

Electric

Components - Electric

- Energy Usage
- Distribution
- Lighting
- Wiring Devices
- Fire Alarm Systems
- Security Systems
- Lightning Protection
- Technology
- Telecommunications Grounding
- Intercom / Bell Systems

Standards - Energy Usage - Electric

1. All systems shall be designed in compliance with the latest version of ASHRAE Standard 90.1 "Energy Standard for Buildings Except Low-Rise Residential Buildings," and the energy usage requirements prescribed by the latest Arkansas adopted version of the Arkansas Energy Code and the Department of Energy.
2. All electrical work shall be in compliance with the latest edition of the National Electrical Code (NEC) as adopted by the State of Arkansas.

Guidelines - Energy Usage - Electric

- Consideration should be given to provide a metering device to measure all electrical usage for new buildings over 6,000 SF

Standards - Electric Distribution

1. Electrical systems distributed throughout the building shall be based upon the 480-volt or 208-volt, three-phase, grounded wye configuration except electrical system extensions in existing buildings, which may match existing criteria where not economically feasible to reconfigure. All attempts shall be made to rectify potentially dangerous voltage configurations.
2. Transient voltage surge protection and lightning arrester devices shall be located on main service distribution equipment.
3. Current carrying conductors shall be a minimum No. 12 American Wire Gauge (AWG), except for systems wiring such as fire alarm, data, telephone, etc. Conductors shall only be copper except aluminum conductors which may be utilized in lieu of copper conductors for wire size 4/0 AWG and larger. Terminations must be listed compression connectors using a compatible oxide inhibitor. A School District shall put in place and submit to the Division a maintenance plan for annual review of all terminations by qualified personnel. Conductor size No. 12 AWG and No. 10 AWG must be solid type, except where flexibility is required, such as at motors. Conductors larger than No. 10 shall be stranded. Aluminum lugs for terminating copper conductors are acceptable, if labeled for that purpose.

4. Current carrying conductors shall be installed in conduit systems conforming to the NEC, latest edition adopted by the State.
5. Continuous equipment grounding conductors shall be installed in all circuits bonded to all ground lugs, bussing, switches, receptacles, equipment frames, etc., per the NEC. The main facility grounding field electrode system to ground shall be 5 ohms or less.
6. Electrical systems main service equipment shall be designed with a minimum 25 percent spare amperage capacity and 20 percent spare space capacity. Panel board loads shall not exceed 75 percent of amperage capacity and each panel shall be provided with a minimum of 6 spare overcurrent protection devices. Provide spare overcurrent protection devices in branch distribution panel boards and main service equipment boards.
7. Electrical energy distribution equipment shall be located in dedicated electrical or mechanical rooms, and mounted at heights in accordance with the "Device Locations" table at the end of this Section 7400. Main electrical service (switchboards) distribution equipment shall not be located in the main heating or cooling generating room. Branch circuit panel boards recessed in corridor walls will not be acceptable. Provide exterior lockable Main Disconnecting means.
8. Coordinate service entrance requirements with local utility service companies for electrical energy, telephone, and cable television.
9. Dry type transformers shall be National Electrical Manufacturers Association (NEMA) TP-1/TP-2 compliant energy efficient type. Dry type transformers shall be floor mounted.
10. Electrical branch circuits to 5 horsepower, 3-phase, and larger motors for air-handling units, exhaust fans, pumps, chillers, and condensing units shall be provided with phase loss protection. Protection shall prevent equipment from single phasing. Phase loss protection equipment shall be integral to starters or variable frequency drives serving the equipment.
11. Voltage drop for feeders between the service entrance equipment and the branch circuit distribution equipment shall conform to the requirements found in the latest State adopted version of the NEC.
12. The intent of connecting emergency power to selected components of the HVAC system is to provide an opportunity to limit damage from freezing weather during a power outage of short duration. The following components are not required to be connected to the emergency power source and are optional within budgets:
 - Air handling unit pre-heat coil (heating coil)
 - Cooling tower basin heaters
 - Chilled water circulating pump, when used for chiller freeze protection
13. Independent, separate raceway, wiring, and transfer switches shall be provided for emergency life safety systems and non-emergency life safety systems.
14. Run all branch circuit and feeder conduits within buildings above ceilings and within walls unless stated below. No

device conduits are permitted in or below slabs unless serving a device or millwork that requires it. Below slab conduit may be used from MDP to the secondary panels only. Conduit shall be $\frac{3}{4}$ " minimum trade size. MC cable may be used for "lighting whips" of lengths less than 6'0". EMT conduit should be used within walls and above ceilings to ease future circuit and technology upgrades.

15. PVC conduit is not allowed except for the underground portion of the incoming utility service to the buildings. It must then be encased in 3" of concrete. All elbows and risers to 6" above finished floor in PVC conduit runs must be rigid steel. PVC elbows are not allowed.
16. MC cable is not allowed for use in walls to devices.

Standards - Lighting

1. Interior instructional spaces shall be artificially illuminated with energy-efficient and high-efficiency light fixtures.
2. High volume spaces such as gymnasiums, student dining, etc., shall be illuminated with high-efficiency, high-intensity discharge lamp type light fixtures; or, an equal or better energy efficient fluorescent luminaire that maintains or increases light levels. Fluorescent luminaires which are at least as efficient as high-intensity discharge fixtures are recommended over seating areas. Quartz restrike options shall be incorporated into some fixtures to provide an average of 2 foot-candles of illumination during the cool-down/warm-up (restrike) period caused by momentary electrical outages.
3. The minimum illumination (foot-candle) levels shall conform to the established Illuminating Engineers Society of North America (IES) guidelines. See the "School Lighting Levels" chart at the end of this Section 7400. Foot-candle calculation shall be developed by using computerized point-by-point analysis of classrooms and other learning spaces. Ceiling, wall, and floor material reflectances shall be verified with the Electrical Design Professional.
4. Emergency means of egress lighting shall be provided per local and NFPA Code requirements. The following areas shall have emergency illumination whether having natural illumination or not:
 - Exits and exit access corridors
 - Small and large assembly areas
 - Locker rooms
 - Student restrooms
 - Main and other dedicated electrical rooms
 - Main mechanical room and other mechanical decks
 - Emergency power equipment location
 - Administration and other building control areas
 - Kitchen/student dining
 - Interior instructional space
 - Rooms with occupant load over 50 people
 - Exterior side of exterior exit doorsWhere the total emergency power load exceeds 8 kW, emergency power shall be delivered by on-site, standby power generator. Generators rated 150 kW and below

- shall use gaseous fuel (if available, large units shall be diesel).
5. Light fixtures shall be controlled by switches on a per room basis where fixtures are located. Circuit breakers will not be acceptable for turning lighting "on" and "off". Switches are to be installed in accordance with "Device Locations" table at the end of this Section 7400.
 6. Exterior parking areas shall be illuminated with high-intensity, discharge lamp type light fixtures. Do not use high pressure sodium or mercury vapor. Fluorescents or LED lighting shall be used.
 7. Computer labs shall be illuminated with fluorescent light fixtures constructed and configured to reduce glare on computer monitors. Minimum Visual Comfort Probability (VCP) in these rooms shall be 80%.
 8. Fluorescent lighting in instructional spaces shall be oriented so the long dimension of the fixture is parallel with the chalkboard on the primary instructional wall and switched separately unless design parameters suggest otherwise. Optionally provide wall wash type fixtures to illuminate white-boards or chalk-boards.
 9. Provide site lighting to foot-candle levels recommended by the IES.
 10. Light fixtures located in gymnasiums and auxiliary gymnasiums shall be equipped with protective wire guards.
 11. Exit signs shall be wall mounted, where possible, in lieu of ceiling mounted and be of the LED type.
 12. Middle School and High School Art rooms shall be provided with supplemental track lighting that comes as close as possible to the color and quality of daylight, generally in the color temperature range of approximately 5000 Kelvin to 5900 Kelvin.
 13. Walk through fluorescent lighting shall be provided to supplement main lighting in gymnasium and auxiliary gymnasiums to illuminate area to 5 foot-candles. Fixtures shall be vandal-resistant type and protected with wire guards. Mount fixture at same level as high intensity discharge lighting. LED or fluorescent lighting shall be used.
 14. Options shall be investigated for control of exterior and interior corridor lighting by direct digital control, the energy management system, or occupancy sensors.
 15. Interior lighting shall be controlled by occupancy sensors, automatic timed lighting controlled system or a combination of both to comply with ASHRAE 90.1 as required by the Arkansas Energy Code. Exterior lighting shall be controlled by photo sensor or astronomical time clock to comply with ASHRAE 90.1 1 as required by the Arkansas Energy Code to automatically turn lighting off when sufficient daylight is available.
 16. Instructional space lighting shall be configured to provide at least two levels of light. One level shall be configured to darken the area around a video or projection screen.
 17. Options shall be investigated for providing non-disruptive day-light harvesting in classrooms and other spaces with natural lighting.

Standards - Wiring Devices -Electric

1. Receptacles, switches, and other wiring devices to be installed at heights above finished floor in accordance with the "Device Locations" table at the end of this Section 7400.
2. General purpose use, 120-volt duplex receptacles shall be specification grade, 20 amp standard grounded type.
3. Separate receptacles located within instructional spaces shall be provided for general purpose uses and for computer/video technologies.
4. Instructional spaces shall be provided with a minimum of 8 general use receptacles, as well as double duplex receptacles next to computer/video technologies ports.
5. Each space or room shall be provided with a minimum of one, 120- volt receptacle.
6. General purpose receptacles in corridors shall be spaced a maximum of 50 feet apart and not on classroom circuits.
7. Office areas, conference rooms, and teacher workrooms shall be provided with a minimum of 4 receptacles.
8. Duplex receptacles within 6 feet of plumbing fixture units shall be ground fault protected. These receptacles shall be protected by a local or an integral ground fault device.
9. A maximum of 4 computers shall be on a single 20-amp, 120-volt electrical circuit with a dedicated ground, and neutral. Do not share computer circuit neutrals with other branch circuits.
10. Key-type switches protected with wire guards shall be used to control lighting in gymnasiums, auxiliary gymnasiums, and locker rooms. Non-protected key switches shall be used to control lighting in corridors, large group restrooms, and other public spaces. Instructional type spaces shall be controlled by toggle-type switches.
11. Provide an exterior, weatherproof ground fault protected duplex receptacle outside each main exterior door.
12. Electrical receptacles serving food service equipment not located against walls shall be mounted above the floor line on pedestal-type mountings.
13. Kindergarten classrooms and their auxiliary spaces shall have duplex, tamper-resistant receptacles installed.
14. Receptacles shall be side-wired using pigtails. Back-wiring or thru- wiring on device terminals is not acceptable.
15. A dedicated 20 amp charging station shall be installed per every eight instructional spaces.

Standards - Fire Alarm Systems

1. Fire alarm and fire protection systems shall be installed per the Fire Prevention Code and NFPA 70. System device mounting heights above finished floor provided in the table "Outlet Locations" at the end of this Section 7400.
2. Companies designing, installing or servicing fire alarm systems in Group E occupancies shall be properly licensed by the Arkansas Board of Private Investigators, Private Security Agencies and Alarm Systems Companies.
3. Fire alarm shop drawings shall be prepared in accordance with the Arkansas Fire Prevention Code and approved by the State Fire Marshal's office or their Designee prior to installation.

4. Main control panel shall be located in the administrative area.
5. A Sequence of Operation document shall be provided to the District with each system.

Standards - Security Systems

1. Within the base building electrical system cost, provide the following basic security systems:
 - Provide conduit rough-in and wiring only for key pad locations, motion sensors, door contacts switches, card readers, and control panel
 - System selection, installation and funding shall be by the school district
 - A minimum system design shall include door contact switches at exterior doors, and motion detectors distributed throughout corridors, administrative areas, and in rooms with 6 computers or more

Standards - Lightning Protection

1. Within the design of the base building electrical system, the Electrical Design Professional has the option of including an Underwriter's Laboratory (UL) listed and certified lightning protection system, where calculations indicate the facility may be at elevated risk. Therefore, where calculations indicate the facility may be at an elevated risk, new school buildings shall be protected but additions to existing schools with no history of damage with similar roof elevations may be omitted.

Standards - Technology

1. As a minimum in the base electrical cost for every construction project, provide a broadband internet connection to the building (or, to each building on the campus) and provide the Technology rough-ins required by this sub-section. Coordinate the placement of all Technology Conduits, boxes and outlets with the Technology Design Professional and in accordance with Section 7500 - Technology Systems.
2. Provide Telecommunications cable tray above corridor ceilings of academic wings. Cable tray depth shall be calculated per NEC requirements.
 - Provide 24" center-hung raceway in main corridors
 - Provide 18" center-hung raceway in secondary corridors
 - Cable tray shall connect between all intermediate closets Telecommunication Rooms (TRs) and the Main Cross-connect (MC)
 - Provide continuous bonding conductor (minimum # No.6 AWG), in accordance with NEC-250 and TIA/EIA-607-B, in all cable trays and bond to associated Telecommunications Grounding Busbar (TGB)
 - NOTE: Cable "D" devices may be used in lieu of cable trays in both main and secondary corridors, providing they are of sufficient size to clearly distinguish individual runs. J-Hooks shall be pre-galvanized, with a static load capacity of 30 lbs. , and cable retainers.

- All firewall penetrations shall be appropriately and properly sealed per latest state adopted version of the NFPA
3. Junction boxes used for data/voice/video outlets shall be 2-gang, 3 1/2:" deep boxes and equipped with a minimum of a 1" conduit home run to the associated Telecommunications Cable Tray, except where noted by the Telecommunications Design Professional.
 4. Telecommunications Rooms (TRs) shall be provided with a minimum of two (2) 120-volt, 30 Amp circuits for powering rack mounted UPS Units. Each receptacle used for powering UPS units shall be twist lock. Quantity and location of circuits will depend upon requirements of Technology Design professional. If the building has a standby Generator, these circuits shall be attached to the standby power. General use receptacles, as well as double duplex receptacles shall be provided next to computer/video technologies ports.
 5. In concert with the "Device Locations" table at the end of this Section 7400, provide power outlets, technology cabling home-run conduits and projector mounting brackets as follows:
 - Provide one (1), 2-gang, 3-1/2" deep box for Technology use (HI station) and a quad power outlet mounted at 18" below finished ceiling for monitors installed in wall or ceiling mounts
 - Provide one (1), home run, 1-1/4" conduit from HI Station box to associated instructor LO Station box
 - Provide one (1), home run, 1" conduit from HI Station box to associated Telecommunications Cable Tray
 - Provide one (1), 2-gang, 3½" deep box for the instructor's LO station and quad power outlet at 18" AFF
 - Provide one (1), 1-1/4" conduit from LO Station box to associated monitor HI Station box
 - For locations with an Overhead Mounted Projector in lieu of a Monitor, provide one (1), 1-gang, 3-1/2" deep box for Technology use (Projector HI station) and a dual power outlet mounted in a finished ceiling tile, projector bracket in the finished ceiling
 - Provide one (1), 1-1/4" conduit from Projector HI Station box to associated instructor LO Station box
 - Provide one (1), home run, 1" conduit from Projector HI Station box to associated Telecommunications Cable Tray
 6. Provide a minimum 4-3/4 inch high center divided surface applied metal raceway in computer labs where equipment is located on perimeter of room.
 - Provide one (1), 1-1/4" conduit for every six computer workstation locations stubbed up above the nearest finished ceiling and home run to the Telecommunications cable tray
 7. Provide two (2), 2-gang, 3½" deep boxes for the video projector local inputs, with one on the backside of the proscenium wall and one in the control booth.

- Provide one (1) home run 1½" conduit from each box to the video projector in the ceiling. Provide a minimum of one 4" conduit for Wide Area Network (WAN) from the Service Provider (SP) Entrance (DEMARC) to the property line.
- 8. Provide a minimum of one 4" conduit for Wide Area Network (WAN) from the Service Provider (SP) Entrance (DEMARC) to the property line.
- 9. Provide one (1), 4" conduit for cable television (CATV) from the Service Provider (SP) Entrance (DEMARC) to the property line.
- 10. Provide one (1), 4" conduit for the telephone from the Services Provider (SP) Entrance (DEMARC) to the property line.
- 11. Provide a minimum of two (2), 4" conduits from the Service Provider Entrance (DEMARC) to the Main Cross-Connect (MC) Telecommunications Room (TR). Conduit runs for fiber optic cable have no more than two (2) 90 degree bends without installations of a pull box. All 90 degree bends are to be wide sweep. Pull boxes should be placed in a straight section of conduit and shall not be used in lieu of a bend. Pull box sizing shall be in accordance with TIA-569-C.
- 12. Provide two (2), 2" sleeves in all classroom walls.
- 13. All empty conduits shall be provided with a rot, mildew, and tangle resistant pull string.
- 14. Exterior conduit shall not exceed 600 feet between pull points and shall not contain more than two (2) 90 degree bends. Covers shall be rated per application.
- 15. Ground floor outlet boxes shall be rated for damp locations with a direct pathway provided under slab to the nearest telecommunications room. All telecommunications copper cabling located under slab shall be OSP rated.
- 16. Generic telecommunications cabling shall be installed in a hierarchal star topology.

Standards - Telecommunications Grounding

1. Provide Telecommunications Grounding/Bonding System in accordance with NEC-250 and TIA/EIA-607 using Designer approved Grounding Hardware. CAD Weld Bonding Conductors to Building Steel.
2. Provide Telecommunications Main Grounding Busbar (TMGB) in the main cross-connect, and a Grounding Busbar (TGB) in the Telecommunications Rooms (TR).
 - All TMGB and TGB Connections to be made with double- bolted, Compression style, Grounding Lugs, as a minimum. Bond TMGB to following:
 - Building Steel (minimum No. 6 AWG insulated copper bonding conductor). Sizing per TIA-607-B
 - Main Electrical Service Ground (minimum No. 6 AWG insulated copper bonding conductor). Sizing per TIA-607-B
 - Local Service Panel Ground (minimum No. 6 AWG insulated copper bonding conductor). Sizing per TIA-607-B
 - Telecommunications Bonding Backbone (TBB) that connects TMGB to other TGBs (minimum No. 6 AWG

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- insulated copper bonding conductor). Sizing per TIA-607-B
- Associated Telecommunications Cable Tray(s) (minimum No. 6 AWG insulated copper bonding conductor). Sizing per TIA-607-B
 - Telecommunications Conduit(s) Entering TR (minimum No. 6 AWG insulated copper bonding conductor). Sizing per TIA-607-B
3. Provide Telecommunications Bonding Backbone (TBB) between all TGBs and the TMGB
- The TBB shall be a minimum of No. 2 AWG insulated copper bonding conductor. Sizing per TIA-607-B
 - All TBB Connections to be made with double-bolted, Compression style, Grounding Lugs
4. As a minimum, the Technology Contractor shall bond the following devices to the associated TMGB and TGBs using a minimum No. 6 AWG (sizing per TIA-607-B) insulated copper bonding conductor using compression style lugs:
- PABX equipment
 - Equipment racks and cabinets
 - TR cable ladder and tray
 - CATV Equipment
 - Lightning and surge protectors
 - Telecommunications devices
 - Coupled Bonding Conductors (CBCs)
 - Backbone cable shields
 - Telecommunication and fiber cable shields
 - Antenna cable shields
 - Raised floors

Standards - Intercom / Bell Systems

1. Provide a complete intercom communication system with call stations and speakers in each occupied space and speakers on the building exterior. Speakers shall be located and sufficiently powered to be clearly heard.
2. The intercom system shall be capable of generating various tone signals to be used in special notification situations.
3. Provide Battery Back-up for operation during a power failure.



School Lighting Levels - 2004

ROOM TYPE CLASSIFICATION	2000 IES FOOTCANDLES	RECOMMENDED DESIGN FOOTCANDLES DIRECT LIGHTING(1)	RECOMMENDED DESIGN FOOTCANDLES INDIRECT LIGHTING
ADMINISTRATIVE			
Offices/Receptionist	50	50	40
Storage Rooms	-	25	25
Restrooms	5	25-30	25-30
Conference/Resource Rooms	30-100	50	40
Health Clinic	50	50	40
Teacher Prep/Workroom	50	50	40
CLASSROOMS-GENERAL			
Art Rooms/Kiln	50	50	40
Modular Technology Labs	-	50	40
CADD Labs	30	30	30
Industrial Tech/Production Labs	100	60	60
Computer Labs	30	40	40
Graphics Labs	30-100	50	40
Life Skills Labs	50	50	50
Science Labs	50	50	50
Laundry Rooms	-	25	25
Music Rooms	30-50	50	40
Large Group Instruction Rooms	30	50	40
MEDIA CENTER			
Active Areas	30 vertical	50	40
Inactive Areas	5 vertical	40	40
ATHLETIC AREAS			
Gymnasium - Elementary School	100	50	-
Gymnasium - Middle School	100	50	-
Gymnasium - High School	100	60	-
Multi-use P. E. Rooms	-	50	-
Locker Rooms	10	25	25
PERFORMING ARTS			
Assembly	10-20	20	-
Stage/Work Lights	30	20	-
Make-up/Dressing Rooms	30-50	50	-



Theatrical Control Room	10-30	30	-
Equipment room with dimmable incandescent lighting offering 10 foot-candles of illumination.			

School Lighting Levels - 2004

ROOM TYPE CLASSIFICATION	2000 IES FOOTCANDLES	RECOMMENDED DESIGN FOOTCANDLES DIRECT LIGHTING(1)	RECOMMENDED DESIGN FOOTCANDLES INDIRECT LIGHTING
STUDENT DINING	10-50	50	40
Cooking	50	75-80 (2)	-
Food Preparation	50	75-80 (2)	-
Serving Line	50	75-80 (2)	-
Ware Washing	10	75-80 (2)	-
CUSTODIAL CLOSETS	10-30	20-30	-
ELECTRICAL ROOMS	30	20-30	-
MECHANICAL ROOMS	30	30	-
PARKING AREA	.2	(1)(3)	-
DRIVEWAYS	.3	.5 (3)	-
CIRCULATION AREAS			
Building Entries	5	5-10 (3)	-
Corridors	5	20	20
Corridors with Lockers	5	20	20
Stairways	5	20	20
(1) Maintenance factor 70% LL/SF = Lamp Lumens per square foot			
(2) Foot-candles shall comply with local health department regulations			
(3) Foot-candles shall conform to Sub-section 4000			



Recommended Device Locations

ELECTRICAL OUTLET DEVICE TYPE	Masonry Wall, Base (Starter) Course Height 4 inch Mounting Height Above Floor to Bottom of Outlet (Device) Box	Masonry Wall, Base (Starter) Course Height 8 inch Mounting Height Above Floor to Bottom of Outlet (Device) Box
Receptacle outlets, microphone outlets (jacks), equipment outlets (jacks), television outlets (jacks), portable telephone outlets, computer outlets, etc. * General throughout * Mechanical equipment rooms * Above counter tops 30"H 36"H 48"H * Above backsplash top * Above radiators * Above or adjacent to lavatories * Behind domestic refrigerators * Behind domestic washers and dryers * Serving domestic dishwashers * Wall-mounted telephone outlets * Telephone/video control	18" 52" 36" 44" 52" 2" minimum 6" minimum 44" 52" 36" 2" 44" 44"	18" 48" 40" 48" 56" 2" minimum 6" minimum 48" 56" 32" 2" 48" 48"
Toggle switches	48"	48"
Recessed motor controllers	60"	56"
Electric panels, terminal cabinets, etc., to center of tub or box	50"	48"
Clocks	Near ceiling	Near ceiling
Pull stations (fire alarm)	44"	44"
Volume controls, call-in switches, doorbell buttons	44"	44"
Horn/strobes (fire alarm)	80"	80"