

SECTION 00 60 00

ELECTRICAL DESIGN GUIDELINES

PART 0 PURPOSE

- A. Describe broad guidelines for design of schools.
- B. Establish materials qualities and applications.
- C. Describe materials and conditions which do not easily fit into specific specification sections.
- D. See specific sections of Design of Construction Standards for additional requirements.

PART 1 COMMON WORK RESULTS FOR ELECTRICAL

- A. Provide lighting load reduction capabilities on remodel projects.
 - 1. Load shed shall be by dual level switching for fluorescent based lighting systems and full range dimming for LED based lighting systems.
 - 2. Provide means to reduce lighting load by at least 50% in all spaces.
- B. Design wiring and specify equipment so that electronic devices that distort the harmonics of sine wave power, such as computer power supplies, variable frequency drives (VFDs), and solid state ballasts do not adversely affect each other or the building power circuits, particularly the neutral and ground wiring.
- C. Do not design corridor receptacles or custodial use receptacles on classroom or office circuits.
- D. Provide receptacles in custodian's closets.
- E. Receptacles for school kitchen point of service (POS) shall be on a dedicated circuit with isolated ground.
- F. Do not use telecommunications rooms as pass through rooms to other rooms. Refer to Division 27 Design Standards.
- G. Coordinate placement of receptacles and other outlet boxes for TV casework and other casework for computers, TVs, VCRs, projectors, etc. Receptacle location should be 6" above top of casework. Coordinate with the architect the locations and sizes of grommets for equipment cables as necessary.
- H. Equipment controllers and system controllers: Coordinate controls standards with the DPS Project Manager and the DPS Controls Application Engineer.
- I. Coordinate controls standards with the DPS Project Manager and the DPS Controls Application Engineer.
- J. Design electrical distribution within the facility such that mechanical loads and kitchen loads are separately metered from lighting and convenience receptacles. Metering from the mechanical, kitchen, and lighting/convenience loads shall be tied into the IBAS system. Metering shall be provided at 480/277V and 120/208V if necessary to accomplish this.
- K. Design sufficient facilities and clearances for orderly arrangements, concealment, and optimal maintenance of equipment, piping, and conduit. Give special consideration to ceiling spaces.
- L. Rooftop electrical conduit over 2" shall be fastened to Unistrut stands. Stands shall be mechanically fastened to 2'x2'x2" concrete paver. Pavers shall be set on modified rolled roofing pads. One stand for every ten foot (10') of conduit and no more than one paver per stand.

PART 2 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- A. Where harmonic currents exist on circuits supplying electric discharge lighting, data processing or similar equipment, a full-sized neutral shall be provided for each single phase circuit, and an oversized neutral may be required for each multi-wire circuit. All neutrals shall be minimum, same size as the phase conductors. The design engineer shall determine where harmonic currents may exist and shall clearly specify and/or show on drawings which circuits will require oversized neutrals.

PART 3 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

- A. For specific telecommunications, data, audio/visual and safety/security system box depth, size and plaster ring requirements, see Section 27 05 33 – Electrical Technology – Conduit and Boxes.
- B. Telecommunications Conduit: Provide conduits for telecommunications systems. Coordinate locations and requirements with Section 27 05 33 –Electrical Technology – Conduit & Boxes and 27 05 39 – Electrical Technology – Surface Raceways. All telephone system wiring shall be installed in conduit.
- C. Audio Enhancement Systems: Provide conduits for audio enhancement systems. Coordinate locations and requirements with Section 17300 – Audio Enhancement Systems. All audio system wiring shall be installed in conduit.
- D. Kitchen POS (Point of Service) Avoid kitchen POS locations in floors. Try and locate on walls or columns. Conduit and floor boxes in slabs are prohibited per this Section and Section 26 05 33 unless written approval from DPS Project Manager.

PART 4 ELECTRICAL COMMISSIONING

- A. The commissioning responsibilities applicable to the electrical Contractor, Commissioning Authority (CA) and others are outlined in Section 26 08 00 – Commissioning. This section covers the specific commissioning tasks for Division 26 and 27.
- B. A/E shall edit this section to match the scope of the project.
- C. The purpose of this section is to specify Division 26 and 27 responsibilities in the commissioning process which are being directed by the Commissioning Authority (CA). Electrical systems testing is required under the direction of the Contractor.

PART 5 LOW VOLTAGE TRANSFORMERS

- A. Transformer Cooling: Coordinate with mechanical engineer to provide adequate ventilation of rooms with transformers. Coordinate with mechanical engineer to assure adequate air quantities for proper ambient conditions in electrical room. Locate transformers to assure adequate air movement around transformer enclosure.
- B. Design of transformer capacities should allow a minimum 25 percent growth of electrical loads served by transformer.
- C. Do not locate transformers on or next to walls adjacent to telecommunications equipment rooms.
- D. In areas with heavy computer loads , K-rated transformers shall be provided. Only non-linear loads shall be connected to the transformer.
- E. For new construction, consider specifying main transformer as K-rated. Provide cost difference to DPS Project Manager during DD or 50% CD review.
- F. Floor mounted transformers shall be mounted on a 4” housekeeping pad. Coordinate with architect.

PART 6 PANELBOARDS

- A. Design
 - 1. Lighting and receptacle branch circuit breakers shall be minimum 20 ampere.
 - 2. Provide minimum 25 percent future circuit spaces for total connected circuit breakers in panelboard.
 - 3. Specify minimum of 42 poles per panelboard. If more are required, specify two-section panelboards. Where two-section panelboards are required, use full capacity sub-feed lugs. Sub-feed breakers are prohibited except in remodel projects. Both sections shall be the same size (ampacity and number of breakers).
 - 4. Panelboards which are installed in electrical equipment rooms shall not share the space with other systems such as piping, ductwork, telephone equipment, etc.
- B. Drawings
 - 1. The Drawings shall contain a schedule of panelboards which clearly indicates the following information:

- a) Panelboard type.
 - b) Number of poles.
 - c) Main bus ampacity.
 - d) Main circuit breaker or main lug ampacity.
 - e) Quantities of each size of circuit breaker.
 - f) Flush or surface mounting.
 - g) Total connected load and demand load.
 - h) Design load.
 - i) Panelboard short circuit rating.
 - j) Calculated available short circuit at panelboard.
 - k) Each circuit shall have its load in watts or volt-amp (VA) shown and a description of what and where the circuit feeds.
 - l) Circuits requiring lockout device.
 - m) Circuits requiring specialty breakers, such as shunt trip or GFI.
- C. Remodel projects:
- 1. On remodel projects, provide a full panelboard schedule with all existing devices and loads shown, and note the vacated/reused circuits. A load study is required on remodel projects and depending upon the project size, a load change calculation (total existing load - removed load plus new load) may be acceptable. If existing loads are unknown, engineer shall identify existing loads and note on directory card. Engineer shall also identify upstream overcurrent device, if not presently known.
 - 2. Engineer shall require contractor to make existing panels comply with the panel and circuit identification, wire labeling, and cleanliness requirements of this specification.

PART 7 WIRING DEVICES

- A. Provide receptacles at maximum 40' on center in corridors.
- B. Special requirements for telecommunications receptacles are outlined in Section 271543 Communications – Faceplates and Connectors.
- C. Do not specify 15amp receptacles. Utilize 20amp receptacles in all locations.
- D. Provide outdoor receptacles every 75 feet of perimeter wall space; and one at main entrance and delivery door.

PART 8 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- A. Specify disconnects for all motors and mechanical equipment. Locate adjacent to units per NEC.
- B. Coordinate fusing of disconnects with mechanical equipment electrical characteristics.
- C. Create schedule of equipment to indicate ratings of disconnects and fuses for each item of equipment.

PART 9 ENCLOSED CONTROLLERS

- A. Utilize full-voltage starting where possible.
- B. Magnetic motor starter operation configurations:
 - 1. Full-voltage starting.
 - 2. Full-voltage reversing.
 - 3. Reduced-voltage starting
- C. NEMA-style starters shall be specified and utilized. Starters shall be capable of starting a range of motors with no degradation of starter life

- D. Locate controllers and motor control centers in acceptable environments not subject to temperature extremes beyond UL-listing criteria. Provide appropriate enclosure rating for environments in which installed.
- E. Preference is for electronic overload relays instead of individual overload heaters.
- F. Coordinate size of control center with door openings and access corridors to assure that control center can be moved into room after structure is completed. Indicate shipping splits as necessary.
- G. Preference is to not use fusible switch assemblies or MCPs.
- H. Provide minimum 10% spare space or one vertical section, whichever is greater, to allow for future starters to be installed in MCCs.
- I. Branch circuit disconnecting devices are not specified here, but are allowed if necessary in an MCC.

PART 10 VARIABLE FREQUENCY MOTOR CONTROLLERS

- A. Coordinate starter needs for mechanical equipment prior to 50% CD and confirm again for 100% CD submittal.
- B. Coordinate temperature controls requirements with other Division 25 standards.
- C. Coordinate auxiliary contacts as required for application of fire alarm system interface.
- D. Coordinate available short circuit current values at connections.
- E. Select type of reduced voltage motor starter and incorporate appropriate requirements from Part 2 below in project specification.

PART 11 ENGINE GENERATORS

- A. Design Requirements:
 1. This section covers the requirements for standby generators, however, design requirements are included here for use of portable generators as well.
 2. Standby diesel generators are not required for elementary, middle, or high schools, unless a fire pump is required for the building. Natural gas generators are not allowed per the AHJ to serve fire pumps. A natural gas generator is required for schools that have a sump pump, sewage ejector, or for schools that are used as emergency shelters. If a school has a fire pump and has a sump pump, sewage ejector, or is used as a shelter, then the same standby diesel generator may be used.
 3. Standby generators shall be located on the exterior of the building, near the loading dock area to provide adequate access for maintenance personnel and equipment.
 4. For diesel standby generators, provide adequate access for a fuel truck to fill the fuel tank.
 5. All schools that do not require a standby generator shall be equipped with one or more exterior places to plug in a portable diesel generator. The location shall be a dedicated and adequate space for a trailer mounted diesel generator and day tank. Each plug-in point shall be wired back to a manual transfer switch. Individual transfer switch loads shall not exceed 100 amp, 480/277 volts.
 6. Loads that shall be designed for service by a portable diesel generator are as follows:
 - a) Basic heat (boilers, etc.) to prevent pipes and systems from freezing.
 - b) Emergency lighting, if on a separate panel from normal lighting; otherwise all lighting, including battery powered emergency lights.
 - c) Kitchen walk-in coolers, refrigerators and freezers.
 - d) Loads served by the emergency panel (to keep batteries charged).
 - e) Other critical loads as determined by DPS Project Manager.
 7. Engineer shall design the power distribution system within the building such that the above loads can be isolated by a manual transfer switch and served by portable generator(s). If more than one 250KW portable generator is required to power all of the loads above, then multiple plug-in points and manual transfer switches shall be designed.

B. Systems Description:

1. Interface with Other Systems: It is important to note that this system, more than any other in Division 26, closely relates to Divisions 22 and 23 installation procedures. Close coordination with the mechanical design engineer is required to assure that installation procedures for standby generators are contained in the appropriate Divisions 22 and 23 sections for equipment furnished under Division 26 but installed under Divisions 22 and 23. Close coordination is also required to ensure appropriate equipment necessary for basic heat are included for service by a portable generator.
2. Controls:
 - a) Connect to Integrated Building Automation System. Refer to Section 25 50 00 – Integrated Building Automation System (IBAS) for interface requirements.

PART 12 CENTRAL BATTERY SYSTEMS FOR EMERGENCY LIGHTING

- A. Although battery systems are viable systems, they are usually more expensive than other systems. Accordingly, these will only be used with DPS Project Manager approval or in renovations to existing systems if replacement with an alternate system is not warranted.
- B. Specify a forward transfer-type emergency power supply consisting of rectifier/charger unit, storage battery and mechanical transfer switch. NOTE: If HID luminaires are to be supplied from this system, specify a static transfer switch.
- C. Optimum operating temperature for batteries shall be maintained at 77°F. Coordinate location of batteries with HVAC to ensure proper cooling and environmental conditions are maintained. Battery life degrades rapidly if subject to extreme temperatures.
- D. DoTS supplies their own rack mounted UPS for their equipment.

PART 13 TRANSFER SWITCHES

- A. Locate automatic transfer switch (ATS) indoors.
- B. Select switches capable of automatically transferring the load from normal to emergency source.
- C. ATS will normally be used with a generator. An ATS may also be required with auditorium lighting to turn on all house lights at full bright during a fire alarm condition. A/E shall review code requirements.
- D. Controls:
 1. Connect to Integrated Building Automation System. Refer to Section 23 09 00 – Integrated Building Automation System (IBAS) for interface requirements.

PART 14 LIGHTNING PROTECTION FOR STRUCTURES

- A. Lightning Protection System Description
 1. Design Consultant to calculate NFPA lightning probability to determine if NFPA recommends a lightning protection system at the project site.
 2. Specify the features and the requirements for a complete UL master-labeled lightning protection system, if a system is required. Indicate the requirement for bonding roof-mounted mechanical equipment, structural elements, vents, etc.
- B. Surge Protection Devices (SPD)
 1. This section describes the materials and installation requirements for a SPD. These devices are used to protect AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.
 2. Provide SPD units at the load side of each utility service entrance and each main breaker of separate switchgear lineups.
 3. SPD unit should be purchased based upon price. The SPD unit does not have to be an integral part of the main switchboard equipment.

4. SPD units on panelboards should be an integral part of the panelboard. If it is separate, the unit shall be easily accessible and adjacent to the panelboard.

PART 15 FIRE ALARM SYSTEM (POINT GRAPHIC SYSTEM)

A. General Design Guidelines:

1. “General Requirements”, DPS Design and Construction Standards of the Project Manual and project specific bid documents pertain to and are hereby made part of the work of the Specification Section.

B. Description Of Work:

1. The work under this section includes furnishing all fire detection equipment, piping and specialties and all labor necessary for a complete installation of the Fire Detection System as indicated on the drawings and specified herein.

C. Definitions:

1. Authorities Having Jurisdiction (AHJ(s)):

- a) State of Colorado
- b) City and County of Denver
- c) Denver Fire Department

2. Fire Detection Contractor:

- a) Where DPS Design and Construction Standards refer to “Fire Detection Contractor”, those references mean the “Work” shall be completed only by an Approved DPS Term & Supply Fire Detection Contractor.

3. System Design Engineer:

- a) Where DPS Design and Construction Standards refer to “System Design Engineer”, those references mean the “Architect, Engineer, or other Design Consultant” shall complete the “Work Product” and shall be in accordance with the AHJ and have a minimum NICET Level-III Engineering Technician or a qualified Professional Engineer.

D. General Design Requirements:

1. This design build specification shall not be modified, amended, or altered.
2. All work related to the fire detection system must be completed by an Approved Term & Supply Fire Detection Contractor. Contact DPS Purchasing for a list of the Approved Term & Supply Fire Detection Contractors.
3. The DPS approved Fire Detection Contractor must contract directly with the General Contractor. If there is no General Contractor on the project, only DPS approved Fire Detection Contractors will be allowed to work on the fire detection system.
4. The Architect and/or DPS Project Manager shall clearly define the scope of work, and limits of construction, including but not limited to modifications and/or additions to the existing system.
5. Nothing in this standard shall be construed to relieve the System Design Engineer and/or Fire Detection Contractor of their responsibilities with respect to applicable codes, laws or ordinances.
6. If there are overlaps in, or conflicts between code requirements, laws and ordinances, and this standard, then the requirement which provides the most stringent design criteria and provides the highest level of safety shall govern.
7. While it is expected that this standard will be of assistance to the System Design Engineer and/or Fire Detection Contractor in developing plans, specifications, and contract documents on particular projects, this standard shall not constitute the complete contract documents.
8. To ensure the accuracy of the design, the System Design Engineer shall only obtain Record Drawings of the existing facility from the DPS Space Management Office, which include but are not limited to

Architectural, Structural, Mechanical, and Electrical drawings. These drawings are available for review at DPS Space Management located at 2800 W. 7th Avenue, Denver, CO. Arrangements must be made through the DPS Project Manager to gain access to the DPS Space Management Office; drawings are not available for checkout.

9. In areas where there is full sprinkler protection, DPS requires full detection for the fire alarm system.
10. The Architect (if applicable) and the System Design Engineer's construction drawings shall:
 - a) Be on separate sheets from lighting, power and special systems.
 - b) Be to scale, showing room numbers and room occupancy descriptions.
 - c) Show the placement of alarm initiating devices and alarm notification appliances. The type of alarm initiating devices, such as smoke sensor, rate-of-rise or fixed temperature heat sensor, duct sensor, etc., shall be indicated.
 - d) Show the location of the FACP, annunciators, graphic map, zone maps, interface panel, power supplies, DFD transmitter, transmitter antenna, IBAS connection, electrical circuits used for FACP, interface, power supplies and risers.
 - e) Show a detail of the graphic annunciator panel. The detail shall show the layout of the floor plans and the location and labeling of LEDs. The detail is not required to be actual size.
 - f) Include the sequence of operation, even if the sequence is included in the specifications.
 - g) Include a zone schedule indicating the grouping of addressable devices for the annunciator.
 - h) Include a schematic system one-line diagram.
11. System Design Engineer and/or Fire Detection Contractor shall design the system to avoid conflicts with existing windows (including protection screens), transfer grilles, clocks, speakers, outlets, electrical junction boxes, data junction boxes, ceiling fans, security system devices, wiremold, and all other existing wall or ceiling equipment. It shall be the responsibility of the System Design Engineer and/or Fire Detection Contractor to maintain visibility of and/or access to the aforementioned building elements and devices.
12. The System Design Engineer and/or Fire Detection Contractor shall design the system according to the latest requirements of IFC, NFPA, State of Colorado (AHJ), City and County of Denver (AHJ), and Denver Fire Department (AHJ).
13. The Architect and/or System Design Engineer shall include the design and all necessary components for the complete installation and tie-in of the existing Elevator(s) and/or Dumbwaiter(s). If the existing building is missing or does not have a code compliant Shunt Trip(s) for the Elevator(s) and/or Dumbwaiter(s); the Architect and/or System Design Engineer shall be responsible for all necessary components (including electrical equipment, and tie-ins to a dedicated electrical circuit) for the complete installation of the required Shunt Trip(s), which meet or exceed current codes established by the AHJ:
14. If the existing building elevator(s) is missing or does not have recall functions and/or Fire Hat Operation in accordance with the AHJ; the Architect and/or System Design Engineer shall be responsible for all necessary components (including electrical equipment, elevator equipment and circuitry upgrades) for the complete upgrade of the elevator in accordance with the AHJ.
15. New facilities and facilities to be substantially renovated must include a fire alarm system:
 - a) Exceptions include very small single story buildings, sheds, and temporary facilities where code-required systems are not mandatory and the occupancy does not warrant a system.
16. Renovations affecting existing systems shall be handled on a case-by-case basis with direct input from the DPS Project Manager and DPS QA/QC:
 - a) **On projects where existing systems are modified, revised, or expanded, the System Design Engineer and/or Contractor shall meet with the DPS Project Manager and DPS QA/QC prior to the RFP or Bid Date to verify the operating condition of the existing system (i.e., is the existing**

system functioning properly, DOES THE SYSTEM HAVE ADEQUATE CAPACITY FOR THE PROPOSED SCOPE OF WORK, etc.).

17. Where a new system is being installed to replace an existing system:
- a) **The existing fire alarm systems or a temporary system shall remain fully operational until the new work is completed and the entire new system is functional and accepted by the AHJ. The Contractor shall coordinate with the AHJ concerning the requirements for keeping the existing system operational or a temporary fire alarm system operational and any fire watches that the AHJ may require.**
 - b) **Full replacement of fire alarm system shall include changing from tone based audible system to voice alarm system to meet current code requirements. Tone devices to be replaced with speakers. Voice alarm input panel and associated amplifiers and power supplies to be included as necessary to accommodate change from tone to voice system.**
 - c) **Scope of Work, includes but are not limited to the following:**
 - i) **FACP: If the FACP is not located in the Main Office, the Contractor must relocate the FACP to the Main Office.**
 - ii) **Remove all existing FA cabling.**
 - iii) **Install new cabling throughout the building in accordance with DPS Design and Construction Standards (new cabling color shall be determined by the DPS QA/QC department).**
 - iv) **Initiation Devices**
 - v) **Notification Devices**
 - vi) **Graphic Annunciator(s) and Map(s)**
 - vii) **Locations**
 - viii) **Magnetic Door Hold Opens**
 - ix) **Guards**
 - x) **Elevator(s): Tie-in and Upgrade**
 - xi) **Kitchen Hood System(s): Tie-in**
 - xii) **Mechanical: Fire/ Smoke Damper Controls and HVAC Systems**
 - xiii) **Fire Sprinkler System: Flow(s)/ Tamper(s) Switch Tie-In**
 - xiv) **Auditorium/ Gym: Lighting/ Sound Control Tie-in**
 - xv) **AES Subscriber Installation (if building doesn't have an existing AES Subscriber)**
 - xvi) **Room Labeling, Re-numbering, and Signage: The Contractor shall be responsible for all Room Labeling, Re-numbering, and Signage including but not limited to:**
 - **Updating the Graphic Maps and Annunciators**
 - **Updating the DFD Door Tags (above each door)**
 - **Updating the Wall Signage adjacent to doors**
 - **Updating all Electrical Panel Labels**
18. Before the proposed scope of work begins, the Contractor and DPS Project Manager must complete the “DPS FIRE ALARM CONTROL PANEL (FACP) STATUS & ACCEPTANCE REPORT”. This “DPS Fire Alarm Control Panel (FACP) Status & Acceptance Report” will document the condition of the Fire Alarm Control Panel and Components prior to the start of any construction within the building. After the “DPS Fire Alarm Control Panel (FACP) Status & Acceptance Report” has been executed, the Contractor will assume responsibility and maintenance for the fire alarm system until the project is complete.

19. Comply with requirements of NFPA Standard-72 for Protected Premises Signaling Systems except as modified and supplemented by this standard. The system shall be electrically supervised and monitor the integrity of conductors.
20. The system, its components, and installation shall be Underwriters Laboratories, Inc. (UL) listed under the appropriate UL testing standards for fire alarm applications. New equipment only. Used/re-manufactured equipment will not be allowed.
21. Fire Alarm Control Panel (FACP):
 - a) New Fire Detection System shall be Microprocessor-based with intelligent addressable smoke and heat sensors, and addressable contact monitoring devices for initiating devices such as manual fire alarm boxes, water flow switches, tamper switches, etc. in accordance with 2.03 Fire Alarm Control Panel (FACP).
 - b) Annunciation: Provide a point graphic annunciator that shows each initiating device as a point with a symbol:
 - i) Use high intensity LED's in graphic.
 - ii) Follow current version of Denver Fire Department "Guideline for Graphic Wall Maps".
 - iii) No Fire Detection Contractor logo's allowed on graphic panels.
22. 120-Volt power supply:
 - a) Power shall be provided from an emergency power branch circuit dedicated to the fire alarm.
 - b) Provide a Surge Protection Device (SPD) device on the incoming power. The system shall be capable of operating the system under normal load for four (4) hours while in standby operation and then be capable of operating the entire system in alarm continuously for five (5) minutes. Where the building is equipped with a standby generator, the fire alarm system shall be connected to a dedicated emergency branch circuit connected to the generator. Otherwise connect to an "EM" dedicated circuit.
23. Device and appliance layout:
 - a) The Architect and/or System Design Engineer shall meet with the Denver Fire Department, DPS Project Manager, and DPS QA/QC before submitting construction drawings, to locate control panels, annunciators, graphic wall maps, etc.
 - b) Include complete detection throughout all spaces of the building.
 - c) Devices, control panels and remote annunciators shall be flush or semi-flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
 - d) Provide photoelectric smoke sensors in toilet rooms.
 - e) Smoke detectors shall be provided at elevator lobbies, programmed for general alarm and elevator recall.
 - f) Provide a smoke detector above the Fire Alarm Control Panel (FACP).
 - g) **The maximum allowable distance between any smoke detector and any corner inside a room is 21.2 feet regardless of code exceptions.**
 - h) Smoke detectors shall not be located less than eighteen (18") inches from any light fixture and not less than three (3') feet from any HVAC ceiling mounted diffuser, return air grille, or fan.
 - i) Locate smoke detectors to avoid dirty environments that would be prone to false alarm.
 - j) Smoke detector's are required in pockets where the depth of the pocket is 10% of the ceiling height AND spacing of the beam pocket is 40% of the ceiling height.
 - k) Heat sensors in concealed and unconcealed attics (heated & unheated) and crawl spaces (heated and unheated) in accordance with their listing with the following exceptions:

- i) Sensors must be accessible from catwalks and access doors. In existing buildings, the sensors should be located over existing catwalks, if allowed by the AHJ. It is not required to add catwalks simply to meet spacing requirements.
 - ii) Spacing may be modified in order to locate sensors where they will be accessible.
 - iii) In crawl spaces and attics with limited access, locate heat sensors at the access to the space and at equipment located in the space.
- 24. Fixed-temperature heat sensors shall be located in boiler rooms, kitchens, exterior storage rooms, kiln rooms, and other similar spaces.
- 25. Provide Stopper-II model STI-1100 on all proposed and existing pull stations, except at the FACP.
- 26. Fire alarm audibility and visual notification is required throughout the building:
 - a) Devices shall be combination horn/strobe for minor modifications to existing tone systems and shall be speaker/strobe for new installations:
 - i) Horn or speaker/strobes are also required in acoustic (sound) rooms, walk-in coolers and freezers, environmental rooms and other areas resistant to sound transmission that are regularly occupied.
 - ii) Ceiling mounted horn or speaker/strobes are encouraged for discouraging vandalism.
 - Exception: Individual strobes are also acceptable where appropriate (i.e. small restrooms and conference rooms that receive adequate audibility from adjacent area horns).
 - Exception: Provide only a horn or speaker for photographic dark rooms.
 - Ceiling mounted horn or speaker/strobes shall not be used in areas with exposed structure and shall not be pendant mounting in these spaces in lieu of wall mounting.
 - iii) Visual notification must be in compliance with NFPA-72, including minimum candela intensity:
 - Strobe design must include candela rating on the individual device.
 - Use a template for strobe design to ensure sufficient intensity providing coverage to all required areas.
 - When mounted on the walls, visual alarm strobes shall be mounted eighty (80") to ninety-six (96") inches above the finished floor level or within a space of six (6") inches below the ceiling, whichever is lower.
 - In general, visual alarm strobes shall be no more than fifty (50') feet from any point in a room or corridor.
 - b) Provide horn/strobe on exterior of building above the Fire Department Connection(s).
 - c) Provide interconnection from fire alarm system to stage lighting system to illuminate the auditorium upon activation of the fire alarm system to meet the requirements of the AHJ.
 - d) Provide interconnection from fire alarm system to Stage, Auditorium, and Gym sound system to silence upon activation of the fire alarm system to meet the requirements of the AHJ.
 - e) Provide two-way firefighter phone jacks in spaces with occupancy of one thousand (1,000) or more.
- 27. System Performance requirements:
 - a) The connection between network control panels shall be a recognized network communication scheme and shall be wired in a Class-A fashion.
 - b) Alarm, trouble and supervisory signals from intelligent reporting devices shall be encoded on NFPA Class-B Signaling Line Circuits (SLC).
 - c) Initiation Device Circuits (IDC) shall be wired Class B as part of an addressable device connected by the SLC Circuit. Power for initiating devices and notification appliances must be from the main FACP or from a Field Charging Power Supply (FCPS).

- d) Notification Appliance Circuits (NAC) shall be wired Class B. Power for initiating devices and notification appliances must be from the main FACP or from a Field Charging Power Supply (FCPS).
 - e) A single ground fault or open circuit on the system SLC shall not cause system malfunction, loss of operating power or the ability to report an alarm.
 - f) Alarm signals arriving at the main FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
28. Auxiliary controls:
- a) Coordinate auxiliary controls for HVAC units, fans, dampers, fire sprinklers, elevator, lighting, sound, door control, etc.
 - b) Dampers:
 - i) The FACP must not provide power for dampers.
 - ii) Electric 120-VAC actuated dampers.
 - iii) Electric 120-VAC door controls.
 - iv) Control fire smoke dampers and door controls from the FACP via a supervised relay serving a number of dampers and doors.
 - c) Relays shall be accessible for maintenance:
 - i) All control relays must supply control to a fire alarm relay module. Only The fire alarm relay module will switch 120 volt AC power. The control relay must be located in the same location as the fire alarm relay module. The maximum number of door magnets allowed per control relay is twenty (20). Control relays will not provide switching for multiple floors. All relays must be accessible and documented on the Record Drawings.
 - d) To minimize duct over-pressurization, damper interface from the FACP shall include a delay programmed into the FACP to ensure fan blades have stopped rotating.
 - e) Include interface with necessary fire sprinkler components, water flow devices and valve supervision.
 - f) Provide fire alarm circuits to elevator controller. Provide two supervised relays in elevator machine room.
 - g) Magnetic door hold-opens and door closers with electric hold-open:
 - i) All control relays must supply control to a fire alarm relay module. Only The fire alarm relay module will switch 120 volt AC power. The control relay must be located in the same location as the fire alarm relay module. The maximum number of door magnets allowed per control relay is twenty (20). Control relays will not provide switching for multiple floors.
 - ii) Shall be connected to a dedicated circuit from the building electrical system (120 volt AC) and shall not obtain their power from the fire alarm system or convenience outlets.
 - iii) Door hold open release shall occur upon any alarm.
 - iv) For classrooms with door hold open devices, provide manual door hold open release button in each classroom, located by the room light switch.
 - v) DPS does not allow 24 volt magnetic door hold-opens.

END OF SECTION 00 60 00