BEAVERTON SCHOOL DISTRICT

BSD Technical Standard
Division 26: Electrical

1. PURPOSE

This Technical Standard is a narrative describing Beaverton School District's (BSD's) Basis of Design for electrical systems. The information contained herein shall be used by the Project Design Team to develop a sustainable and integrated electrical, lighting, and controls system that is economical to construct, maintain, and operate; that enhances learning by providing a safe and suitable work environment for staff and students. This Technical Standard shall be used as part of the BSD's General Design Standards (comprised of the BSD Educational Specifications and the BSD Technical Standards).

2. GENERAL

2.1. ENGINEERING DESIGN PRIORITIES

2.1.1. These Standards were developed with the intent of extending the trouble-free life of equipment, reducing future maintenance problems and addressing energy conservation as a priority. Within these goals and project budget constraints, electrical engineering design for BSD projects should comply with the following hierarchy of priorities:

2.1.1.1. Occupant safety

2.1.1.2. Program compliance/occupant comfort

2.1.1.3. Life-cycle cost including maintenance and energy

2.1.1.4. Initial cost

2.2. DESIGN DOCUMENTS

2.2.1. The District's assigned numbers shall be used for all labeling. Design assumptions that define the capabilities of the building shall be documented on the drawings. These include, but are not limited to: electrical load, lighting power density, assumed hours of operation, provisions for future expansion (if any).

2.3. CLOSEOUT

2.3.1. Training

2.3.1.1. Provide training for appropriate District personnel. Training will review complete Operations and Maintenance (O&M) Manual, including but not limited to, programming and setup of any control systems, required maintenance, and troubleshooting, including contact names and phone numbers for factory support.

2.4. SAFETY

2.4.1.Electrical Equipment

2.4.1.1. Secure and limit access to all energized electrical equipment. Electrical equipment and panels shall be behind closed doors or in non-public access areas.

2.4.2.Hazardous Materials

2.4.2.1. Including, but not limited to, fluorescent lamps and PCB containing transformers, ballasts and fixtures, must be handled and disposed of in compliance with all applicable environmental regulations.

2.4.2.2. Notify the Owner and file all required reports upon discovery of any hazardous materials. All handling or disposal of hazardous materials must be documented and handled in compliance with all current EPA and Oregon DEQ requirements and regulations.

2.4.3.Outages

2.4.3.1. A minimum of seven (7) calendar days, in advance, coordinate all electrical service outages with the District and the power company.

2.4.3.2. Confirm outage times with BSD Representative, in advance, a minimum of 48 hours.

2.4.3.3. Plan all work so that the duration of outage is kept to an absolute minimum.

2.4.3.4. Provide temporary wiring as required in order to maintain continuous service to occupied portions of the building during business hours.

2.5. DEMOLITION AND SALVAGE

2.5.1.Salvage

2.5.1.1. BSD has first rights of salvage for equipment and materials removed during construction. Coordinate project specific details with the BSD Representative.

3. BASIC ELECTRICAL REQUIREMENTS

3.1. SUPPORTING DEVICES

3.1.1.Conduits

3.1.1.1. Conduits shall be supported within 18” of outlets, boxes, panels, cabinets, and deflections (current code is 36”). Maximum distance between supports is not to exceed 5’-0” (current code is 10’-0”).

3.1.1.2. Prevent movement and/or sag of junction boxes, pull boxes, or other conduit terminating housings located above suspended ceilings by suspending them from appropriate supports or roof structure.

3.2. POWER

3.2.1.Primary

3.2.1.1. Transformers and power cable for primary feeders over 600V shall be furnished, installed, connected, and owned by the serving utility company.

3.2.2.Secondary Main

3.2.2.1. At new installations, provide a cost/benefit analysis comparing a single service at 480V 3-phase versus two services, one at 480V 3-phase and the other at 208V 3-phase. The desire is to have all transformers located on the utility side of the meters.

3.2.2.2. Single-phase main power is only allowed with BSD Representative approval.

3.2.3.Capacity

3.2.3.1. Switchgear and main distribution shall be designed and sized for 150% of the code calculated loads to allow for future expansion in both ampacity and physical capacity.

3.2.4.Dry-Type Transformers

3.2.4.1. Manufacturers: Cutler-Hammer, Siemens, Square D, General Electric

3.2.4.2. Rating: 480V 3-phase primary; 208/120V 3-phase secondary, KVA rating as required.

3.2.4.3. Use NEMA Standard TP-1 compliant transformers. Transformer shall be rated for average 115°C temperature rise above 40°C ambient with 100% of rated nameplate load connected to the secondary.

3.2.4.4. Provide mechanical type lugs for conductor terminations.

3.2.4.5. Mount on a vibration mounting pad suitable for isolating the transformer housing from building structure. Provide 4” thick, concrete housekeeping pad above adjacent finished floor for floor-mounted transformers.

3.2.5.Back-up Power and Standby Generators

3.2.5.1. Generators should last 96 hours at minimum. Acceptable Manufacturers: Caterpillar, Kohler, Cummins. UL2200 listed.

3.2.5.2. Diesel Generator System

3.2.5.2.1. The following items shall be served by the emergency generator at schools:

3.2.5.2.2. Main reception and Principal’s office convenience outlets

3.2.5.2.3. Custodian’s office convenience outlets

3.2.5.2.4. Kitchen convenience outlets

3.2.5.2.5. Bathroom lighting

3.2.5.2.6. Egress/Security lighting

3.2.5.2.7. Exit lights

3.2.5.2.8. Common area lights

3.2.5.2.9. Gym lights

3.2.5.2.10. Fire Alarm systems

3.2.5.2.11. Security systems

3.2.5.2.12. MDF/Office IDF/phone systems

3.2.5.2.13. Elevator on selective switch on manual transfer

3.2.5.2.14. Emergency Voice/alarm communications

3.2.5.2.15. Recirculation HVAC fans, not to include heating or cooling

3.2.5.2.16. Ventilation fans

3.2.5.2.17. Power exhaust fans

3.2.5.2.18. Freezer

3.2.5.2.19. Cooler

3.2.5.2.20. Fire Sprinkler Dry-system Air Compressor

3.2.5.3. Engine

3.2.5.3.1. Liquid-cooled diesel engine

3.2.5.3.2. 90 amp hour battery with rack, cables and 2 amp charger

3.2.5.3.3. Coolant heater

3.2.5.3.4. Critical exhaust silencer

3.2.5.3.5. Fuel filter and water separator

3.2.5.3.6. Air cleaner and oil filter with internal bypass

3.2.5.3.7. Low coolant, low oil pressure, high water temperature, over crank, and overspeed shut downs

3.2.5.3.8. 1.5 HP per KW rating

3.2.5.3.9. Thermostatically controlled block heater

3.2.5.3.10. Skid mounted radiator with blower fan and fan shroud

3.2.5.3.11. Electronic governor

3.2.5.3.12. Oil drain extension

3.2.5.3.13. Operators Manual

3.2.5.4. Generator

3.2.5.4.1. Rotating exciter mounted to generator shaft through brushless rotating diode system

3.2.5.4.2. Class F insulation windings per NEMA MG-1

3.2.5.4.3. Static type voltage regulator maximum 15% voltage drop for zero to full load step

3.2.5.4.4. Electronic governor with 0.5% frequency regulation

3.2.5.4.5. Analog/digital control panel with AC V/A/Frequency meters with phase selector switch/emergency stop switch with audible alarm/programmable engine control and monitoring output

3.2.5.4.6. Main line circuit breaker sized to specification

3.2.5.4.7. Two-year, on-site parts and labor warranty

3.2.5.5. Annunciator

3.2.5.5.1. Remote alarm annunciator panel for emergency generator shall be located in the main office and must contain the following alarms at a minimum:

3.2.5.5.2. High or low voltage, AC, and battery

3.2.5.5.3. Overcrank overspeed

3.2.5.5.4. High or low frequency

3.2.5.5.5. Unit not in “automatic”

3.2.5.5.6. Low or pre-low oil pressure

3.2.5.5.7. On utility power

3.2.5.5.8. Low water temperature and level

3.2.5.5.9. On generator power

3.2.5.5.10. High and pre-high engine temperature

3.2.5.5.11. High, low, critical low fuel alarms

3.2.5.6. Mounting

3.2.5.6.1. Skid mounted with internal vibration isolators mounted on a concrete pad and seismic rated spring isolators. Seismic Zone 3 rated.

3.2.5.7. Housing

3.2.5.7.1. Weather housing with rodent guards and sound attenuated enclosure providing a noise level at 3’-0” from the machine under full load of 80 dB or less.

3.2.5.8. Fuel Storage

3.2.5.8.1. 12 hours of diesel fuel in above ground dual wall storage tank.

3.2.5.9. Transfer Switch

3.2.5.9.1. 3-pole contactor type mechanically latched

3.2.5.9.2. Time delay neutral

3.2.5.9.3. Automated transfer to generator power when utility power is interrupted

3.2.5.9.4. Automatic transfer back to utility power when restored

3.2.5.9.5. Adjustable automatic exerciser

3.2.5.9.6. Use 4-pole type switch with grounded generator when generator backs loads

3.2.5.9.7. Normally served on more than one electrical service

3.2.6. Testing

3.2.6.1. Factory testing, field load bank test, and full building load test. Provide a copy of test report to BSD Representative.

4. WIRING METHODS

4.1. GENERAL

4.1.1. All installations shall meet NECA standards for workmanship. All systems shall be complete and operable. Architect/Engineer (A/E) is responsible for determining voltage, phase, circuit ampacity, and number of connections.

4.1.2. Wiring shall be in cable tray or conduit unless otherwise noted. When open wiring is permitted, raceways will be required in insulated walls and other inaccessible areas. See Appendix A: Category Cabling (5e, 6, 6a) for cable coloring specifications.

4.1.3. All pull boxes, junction boxes, and other enclosures shall be accessible without conflict from other equipment or trades.

4.1.4. Use keyed switches in corridors and commons areas to control lighting locally. See **WIRING DEVICES** for key switches specification.

4.1.5. There shall be no more than six convenience outlets per circuit. Provide a minimum of four convenience outlet circuits in each classroom alternating between outlets. Classroom outlet circuits shall not be used in other rooms or corridors.

4.1.6. Provide single circuit outlets for the following, and where directed or required for a specific use:

4.1.6.1. Copiers

4.1.6.2. Data/telephone intermediate data frames (IDFs)

4.1.6.3. Fire alarm panel

4.1.6.4. Mobile laptop charging station locations

4.1.6.5. Main data frames (MDFs)

4.1.6.6. Security panel

4.1.6.7. Classroom projectors, or other display equipment

4.2. GROUNDING/BONDING NETWORK

4.2.1. Ground Rods

4.2.1.1. Copper clad steel, ¾” diameter, 10’-0” long, tapered point, chamfered top.

4.2.2. Ground Connectors

4.2.2.1. Hydraulic compression tool applied connectors where possible, or exothermic welding process connectors. Burndy, Thomas & Betts, Cadweld.

4.2.3. Equipment Grounding Conductor

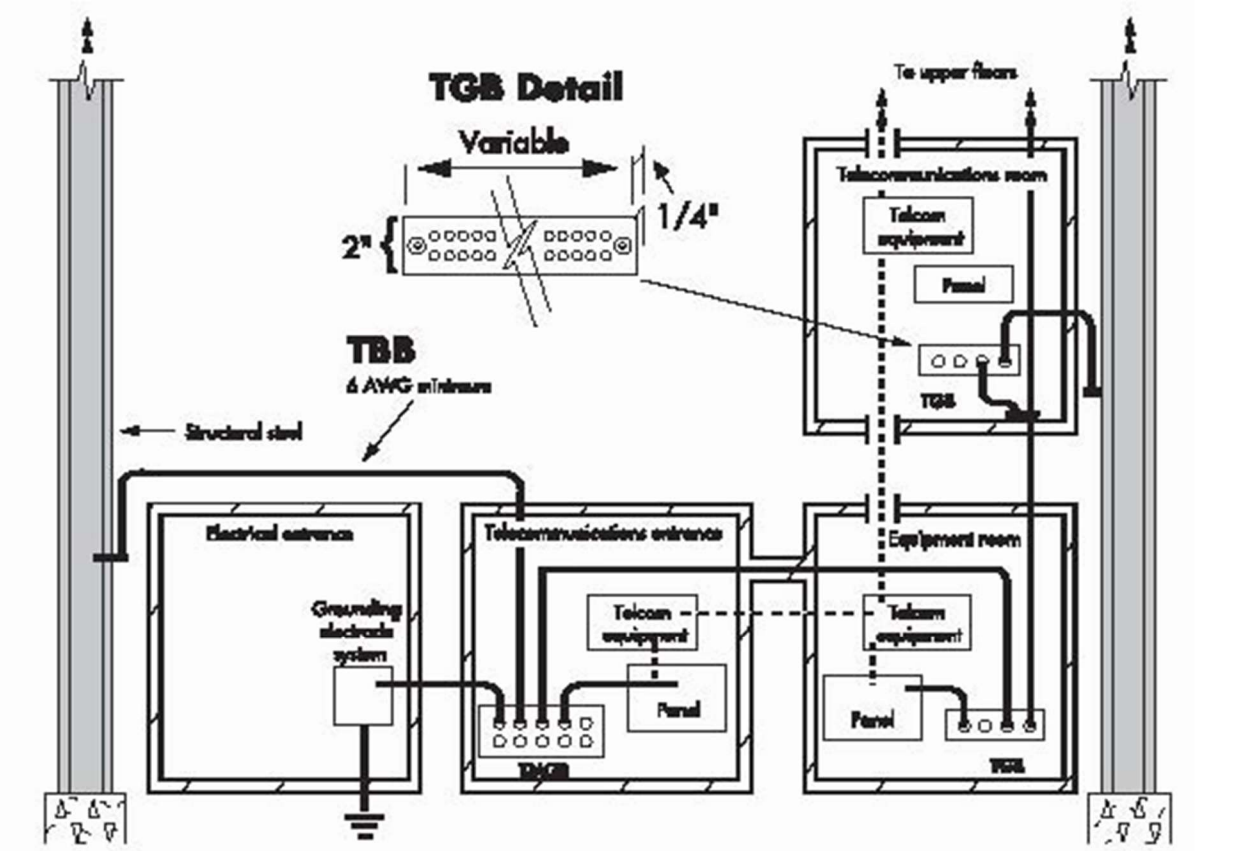
4.2.3.1. Install continuous equipment grounding conductor, code size minimum, in all raceway systems.

4.2.4.Telecommunications Bonding Backbone (TBB)

4.2.4.1. Provide a TBB. The Telecommunications Main Grounding Busbar (TMGB) serves as a dedicated extension of the building ground electrode system at the main service equipment room.

4.2.4.2. TMGB shall be bonded with 6AWG or larger stranded copper cable to the Telecommunications Grounding Busbar (TGB) at each Telecommunications Frame Room. At each frame room, provide TGB: ¼" thick by 4" high by 10" long copper ground bar with insulators, Harger, Erico/Cadweld, or equal approved.

4.2.4.3. All racks, ladder rays, and conduit shall be grounded with a minimum of 6AWG copper conductor to TGB.



Schematic of Grounding/Bonding Network

4.2.5.Protection

4.2.5.1. Where exposed, protect ground electrode conductor in rigid PVC conduit. Do not use metal conduit for grounding electrode conductor protection.

4.2.6.Remodels, Retrofits, and Additions

4.2.6.1. Evaluate existing grounding and upgrade existing grounding electrode system at main service and dry-type transformers, if necessary, to meet current code requirements. Include re-bonding of main service ground bus to new ground rods.

4.2.7.Extension

4.2.7.1. The Contractor shall extend existing grounding electrode systems and equipment grounding systems.

4.3. PANELBOARDS

4.3.1.Manufacturers

4.3.1.1. Square D, General Electric, Siemens, Cutler-Hammer. Match manufacturer and breaker style with existing panelboards where applicable.

4.3.2.Service Distribution Switchboards

4.3.2.1. Freestanding dead front NEMA 1 enclosure. Fuses shall not be used. All main service switchgear shall be equipped with circuit breakers fully-rated for available fault current. Plated copper busbars.

4.3.2.2. Provide fully-rated integrated equipment rating greater than the available fault current. Compression-type lugs rated for both aluminum and copper conductors.

4.3.2.3. All new facilities to provide electrical usage sub-metering capability so that HVAC, lighting and plug loads may be viewed independently and analyzed. At a minimum, HVAC bus, lighting bus, plug loads and other equipment shall be independently bussed and metered.

4.3.2.4. Equipment shall be labeled so that future circuits can be added to correct metered bus. All metering shall be BACnet IP native and commissioned to Direct Digital Control (DDC).

4.3.3.Branch Circuit Panelboards

4.3.3.1. Bolt on circuit breaker type. Fuses shall not be used. Plated copper busbars. Provide fully-rated integrated equipment. UL series rating is allowable if all upstream panels, including the main service, are installed under this Contract.

4.3.3.2. Compression-type lugs rated for both aluminum and copper conductors. Provide double hinge covers. Key all branch panels alike. Provide 20% or more spare circuit capacity for future expansion.

4.3.4.Expansion

4.3.4.1. Where distribution equipment, switchboards, panel boards, or control panels are installed, it is required that Electrical Metallic Tubing (EMT), Intermediate Metal Conduit (IMC), or Galvanized Rigid Conduit (GRC) raceways be installed for a minimum of 5’-0” out of each piece of equipment.

4.3.4.2. Provide two additional ¾” and two additional 1” spare conduits from each panel board to accessible space above and as applicable below panel board for future expansion.

4.4. OVERCURRENT PROTECTIVE DEVICES

4.4.1.Fuses

4.4.1.1. Dual element, time delay, current limiting, nonrenewable, rejection feature. UL Classes RK1 and L. Provide with indicator window to show when fuse is blown.

4.4.1.2. Product: Cooper-Bussmann, Ferraz Shawmut, Littelfuse, or approved equal.

4.4.2.Molded Case Circuit Breakers

4.4.2.1. Adjustable magnetic trip breakers for motor and compressor loads greater than 100A. Bolt-in style only.

4.4.2.2. Product: Cutler-Hammer, General Electric, Siemens, Square D.

4.5. RACEWAYS AND CONDUITS

4.5.1.General

4.5.1.1. All conduits shall be installed in a concealed manner where possible and shall be installed parallel to the lines of the building. All conduits shall be a minimum of ¾".

4.5.1.2. Any exposed conduits shall be installed parallel or at right angles to the building walls or floors. All exposed conduits shall be securely fastened in place on maximum 5'-0" intervals for ¾" through 2 ½" nominal sizes.

4.5.1.3. Runs between junction boxes shall not contain more than the equivalent of three 90° bends. (No more than 270° total in bends.) Conduit bends shall be made with appropriate tools of proper size; radius of bends shall be at least six times the diameter of the conduit.

4.5.1.4. Conduits are required in inaccessible locations (i.e., hard-lid ceilings, behind walls, under windows, etc.).

4.5.2.Underground

4.5.2.1. PVC Schedule 40 conduit shall be used for all underground installations. Where installed in concrete, provisions shall be made to assure a minimum cover of 2" of concrete. Where installed underground, a minimum of 18" of cover shall be provided.

4.5.2.2. PVC conduit shall transition with a 90° GRC bend where it emerges from the ground or concrete in all locations in which it is installed.

4.5.3.Dry, Protected Locations

4.5.3.1. GRC, IMC, EMT. If subject to movement or vibration, use flexible metallic conduit. All flexible conduits will not exceed 6'-0" in length and shall be used only in areas where vibrations and/or expansion joints are present.

4.5.4.Damp Locations

4.5.4.1. Conduit and related equipment must be rated and suitable for the application. Use GRC or IMC for areas subject to mechanical damage. If subject to movement or vibration, humidity, water spray, or oil spray, use PVC coated flexible metallic conduit.

4.5.4.2. Sealtite, or equal, shall be used where flexible conduit connections are required and at connections to all motorized equipment and motors.

4.5.5. Exposed Work in Finished Spaces

4.5.5.1. Use metallic raceway in all applications. Under no circumstances shall low-voltage cable bundles be hung from existing electrical conduit systems.

4.5.6. Conduit Bodies

4.5.6.1. Conduit bodies are allowed for feeders and branch circuits less than or equal to 100A and for signal cabling not related to data communications.

4.5.7. Tele-Power Poles

4.5.7.1. Use aluminum construction, two-compartment poles with minimum thickness of 0.05". Wiremold NP600 series, or equal.

4.5.8. Conduit Installation

4.5.8.1. Bushings and connectors shall be plastic insulated, lined, 105°C rated. A bushing shall be used where conduit enters a panel box.

4.5.8.2. All heavy wall conduits shall have two locknuts and a bushing at each termination outlet box, junction box, etc., except where terminated in a threaded hub.

4.5.8.3. Fittings on EMT shall be set screw type with an insulated throat.

4.5.8.4. Expansion fittings shall be provided at all conduits across the building expansion joints.

4.5.8.5. Fittings shall be Type "AX" or "TX" as made by O-Z Gedney Appleton Group, or equal. Provide copper bonding jumper at each expansion fitting.

4.6. BOXES

4.6.1. General

4.6.1.1. All pull boxes, junction boxes, and other enclosures shall be accessible without conflict from other equipment or trades. Pull boxes and junction boxes shall be installed where required to facilitate wire installation.

4.6.1.2. All switch, pull, junction boxes, and other enclosures shall be hot dipped galvanized, concrete tight, with interlocking ring.

4.6.1.3. Avoid proximity to heat ducts and/or steam lines. All conduits shall clear ducts or lines and their coverings by a minimum of 6".

4.6.2. Interior Outlet

4.6.2.1. One-piece boxes and one-piece device covers are required

4.6.2.2. Minimum box sizes: Galvanized steel, 4" square, 1½" deep

4.6.2.3. Signal system outlets' minimum box size: 4" square, 2⅛" deep

4.6.3.Floor Boxes

4.6.3.1. Limit use of floor boxes for specific applications only, except where required by current NEC code. All floor boxes shall be code-approved metal construction, with gasketed metal covers, flush with floor grade (even in use).

4.6.3.2. No plastic boxes or components. Wiremold Omnibox Series, Hubbell Steel with adjustable collars and frames, or approved by BSD Representative.

4.6.3.3. Minimum floor box requirements: 3 7/16" deep with 1" factory knockouts.

4.6.4.Weatherproof Outdoor Outlet

4.6.4.1. Corrosion-resistant, cast metal, threaded conduit entry. Corrosion-resistant, cast metal, device covers, gasketed.

4.6.5.Large Junction and Pull

4.6.5.1. Painted steel, welded seams, screw on covers.

4.6.6.Vaults and In-Ground Boxes

4.6.6.1. Vaults and in-ground boxes shall have the load bearing capacity to support riding lawn mowers and similar ground-keeping equipment in all locations.

4.7. WIRES, CABLES, AND CONNECTORS

4.7.1.Category Cable (CAT5e, CAT6, CAT6e, etc.)

4.7.1.1. Field category wiring should be color-coded according to Technical Standards Appendix A: Category Cabling (5e, 6, 6a).

4.7.2.Power Conductors

4.7.2.1. All feeder and branch circuit wire shall be 600V conductors

4.7.2.1.1. Feeders above 100A to be aluminum or copper, aluminum not acceptable for mechanical equipment, HVAC or other mechanical equipment

4.7.2.1.2. Branch circuits and feeders equal to 100A or less will be copper. No wire less than 12AWG shall be used except for control circuits or power limited circuits

4.7.2.1.2.1. Wire sizes 12AWG and larger shall be stranded

4.7.2.1.2.2. There shall be no shared neutrals in any multi-wire branch circuits

4.7.3.Insulation

4.7.3.1. THHN, THWN or XHHW-2. Minimum 90°C insulated rating for feeders and branch circuits.

4.7.4.MC Cable

4.7.4.1. Use only for branch circuits within a room space with accessible ceiling

4.7.4.2. Not acceptable in kitchen or other wet environments

4.7.4.3. High strength galvanized steel of flexible armor, no aluminum

4.7.4.4. No conductors larger than 10AWG

4.7.4.5. There shall be no shared neutrals in any multi-wire branch circuits

4.7.4.6. Not acceptable under windows due to inaccessible replacement

4.7.5.Connectors

4.7.5.1. Quick push-in wire connectors are prohibited

4.7.5.1.1. 18AWG - 8AWG spring connector wire nuts to be used

4.7.5.1.2. Terminal strips in J boxes are allowed

4.7.5.1.3. Note: Theatrical devices should be connected directly to dimmers or terminal strips, no wire nuts to be used.

4.7.6.Splices, Taps, and Terminations

4.7.6.1. All splices, taps, and terminations shall be made in outlet, junction, or pull boxes. Wire to 8AWG shall be spliced using spring connector wire nuts.

4.7.6.2. 6AWG and larger, use indent compression or split bolt connectors for all conductors.

4.7.6.3. Splices 6AWG and larger shall be insulated to voltage rating of feeder or circuit. Splices shall not be permitted in automation input and output wiring.

4.8. WIRING DEVICES

4.8.1.Manufacturers: Hubbell, Pass & Seymour, and Leviton

4.8.2.Color: Gray for all devices

4.8.3.Wall Switches: Specification Grade, Toggle type, 20A, 120/277V

4.8.4.Key Switches: Specification Grade, Pass & Seymour[1] only for key standardization

4.8.5.Receptacles: Specification Grade, Duplex 20A, 125V, 2-pole, 3-wire grounding

4.8.5.1. Note: For Plug & Play devices, only Pass & Seymour acceptable.

4.8.6.Ground Fault Circuit Interrupter (GFCI) Receptacle: Specification Grade, Feed-through type, 20A, 125VAC

4.8.7.Finish Plates: Type 302 stainless steel, satin finish, beveled edge

[1] See List of Brand Name Products as approved via School Board Resolution 14-409 in accordance with ORS 279C.345.

4.9. CIRCUIT AND MOTOR DISCONNECTS

4.9.1. Provide disconnect switch in sight of each motor, clearly labeled with circuit and panel identified. Motor disconnects for overhead doors shall be within 24” of motor.

4.9.2. Manual Motor Starters: Square D, Class 2510, or equal

4.9.3. Safety Switches: Heavy Duty, Class R fuse type

5. IDENTIFICATION

5.1. ENGRAVED LABELS

5.1.1. Engraved labels shall be plastic laminate, black with white core. Install engraved label on each major unit of electrical equipment, including disconnects, services, distribution panels, and branch panel boards, main and satellite control panels of each signal system.

5.1.2. Install engraved label on the inside of flush panels, visible when the door is opened.

5.1.3. Minor components such as relays, contactors, time switches, override switches, etc., do not need to be engraved, but must be clearly labeled.

5.2. RECEPTACLES AND SWITCHES

5.2.1. On the finish plate, use a label, or legibly write with indelible ink on the back, the circuit to which each device is connected.

5.3. JUNCTION AND PULL BOXES

5.3.1. On the cover, use a label, or legibly write with indelible ink, the panel number, circuit number and voltage for each box.

5.4. UNDERGROUND UTILITY MARKERS

5.4.1. Use inert polyethylene plastic ribbon, 6” wide by 4 mils thick. Install continuous tape, 6” to 8” below finish grade, for each exterior underground raceway.

5.4.2. Provide trace wire with all underground conduits.

5.5. PANEL IDENTIFICATION

5.5.1. Label shall identify panel, voltage, and electrical source. Each electrical panel ID should start with number where "2" will indicate 208/120V system and "4" will indicate 480/277V system. Example: 2A4/XFMR-T1/MDP4 208/120V identifies 208/120V Panel 2A4, fed from XFMR-T1, fed from MDP4.

5.5.2. Emergency panels should have letter "E" after the number 2 or 4 in panel ID. Example: 4ED, 2E1.

5.6. BRANCH CIRCUIT SCHEDULES

5.6.1. Schedules shall be typewritten with separate columns for odd and even numbers, using final building room numbers and identifications.

5.6.2. The A/E shall provide a list and drawing which cross-references the room numbers originally used on all plans and drawings with the final room numbers assigned by the District.

5.7. ONE LINE DIAGRAM

5.7.1. Contractor to supply laminated one-line diagram showing disconnects with Record Drawings for posting in main electrical room.

6. CONTACTORS AND CONTROL DEVICES

See Division 23: HVAC for Motors and Variable Frequency Drives

6.1. CONTACTORS/RELAYS

6.1.1. Lighting contactors and relays, electrically operated mechanically held.

6.1.2. Manufacturer: ASCO, Cutler Hammer, Siemens, Square D, or equal.

6.2. TIME SWITCHES

6.2.1. Seven day, 24 hours, digital astronomical time clock with automatic adjustment for daylight savings, holiday schedule, and leap year. LCD display. Battery backup to retain schedules.

6.2.2. Manufacturer: Intermatic, or equal.

6.3. PHOTOELECTRIC SWITCHES

6.3.1. 120VAC, 1800VA, adjustable light level slide.

6.3.2. Manufacturer: Intermatic, Paragon, TORK.

6.4. EMERGENCY LIGHTING RELAY

6.4.1. UL924 listed. On-board test switch for local inspection. If mounted above 60", a remote test switch is required below 60". If mounted above 60", and in a drop ceiling, remote test switch may be exposed through a ceiling which is 10' or lower.

6.4.2. Indicator lights for presence of normal utility power, un-switched emergency power, and for when test switch is activated, causing emergency lamps to activate.

7. LIGHTING GUIDELINES

7.1. LIGHT LEVELS

7.1.1. Light levels in all spaces shall be designed to be in compliance with Illuminating Engineering Society of North America (IESNA) guidelines and to meet NFPA 101 standards.

7.2. LIGHT SOURCES

7.2.1. Light sources should be evaluated on the basis of energy efficiency, lamp life, light quality, control capability, initial cost, ease of maintenance, and warranty.

7.2.2. General Lighting Needs

7.2.2.1. Light Emitting Diodes (LED) lighting shall be used as the basis of design for all new and remodel projects, excluding special use lighting as required.

7.2.2.1.1. LED light fixtures should be DLC, IESNA, and UL listed luminaries

7.2.2.1.2. LED light fixtures should be Energy Star rated

7.2.2.1.3. 100 lumens/watt minimum

7.2.2.1.4. LED Fixtures shall be dimmable 0-10V, DMX or ACN

7.2.2.1.5. Drivers should be easily replaceable; for fixtures in hard-to-reach areas, drivers shall be remote, and located in accessible area approved by BSD representative

7.2.2.1.6. Minimum 5-year warranty

7.2.2.1.7. Approved manufacturers: Acuity/Lithonia, Eaton/Cooper Industries, ETC or Philips

7.2.3.Exterior Sports Facilities

7.2.3.1. MUSCO[2] LED lighting solutions shall be used, or approved equal.

7.2.4.Fluorescent

7.2.4.1. The majority of lighting in BSD buildings are currently fluorescent troffer systems. These systems will continue to be supported and may be installed in retrofit applications for small projects if necessary, but are not approved for new construction. Fluorescent lamps shall have the following:

7.2.4.1.1. General Lighting:

7.2.4.1.1.1. Color rendering index (CRI) of greater than 80

7.2.4.1.1.2. Color temperature of 3500K

7.2.4.1.2. Lighting in Production Spaces:

7.2.4.1.2.1. Color rendering index (CRI) of greater than 90

7.2.4.1.2.2. Color temperature of 2700-3000K

7.2.4.1.3. Acceptable Fluorescents

7.2.4.1.3.1. Compact fluorescents (CFL) shall not be used for screw type bases.

7.2.4.1.3.2. T8 – 4’-10’; lamp/ballast combination in T8 luminaires shall meet the CEE (Consortium for Energy Efficiency) specification

7.2.4.1.3.3. LED TLED retrofit troffer lamps are currently not acceptable in the District due to safety concerns

7.2.4.1.3.4. T5 and T5HO may be used only for existing conditions; not to be used for new construction.

7.2.5.Ballasted Fixtures

7.2.5.1. When necessary, ballasted fixtures shall be High Power Factor, and less than 20% total harmonic distortion (THD) and have Class P thermal protection.

7.3. CONTROLS

7.3.1.General

[2] See List of Brand Name Products as approved via School Board Resolution 14-409 in accordance with ORS 279C.345.

7.3.1.1. For new construction, WattStopper Digital Lighting Management (DLM)[3] shall be the basis of design, except for rooms such as custodial closets, or rooms requiring special lighting controls such as theaters, sports fields and other presentation spaces.

7.3.2.Switches

7.3.2.1. Switches shall be located in the space that they control. Control switches (3-way, presets, etc.) shall be provided at all entrances to space. Switches shall be located by each of the doors.

7.3.2.2. Switches in corridors and public spaces shall be keyed switches: compatible with Pass & Seymour[1] only, momentary contact switch key for heavy-duty locking switch, 500K, to provide District-wide key standardization.

7.3.2.3. Classroom luminaires shall have dimmable control.

7.3.2.4. The row of lights closest to the white board/projection screen shall be capable of being switched off/dimmed independently of the classroom lighting. The remaining classroom lighting shall be able to be dimmable during video instruction.

7.3.3.Occupancy Sensors

7.3.3.1. General

7.3.3.1.1. Occupancy sensors shall be used to control lighting in classrooms, restrooms, corridors, gyms, multi-purpose rooms, cafeterias, and small offices. Occupancy sensors shall provide complete coverage of area to prevent nuisance OFFs even when the only activity is writing on a desktop or typing at a computer keyboard.

7.3.3.1.2. Occupancy sensor circuits shall be wired to allow OFF override of the lighting in the area. The occupancy sensor system shall be designed to have no effect on power quality or ballast inrush current.

7.3.3.1.3. Occupancy sensors and their related relays shall incorporate "zero-crossing circuitry." BSD has standardized WattStopper[4] brand of occupancy sensors.

7.3.3.2. Classrooms

7.3.3.2.1. Two dual technology occupancy sensors shall be used. Sensors shall be set to time-out after 10 minutes of no activity. To include areas such as music and other such teaching spaces.

7.3.3.3. Restrooms

7.3.3.3.1. Multi-stall restrooms shall use ultrasonic technology sensors to detect occupancy inside stalls and around corners. Other technology only with BSD approval.

[3] See List of Brand Name Products as approved via School Board Resolution 14-409 in accordance with ORS 279C.345.

[4] See List of Brand Name Products as approved via School Board Resolution 14-409 in accordance with ORS 279C.345.

7.3.3.3.2. Restroom occupancy sensors should be set to time-out after 15 minutes.

7.3.3.4. Gyms and High Ceiling Areas

7.3.3.4.1. Passive Infrared (PIR) sensors shall be used in high ceiling areas per manufacture's installation requirements.

7.3.3.4.2. Wire guards are required to protect sensors from projectiles in all installations

7.3.3.5. Small Offices and Single Stall Restrooms

7.3.3.5.1. Wall switch occupancy sensors are acceptable for use in small offices and single stall restrooms if the sensors have a clear view of the space.

7.3.3.5.2. The occupancy sensor shall control the run time for restroom exhaust fans and be set to time-out after five minutes.

7.3.4.Daylight Harvesting

7.3.4.1. Daylight harvesting controls shall be incorporated into the lighting controls design where there is a significant contribution to the lighting from daylight.

7.3.4.2. Sensor set points should be selected to maintain appropriate light levels and incorporate a large enough dead band to prevent cycling on days with partial cloud cover.

7.3.5.Lighting Control Panels

7.3.5.1. General

7.3.5.1.1. Lighting control panels shall be used to control egress lighting, lighting in commons areas, lighting in kitchens, and parking lot and exterior building lighting.

7.3.5.1.2. The lighting control panel shall be BACnet IP native, coordinate with Division 27: Communications & Technology Technical Standards.

7.3.5.1.3. The lighting control panel shall be integrated with the building security and Fire Alarm System.

7.3.5.1.4. The lighting control panel shall be programmed per District requirements, see Control Matrix. Obtain schedule from BSD Representative. Lighting control panel shall allow over-ride via remote input.

7.3.5.1.5. Acceptable manufacturers: Greengate ControlKeeper (preferred), LC&D, WattStopper, and/or Echo by ETC[5] only.

[5] See List of Brand Name Products as approved via School Board Resolution 14-409 in accordance with ORS 279C.345.

7.3.5.2. Intrusion Alarm and Lighting Control Integration

7.3.5.2.1. See also Division 28: Electronic Safety & Security; see Control Matrix

7.3.5.3. Egress Lighting Control Parameters

7.3.5.3.1. Power Outage - All lighting fails to the ON position.

7.3.5.3.2. Occupied Building - Egress lights will be turned ON when building is occupied (security disarmed) if occupancy sensors do not turn lights on in occupied space.

7.3.5.3.3. Entry to Building (Security is Armed) - Egress lights will be turned ON to light a pathway to the security panel when the designated main entry door is opened. If security has not been disarmed within 10 minutes, egress lights will shut OFF, unless controlled by occupancy sensors.

7.3.5.3.4. Unoccupied Building (Security is Armed) - Egress lights will be turned OFF when building is unoccupied. There will be a 10-minute time delay before shutting lights OFF when security is armed, unless controlled by occupancy sensors. As a warning, the egress lights will blink when the security panel is "coded out."

7.4. LUMINAIRES

7.4.1.General

7.4.1.1. All luminaires to be LED unless BSD approved. When necessary, luminaires shall use a standard ballast regularly manufactured by Advance, Osram Sylvania, or General Electric. Luminaires that require proprietary ballasts or lamps will not be accepted.

7.4.1.2. Tandem wiring of luminaires is discouraged and requires BSD Representative approval. Master slave ballast systems will not be accepted.

7.4.2.Pendant Mounted

7.4.2.1. Particular concern should be given to protecting lamps and louvers from collecting debris and projectiles.

7.4.3.Diffusers

7.4.3.1. Use two lamp, advanced lensed. Diffusers are to give proper washes of light.

7.4.4.Gyms and Multi-Purpose Rooms

7.4.4.1. Use impact-resistant lenses with wire guards in gyms and multi-purpose rooms. All suspended luminaires shall be mounted using a working load 5:1 ratio or greater. Fixtures in these spaces shall not be mounted with open fixtures.

7.4.5.Exit Lights

7.4.5.1. LED lighting, with stencil lettering, aluminum or PVC housing. "EXIT" spelled out and back-lit.

7.4.6.Egress Lighting

7.4.6.1. In addition to code requirement, classrooms, hallways, stairways, and restrooms shall have egress lighting. Provide Code minimum or better foot-candles for egress lighting.

7.4.7.Exterior Lighting

7.4.7.1. Exterior lighting shall be controlled by astronomical time clock for small remodels. Use lighting control panel for all new construction.

7.4.7.2. Site lighting shall be controlled by time clock to provide dark campus between 11:30 p.m. and 5:30 a.m. Lighting shall be "dark sky" compatible fixtures.

REVISION HISTORY FOR DIVISION 26 ELECTRICAL TECHNICAL STANDARD

Rev 1 6/24/16

Section	Section Title	Revision
III.B.5.	BASIC ELECTRICAL REQUIREMENTS; POWER; Back-up Power and Standby Generators	Add; Note: generators should last 96 hours at minimum
III.B.5.a)	BASIC ELECTRICAL REQUIREMENTS; POWER; Back-up Power and Standby Generators; Diesel generator system	Add to generator; ▪ Main reception and Principal's office convenience outlet(s) ▪ Custodian's office convenience outlet ▪ Kitchen convenience outlets ▪ Common area lights ▪ Gym lights ▪ MDF/Office IDF/phone systems ▪ Elevator/Elevator(s) on selective switch on manual transfer ▪ Emergency Voice/alarm communications ▪ Recirculation HVAC fans, not to include heating or cooling ▪ Ventilation fans ▪ Power exhaust fans ▪ Freezer ▪ Cooler
IV.	A.) WIRING METHODS	*Add* **See Appendix A: Category Cabling (5e, 6, 6a) for cable coloring specifications.**

IV.	B.) WIRING METHODS	*¶3; this moved to IV.F.4. and Modified*;) Use only for branch circuits within a room space with accessible ceiling) Not acceptable in kitchen or other wet environments) High strength galvanized steel of flexible armor, no aluminum) No conductors larger than 10AWG) There shall be no shared neutrals in any multi-wire branch circuits) Not acceptable under windows due to inaccessible replacement
IV.	C.) WIRING METHODS	Add, for keyed switches; See section G. WIRING DEVICES for key switches specification.
IV.	D.) WIRING METHODS E.)	¶4; add; Provide single circuit outlets for the following, and where directed or required for a specific use: ▪ Copiers ▪ Data/telephone intermediate data frames (IDFs) ▪ Fire alarm panel ▪ Mobile laptop charging station locations ▪ Main data frames (MDFs) ▪ Security panel ▪ Classroom projectors, or other display equipment
IV. F.1.	F.) WIRING METHODS; WIRES, CABLES, AND CONNECTORS; CATEGORY CABLE (CAT5E, CAT6, CAT6E, ETC.)	**i.** *Add new section* **1. Category Cable (CAT5e, CAT6, CAT6e, etc.)** **Field category wiring should be color-coded according to Appendix A: Category Cabling (5e, 6, 6a).**
IV. F.2.	G.) WIRING METHODS; WIRES, CABLES, AND CONNECTORS; POWER CONDUCTORS	Modify this section; All feeder and branch circuit wire shall be 600V conductors h.) Feeders above 100A to be aluminum or copper, aluminum not acceptable for mechanical equipment, HVAC or other mechanical equipment i.) Branch circuits and feeders equal to 100A or less will be copper. No wire less than 12AWG shall be used except for control circuits or power limited circuits

IV. F.3.	J.) WIRING METHODS; WIRES, CABLES, AND CONNECTORS; INSULATION	Change; ~~XHHW~~ to XHHW-2
IV. F.5.	K.) WIRING METHODS; WIRES, CABLES, AND CONNECTORS; CONNECTORS	Add; Terminal strips in J boxes are allowed Note: Theatrical devices should be connected directly to dimmers or terminal strips, no wire nuts to be used.
IV. G.	L.) WIRING METHODS; WIRING DEVICES	Add; Note: For Plug & Play devices, only Pass & Seymour acceptable.
IV.B.2.	M.) WIRING METHODS; PANELBOARDS; SERVICE DISTRIBUTION SWITCHBOARDS N.)	Add; All new facilities to provide electrical usage sub-metering capability so that HVAC, lighting and plug loads may be viewed independently and analyzed. At a minimum, HVAC bus, lighting bus, plug loads and other equipment shall be independently bussed and metered. Equipment shall be labeled so that future circuits can be added to correct metered bus. All metering shall be BACnet IP native and commissioned to Direct Digital Control (DDC).
IV.D.	O.) WIRING METHODS; RACEWAYS AND CONDUIT	Add; Conduits are required in inaccessible locations (i.e., hard-lid ceilings, behind walls, under windows, etc.).
V.E.	P.) IDENTIFICATION; PANEL IDENTIFICATION	Add; Emergency panels should have letter "E" after the number 2 or 4 in panel ID. Example: 4ED, 2E1.

VI.D.	Q.) CONTACTORS AND CONTROL DEVICES; EMERGENCY LIGHTING RELAY	Revise Text; UL924 listed. On-board test switch for local inspection. If mounted above 60", a remote test switch is required below 60". If mounted above 60", and in a drop ceiling, remote test switch may be exposed through a ceiling which is 10' or lower. Indicator lights for presence of normal utility power, un-switched emergency power, and for when test switch is activated, causing emergency lamps to activate.
VII.B.	R.) LIGHTING GUIDELINES; LIGHT SOURCES	This section a complete re-write. i. Note; Exterior Sports Facilities MUSCO LED lighting solutions shall be used.
VII.C.	S.) LIGHTING GUIDELINES; CONTROLS	This section a complete re-write. Note; Acceptable manufacturers: Greengate ControlKeeper (preferred), LC&D, WattStopper, and/or Echo by ETC only.
VII.D.	T.) LIGHTING GUIDELINES; LUMINAIRES	Revise; All luminaires to be LED unless BSD approved. When necessary, luminaires shall use a standard ballast regularly manufactured by Advance, Osram Sylvania, or General Electric. Luminaires that require proprietary ballasts or lamps will not be accepted.

VII.D.3.	i.	*New* **Use impact-resistant lenses with wire guards in gyms and multi-purpose rooms. All suspended luminaires shall be mounted using a working load 5:1 ratio or greater. Fixtures in these spaces shall not be mounted with open fixtures.**

VII.D.4.	ii.	*Revise* LED lighting, with stencil lettering, aluminum or PVC housing. "EXIT" spelled out and back-lit.

VII.D.5.	iii.	*Revise* In addition to code requirement, classrooms, hallways, stairways, and restrooms shall have egress lighting. Provide Code minimum or better foot-candles for egress lighting.

Rev 2: 4/30/17

Section	Section Title	Revision
III.B.5.	BASIC ELECTRICAL REQUIREMENTS; POWER; Back-up Power and Standby Generators	*Add* **Fire Sprinkler Dry-system Air Compressor**

Rev 3: 4/30/18

Section	Section Title	Revision
IV.F.1.	WIRING METHODS; WIRES, CABLES, AND CONNECTORS; Category Cable	**iv. Category Cable (CAT5e, CAT6, CAT6e, etc.)** **Field category wiring should be color-coded according to** ~~Appendix A: Category Cabling (5e, 6, 6a)~~ **Technical Standards Appendix A: Category Cabling (5e, 6, 6a).**

Rev 4: 6/15/18

Section	Section Title	Revision
VII.C.	LIGHTING GUIDELINES; CONTROLS	*Remove all lighting control manufacturers except Wattstopper, in order to align with List of Brand Name Products.*

Rev 5: 12/31/18

Section	Section Title	Revision
various	various	*Removed hyperlink to List of Brand Name Products.*

Rev 6: 5/31/19

Note: **Bold** indicates new text; ~~strikethrough~~ indicates removed text; plain text indicates unchanged text; *italics* indicate summarized information.

Section	Section Title	Revision
III.F.2.	Floor Boxes	*GDSR-127* Limit use of floor boxes for specific applications only, **except where required by current NEC code**.
VI.D.6	Exterior Lighting	*Relocated existing dark sky requirements from Div 32.*

Rev 7: 2/2025

Section	Section Title	Revision

All	All	Renumbered all sections of the Technical Standard; included other minor formatting and edits for clarity.