

**GENERAL:**

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1. The objective of this guideline is to provide minimum standards for design and installation of fire alarm systems for the University of Missouri.
2. Fire alarm systems are Life Safety Systems and the utmost of care must be taken when designing these systems.
3. All designs must be in full compliance with the UM adopted version of IBC and NFPA Standards, including NFPA 72 *National Fire Alarm Code* that is in effect for the project as well as all other applicable codes and standards adopted by the University of Missouri.
4. Design is to be done by an engineer who is licensed by the State of Missouri or a NICET Level IV technician certified in Fire Protection Engineering Technology – Fire Alarm Systems. Fire alarm plans and specifications must be sealed by a Missouri Professional Engineer who has training and experience in the design of fire alarm systems of the type and scope included in the project. Further, the registrant who seals the documents must be able to answer questions posed by code reviewers on the project.
5. Ensure construction drawings include details for all the proposed firestopping systems that could be encountered on the project based on the construction type and rating of the assemblies being penetrated. A specific Division 28 firestopping spec can be inserted, or reference related section 078400 for details.
6. The consultant shall review all submittals from the installing contractor to verify conformance with the contract documents.
7. Prior to final inspection, the AHJ approved inspector is responsible for verifying the fire alarm contractor has fully tested and certified the system in accordance with NFPA 72. A copy of the NFPA 72 Record of Completion shall be sent to the Engineer of Record and Owner's Representative.
8. Designers shall use and follow the guidelines herein only for the purpose of preparing the designer's plans and specifications for the specific project in their contract. These guidelines are not written in contractual language for bidding purposes and contract enforcement. Therefore, the designer is not to insert the document "as-is" into the specifications. The designer is to revise the language to be contractual, make project specific decisions on

alternatives and options, and provide device locations specific to the project. This guideline is also available on the UM web site.

9. The Owner's Representative is the point of contact for the contractor. The local fire department will be contacted ONLY by the Owner representative, unless directed otherwise by the Owner's representative.
10. Fire alarm symbols and details shall comply with NFPA-170.

### **DESIGN GUIDELINES:**

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1. This design guideline establishes the basic requirements for the design of fire alarm systems including functions, layout, industry standards, permissible systems, and materials.
2. Fire alarm system design includes but is not limited to all the following components and systems:
  - 2.1. Fire alarm panel
  - 2.2. Initiating devices
  - 2.3. Notification devices
  - 2.4. Mass notification systems (if desired or required)
  - 2.5. Other code required components
3. Design calculations shall be done in accordance with NFPA 72 and the following requirements:
  - 3.1. Current draw on each notification circuit with allowance for 20% expansion.
  - 3.2. Voltage drop on each notification circuit.
  - 3.3. Stand-by battery capacity for entire system including any power expanders.
  - 3.4. Table showing specified device capacity for each addressable loop and the corresponding number of devices assigned.
4. Coordination
  - 4.1. Coordination of design is critical to a successful building project. During the design phase of a project, promptly notify architect, structural, civil and electrical engineers of changes which affect their work. Coordination should include but is not limited to the following:
    - 4.1.1. Confirm location of the remote annunciator with PM. The remote annunciator with full capabilities must be provided at the designated fire department

- entrance. The PM will confirm this, the location of the main fire alarm panel, knock box, and other alarms with the local fire department.
- 4.1.2. Provide a communication method that satisfies all applicable requirements in Chapter 10 of NFPA 72 to communicate alarms to:
    - 4.1.2.1. UL 3<sup>rd</sup> party monitoring service
    - 4.1.2.2. Building Automation System. MU only – Trouble signals to MU Campus Facilities designated representative. UMSL – consult campus PM.
    - 4.1.2.3. Campus Facilities (as instructed by the PM) – by UL 3<sup>rd</sup> party monitoring service.
    - 4.1.2.4. Campus Police Building – by UL 3<sup>rd</sup> party monitoring service.
  - 4.1.3. Coordinate with fire protection engineer for locations of flow switches, tamper switches, fire pumps as well as any other code required components.
  - 4.1.4. Coordinate architectural features with Architect including door hold open devices, door locking devices that must be released by the fire alarm system, or other building related features.
  - 4.1.5. Coordinate with the electrical engineer for power needs as well as any other electrical devices requiring interconnection with the fire alarm system.
  - 4.1.6. Coordinate with the HVAC engineer for connections to air handlers including smoke devices and any code required smoke evacuation systems.
  - 4.1.7. If a new fire alarm system is being installed in an existing building, the existing fire alarm system areas of coverage shall remain fully operational to the greatest extent possible until the new equipment has been tested and accepted by the Owner.
  - 4.1.8. For Renovation and Phased projects: the construction documents shall provide sufficient detail; via General Notes, a table of intended system outage(s), and/or scheduling language to minimize the disruption of the existing fire alarm detection coverage, provide additional outage instructions, or provide specific dates when the outage is to occur. This will assist in providing continued fire alarm detection and notification for the remaining occupied portions of the building during construction.
  - 4.1.9. If an outage to the fire alarm system is absolutely necessary, the contractor shall provide a Fire Watch, as required by Code, or when directed by the UM AHJ.
  - 4.1.10. Contractor shall include a Fire Watch any time the fire alarm system is taken out of service and must remain out of service for extended periods of time. Fire

watch shall include a minimum of one person provided by the contractor to perform an hourly tour of the area out of service and provide weekly documentation to the Owner's representative. Documentation shall include the person or persons assigned to the Fire Watch as well as reporting when rounds were conducted. During the Fire Watch any possible fire conditions shall immediately be reported to the Campus Police and to the Owner's representative. These requirements should be added to the special conditions of the University's Division 1 documents. The contractor must notify the Owner's representative including any other parties as specified by the campus. (MU Fire Shop, MU Health Care, UM AHJ, local fire department, campus police, building coordinator, and others as required.)

- 4.1.11. On existing and new fire alarm systems, the use of a Digital Communicator can be used provided the DACT unit complies with currently adopted NFPA 72 Edition.
- 4.1.12. The campus will contract with a 3<sup>rd</sup> party monitoring service and will pay all initial and monthly monitoring fees. The contractor shall notify the owner's representative 60 days in advance of when the digital communicator and the alarm system will be ready to test so that the owner can arrange for monitoring service.

## 5. System Requirements

- 5.1. All new fire alarm panels shall be microprocessor based non-coded, addressable systems.
- 5.2. All new fire alarm panels are to be expandable. Future ability to provide fire alarm service for entire building or planned building expansion is required. Each notification circuit shall contain a minimum of 20% excess capacity. The 20% capacity should be in addition to the capacity for any planned expansion of the fire alarm or voltage drop.
- 5.3. If a voice system is specified and it is used for other purposes than fire (such as mass notification or broadcasting), comply with NFPA 72 requirements for use of fire alarm system for other purposes than fire. For mass notification requirements refer to NFPA 72 Emergency Communications Systems sections, as applicable. All device locations shall comply with ADAAG requirements. Special care will be taken on systems for residential occupancies.
- 5.4. Wiring systems for both notification and addressable loops is typically Class B. Unless specifically required by the University, Class A wiring systems is a design decision, based on an evaluation of site specific conditions and the needs of the facility. MURR,

BSL3 labs, hospitals, ambulatory care facilities, high rise, or other high risk facilities could require the addressable loop as Class A wiring.

5.5. Notification zones

5.5.1. These requirements shall include all notification devices such as strobes, horns, or speakers. Multiple circuits may be needed as in the case of speakers and strobes.

5.5.2. At a minimum, each occupied floor shall be on a separate circuit.

5.6. Initiation zones

5.6.1. Addressable loops shall be designed for reliability. For that reason, the fire alarm system will require a minimum of two loops for smaller buildings and additional loops for larger buildings.

5.6.2. Each building shall have one addressable loop per floor to parallel the notification circuits.

5.6.3. The number of fire alarm devices in a loop shall not exceed 20 otherwise provide IM (intelligent Module). IM shall be used every 20 fire alarm devices.

6. Information Shown on Drawings

6.1. Plans shall show all devices required by code including:

**6.1.1. Alarm Sequence Matrix & Coordination**

6.1.1.1. Provide a matrix showing alarm and initiation devices by category on one axis and device action on the second axis. An example would be elevator lobby smoke detector. Actions would be such as general alarm, elevator recall, shut down air handlers, etc.

6.1.1.2. Show and specify sequence on air handler shut down. Air handlers shall be controlled by the FA panel through an addressable relay and not a contact on the smoke detector.

6.1.1.3. Smoke detectors, heat detectors, flow switches, and pull stations activate the general alarm mode unless directed otherwise by the PM and supported by code. For example, duct smoke detectors in facilities monitored by a constantly attended location, or UL listed supervising station, can initiate a supervisory signal along with the shutdown of the associated AHU.

**6.1.2. Alarm Initiation Devices**

6.1.2.1. Pull stations are required on all occupancies and must be located within 5' of each exit from a floor. Mounting height is to be noted on drawings. The preferred mounting height is 48" to the center of the device.

6.1.2.2. Smoke and heat detectors are to be shown where required by applicable codes.

6.1.2.3. Plans shall clearly show where more than one duct detector is required because of duct size.

6.1.2.4. Flow switches are to be shown on the fire alarm plan as well as the riser. These devices are to be coordinated with the sprinkler design.

### **6.1.3. Notification Devices**

6.1.3.1. Notification devices shall be limited to strobes, horns and speakers unless approved otherwise by the Project Manager.

6.1.3.2. All strobes, horns, speakers, etc. are to be shown on the plans

6.1.3.3. The mounting height, candela rating, sound level settings are to be shown on the drawings. Sound level, candela, or other information that must be set by device shall be shown next to the device. Mounting height for strobes, horns, and speakers shall be 80” to the bottom of the device. Where a low ceiling does not permit this mounting height, consult NFPA 72 for mounting height and adjustments for coverage. For residence hall sleeping rooms, consult “Sleeping Area” tables in Chapter 7 of NFPA 72.

6.1.3.4. Spacing of devices is outlined in NFPA 72. Designer must be diligent in showing spacing for strobes that meet code requirements as well as the sound levels required for horns and speakers. A note shall be put on the plans to instruct the contractor to get the approval of the engineer prior to moving any device more than 12”. The placement of devices on the plans shall take this movement into account when allowing for clearances and code required locations.

### **6.1.4. Supervisory Devices**

6.1.4.1. Show required supervisory devices including tamper switches, fire pump, engine generator, or other required supervisory signals. Coordinate the location of tamper switches and other supervisory devices with the appropriate discipline.

### **6.1.5. Emergency Control Functions**

6.1.5.1. All emergency control functions, and their locations shall be shown on the drawings

6.1.5.2. Door hold opens are to be coordinated with the Architect for location and function. Provide required smoke detectors where applicable. Hold opens controlled by addressable relays and may, in some cases, be controlled by other systems in concert with fire alarm. Designer shall be fully aware of and design control for the functions desired and required by code.

6.1.5.3. Door unlocking where desired or required shall be coordinated with other

disciplines and assure that all applicable egress codes are being followed. Door security (locking) and unlocking functions must be reviewed and approved by the AHJ.

6.1.5.4. Elevator recall shall be done in accordance with the UM adopted version NFPA 72 and the latest ASME A17.1 elevator code adopted by the State of Missouri. All work shall be coordinated with other disciplines. Typical recall is as follows and each requires a separate output device on the system.

6.1.5.4.1. Elevator recall to designated level

6.1.5.4.2. Elevator recall to alternate level

6.1.5.4.3. Visual warning for elevator(s) activated by equipment room or hoistway devices.

6.1.5.4.4. Elevator shutdown initiated by equipment room heat detectors.

#### **6.1.6. Expander Panels**

6.1.6.1. Expander panels should only be used on renovation projects. New buildings should use panels and sub-panels that are capable of full coordination and communication.

6.1.6.2. Where used, expander panels will not be placed above ceilings, in closets or other hard-to-find places. The designer will show the location of all expander panels clearly on plans.

#### **6.1.7. Sub Panels and Annunciators**

6.1.7.1. Sub panels and annunciators shall be clearly shown on the plans.

#### **6.1.8. Riser diagrams are required for the entire system including:**

6.1.8.1. Notification devices for each and every floor indicating circuiting which will correspond with calculations done under paragraph 3 above.

6.1.8.2. Expander panels including notification devices connected to expander panel and sufficient information to verify calculations required in paragraph 3 above.

6.1.8.3. Addressable loops showing all initiating devices, supervisory devices and output devices on each loop that will correspond to paragraph 3 above. This includes all relays and monitoring devices for air handlers, elevators, fire alarm systems, kitchen suppression systems, etc.

6.1.8.4. Sub panels and annunciator panels.

6.1.8.4.1 Sub panels and annunciators shall be clearly shown on the plans.

6.1.9. Power Alarm power supply disconnect, where not in a panel board, shall be painted red and labeled "FIRE ALARM". Where in a panel board provide with lockable handle or cover and red laminated plate next to breaker with

white lettering “FIRE ALARM”. Location for power shall not be located in corridors or other public areas. Power disconnect shall be in a secure space accessible only by authorized personnel. All fire alarm equipment as well as supplemental fire equipment shall be placed on dedicated circuits.

## 7. Specifications

- 7.1. All items in this section must be included in the fire alarm specifications.
- 7.2. All devices, equipment and installation are to be provided by a single source who assumes responsibility for the entire system per NFPA 72. Non addressable devices do not have to be of the same brand as the main system, but must meet the manufacture’s requirements and UL ratings for the system installed.
- 7.3. Fire alarm cabinet shall be lockable dead-front, steel enclosure arranged so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control panel, provide exactly matching modular unit enclosures. Provide cabinets large enough to accommodate all components and to allow ample gutter space for interconnection of panels as well as field wiring. Identify each enclosure by an engraved red laminated phenolic resin nameplate. Lettering on the enclosure nameplate shall not be less than 1 inch high. Identify individual components and modules within the cabinets by machine lettered signs or labels.
- 7.4. System submittals must include:
  - 7.4.1. Power Calculations:
    - 7.4.1.1. Battery Capacity Calculations: Battery size shall be a minimum of 125% of the calculated requirement. Batteries must be capable of operating the panel in normal mode for 24 hours with sufficient capacity to operate the panel in alarm mode for 15 minutes at the end of that 24 hour period.
    - 7.4.1.2. Supervisory power requirements for all equipment.
    - 7.4.1.3. Alarm power requirements for all equipment.
    - 7.4.1.4. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst case condition.
  - 7.4.2. Complete manufacturer's catalog data on all devices, modules, bases, etc.
  - 7.4.3. Submit panel and annunciator panel configuration showing layout including the following as applicable:
    - 7.4.3.1. Master system CPU including all fire detection, evacuation alarm control modules, and supervised power amplifiers with the required back up modules.
    - 7.4.3.2. Circuit interface panels including all modules.



- 7.4.3.3. Power supplies, batteries and battery chargers.
- 7.4.3.4. Pre-amplifiers, amplifiers, and tone generators.
- 7.4.3.5. Equipment enclosures.
- 7.4.3.6. Alarm monitoring modules, and supervised control modules.
- 7.4.3.7. Initiation loop must be capable of supporting at least 60 devices of any type. If the loop supports different numbers of different type devices, it must be capable of supporting at least 60 devices of each type.
- 7.4.3.8. Alarm notification circuits must be capable of 1.5 amps per circuit at 24vdc. Panels capable of allowing varying current draws per circuit, but allowing an average of 1.5 amps average may be allowed if the engineer designs the circuits appropriately. In that case each circuit must still have .3 amp minimum allowed for future in addition to the designed load.
- 7.4.3.9. Wireless systems are not permitted.
- 7.4.4. A complete proposed system database including a description of all logic strings, control by event programming and point identification labels on electronic format and in a formatted printed form, as required for offsite editing, uploading and downloading shall be submitted for evaluation by the owner. A programming manual shall accompany the submitted program and shall be adequate to allow understanding, operation and editing by the system.
- 7.4.5. The latest version of software for programming the fire alarm system. A programming manual shall accompany the submitted program and shall be adequate to allow understanding, operation and editing by the system. At MU, Master fire panel access codes shall be given to the owner.
- 7.5. Specification submittal requirements are to state that proposed vendors must be able to show the ability to respond to requests for service within 24 hours and the ability to supply replacement parts for the system within 48 hours relative to the site where the system is to be installed.
- 7.6. All fire alarm panels will be equipped with a "walk test" feature. This allows each activating device to be tested without the need to reset the panel after each device is activated.
- 7.7. All fire alarm panels will be equipped with a "building evacuate" switch.
- 7.8. System shall be capable of silencing horns while leaving strobes in alarm. System reset shall reset both horns and strobes. Acknowledge shall silence horns. These functions shall only be accessible to authorized personnel. This provision may be in conflict with NFPA 72, but is accepted as a variance by UM. A trouble alarm shall be indicated in the fire alarm panel and in the annunciator panels.

- 7.9. Each circuit, initiating and notification, will have a disconnect switch in the Fire Alarm Control Panel (FACP) to disable the circuit during maintenance. This may be a physical switch or a “soft” switch that disables the circuit and causes a trouble on the panel until the circuit is re-set. The circuit must be disabled and reset by one action of a qualified person who has access to these switches. These switches are not to be accessible from the operator portion of the panel but must require the panel to be fully opened to gain access.
- 7.10. If door hold-opens are used, they will be wall-mounted, magnetic type with proper mounting blocking in the wall. Combination door closer/hold-opens will not be used.

#### **7.11. Initiation Devices**

- 7.11.1. All pull stations will be key operated, keyed the same as the building fire alarm panel. Engineer shall verify key type used by the campus and specify that key type where the campus has a standard.
- 7.11.2. Infrared detector light source with matching silicon cell receiver. Ionization type smoke detectors will not be allowed unless directed by the Project Manager.
- 7.11.3. Provide detectors that can be individually monitored at the FACP for calibration, sensitivity, and alarm condition, and have capability of individually adjustable sensitivity from the FACP.
- 7.11.4. Provide visual indication detector has operated.
- 7.11.5. Duct detectors shall be installed with sampling tube properly designed and sized per manufacturer’s recommendation including an accessible test button. Mount remote indicator (LED) if detector is not visible from the floor. Use White single gang faceplate labeled: Duct Smoke Detector per NFPA 72.
- 7.11.6. Addressable devices shall not be installed in unconditioned spaces. Fire Alarm devices mounted outside, such as in parking decks or exterior canopies in loading docks, shall be listed for the location and be installed according to the listing. The addressable part of the device shall be remotely mounted in a conditioned space. Final location of the remote addressable device shall be coordinated with the Engineer.
- 7.11.7. Proper installation and physical location of each duct detector and access doors shall be coordinated between the Electrical, Mechanical, and fire alarm subcontractors, and approved by the Electrical Engineer prior to equipment installation.
- 7.11.8. If new devices or new Fire Alarm Control Panel is added to an existing system, new certification for the existing Fire Alarm Control Panel shall be used in accordance with NFPA 72 Chapter 14 reacceptance testing requirements. This includes the testing of existing devices as described in the code.

- 7.11.9. The smoke detector in a Handicap accessible room shall also activate the strobe for that room.
- 7.11.10. All detectors or other initiating devices will be installed in locations that are readily accessible for maintenance. Any initiating device installed above a suspended ceiling (i.e. duct smoke detectors) shall have an indicator showing below the ceiling the location of the device. Beam detectors will be used in atriums or other high ceiling areas. Special consideration shall be given if the area where it is being installed is susceptible to vibrations that may lead to a faulty detector.
- 7.12. Wiring shall be U.L. listed as fire alarm protection signaling circuit cable per NEC. Wire for analog loops will be a minimum of #18 AWG, twisted pair, shielded type FPL, FPLP, FPLR. Wire for notification circuits will be a minimum #14 AWG, type KF-2 or KFF-2. Alarm speaker wire will be a minimum #14 AWG, shielded type CM. Cable type may vary if recommended by the system manufacturer for compatibility with system warranty or design. When a “network” cable is installed between multiple fire alarm control units, verify the manufacturer’s wiring requirements and install it in a dedicated conduit. No other wires can be installed in that conduit.
- 7.13. All fire alarm system wiring shall be installed in a dedicated raceway. Raceway may be EMT, RMC, FMC, LFMC (flexible type limited by NEC), and surface raceway (only in areas where not subject to damage). Note – For renovation projects where new raceways may be difficult or alternatives such as Class A wiring systems could be used to provide reliability and/or survivability, a variance to this design guideline may be submitted to the AHJ. The variance request must include the building occupancy, fire alarm system description, project scope of work, confirmation that all devices are fully addressable, and the justification.
- 7.14 Exposed conduit shall be factory painted red.
- 7.15. Ground fire alarm equipment, conductors, and cable shields per NFPA and manufacturer.
- 7.16. **Notification Appliances**
- 7.16.1. Fire alarm horns shall be capable of 10 dBA output higher than NFPA requirement at ten (10) feet. Horns will be Wheelock NH or AH series or equal.
- 7.16.2. Fire alarm strobe flash rate to be one flash per second with low current design. Strobes will be Wheelock RSS series or equal. Strobes with adjustable candela levels from 15 to 110 shall be specified.
- 7.16.3. Synchronized strobes are required where more than one strobe is visible from any location, including corridors. Where synchronized strobes are used, use appropriate control module based on manufacturer’s recommendations, such as Wheelock SM, DSM or equal.

- 7.16.4. Alarm speakers will be Wheelock series ET or equal.
- 7.16.5. Only speakers or horns will be used unless approved otherwise by the PM in which case all code requirements must still be met.
- 7.17. Before partial occupancy, on all fire alarm installations or modification, manufacturer shall provide a written satisfactory completion of the required test outlined in NFPA 72. A copy of the NFPA 72 Record of Completion shall be sent to the Engineer of Record and the Owner's Rep.
- 7.18. If a new Digital Fire Alarm communicator is included in the project, the system shall meet the following requirements:
- 7.18.1. The Communicator must be a listed UL product fully compliant with the NFPA 72 edition currently adopted and be listed and labeled by an NRTL for use as a *Single Communications Path* or in combination with other technologies as a *Secondary Communications Path* per the code as set forth in Chapter 26.
- 7.18.2. Supports both dynamic (DHCP) or Public and Private Static IP addressing.
- 7.18.3. Communicates over any type of customer-provided Ethernet 10/100 Base network connection (LAN or WAN), DSL modem or cable modem.
- 7.18.4. Data transmits over standard contact-ID protocol is secured with the industry's Advanced Encryption Standard (AES 256 bit).
- 7.18.5. Dual path communications: Uses Internet or GSM as primary. MU – Use Internet
- 7.18.6. User programmable
- 7.18.7. Diagnostic LEDs: Signal strength and status indications.
- 7.18.8. Self-Test: Conducted automatically every 24 hours with report transmitted to central station. shall be tested everyday per NFPA 72.
- 7.18.9. All circuits shall be power-limited, per UL864 requirements.
- 7.18.10. Existing and new BAS servers are to be made capable of translating the new communicator signals. If unit is connected to an existing non-addressable (conventional) fire alarm system the communicator shall transmit alarm, trouble and supervisory conditions only. Units capable should be considered to provide point identification of alarms.
- 7.18.11. Battery backup to provide 24 hours of backup in standby and 5 minutes of alarm operation and battery supervision.
- 7.18.12. Units using cellular communication shall be provided with a local panel mounted antenna and shall also be capable of utilizing a remote high gain antenna if the LTE or greater signal strength is not adequate at the communicator location.

7.18.13. Each University may prefer to procure and install the digital communicator under separate contract. Verify preference with the University PM.