All exposed conduit must be clearly annunciated on shop drawings by use of heavy weight pen markings and color.
- V. Submit one (1) actual sample of each type of device intended for installation. If devices differ from area to area, then two (2) actual samples of each type of device labeled for the specific area must be submitted. These items include but are not limited to the following:
1. Manual Pull Stations
 2. Audio Devices
 3. Visual Devices
 4. Smoke Detectors
 5. Heat Detectors
 6. Duct Detectors and remote test switch
 7. Conduit and Pipe
 8. Wiring
 9. Junction and Back Boxes
 10. Din Rail Compression Terminal Blocks
 11. Weather Proof Enclosures
 12. Water Tight Junction Boxes
 13. Mounting Plates
 14. Addressable Modules (if not in Monitor control panel).
 15. Detail drawing and sample of each wiring connection to all devices and any proposed splice connections.
 16. Wire mold and back box (if applicable).

W. Shop drawings shall include original design notes for basis of design.

1.6.2 Submittals at the Time of Acceptance Testing

A. Prior to acceptance test submit manufacturer's descriptive literature of actual equipment installed and the following:

1. Equipment installation manual.
 2. Equipment and device operating instructions manual.
 3. Equipment maintenance and programming manuals.
 4. Equipment/system service and repair data manual.
 5. Parts lists.
 6. Spare equipment and parts equipment and inventory list.
 7. Testing and maintenance schedule as per requirements of these specifications.
- B. For testing and documentation submittal requirements, see Testing and Documentation, Part 5 in these specifications.
- 1.10 Warranty
- A. The successful Bidder shall be responsible for all warranty and guarantee issues regardless of subcontractors, vendors or others operating as subcontractors under the successful Bidders contract. Bid submission documents shall include a document executed by the successful Bidder's senior corporate or company officer indicating that the successful Bidder understands that he/she is solely responsible legally and financially to the Owner for compliance to warranty and guarantee issues as follows:
1. All system equipment shall be guaranteed for a period of one year from date of final acceptance of each system in accordance with Part 5 of these specifications.
 2. All raceways and wiring are guaranteed to be free from inherent mechanical or electrical defects for one year from the date of final acceptance of the systems in accordance with Part 5 of these specifications.
 3. Regardless of typical manufacturer or Contractor canned warranties and guarantees, the base bid price shall include all fees for warranty or guarantee cost to include parts, labor, shipping, stocking, overhead, markup or other costs associated with performing work under the warranty or guarantee agreement. It is the intent of this section that the entire system will be warranted and guaranteed from any fault (other than an act of God or acts by other than the alarm system Contractor). If anything goes wrong with the system, the Contractor shall repair/correct at no cost to the Owner with components, parts and workmanship that are NEW, not rebuilt or reconditioned parts or equipment. If this intent is not clear or understood by the Bidder, the Bidder shall seek clarification from Owner prior to bid submission.
- B. As part of the successful bidder's warranty package, the successful bidder shall submit at the time of system acceptance under Part 5 of the specifications, a schedule of maintenance, testing, and service as prescribed by these specifications and referenced standards, for the first year warranty period, (see NFPA 72 for additional requirements). The cost for the first year maintenance and testing shall be included in the base bid price.
- C. All warranty service that impairs the function of the fire alarm system shall be provided within four hours of notification to the Contractor. Cost for this service shall be included within the base bid price.
- D. All warranty service that does not impair the function of the fire alarm system but is obligated under the warranty shall be performed within 24 hours of notification to the Contractor unless otherwise approved by the Owner.
- E. Warranty starting period shall be based upon the determination of substantial completion as defined by the American Institute of Architects General and Federal Supplementary Conditions of The Contract for

Construction, AIA Document A201-1976 and A201/SC-1977. For purposes of this work, Owner shall be known as the “architect” regarding implementation of substantial completion.

1.11 Qualifications

- A. Contractor shall be licensed with the Delaware State Fire Marshal’s Office. Contractor shall (or contractually be supported by a company) specialize in fire alarm systems and have a minimum of five years of documented experience with the design and installation of the actual system and devices being installed.
- B. Contractor shall have (or contractually be supported by a company) on staff and assigned to the project a NICET Level IV certified person for fire alarm systems. Such person shall have a minimum of ten years of documented experience in the design and installation of NFPA compliant local fire alarm systems.
- C. The Contractor shall assign the NICET Level IV certified person to supervise the preparation of all technical documentation, drawings, installation, testing and acceptance testing as required by these specifications. The NICET Level IV certified person shall be present at shop drawing review meetings, design issue meetings and all acceptance testing.
- D. Equipment manufacturer shall be a company specializing in NFPA 72 fire alarm and detection systems with a minimum of ten years of documented experience.
- E. All qualification documentation shall be submitted at the time of bidding and verified at bid acceptance.
- F. Contractor shall assign to the project a project manager who is experienced in the installation of fire alarm systems. The Project Manager shall be assigned to the project as his primary responsibility. He shall be dedicated to the design, installation and successful completion of a complete and working system. The Project Manager shall demonstrate qualification through experience and/or education to the satisfaction of the Owner. The Project Manager shall supervise the preparation of all technical documentation, drawings, installation, testing and acceptance testing as required by these specifications. The Project Manager shall have a position within his/her company that allows him/her to make decisions and commit his/her company legally and financially so as to minimize corporate bureaucracy during the resolution of issues and problems.
- G. All qualification documentation shall be submitted at the time of bidding and verified at bid acceptance.

Part 2 – Products

2.1 Manufacturers

- A. Simplex
- B. Siemens
- C. Notifier

- 2.1.1 Substitute equipment proposed as “equal to” equipment as specified in sections 2.1 and 2.2 shall meet or exceed the requirements of these specifications.

The submitter of substitute equipment shall provide proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. This proof shall be provided by an analysis of the substitute equipment against each system and component specified in 2.1 and 2.2. The analysis shall use a copy of each listed manufactures (Simplex, Siemens, Notifier) equipment

and specification manuals. The analysis shall compare the substitute equipment with the specified manufactures equipment by marking each paragraph as compliant or noncompliant as compared to the requested substitute equipment.

Along with the analysis, the submitter shall provide a letter from the substitute manufacture that certifies the information presented as either compliant or non-compliant, including a detailed explanation of each paragraph identified as non-compliant. The letter shall be signed and sealed by the substitute manufactures registered electrical engineer, substitute manufactures registered fire protection engineer or substitute manufactures NICET IV certified technician (in fire alarm).

In order to ensure that the Owner is provided with a system that incorporates required survivability features, this letter shall also specifically certify that the system is capable of complying with the test requirements of this specification and quality testing as specified by the three listed products in section 2.1 and 2.2.

2.2 Fire Alarm and Detection Control Panels and Associated Equipment.

A. Networked Control panels shall be:

- 1) Simplex 4100ES with Voice Evac Audio
- 2) Siemens XLS with Voice Evac Audio
- 3) Notifier 3030 with Voice Evac Audio

B. Networked Control panel(s) shall be point addressable and networkable using copper or fiber optic cable. Panels shall be surface wall-mounted enclosures unless otherwise approved by the Owner. All fire alarm panel and system design shall have alarm verification feature and environmental compensation for all smoke detection.

C. Power Supply: Adequate to serve control panel modules, detectors, remote annunciator, door holders, smoke dampers (relays), initiating devices, amplifiers, and all alarm signaling devices.

D. Initiating Circuits: Supervised, twisted/shielded circuits sufficient for remote addressable zone monitoring and capable of alarm and trouble indication at primary control panel. Each initiating circuit shall have a supervised addressable point which can be switched or have a programmed disconnect feature independent of all other initiating zones or points.

E. Indicating Circuits: Supervised, twisted/shielded circuits sufficient for horn and strobe signal devices connected to system.

F. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts (for each detection zone) to provide accessory functions specified.

G. Provide separate programmed switches to disengage door hold-open devices.

H. Provide TROUBLE ACKNOWLEDGE, DRILL and ALARM SILENCE switch.

I. Control panel shall have historical record recordation ability inherent in panel memory for Alarm, Trouble and Supervisory signals. Historical record shall store a minimum of 600 events per signal type and be configured to record all events including but not limited to alarms, acknowledgments, power loss and related testing features.

J. Surge Protector (AC transient suppresser, AC power).

- J.1 Suitable for protection of electronic equipment and electrical systems of 600 volts and less. Device shall be capable of protection of all AC electrical circuits and equipment from the effects of lightning inducted voltages, external switching transients, and internally generated switching transients resulting from inductive and/or capacitive load switching.
- J.2 Surge protector and installation shall be in accordance with:
1. NFPA 70.
 2. UL #1449 Standard for Fire and Safety-TVSS/SPD
 3. IEEE Std. 142-Recommended Practice for Grounding Std. 518-Recommended Guide on Electrical Noise ANSI/IEEE C62.41-1991 Edition. Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 4. Federal Information processing Standards Publication 94 (FIPS PUB 94)
- J.3 Acceptable Manufacturers:
1. DITEK Center
1720 Starkey Road
Largo, FL 33771
1-800-753-2345
- Or Equals: None
- J.4 Surge Protection Panel enclosure shall be a minimum of a (NEMA 4) construction, factory primed and field painted to match mounting surface.
- J.5 The SPD system as required shall consist of a Service Protection Panel for each service rated 600 volts or less, and/or Branch Panel Protectors. All devices shall operate as a total coordinated and engineered system, as well as be engineered as a system by the manufacturer.
- J.6 Maximum continuous operating voltages of any system component shall not be less than 115% of the nominal system operating voltage.
- J.7 All SPD components shall be rated with an operating temperature range of 30 to 120 degrees Fahrenheit, and from 0 to 85% humidity non-condensing.
- J.8 Nominal system frequency is 60 Hertz, operating frequency range of the SPD system shall be 0 to 400 Hertz.
- J.9 All SPDs shall be connected in parallel with the power system they are protecting. Series connected components shall not be used. Suppression paths shall not be ground.
- J.10 All SPDs shall be UL 1449 listed and bear the UL label.
- K. Remote Annunciator: Provide supervised LCD remote annunciator including audible and visual indication of fire alarm by zone, and audible and visual indication of system trouble. Install in wall-mounted enclosure as specified. Remote annunciator shall provide the same English descriptor as all other required annunciation from printers, CRTs and fire alarm panel annunciator. Provide remote annunciator at all locations shown on drawings. Annunciation shall be remote LCD annunciator which shall indicate alarm, trouble and supervisory conditions by individual English descriptors. The remote LCD annunciator

shall also be provided with a keyed switch or access code to perform system acknowledgment and system reset. Coordinate specific location with Owner.

- L. IP Alarm Communicator - Keltron 922 IP Alarm Communicator shall be installed in a separate enclosure adjacent to the main fire control panel and shall not be installed inside of the main fire control panel. The enclosure shall be labeled "IP Alarm Communicator" and marked with its unique identifier number. The enclosure shall be of sufficient size to contain all components parts of the IP Alarm Communicators system to include the communicator, secondary power supply and like equipment. All wire connections between FACP and the 922 IP Alarm Communicators system and the fire alarm control panel shall be in conduit. The 922 IP Alarm communicator shall be provided and programmed by the Manager of Electronic Services and shall be installed by the Contractor.

Keltron Signal Communication Path. The fire alarm contractor/vendor shall coordinate with the project information technology contractor/vendor to ensure that the Keltron IT signal routing shall be through paths and devices that are provided with an emergency generator or UPS 8 hour power source.

- M. Voice Evacuation Module:

- M1. Shall be based upon a 70 VRMS system.
- M2. Install audio speakers wattage tapped based upon NICET IV recommended wattages. Each speaker wattage tap shall be shown on shop drawings for Owner review.
- M3. Amplifiers shall be sized with 40% spare capacity above wattages as listed on shop drawings.
- M4. Remote control and microphone must be in a lockable, flushed mounted cabinet.
- M5. All voice evac speakers that are in public areas and are being installed in ceilings that are in excess of 10 feet above finish floor shall be 8" UL listed fire alarm speakers with back box and tile bridge support. All ceilings 10 feet or less and wall mounted speakers and speakers in non-occupied spaces may be 4" speakers.
- M6. Audio voice evac shall be zoned, wired and configured to allow selective paging by floor and significant individual acoustic spaces.
- M7. Mechanical, utility and storage rooms are not required to have voice evacuation. These spaces may have a standard audio device.
- M8. Voice Evac Speakers shall be Cooper/Wheelock based upon contractors recommendations and submittals. Proprietary addressable speakers may be considered on a project-by-project basis. All speaker color shall be white. All wall and ceiling speakers shall be multiple watt tap.
- M9. Voice zoning shall be on a project-by-project basis. Contractor/vendor shall consult with University Environmental Health and Safety for approval of zoning arrangement. Contractor/vendor shall assume voice zoning on a per floor and per building wing basis.

2.3 Initiating Devices - General Requirements

- A. Manual Pull Station: Double action, addressable. Flush and/or surface mounted as indicated by the specific building construction or drawings and as identified in Part 4 of these specifications. All manual pull stations must be keyed alike to the fire alarm control panel. Allen wrench opening devices not permitted.
- B. Heat Detector in conditioned spaces: Shall be addressable combination rate-of-rise and fixed temperature, rated 135 degrees F for conditioned spaces. Contractor shall survey areas where heat detector is to be installed for possible need of higher fixed temperature rating.
- C. Heat Detector in unconditioned spaces: Shall be Thermotech model 302ET or EPM anticipation type self-restoring rated at 194 degrees F or match existing. All heat detectors in unconditioned spaces shall be

individually addressable through monitor zone actuated modules. Contractor shall survey areas where heat detector is to be installed for possible need of higher fixed temperature rating.

- D. Smoke Detectors: Style and design shall be photo electronic with base having visual indication of detector actuation, bug screen and suitable for mounting on 4 inch outlet box and/or low profile wire mold back box. Detector and/or fire alarm panel shall have environmental compensation and provide automatic signal for dirty detector in advance of and prior to reaching alarm threshold. Smoke detection locations to include all Storage rooms, IT/NSS Server Rooms, Electrical Rooms, Common Corridors and Tops of Stairwells, unless otherwise specified by UD Fire Marshal.
- E. Duct Mounted Smoke Detectors: Style and type shall be photo electronic type with auxiliary SPDT relay contact, key-operated NORMAL-RESET-TEST switch, duct sampling tubes extending width of duct, visual indication of detector actuation and duct-mounted housing. Duct detectors must be provided with remote annunciation lamp at key switch mounted five feet above finished floor.

Remote annunciation lamp must be located in normal occupied area at the approval of the Owner's representative. Duct Mounted Smoke Detectors must be securely mounted "without possibility of vibration" and located for accessibility and ease of maintenance/testing. Duct detector shall be provided with a remote test switch: Key-operated switch may be on flush cover with lamp to indicate detector actuation. (Provide one switch for each duct mounted smoke detector). All flex connections from and to duct detector and fan/damper control equipment shall be installed in Sealtight.

2.4 Signaling Devices

- A. Strobe Lights - where noted on drawings: Owner's choice based upon contractor submittal approvals. Style and type shall be visible notification appliances with 1Hz strobes. Contractor shall provide both wall mount and ceiling mounted visible appliance assembly with white housing and clear lens in accordance with NFPA 72, meeting the requirements of ADA. Where strobe lights are shown on the drawing to be mounted on walls, the strobe light shall be mounted at a minimum of 80" and a maximum of 90" above the finished floor.
- B. Horn: Owner's choice based upon contractor recommendations and submittals. Device must be approved by the Owner. Color shall be white. Contractor must provide both ceiling and wall mounted versions.
- C. Combination Horn & ADA Strobe: Owner's choice based upon contractors recommendations and submittals. Device must be approved by the Owner. Color shall be white. Contractor must provide both ceiling and wall mounted versions.
- D. Transmission of Signals: All fire alarm control panels shall be equipped with RS 232 Cards and Ports to accommodate **and be fully compatible with** Keltron LS 922 IP Transceiver for transmissions to UD PD remote station alarm receiving center (Keltron LS-7000), unless otherwise approved by UD Fire Marshal.
- E. Upon consultation with the Department of Environmental Health and Safety, Facilities Electronics Manager and the University Liaison Representative and the design team, the fire alarm system shall also include an exterior alarm light and horn. The alarm light shall be a 360° revolving red light, weather tight seal and approved for use in exterior locations. Each exterior light shall be combined with an exterior audio horn in a weather tight enclosure approved for exterior use. The alarm light can be powered by ordinary building AC power and need not be provided with a secondary power supply. Location of the exterior light and horn shall be as shown on the drawings and shall be coordinated with the Owner for elevation and placement.

2.5 Auxiliary Devices

- A. Door Release: Existing

2.6 Fire Alarm Wire and Cable

- A. Fire Alarm Power Branch Circuits: Shall be wired in accordance with NFPA 72 Local Fire Alarm Regulations and NFPA 70, Section 760. Each power source shall be obtained from an emergency power circuit and the breaker shall be marked "FIRE ALARM POWER SOURCE" and be provided with a "red" locking device so as to prevent accidental power loss. Contractor shall be responsible to run all power from the closest emergency circuit panel to the fire alarm system.
- B. Initiating, Signal and Communication Buss Circuits: Shall be Aerospace Wire & Cable Inc., Aerospace
- #7140 18/2 TW/SH 200 deg.C. FPLP (New York City Certified)
 - #7130 16/2 TW/SH 200 deg.C. FPLP (New York City Certified)
 - #7120 14/2 TW/SH 200 deg.C. FPLP (New York City Certified)
 - #7110 12/2 TW/SH 200 deg.C. FPLP (New York City Certified)

Any and all fire alarm cable used in this system shall be "solid copper" conductors. No exceptions.

Important Note: 12 inch wire samples for 18 T/S, 16 T/S, 14 T/S and 12 T/S shall be submitted at the time of shop drawing submittals and prior to material purchase and installation. Wire samples shall be approved by Owner prior to purchase.

"Or equal" for wiring: NONE

Recommendation: contractor to purchase and use Cyclops Data Cable Stripper Ideal #45-514 Wire Stripper to strip the Aerospace wire to make project easier and minimize wire damage.

- C. Use 14 AWG (minimum size) twisted/shielded solid conductors for fire alarm indicating circuit conductors. All communication bus cable shall be 18 AWG twisted/shielded solid copper wiring using fire alarm listed plenum cable in all exposed areas. Any area subject to moisture or the effects of weather shall use water resistant conduit, enclosures, fittings, adapters, and like equipment. This includes all exterior mounted devices. Weather tight and water resistant installation shall extend for 12 inches within building envelope.

Part 3 – Execution

3.1 Installation

- A. Install system in accordance with Manufacturer's instructions, code requirements and these specifications.
- B. All devices, boxes and conduit shall be installed plumb and level.
- C. Install manual pull stations with operating handle at 48 inches above finished floor. Install audible and visual devices as noted on drawings. All wall mounted visual devices shall be mounted no less than 80 inches above finished floors.

- D. All devices shall be securely mounted with approved back box. All back boxes shall be recessed in walls or of an approved surface mount, wire mold type. Standard back boxes and extension rings with knockouts are not permitted when location requires surface mounted box. Contractor must use a finished back box suitable for painting. Only approved and appropriate type of conduit connectors shall be used for connection to back boxes.
- Note: It is the intent of this section to only allow recessed fire and device installations in wall and ceilings of finished spaces. Wire mold and surface mounted conduit will only be permitted by the Owner on a case-by-case basis at the time of shop drawings. Contractor shall bid the project to exclude surface mounted wiring and devices and approach surface mounting on an individual basis only. All surface mounted devices, conduit or wire mold shall be clearly shown on the drawing in a color specified by submittals details previously listed in this specification.
- E. All wiring for initiating, signaling and auxiliary devices shall be installed in "red" Allied Tube Fire Alarm EMT or equal conduit, or wire molding except those areas where the wire can be fished in walls or hung above suspended ceilings. When wire is installed above ceilings and not in conduit, it must be run above the bottom of any red steel (or other type of super structure) and supported every 4-1/2 feet by a J strap or other approved support device. Wiring shall not be laid directly on a ceiling or supported by pipes, duct work or other building equipment. All wiring shall be secured within 12 inches of all junction boxes, back boxes, other devices or splice connections. All conduits shall be secured to building structure every 4 feet. When construction is of a wood frame, wire staples shall not be used to secure wire in place of J strap.
- F. All fire alarm cabling and/or devices which are installed within 10 feet of water or sprinkler equipment shall be installed in Sealtight conduit with liquid tight connections and liquid tight (waterproof) boxes. When there are three or more monitoring/alarm points within the same area, monitor relays shall be mounted with a NEMA 4 Hoffman.
- G. Mount end-of-line (EOL) devices in a back box. All end-of-line resistors shall be landed on terminal strips mounted into device back boxes or appropriate electrical enclosures or in a separate junction box adjacent to the last device in circuit. Each EOL device back box shall be labeled "EOL" and be visible from front of device. If "EOL" is mounted in separate junction box, the face of the box shall be labeled. All end-of-line device leads shall be insulated from short conditions by use of approved heat shrink wire insulation.
- H. All wiring connections to sprinkler system water flow switches, sprinkler and/or fire pump system valve tamper switches, fire extinguishing systems, duct detectors and building interface equipment shall use conduit to within ten feet of device wherein the conduit shall terminate at a junction box. From the junction box to the device, the fire alarm wire shall be run in an approved Sealtight conduit and secured at each connection point to withstand a 50 pound pull force.
- I. Automatic Detector Installation: Devices shall be installed as per the manufacturer requirements, NFPA 72 and these specifications. All detectors shall be securely mounted with approved back box. All back boxes shall be recessed. Only approved and appropriate type of conduit connectors or strain relief connectors shall be used for connection to back box.
- J. Any wire entry or exit from a device, conduit or Sealtight shall be through an appropriate and approved box which is designed and installed to prevent chafing, cutting or other damage to the cable. All connections to devices, boxes, back boxes and like devices including any wiring exiting properly terminated conduit or EMT shall be provided with strain relief sufficient to secure cable at the point of entry or exit. Strain relief from back boxes, devices junction and panel boxes for wire cable shall consist of Arlington Ind., Inc LPCG50 connectors for single cable entry and Arlington NM 840 series for multiple cable entry.

- K. Any conduit that is installed within areas subject to moisture, rain or water drainage shall be installed using approved water resistant and watertight conduit, enclosures and like equipment.
- L. All system devices, panels and junction boxes shall have a unique identifier number which shall be:
 1. Labeled on each device, panel and junction box with a durable label capable of surviving environmental conditions.
 2. Labeled on all drawings.
 3. Labeled on all parts lists and required testing documentation.
 4. The unique identifier numbering system shall be approved by the Owner at the time of shop drawing submittals.
 5. Label for smoke detectors shall be installed on the base and readable from the floor at a distance of 10 feet.

Note: The intent of this requirement is to have each and every device and component (except panel components) installed with a logical and unique number whereby all inventory, documentation and life effort can be tracked by the unique number. Device labels shall be designed and installed to have a survival life of 10 years.

- M. Each conductor (individual wire) shall receive a unique and durable wire number at each terminal block, slice connection, device terminal and any other location where a conductor is landed. Only “Brady Permasleeve” heat shrink wire markers will be permitted. No other label/marker systems shall be approved. In areas where the atmosphere is unconditioned, the wire number shall be protected with a clear heat shrink protector sleeve.
 1. System devices that are located above a suspended lay-in ceiling shall have the heat shrink wire markers installed on each cable 12 inches before entering the back box and 12 inches after exiting the back box.
 2. Cable labeling in junction panels, control panels and other covered boxes shall have the shrink wire marker installed at the end of the cable prior to the protective heat shrink stripping cap. See wiring detail on bid drawings.
Each wire number shall be shown on the final as-built drawings or on a separate approved document which shall be included in the final documentation and describes the wiring to each device as follows:

Device No.	Circuit Type	In From/ Out to	Last/Next Termination	Wire No.	Type	Color

- N. The power supply surge suppression device(s) shall be installed in a separate NEMA 4 enclosure adjacent to each fire control panel and shall not be installed inside of the fire control panel. The surge suppression enclosure shall be labeled “Power Supply Surge Suppression” and marked with a unique identifier number. The surge suppression enclosure shall be of sufficient size to contain all components of the surge suppression system and including terminal strips. All wire connections between the surge suppression devices and the fire alarm control panel shall be in conduit. It is the intent of this

specification to require additional and redundant surge suppression protection for all system components whenever they receive AC or DC power.

- O. When installing wire numbers at back boxes, the wire numbers shall be installed on each cable inside of the back box when the back of the back box is **not** accessible (i.e. when the back box is installed on hard ceilings, on concrete or block surfaces or in gypsum walls). If the back of the back box **is** accessible, then the wire number shall be installed as listed in section M (1) above.
- P. The labeling of system devices and other equipment may be accomplished by using a P-touch type labeling system. No hand written labels or "Sharpie" markers will be permitted.
- Q. Traditional wire ties are permitted for use in the system to secure wire bundles. The contractor shall provide written instruction to each employee on the correct use of wire ties so as to avoid compression of the cable jacket, shield or conductor insulation. Wire ties may not be used to secure cables to J strap, building structure, back boxes, panel enclosures, conduit or as wire restraint at device and other terminations.
- R. All terminal blocks, cards, relays and other devices shall be rigidly mounted within a cabinet enclosure or back box using screws, bolt & nut or epoxy glue. Double back tape or similar mounting systems shall not be permitted.

Wire terminations, splice connections and all other connections shall be made by the use of UL listed compression terminal blocks as follows:

All panel and junction box connections:

- "Square D" 9080 GM6 Terminal Blocks, 600V, 30A with Din Rail or equal.

All back box connections for shields and small connections:

- "Ideal" #89-608 Barrier Strip, 600V, 20A or equal

No wire nuts or crimp connection devices will be approved. When terminal blocks are added to devices which incorporate a pig tail, the terminal block shall be securely mounted with mechanical fasteners (no double back tape) in the back box or on the back of the fire alarm device.

All Din Rail terminal blocks shall be provided with a number which shall be shown on all panel drawings and as-builts along with wire numbers.

- S. All conduit, devices and other system components that are installed in areas subject to moisture, water, rain or water drainage shall be installed using approved water resistant and water tight conduit, NEMA 4 enclosures and like equipment.
- T. Provide power supply wiring to fire alarm system components from building electrical panel. Circuit breaker shall be sized in accordance with fire alarm system demand and the NEC. Branch circuit breaker shall be clearly labeled for fire alarm service, contiguous to the circuit breaker toggle switch and the toggle switch shall be provided with a lock to prevent accidental movement. See Section 3.1 (M) for labeling requirements.
- U. Provide all low voltage signal wiring for systems specified herein in a workmanlike manner. Provide system raceways in accordance with manufacturer's requirements for installation of system's wiring. Provide and tag conductors at all junction and terminal points and identify by same number on all shop

drawings. All conduit, cable, outlet and mounting boxes required as part of mounting arrangements shall be color-coded red if not in public area.

- V. Protect exposed wiring installed above ceiling construction from physical damage where necessary by conduit, guard strips or other approved means. Install all drops to wall devices in wire mold unless fished in walls. Properly support all low voltage cables and conduit from the building structure by the use of J straps. At those points where the wire descends below the concrete/steel structure, the wire must be provided with adequate strain relief which is designed not to cut or ground the cable shields. The wire shall descend plumb to the device or transition. Secure cable in place at intervals not exceeding 4-1/2 feet and within 12 inches from every cabinet, box or device. Cable stress relief shall be required for all connections to devices and boxes.
- W. In running plenum cable not in conduit, all J straps running parallel with red steel (and/or wood framing) shall be turned up on the bottom flange of red steel (and/or wood framing) so as the wire run is on top of the bottom flange and cradled by the bottom flange. Where intersecting beams must be crossed, the wire run shall be routed as follows:
1. When a corrugated steel flute is available above the red steel, the wire shall be routed through the flute and over top of the steel beam.
 2. When a corrugated steel flute is not available, the wire run shall be taken under the intersecting beam and held off the beam by J strap on each side.
 3. When running wire through wood flooring and truss members, the wire shall be secured so as not to be exposed to metal gusset edges or other metal objects that could cause damage to the cable from weight, strain or vibration over time.
- X. When any wire run transitions from above a suspended or hard ceiling into a room or area which has no ceiling and is below an elevation of 7 feet above the floor, the entire wire run shall be run in red EMT through the entire room or until the red EMT terminates within a junction or back box. The intent of this requirement is to not permit any exposed plenum wire in areas without ceilings.
- Y. Install all fire alarm wiring in separate raceways. Do not mix 120 volt AC power with fire alarm initiating, signaling or communications cable in the same raceway. All 120 volt AC power wiring shall be separated from initiating, signaling or communications cable inside of FACP, NAC or junction boxes with a paper or fiber board separation.
- Z. Be responsible for assuring that conduit sizes and the wire quantity, size and type are suitable for the equipment and conditions as they exist. Review the proper installation of each type of device with the equipment supplier. Make final connections between the wiring and equipment under the supervision of equipment manufacturer's certified technician and NICET person in charge.
- AA. Be responsible to seal all floor, ceiling and wall penetrations with approved materials which will provide the equivalent fire resistive rating as that of the wall, floor or ceiling that was penetrated. Contractor shall also be responsible to re-seal or repair any access ways or penetrations made through draft stops or fire stops with materials and workmanship which equals the original intended fire rating of the draft stop. All fire penetrations shall be sealed the same day of penetration.
- BB. All fire alarm wiring which is not concealed above ceilings, fished in walls, or run in Sealtight, shall be installed in conduit and/or wire mold unless specified otherwise on drawings.

- CC. Elevators: Smoke detectors shall be located outside each elevator landing in accordance with NFPA 72 and programmed to recall the protected elevator. Heat detectors shall be located within two feet of each sprinkler head that is located within the elevator machine room. The FACP shall be programmed to shunt trip the elevator upon activation of the machine room heat detector.
- DD. Where required, all smoke detectors and alarm monitor or control devices which are to be installed under a raised floor shall be provided with an approved drip shield to protect the device from water that could drip from above or on top of the raised floor surface. Each device shall also be provided with LED annunciation at an approved location. The design and installation method shall be proposed by the contractor and shall be subject to the approval of the Department of Environmental Health and Safety at the time of shop drawings.
- EE. All junction and termination boxes using Din rail shall have a hinged cover with a latch, or keyed locked keyed alike to the primary FACP. Box covers with screws or other fasteners will not be accepted. This includes surge suppression and similar enclosures.
- 3.2 Wire Jacket Ends and Shield Drains
- A. All signal, communications and power wire (low voltage) shall be twisted/ shielded as specified in Section 2.6, B. There shall be no use of unshielded cable on the project with the exception of 120 VAC power to surge suppressors and system power supplies. All cable and shields shall be installed as follows:
1. Initiating circuits: all shields shall be carried through each device back box through the use of a compression terminal block as specified in Section 3.1 (R) of these specifications. Each shield drain wire shall be insulated with "clear" heat shrink wire insulation installed from the cable end heat shrink strip to the terminal block. The shield shall be landed at the "panel end" as per manufactures recommendations. The "field end" of the shield shall be terminated in the last device back box at the compression terminal strip.
 2. Indicating horn, speaker (where applicable) and strobe circuits: all shields shall be carried through each device back box through the use of a compression terminal block as specified in Section 3.1 (R) of these specifications. Each shield drain wire shall be insulated with "clear" heat shrink wire insulation from the cable end heat shrink strip to the terminal block. Shield landing shall be as follows:
 - In NAC panels, the shield shall be landed on an acceptable ground at the junction panel (See Section 2.2 F) located adjacent to the NAC panel. The field end of the shield shall be terminated in the last device back box, in the compression terminal strip.
 - In FACP or transponder/data collection panels, the shield shall be landed as specified by the system manufacturer.
 3. Communication, signal and data circuits shall be carried through each device junction box, back box, or other enclosure necessary through the use of a compression terminal block as specified in Section 3.1(R) of these specifications. Each shield drain wire shall be insulated with "clear" heat shrink wire insulation from the cable end heat shrink strip to the terminal strip. The shield shall be landed at the panel as per manufactures recommendations. The field end of the shield shall be terminated in the last device back box, in the compression terminal block.
- B. Wire stripped ends shall be protected with "red" heat shrink insulation placed at the cable jacket end to insulate the transition from the cable to the stripped drain wire.

3.3 Field Quality Control

- A. All system testing shall be in accordance with NFPA 72 and these specifications, Part 5.
- B. Contractor shall be responsible to install all system components, wiring and conduit in a workmanship like manner and to the satisfaction of the Owner. The Owner shall determine the acceptable level of workmanship. Examples of existing installations or other contractor installations shall not be used for evaluation of acceptable workmanship under the fire alarm contract work. Only the highest quality workmanship will be accepted. There are no exceptions to this requirement.

3.4 Fire Alarm Wire and Cable Color Code

- A. Provide fire alarm circuit conductors with color coded insulation, or use color tape at each conductor termination and in each junction box. Color code shall be specified by the Contractor at the time of shop drawings and shall be consistent throughout all fire alarm systems. Color code shall be listed on all shop and as-built documentation/drawings.

3.5 Electrical Service for Installation Operations

- A. Contractor may use any existing electrical service, outlet or system available where approved prior by the Owner. Contractor shall not assume that evidence of existing outlets implies energized circuits.
- B. When electrical service is not available, the contractor shall provide his own electrical supplies from generators or other suitable service.
- C. Contractor shall provide all necessary cords, leads, generators and other necessary equipment required to perform installation, testing and demolition work.

3.6 Ceiling Device Installations

- A. All installations of ceiling devices including smoke detectors, horns and strobes and where installed in a suspended lay-in ceiling shall be provided with a ten foot coil of wire. The wire coil shall be secured at the floor/roof deck level just prior to the device drop using a "lose secured wire tie" so as not to crimp wire shields. In the case of minimal space above a suspended ceiling, the coil shall be secured to a J strap or other approved mounting point.

3.7 Fire Alarm Control Panel Installation.

- A. All field wiring within the fire alarm control panel shall be dressed and cornered. Wiring shall be run parallel with 90 degree bends for directional changes. Wire straps if applied shall not compress wiring jackets.
- B. All field wiring shall be terminated in a junction box located above or beside the main fire alarm control panel. The junction box shall be provided with terminal strips and segregated into four parts as follows: 1) power, 2) initiating, 3) Signaling and 4) Other. The junction box cover shall be hinged and operable with a standard screwdriver or keyed device.

Note to Contractor: The system installation at the FACP location will include a minimum of five enclosures "all keyed a like" as follows:

- 1) FACP enclosure(s)
- 2) Battery enclosure(s)
- 3) Wiring junction box as described in 3.7(B)
- 4) Surge protector enclosure as described in section 4.2.1
- 5) Documentation cabinet as described in section 5.4.1

Other enclosures may be necessary such as NAC, Support cans, wire trough, etc.

3.8 Visual Strobe Synchronization

- A. All visual strobe devices that are within the same viewing area must be in synchronization. The contractor and equipment vendor shall provide a design and installation that meets the requirements of NFPA 72, Section 7.5.4.3.2.

Part 4 – Alarm Activation Sequence

- 4.1 Sequence of Operation. As a basic operation of the system the designer shall include at a minimum the following sequence of operations;

Upon any fire alarm:

- a. All audio and visual alarms to sound throughout the building or fire area as applicable and said fire area shall be identified and approved by the Department of Environmental Health and Safety.
- b. Annunciate specific device or zone in common plain English at the Fire Alarm Control Panel, printer and remote annunciators in plain English description. Annunciation descriptors shall be the standard terminology used by the University for the specific building and for each area within the building. Descriptors shall not be abbreviated. All terminology and descriptors shall be approved by the University Liaison Representative at the time of shop drawings.
- c. Cause transmission of an alarm signal to the University's remote station service.
- d. Deactivate electro-magnetic door hold open devices.
- e. Output fan shut-down if affected air handler is involved.
- f. Activate other outputs as required by design.

Note: A general alarm device signal is any device signal that is not identified as a special or supervisory device signal.

Special systems may require a special operation sequence. Each special system shall be reviewed by the Department of Environmental Health and Safety and approved. Upon activation of any supervisory or trouble alarm shall cause the following:

- a. Annunciate specific device or zone in common plain English at Fire Alarm Control Panel, printer and remote annunciators in plain English description. Annunciation descriptors shall be the standard terminology used by the University, for each area. Descriptors shall not be abbreviated. All terminology and descriptors shall be approved by the University Liaison Representative at the time of shop drawings.
- b. Cause transmission of the supervisory or trouble alarm signal to the University of Delaware's Remote station service.

4.2 Fire Alarm System - Additional Requirements

- 4.2.1 Fire alarm system (including subpanels, transponders, DGP's or NAC's) power supplies shall be protected with separate surge protection in the power supply line feeding the fire alarm panel, releasing panel and NAC. Surge protection shall be redundant and independent of any surge protection provided in and listed for the fire alarm panel. The surge protection device shall be located within 5 feet of the fire alarm panel, sub panel, transponder or NAC, and be labeled "surge protection, fire alarm panel ##". The surge protection shall be mounted in its own NEMA 4 electrical enclosure with label on exterior of enclosure.
- 4.2.2 Spare Parts. Contractor shall include in the base bid the cost to provide all manufacturer's recommended spare parts and devices. At a minimum, the Contractor shall provide at the final acceptance test the following spare parts and devices:
- a. One smoke detector of each type used on the project.
 - b. One heat detector of each type used on the project.
 - c. One manual pull station of each type.
 - d. Two of each type of fuse used in each fire alarm system.
 - e. One audio device of each type used on the project.
 - f. One visual device of each type used on the project.
 - g. Included shall be any remaining devices not installed under the provisions of section 4.1.5.
- 4.2.3 All spare parts shall be listed on all inventory lists and each spare part shall be labeled for the specific system or component it is intended.
- 4.2.4 All secondary power supplies (batteries) shall be calculated in accordance with NFPA 72 and manufacturer's recommendations and shall include design spare capacity. Battery size shall be increased by 20% above minimum calculation.
- 4.3 Special Conditions
- 4.3.1 Contractor shall conceal all conduit and wiring above ceilings where applicable. The decision to allow exposed conduit shall be made by the Owner at the time of shop drawings. Any exposed conduit or wiring shall be clearly annunciated by the Contractor through the use of color code or other annunciation method on the shop drawings so that it can be easily identified during shop drawing review.
- 4.3.2 Contractor shall connect and monitor all alarm, trouble, and supervisory points for each fire suppression, fire pump and fire extinguishing system to the fire alarm system. It shall be the responsibility of the contractor to coordinate with the Owner's on-site representative to identify any and all such systems prior to development of shop drawings.
- 4.3.3 All manual pull stations shall be recessed and flush mounted with conductors concealed within wall or structure. This includes existing masonry surfaces. If an existing condition exists that will not permit recess and flush mounting (filled masonry), then the contractor shall plan to saw cut/channel the masonry wall to install the raceway and pull station. In the rare event that the Owner approves an alternate of surface mounted wiremold, all wiremold shall be flush against the wall or mounting surface without any space or bends. All wire mold raceway shall enter an approved wire mold back box flush against the wall or mounting surface.

- 4.3.4 If wire mold is approved and installed for this project, it shall be metallic and fastened flush to the wall surface without spaces under the wire mold. Any spaces created by wall surface deviations such as mortar joints and like transitions shall be filled with an appropriate paintable caulk. All wire mold shall be uniquely marked on the shop drawings to show all locations proposed for use.

Part 5 - Acceptance, Testing, and Documentation

5.1 General

- 5.1.1 All fire alarm systems, component parts, and supervisory functions shall be subject to acceptance testing to be conducted by the Contractor. The system shall be completely operational, finished and ready for acceptance testing in accordance with the anticipated project schedule.
- 5.1.2 The Owner shall be notified at least 15 working days prior to acceptance testing with the specific date, time and system being tested.
- 5.1.3 All approvals (with the exception of the acceptance test approval) required by these specifications shall be completed and submitted with the notification of acceptance test date as required under 5.1.2.
- 5.1.4 All as-built completed drawings required by these specifications shall be completed and submitted with the notification of acceptance test date as required under 5.1.2.
- 5.1.5 All Contractor field testing and manufacturer testing documentation as required by these specifications shall be submitted with the notification of acceptance test date as required under 5.1.2.
- 5.1.6 Contractor shall provide the Owner with three complete manuals of "the specific" fire alarm system being tested. The manuals shall document all components of the system identified by unique number, consistent with the shop drawings and "as-built" drawings.
- 5.1.7 Contractor shall provide all items identified under Sections 5.1.3, 5.1.4, 5.1.5 and 5.1.6 in bounded and labeled three-ring binders with zippered ends. The binders shall be labeled on the cover as follows:

University of Delaware, "Name of Building", i.e. Spencer Laboratory
Fire Alarm & Detection System

Each section of the manuals shall be arranged with section tags and documentation as follows:

- a. Project Cover sheet listing project name, contractor, vendor, and consultant.
- b. Manual index.
- c. Service Directory.
- d. Fire Alarm Approvals. Include:
 1. Copy of Fire Marshal Application for fire protection plan review, completed and marked paid.
 2. Copy of Fire Marshal's Office plan approval form.

3. Copy of Fire Alarm Signaling Systems Company License.
 4. Copy of NICET Certification, certificate of technician.
 5. Original of NFPA 72 Fire Alarm System Certification and Description.
 6. Copy of Fire Marshal's System Inspection and Final Approval Form.
- e. Narrative of system description and operation. Include original design notes for basis of design.
 - f. System installation and service manual. (Note that these are two separate documents.)
 - g. Equipment inventory list, with unique identifier labels for each device. Include equipment data sheets.
 - h. Parts list of all components, modules, devices, wiring harness, and cross referenced with unique identifier number/label.
 - i. Divider section labeled "Punch List Items".
 - j. Manufacturer/vendor system testing. This section shall contain all installation, check-out and acceptance testing data as per these specifications.
 - k. First year warranty and test schedule.
 - l. Wire list.
 - m. Alarm and Supervisory Zone Descriptor. As worded using actual plain English descriptors.
 - n. As-built drawings. To be installed in protective clear plastic sleeves. One drawing per sleeve.
 - o. CD or other acceptable media with an electronic copy of AutoCAD as-builts.
 - p. All documentation listed in this section shall include a digital copy on a "thumb-drive" device included with each binder. This includes all as-built drawings, PDF copies of manuals, approvals and items as listed in section 5.1.7 (c) through (n).
- 5.1.8 At the conclusion, the Contractor shall document each part or test result from the acceptance test in a form suitable for installation into the required three-ring zippered binder. It is recommended that the test data collected in the acceptance be performed and documented during Contractor's system check-out and documented in binder prior to delivery to The Owner. If this recommendation is accepted, acceptance test will be performed much faster and any delays in release of final payment will be avoided.
- 5.1.9 The Owner acceptance of system shall not be completed until all faults, malfunctions and documentation as required by these specifications have been completed, delivered and verified by the Owner.
- 5.2 Fire Alarm System Testing
- 5.2.1 The fire alarm system shall be tested in accordance with the guidelines set forth in these specifications and NFPA 72. All testing shall be documented in a report form to the Owner and in accordance with section 5.1.6 of these specifications. A written copy of testing documentation shall be provided to the fire

marshal at time of acceptance testing. Documentation and testing shall consist of each item noted in NFPA 72 and the following:

- a. Stray voltages between circuit conductors and ground. Verify compliance on as-builts.
 - b. Ground faults on all conductors other than those intentionally and permanently grounded should be tested for isolation from grounding using an isolation testing devices such as a “megger”. Documentation of “megger” testing shall identify each conductor in note form on as-builts or in ledger form identifying tested conductor and test results.
 - c. Short circuits on all conductors other than those intentionally and permanently connected together for conductor-to-conductor isolation. To be verified on as-builts.
 - d. Measure and record on as-builts loop resistance with each circuit pair short-circuited at the far end of the circuit with an ohm meter and record the resistance on each circuit as shown on the as-builts.
- 5.2.2 Manufacturer’s representative check. Prior to placing power to the system, a Manufacturer’s representative check-out shall be conducted and verified in writing to the Owner under the requirements of Section 5.1. The report shall contain the following, but shall not be limited to:
- a. A complete list of equipment installed and wired.
 - b. Indicate that all equipment is properly installed and conforms to the manufacturers and these specifications.
 - c. Test individual devices in accordance with NFPA 72 acceptance test criteria Chapter 2, 3, 4, 5, 6, and 7.
 - d. Technician’s name, manufacturer certification, and date.
 - e. Test of individual inputs and outputs for intended function and supervision.
 - f. Test to verify the functional operation of the central monitoring point and remote annunciators individually and as a complete system under the following conditions:
 1. Normal operational condition
 2. Alarm condition
 3. Under primary power failure
 - g. Test and demonstrate proper coordinated interfaces with HVAC, suppression and extinguishing systems and any other interfaced system or device, under the following conditions:
 1. Normal operational condition
 2. Alarm condition
 3. Under primary power failure
 4. Output function features
 - h. Measure, adjust, and record each smoke detector (including duct smoke detection and beam detection), to its medium sensitivity setting. This must be performed at the operational location of the unit and under normal environmental conditions. The sensitivities shall be recorded with serial number, location number and model number for each detector. Confirm that smoke detectors are

within their UL listed sensitivity production window. All sensitivity testing shall be recorded in the documentation or as-builts as required under Section 5.1. All sensitivity recordation shall be in “percent per lineal foot light obscuration”, not voltage, using an approved smoke detector sensitivity testing apparatus as listed by the manufacturer.

- i. Confirm and document that all alarm point annunciation descriptors are correct, in compliance with shop drawings, presented in plain unabbreviated English, and are annunciated to all remote annunciators and printer as required by these specifications.
- 5.2.3 Upon completion of fire alarm testing, the Contractor and respective Manufacturer’s authorized field engineer shall conduct functional and instructional tests for The Owner under the guidelines of Section 5.1 and 5.3.
- 5.2.4 Acceptance testing shall be specified by the contractor (see requirements 5.2.1). The Contractor shall develop an outline for approval by The Owner, but at a minimum, the testing shall be as follows:
- a. Confirm all documentation has been received:
 - As-builts - check accuracy
 - plan views
 - riser diagram
 - panel drawings
 - battery calculations
 - Disk labeled
 - Thumb drive
 - Manual - check content
 - system descriptions
 - parts list
 - spare parts inventory
 - device cut sheets s installed
 - schedule for first year’s maintenance and testing
 - testing documentation of devices and system
 - b. Inspect panel for installation, power, etc.
 - c. General walk-down of devices to identify any missing device or obvious problems.
 - d. Test alarm and annunciation circuits for audio level with dB measurements. Test shall provide an audible alarm with each device on alarm during acceptance testing, hit alarm silence and go on. No walk test mode permitted for acceptance testing.
 - e. Test of battery backup.
 - full load test for five minutes
 - test and record voltage during full load test
 - test and record amps during full load test
 - test and record recharge amp rating
 - test and record battery draw during full load
 - normal standby mode in amps
 - test and record battery recharge voltage no load = vac

- test and record battery recharge voltage with load = vac
- f. Test of primary power.
- voltage=vac/vdc
 - circuit breaker tagged and locked open
 - surge protection under full load after
 - system has been operating on secondary power for 24 hours
- g. Audio/Visual circuit amp loads.
- circuit #1 = amps
 - circuit #2 = amps
 - etc.
- h. Inspect panel boards for faults.
- i. Check spare capacity of system.
- j. Check supervision of all circuits, signal and detection.
- k. A random sample test of detection, supervisory and pull station devices for function, supervision and proper installation.
- l. Confirm English descriptors and labels for zones.
- m. A random inspection of junction boxes, terminal/splice point boxes, conduit, wiring and general installation features. Goal of inspection is review of installation for workmanship and specification issues.
- n. Copies of hard and magnetic media of software.
- o. Additional test as required by individual system design or arrangement.
- 5.2.5 The Contractor shall be responsible to conduct all acceptances testing with the Contractor's calibrated equipment, in the presence of The Owner. The Contractor shall submit at the time of acceptance test notification and outline similar to the one listed in 5.2.3 for approval by the Owner.
- 5.2.6 Audio Acceptance Testing and Adjustments. At the time of acceptance testing the contractor shall conduct the standard NFPA 72 audio level testing throughout the building. In addition, the contractor shall conduct specific audio measurements for the voice evac area. Based upon the readings, if audio levels are not adequate, the contractor shall adjust speaker wattages to bring the audio levels into compliance with minimum code levels.

The contractor shall include in his base bid price sufficient labor to adjust 25% of all installed speaker locations from their original wattage tap to an appropriate up or down tap.

Once wattage taps are adjusted, the contractor shall re-conduct the same audio readings and record the final audio levels on a set of as-built drawings for submission with final documentation as specified in these specifications.

- 5.2.7 At the conclusion, the Contractor shall document each part or test result from the acceptance test in a form suitable for installation into the required three-ring zippered binder.
- 5.3 Owner Instruction
- 5.3.1 Contractor or Manufacturer shall provide the Owner's representatives with a minimum of two, two hour classes of formal instruction on the operation, maintenance, service and testing of the fire alarm system, devices and related building interfaces. The instruction shall be scheduled after acceptance testing but prior to final payment.
- 5.3.2 Contractor and/or Manufacturer shall provide to the Owner an instructional outline for each class with all visual aids. All classes shall be structured consistently with traditional educational standards with performance objectives and testing for all participants. Each student shall receive an instructional certificate indicating number of hours of instruction and satisfactory completion of the course. Owner may video tape class for future use.
- 5.4 Documentation
- 5.4.1 Prior to acceptance testing the Contractor shall purchase and install a documentation cabinet adjacent to the primary fire alarm panel. This documentation cabinet shall be keyed alike with the fire alarm panel and shall be large enough to contain a complete set of documentation as described in these specifications. The cabinet shall be the same color and match the fire alarm panel.

PART 6 – Devices Labeling and Software

- 6.1 Device Demarcation
- 6.1.1 Each and every alarm initiating device, supervisory device, monitoring device, control panel and junction box shall be provided with a unique number which shall be intended to specifically identify that item uniquely within its parent system. The unique number shall be clearly marked on the face of the device so as to be visible from 10 feet from a normal visual position. The type and style of unique label shall be approved by the Owner prior to installation. It shall be a type of label that will survive for a minimum of 10 years under installed conditions.
- 6.1.2 The unique number shall be an identifier within a logical system and numbers shall be assigned in a logical and systematic order.
- 6.1.3 The unique number shall be shown on all shop drawings and other documentation that annunciates, describes or documents said item. This would include inventory listing, materials lists and manuals submitted under Part 5 - Requirements.
- 6.2 Software and Programming
- 6.2.1 Copies and adequate explanatory documentation of all software and programming used in the fire alarm system shall be provided to the Owner within 30 days after acceptance testing approval.
- 6.2.2 The Owner shall own all software and programming that is part of the operational, updating, renovation and maintenance need of the system.

- 6.2.3 If it is a condition of the Contractor or Manufacturer to require licensing of any software or programming, the Contractor and/or Manufacturer shall provide such licensing to the Owner as part of this project. Cost of such licensing shall be part of the base bid package.
- 6.2.4 The Owner shall have the right to modify, use or reproduce for his own use, any software or programming which is part of this project.

---- END OF SECTION ----