



OPEN THIS DOCUMENT FIRST: Design Standards Process

Overview:

SCCD has established standards for design and construction to ensure equity and consistency in facilities and for efficiency in operations and maintenance. The Standards consist of **Design Standards** that are directives and information that Design Consultants should incorporate into their contract documents (drawings and specifications). A few disciplines have also provided **Construction Specifications** and **Typical Details**, which should be customized to the design project.

These Standards were developed by the District, with intensive input from District Facilities, Maintenance and Operations personnel, in addition to IT personnel and the Security shared governance Committee for relevant sections. The Standards are based on prior experience at the District and the best practices from other California Community Colleges, and the products selected were carefully evaluated based on criteria that included aesthetics & user comfort, durability, ease of maintenance, sustainable properties/practices and cost.

Purpose:

These Design Standards are a tool to clarify direction and streamline project execution for design professionals, construction managers and other participants in capital improvement projects. They represent the District's "strong preference" and should be applied, when possible, without compromising the creativity of the overall design. Final disposition, color, size, product choice etc. should conform to the best extent possible where equivalent substitutes are allowed in the Design Standard. If equivalent substitutes are allowed only "if performance and quality equivalency can be evidenced" or the consultant wishes to deviate from the written design standards for other reasons, then the consultant needs to provide evidence/justification and seek District approval as outlined below.

In all cases the written design standards do not diminish or eliminate the standard of care owed by the consultant to SCCD or relieve, in any manner whatsoever, a consultant from any professional responsibility, duty or due diligence required toward that work.

These Design Standards should be incorporated into all Solano Community College ("SCC", the "College") projects. Projects include but are not limited to new construction, Tenant Improvements (TI) projects, remodels, and renovations. It is understood that the College could not attempt to upgrade and retrofit all campus facilities in a single massive construction project; such a process would be prohibitively costly and disruptive. Rather, the strategy is for installations to be implemented continually and concurrently in a phased manner, over time and as funding allows, toward a goal of all campuses and campus buildings eventually meeting the same consistent Design Standards.



Design Standards Process:

The following Design Standards Process Guidelines incorporation and approval process provides procedural guidelines to ensure that project-specific design and contractor teams submit and receive approval by authorized SCCD departmental and administrator personnel at defined milestones. This allows for SCCD review, input, and approval as well as documentation of any approved deviations or variances to the Design Standards early in the design process.

Approved deviations and variances from the Design Standards should be conscious and justifiable, provide a solution for a site-specific need or replace outdated/obsolete requirements, and be compatible with other Design Standards. **Proposed deviations shall be submitted to SCCD in writing for review and approval prior to incorporation into the project.** Approved deviations may be project-specific or permanent; if an approved deviation or variance is intended to be permanent the change should be reflected in the associated Design Standard.

Review and Approval

Review and approval by SCCD is required at the conclusion of each of the design phases listed below prior to progressing to the next phase. Documentation required for review includes project drawings and specifications; manufacturer cutsheets, diagrams, and other product data; associated progress cost estimates and written identification of deviations/variances from District Standards. Not all projects will include all phases.

Schematic Design

Design professionals should become familiar with the **Architectural, Landscape, Sustainability and other Guidelines** (found in Book 1 of the Facilities Master Plan) and the **District Standards** (found in Book 2 of the Facilities Master Plan and on Facilities Website) prior to initiating the design process. While most of the specifics within the District Standards will be reflected in future design phases, there are some aspects reflected in the District Standards that require consideration from the onset of the design process. If any deviations/variations are apparent at this early phase, bring them to District attention for consideration.

Deliverables of this phase are as stipulated in the Contract with the District. In addition for system designs such as Electronic Security and Safety, Fire Alarm etc. provide the following: a written design narrative which describes planned system elements by function and overall design. The narrative should include conceptual device and system floor plan, site layout drawings and functional/operational project planning.

Design Development

This is the phase where the specifics within the Design Standards will need to be reflected and coordinated within the specific project, and any required deviations/variances should be apparent during this phase. Bring all deviations/variances to District attention, in written format, for



evaluation and action as soon as they are determined. Do not assume deviations/variations will be apparent to District personnel during their documentation review towards the end of this phase.

Deliverables of this phase are as stipulated in the Contract with the District. In addition for system designs such as Electronic Security and Safety, Fire Alarm etc. provide the following: refinement of schematic design conceptual elements to provide a greater level of detail of system floor plan, functional/operational project planning and site layout drawings as well as required supporting components such as physical, electrical, MEP, data network, etc.

Construction Documents

By this phase the deviations/variances should have already been resolved. If coordination and detailing efforts during this phase require previously unknown deviations/variances from District Standards, bring them to District attention, via written format, for evaluation and action as soon as they are determined.

Deliverables of this phase are as stipulated in the Contract with the District. In addition for system designs such as Electronic Security and Safety, Fire Alarm etc. provide the following: design drawings indicating location, installation details, cabling and interfaces for elements approved in the schematic design and design development phases. This phase includes written device and systems specifications in the current MasterFormat edition as issued by the Construction Specifications Institute. These specifications should clearly describe interfaces between systems or assemblies and interfaces to any other equipment and systems under other Design Standards.

Project Close-Out

Deliverables of this phase are as stipulated in the Contract with the District. District should endeavor to update District Standards for any deviations or variances that were approved as permanent during that particular project.

End of Document



DESIGN STANDARD for Basic Electrical Systems Design

Purpose:

This design standard has the purpose of maintaining a consistent application of the basic electrical requirements of the electrical systems throughout the Solano Community College District therefore achieving a standard of quality for maintenance, reliability, and operation throughout all renovation and new building projects.

Design Standard:

Electrical systems required for this work includes labor, materials, equipment, and services necessary to complete installation of electrical work specified herein or required for a complete operable facility and not specifically described in other Sections of these Standards.

- Following is a list of abbreviations generally used in Division 26:

ADA	Americans With Disabilities Act
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
APWA	American Public Works Association
ASTM	American Society for Testing and Materials
CBC	California Building Code
CEC	California Electrical Code
CFC	California Fire Code
FCC	Federal Communications Commission
HVAC	Heating, Ventilating and Air Conditioning
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers.
IETA	International Electrical Testing Association



FM	FM Global
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
UL	Underwriters Laboratories Inc.

- Conform to requirements of the CEC, latest adopted version with amendments by local AHJs.
- Conform to latest adopted version of the CBC with amendments by local AHJs.
- Obtain and pay for electrical permits, plan review, and inspections from local AHJs.
- Furnish products listed by UL or other testing firm acceptable to AHJ.
- Conform to requirements of the serving electric, telephone, and cable television utilities.
- Provide like items from one manufacturer, such as luminaire types, switches, receptacles, breakers, panels, and the like.

All materials to meet the following requirements based on Code requirements and industry standard of design and care:

- Provide new electrical materials of the type and quality, listed by UL, bearing their label wherever standards have been established. Indicated brand names and catalog numbers are used to establish standards of performance and quality. The description of materials listed herein governs in the event that catalog numbers do not correspond to materials described herein.
- Provide material and equipment that is acceptable to AHJ as suitable for the use. For example, provide wet labeled equipment in locations that are wet.
- Provide incidentals not specifically mentioned herein, but needed to complete the system, in a safe and satisfactory working condition.

All documents to meet the following requirements based on District requirements and industry standard of design and care:

- Prepare and submit layout drawings to coordinate installation and location of lighting, electrical and signal systems. Prepare composite drawings showing all equipment on a single sheet. The architectural floor plans, reflected ceiling plans, and access floor layout plan shall form the base for the coordination drawings. Prior to completion of Drawings, coordinate proposed



installation with the Architect, structural requirements, and other trades (including HVAC, plumbing, fire protection, ceiling systems, and raised floor system), and provide required maintenance access. Systems shall include, although not limited to, the following:

- Luminaires.
 - Occupancy sensors.
 - Wiring devices.
 - Electrical equipment enclosures.
 - Control equipment enclosures.
 - Route of feeders 100A and larger.
 - Route of cable tray systems.
 - Surface metal raceways.
 - Conduit rack supports.
 - Transformers and supports.
 - Standby engine generator.
 - Fire alarm devices, annunciators and control panel.
 - Outlet boxes and raceway system for security system alarm devices and control panel.
 - Outlet boxes and raceway system for telephone, data and CATV raceways 2 inches and larger.
- Prepare Drawings as follows:
 - Prepare Drawings, to accurate scale, in latest AutoCAD graphics format printed to media as directed by District.
 - Distribute plans to all trades and provide additional coordination as needed.
 - Advise Architect, in event a conflict occurs in location of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
 - Provide means of access to all junction and pull boxes and concealed equipment which may require access, adjustment or servicing.



- Final coordination drawings, with as-constructed information added, are to be submitted as record drawings at completion of project. Plans are to incorporate all addenda items and change orders.

All installation methods to meet the following requirements based on district requirements and industry standard of design and care:

- Install electrical equipment complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of the electrical equipment, examine the instructions thoroughly. When requirements of the installation instructions conflict with the Contract Documents, request clarification from Architect prior to proceeding with the installation.
- Do not install electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block the area passage's intended usage.
- Earthwork:
 - Refer to Division 31, Section "Earthwork."
 - Perform excavation and backfill required for the installation of electrical work.
- Noise Control:
 - Do not install outlet boxes back to back. Do not use straight through boxes.
 - Do not place contactors, transformers, starters and similar noise producing devices on walls which are common to occupied spaces unless specifically directed by the District. Where such devices must be mounted on walls common to occupied spaces, mount or isolate in such a manner as to effectively prevent the transmission of their inherent noise to the occupied space.
- Firestopping:
 - Coordinate with the Drawings the location of fire rated walls, ceilings, floors and the like. When these assemblies are penetrated by electrical equipment, seal around the equipment with approved firestopping material.
 - Install firestopping material complete as directed per the manufacturer's installation instructions.

All field quality control methods to meet the following requirements based on Code requirements and industry standard of design and care:



- Tests:
 - Conduct tests of equipment and systems to demonstrate compliance with requirements specified in Division 26. Refer to individual Specification Sections for required tests. Document tests and include in Closeout Documents.
 - During site evaluations by the Inspector of Record (IOR), provide an electrician with tools to remove and replace trims, covers, devices, and the like, so that a proper evaluation of the installation can be performed.
- Testing shall include:
 - Daylight automatic controls.
 - Occupant sensing automatic controls.
 - Automatic time and override controls for interior lighting.
 - Automatic time and photo controls for exterior lighting.
 - Lighting system control testing and commissioning:
 - Test lighting controls to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with Drawings and Specifications. Provide functional testing of sequences of operation to ensure operation in accordance with Drawings and Specifications. Provide complete report of test procedures and results to engineer and insert approved copy into project closeout documents.

All cleaning methods to meet the following requirements based on district requirements and industry standard of design and care:

- Remove dirt and debris caused by the execution of the electrical work.
- Leave the entire electrical system installed under this Contract in clean, dust-free and proper working order.
- Vacuum clean interiors of all new and modified electrical signal and communication equipment enclosures.

For renovations requiring demolition, all demolition methods to meet the following requirements based on district requirements and industry standard of design and care:



- Coordinate with District so that work can be scheduled not to interrupt operations, normal activities, building access, access to different areas. The District will cooperate to the best of their ability to assist in a coordinated schedule, but will remain the final authority as to time of work permitted.
- Examination: Determine the exact location of existing utilities and equipment before commencing work, compensate the District for damages caused by the failure to locate and preserve utilities. Replace damaged items with new material to match existing.
- Promptly notify District if utilities are found which are not shown on record Drawings.
- Execution:
 - Remove existing luminaires, switches, receptacles, and other electrical equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition.
 - Maintain electrical continuity of existing systems. Remove or relocate electrical boxes, conduit, wiring, equipment, luminaires, and the like, as encountered in removed or remodeled areas in the existing construction affected by this work.
 - Remove and restore wiring which serves usable existing outlets clear of the construction or demolition
 - If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, provide new conduit and wire to bypass the abandoned outlets.
 - If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and wire to reroute clear of the construction or demolition and maintain service to the existing load.
 - Extend circuiting and devices in existing walls to be furred out.
 - Remove abandoned wiring to leave site clean.
 - If existing lighting which is to remain or be relocated is to be relamped, reballasted and cleaned, notify architect and/or District. Leave all luminaires in proper working order.
 - If existing electrical equipment contains PCBs (polychlorinated biphenyl), replace with new. Dispose of material containing PCBs as required by federal and local regulations.
 - Repair adjacent construction and finishes damaged during demolition work.



- Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

For renovations requiring demolition, all methods for salvaged equipment and recycled material shall meet the following requirements based on District requirements and industry standard of design and care:

- Salvage the following equipment not being reused and return to District (as applicable):
 - Luminaires
 - Panelboards
 - Breakers
 - Transformers
- Salvage the following equipment not being reused and sell/give to electrical salvage company (as applicable):
 - Luminaires
 - Panelboards
 - Breakers
 - Transformers
- Electrical equipment that cannot be salvaged for reuse, sell/give to recycling company. Recycle the following excess, removed, or demolished electrical material (as applicable):
 - Copper or aluminum conductors, buses, motor/transformer windings, and the like.
 - Steel and aluminum from raceways, boxes, enclosures, housings and the like.
 - Acrylic and glass from luminaire lenses/refractors.
- Provide separate on-site storage space for recycled and salvaged material. Clearly label space for intended use.

For renovations requiring demolition, all systems requiring continuity of service shall meet the following requirements based on District requirements and industry standard of design and care:

- No interruption of services to any part of existing facilities will be permitted without express permission in each instance from the District. Requests for outages shall state the specific dates and hours and the maximum durations, with the outages kept to these specific dates and hours



and the maximum durations. Obtain written permission from the District for any interruption of power, lighting or signal circuits and systems.

- If overtime is necessary, there will be no allowance made by District for extra expense for such overtime or shift work, due to maintaining continuity of service herein required.
- Organize work to minimize duration of power interruption.

Operation and Maintenance Documentation: Provide copies of certificates of code authority acceptance, test data, product data, guarantees, warranties, and the like.

Closeout Documentation: Submit electrical code authority certification of inspection. Include documentation of on-site electrical testing that was performed.

Sustainable Design Practices

- The Solano Community College District has a desire to build buildings utilizing sustainable design techniques. As part of the Electrical Design Standards, sample sustainable design opportunities are provided in a table in the Sustainability Section of the Solano Community College District standards. Each strategy needs to be integrated appropriately into their respective projects. Development of design strategies for each item is beyond the scope of this Design Standard and requires careful consideration for proper application. The District will select on a case by case basis, which projects will be LEED™ Certified and to what level.

Approved Manufacturers:

Refer to individual standards.

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards and Specifications:

- Division 22 Plumbing
- Division 23 Heating Ventilation and Air Conditioning
- Division 27 Communications

End of Document





DESIGN STANDARD for Medium Voltage Cables

Purpose:

This design standard has the purpose of creating a consistent application of medium voltage cables throughout the Solano Community College District therefore achieving a standard of maintenance, reliability and quality throughout all renovation and new building projects.

Design Standard:

Provide installation of medium voltage cable, terminations, and splicing, as required by code and detailed in the Contract Documents.

Medium voltage cables include the following but not limited to:

- Cables.
- Terminations.

All medium voltage cables to meet the following requirements based on Code requirements and industry standard of care:

- Regulatory Requirements:
 - UL 1072.
 - NEMA-WC7.
 - ICEA Standards S-68-516 and CS6-79.

All cables to meet the following requirements based on code requirements and industry standard of care:

- Type MV-90, 133 percent insulation, single uncoated annealed copper conductor with Class B stranding, with strippable extruded conductor shielding around the conductors.
- Conductor screen consists of an extruded layer of semiconducting compound with a volume resistivity not exceeding 50,000 ohms-cm at 90C and a minimum average thickness of 22 mils.
- Provide flexible thermosetting dielectric based insulation on an ethylene-propylene elastomer (APPEAR).



- Provide insulation screen with an extruded semi-conduction compound with a volume resistivity not exceeding 50,000 ohms-cm at 90C.
- Provide extruded insulation screen shielded with a nonmagnetic 5 mil thick copper tape.
- The overall jacket is polyvinyl chloride, 80 mils thick.
- Cable has continuous factory printed identification on the outer jacket for the full length of the cable indicating manufacture's name, trade name of cable, voltage, wire size, and type of insulation. Deliver cables to the site on factory reels properly identified with the certified test report and marked or tagged to indicate the month and year of manufacturer of the cable. Provide cable from the same manufacturer.

All terminations and splices to meet the following requirements based on code requirements and industry standard of care:

- Provide terminations in weatherproof enclosures with preformed stress cones rated for the system voltage, phase-to-phase with a corona extinction level for the system voltage. Use a stress cone designed specifically to terminate the cable on which it is used, and which provides a watertight seal to the cable insulation. Incorporate a grounding eye, eliminating the need for a metal ground clamp to the cable shield.
- Provide terminations exposed to the weather with a preformed stress cone, as described in preceding paragraph, with the appropriate number of rain shields required for the system voltage.
- Protect terminations of insulated cables from accidental contact, deterioration of covering, and moisture by the use of terminating devices and material. Install terminations in accordance with the kit and cable manufacturer's instructions.
- Provide splicing and terminating materials compatible with the cable supplied. Submit proof of acceptability by cable manufacturer of splicing and terminating materials.
- When installing medium voltage cables:
 - Protect conductors from mechanical and physical abuse, and from exposure to the atmospheric elements. Do not bend cable to less than 12 times the outer diameter of the cable.
 - Provide terminations and splices performed by skilled high voltage personnel. Submit record of experience for personnel performing splices and terminations. Provide the services of a field engineer of the cable manufacturer to supervise and certify terminations and splices.



- Install cables in conduit.
- For quality control of medium voltage cables:
 - Provide field insulation tests on conductors as recommended by ANSI/IEEE 141. Test under DC voltage conditions recommended by cable manufacturer warranty constraints.
 - Provide tests performed by a testing agency with 5 years documentable experience testing medium and high voltage cables.
 - Complete tests with terminal equipment disconnected.
 - Provide written final report and test results to the District.

Approved Manufacturers:

- Cable:
 - General Electric
 - General Cable
 - Rome
 - Okonite
- Terminations and Splices:
 - 3M
 - Elastimold
 - Cable Manufacturer

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards and Specifications:

- 26 00 00 - Basic Electrical Requirements

End of Document



DESIGN STANDARD for Wires, Cables and Connectors

Purpose:

Provide wires, cables, connectors, lugs, and the like for a complete and operational electrical system. This design standard has the purpose of creating a consistent application for the installation of wires, cables, and connectors throughout the Solano Community College District therefore achieving a standard of quality for maintenance, reliability, and operation throughout all renovation and new building projects.

Design Standard:

- Wiring shall be copper, 600 volt rated throughout.
 - Conductors #10 and smaller shall be solid,
 - #8 and larger shall be stranded, 90°C rated.
 - Conductors 3 AWG and larger, minimum insulation rating of 75C.
 - Insulation types THWN, THHN or XHHW. Minimum insulation rating of 90C for branch circuits.
- MC Cable:
 - High strength galvanized steel flexible armor.
 - Full length minimum size No. 12 copper ground wire, THHN 90C conductors, full length tape marker. Overall PVC or nylon cable tape.
 - Short circuit throat insulators, mechanical compression termination.
 - MC Cable is allowed for the following conditions. Installations not meeting these conditions will be removed and replaced at installer's own expense.
 - 20 and 30 amp branch circuiting where following conditions apply:
 - Where there is a suspended ceiling with accessible space above (example: suspended acoustic ceiling tile).
 - Do not use for homeruns from branch circuit to first device or luminaire in circuit.



- For drops to ceiling-mounted luminaires in areas with accessible ceiling space.
- The electrical design engineer must provide for the possible effects of harmonics on the neutral wire and the transformer.
- Phase color to be consistent at feeder terminations; A-B-C, top to bottom, left to right, front to back.
- Color Code Conductors as Follows:

PHASE	208 VOLT WYE	240 VOLT DELTA	480 VOLT
A	Black	Black	Brown
B	Red	Orange (High Leg)	Orange
C	Blue	Blue	Yellow
Neutral	White	White	Or White w/ colored strip
Ground	Green	Green	Green
Isolated Ground	Green w/yellow trace	N/A	N/A

- Connectors types shall have the following characteristics:
 - Copper Pads: Drilled and tapped for multiple conductor terminals.
 - Lugs: Indent/compression type for use with stranded branch circuit or control conductors. Manufacturers: Anderson, IlSCO, Panduit, Thomas & Betts, 3M, or approved.
 - Conductor Branch Circuits: Wire nuts with integral spring connectors for conductors 18 through 8AWG. Push-in type connectors where conductors are not required to be twisted together are not acceptable. Manufacturers: 3M, Ideal, or approved.



- **Conductor Installation:**
 - Install conductors in raceways having adequate, code size cross-sectional area for wires indicated.
 - Install conductors with care to avoid damage to insulation.
 - Do not apply greater tension on conductors than recommended by manufacturer during installation.
 - Use of pulling compounds is permitted. Clean residue from exposed conductors and raceway entrances after conductor installation. Do not use pulling compounds for installation of conductors connected to GFCI circuit breakers or GFCI receptacles.
- **Conductor Size and Quantity:**
 - Install no conductors smaller than 12AWG.
 - Provide required conductors for a fully operable system.
- Provide dedicated neutrals (one neutral conductor for each phase conductor).
- Provide dedicated circuits for refrigerators, microwaves, copiers, large printers, portable heaters, and the like.
- Provide a dedicated computer circuit for every three offices.
- Provide a dedicated convenience circuit for every four offices.
- **Conductors in Cabinets:**
 - Cable and tree wires in panels and cabinets for power and control. Use plastic ties in panels and cabinets.
 - Tie and bundle feeder conductors in wireways of panelboards.
 - Hold conductors away from sharp metal edges.
- Test conductor insulation on feeders of 100 amps and greater for conformity with 1000 volt megohmmeter. Use Insulated Cable Engineers Association testing procedures. Minimum insulation resistance acceptable is 1 megohm for systems 600 volts and below. Notify District if insulation resistance is less than 1 megohm.



Approved Manufacturers:

- General Cable
- Southwire
- Carol

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards and Specifications:

- 26 05 26 - GROUNDING
- 26 05 33 – RACEWAYS
- 26 05 48 – SUPPORTING DEVICES
- 26 05 53 – IDENTIFICATION

End of Document



DESIGN STANDARD for Grounding

Purpose:

Provide grounding and bonding of electrical service, circuits, equipment, signal and communications systems. This design standard has the purpose of creating a consistent application of the electrical system requirements throughout the Solano Community College District therefore achieving a standard of quality for maintenance, reliability, and operation throughout all renovation and new building projects.

Design Standard:

Install equipment grounding such that metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with electrical circuits operate continuously at ground potential and provide a low impedance path for possible ground fault currents. Grounding Electrode Conductor shall be a bare copper stranded conductor.

Supplement the grounded neutral of the secondary distribution system with an equipment grounding system to properly safeguard the equipment and personnel.

The grounding system shall meet the following installation requirements based on Code requirements and standard industry practices:

- Concrete Encased Ground Electrode (“Ufer ground”):
 - From the service equipment ground bus install grounding electrode conductor to footing/foundation rebar.
 - Bond the grounding electrode conductor to independent steel rebars.
 - Protect grounding electrode conductor extension from footing/foundation to service equipment with rigid PVC conduit. Do not use metal conduit for grounding electrode conductor protection.
- Ground Rod Electrode:
 - Coordinate placement of ground rods and interconnecting conductor in base of building concrete footing prior to placement of concrete.



- Install stranded bare copper conductor in base of perimeter concrete footing, minimum gauge: #3/0.
- Layout conductor to provide maximum exposure to earth in the perimeter footing. Do not fold conductor.
- Bond to driven ground rods.
- Tap at center ground rod and extend ground electrode conductor to service ground bus. Install grounding electrode conductor extension in rigid PVC conduit for physical protection. Do not use metal conduit for grounding electrode conductor protection.
- Water Service Grounding: Bond building ground electrode and water service pipe to service ground bus. Connect to water pipe on utility side of isolating fittings or meters, bond across water meters.
- Other Piping Systems: Bond gas piping system, fire sprinkler piping system and other metal piping systems to service equipment ground bus.
- Raceways:
 - Ground metallic raceway systems. Bond to ground terminal with code size jumper except where code size or larger grounding conductor is included with circuit, use grounding bushing with lay-in lug.
 - Connect metal raceways, which terminate within an enclosure but without mechanical connection to the enclosure, by grounding bushings and ground wire to the grounding bus.
 - Where equipment supply conductors are in flexible metallic conduit, install stranded copper equipment grounding conductor from outlet box to equipment frame.
 - Install equipment grounding conductor, code size minimum in raceway systems.
- Feeders and Branch Conduits:
 - Install continuous insulated equipment copper ground conductors within the following circuits; feeders, circuits for computer systems and other circuits as required.
 - Where installed in a continuous solid metallic raceway system and larger sizes are not detailed, provide insulated equipment ground conductors for feeders and branch circuits sized in accordance with Table 250-122.



- Install isolated ground conductors for electrically sensitive equipment. Install isolated grounding conductors isolated from the equipment ground system except at the common ground connection at the service equipment. Provide isolated ground bus in panelboards isolated from the equipment ground system.
- Boxes, Cabinets, Enclosures and Panelboards:
 - Bond grounding conductors to enclosure with specified conductors and lugs. Install lugs only on thoroughly cleaned contact surfaces.
 - Bond sections of service equipment enclosure to service ground bus.
- Motors, Equipment and Appliances: Install code size equipment grounding conductor from outlet box to (motor) equipment frame or manufacturer's designated ground terminal.
- Receptacles: Connect ground terminal of receptacle to equipment ground system by No. 12 conductor bolted to outlet box except isolated grounds where noted. Self grounding nature of receptacle devices does not eliminate conductor bolted to outlet box.
- Telecommunications Grounding System: Mount telecommunications main grounding busbar (TMGB) in each MDF. Mount a telecommunications grounding busbar (TGB) in each IDF. Install main telecommunications bonding backbone (TBB) conductor continuous from the MDF to every IDF. Bond the TMGB to the main building electrical grounding system and the nearest acceptable structural ground with a 3/0 AWG copper equipment grounding conductor.
- Separately Derived Systems: Ground each separately derived system.

Approved Manufacturers:

- Ground Rods
 - Weaver
 - Thomas & Betts
 - Talley
- Grounding Connectors
 - Burndy Hyground Compression Systems
 - Erico/Cadweld
 - Amp Ampact Grounding System



- Pipe Grounding Clamps
 - Burndy GAR Series
 - O-Z Gedney
 - Thomas & Betts

- Telecommunication Grounding Bus Bar
 - Chatsworth
 - Erico
 - Square D
 - Panduit

Substitutes Allowed:

Upon review and approval.

Associated Design Standards and Specifications:

- 26 24 00 - Switchboards and Distribution Panelboards

- 26 05 34 – Boxes

End of Document



DESIGN STANDARD for Raceways

Purpose:

Provide raceways, wires, cables, connector, boxes, devices, finish plates and the like for a complete and operational electrical system. This design standard has the purpose of creating a consistent application for the installation of raceways throughout the Solano Community College District therefore achieving a standard of quality for maintenance, reliability, and operation throughout all renovation and new building projects.

Design Standard:

- Sequencing and Scheduling: Raceway System is Defined as Consisting of: Conduit, tubing or duct and fittings including but not limited to connectors, couplings, offsets, elbows, bushings, expansion and deflection fittings and other components and accessories. Complete electrical raceway installation before starting the installation of conductors and cables.
- Conduits:
 - Galvanized Rigid Steel Conduit (GRC):
 - Hot-dip galvanized after thread cutting.
 - Manufacture in conformance with Federal Specification WWC-581 and ANSI C80.1.
 - Uniform finish coat with chromate for added protection.
 - Rigid Aluminum Conduit: Alloy 6063, threaded at each connection.
 - Intermediate Metal Conduit (IMC):
 - Hot-dip galvanized after thread cutting.
 - Manufacture in conformance with Federal Specification WWC-581.
 - Uniform finish coat with chromate for added protection.
 - Electrical Metallic Tubing (EMT):
 - Hot-dip galvanized and chromate coated.



- Manufacture in conformance with Federal Specification WWC-563 and ANSI C80.3.
- Flexible Conduit:
 - Reduced wall flexible steel conduit.
 - Hot-dip galvanize steel strip prior to forming and joining.
 - Manufacture in conformance with Federal Specification WWC-566.
- Flexible Conduit, PVC Coated:
 - Hot-dip galvanize steel strip prior to forming and joining.
 - PVC chemical resistant jacket extruded to core, up to 1 inch trade size.
 - PVC chemical resistant jacket, tubed over core, up to 4 inch trade size.
- PVC:
 - Class 40 heavy wall rigid PVC.
 - Rated for use with 90C conductors.
 - Manufacture in conformance with Federal Specification WC1094A and NEMA TC-2.
- Conduit Fittings:
 - Bushings:
 - Insulated Type for Threaded Rigid, IMC Conduit or Raceway Connectors without Factory Installed Plastic Throat Conductor Protection: Thomas & Betts 1222 Series or O-Z Gedney B Series.
 - Insulated Grounding Type for Threaded Rigid, IMC Conduit and Conduit Connectors: O-Z Gedney BLG Series.
 - Raceway Connectors and EMT Couplings:
 - Steel conductor and coupling bodies, with zinc electroplate or hot-dip galvanizing.
 - Connector locknuts are steel, with threading meeting ASTM tolerances. Locknuts are zinc electroplated or hot-dip galvanized.



- Connector throats (EMT, flexible conduit, metal clad cable and cordset connectors) have factory installed plastic inserts permanently installed. For normal cable or conductor exiting angles from the raceway, the cable jacket or conductor insulation bears only on the plastic throat insert.
- Steel gland, Tomic or Breagle connectors and couplings are recognized for this Contract as having acceptable raceway to fitting electrical conductance.
- Set screw connectors and couplings, without integral compression glands, are recognized for this Contract as not having acceptable raceway to fitting electrical conductance. A ground conductor sized per this Specification must be included and bonded within a raceway assembly utilizing this type connector or coupling.
- Expansion/Deflection Fittings:
 - EMT, O-Z Gedney Type TX.
 - RMC, O-Z Gedney Type AX, DX and AXDX, Crouse & Hinds XD.
- Conduit Joints: Assemble conduits continuous and secure to boxes, panels, luminaires and equipment with fittings to maintain continuity. Provide watertight joints where embedded in concrete, below grade or in damp locations. Seal PVC conduit joints with solvent cement and metal conduit with metal thread primer. Rigid conduit connections to be threaded, clean and tight (metal to metal). Threadless connections are not permitted for GRC and IMC.
- Conduit Placement:
 - Install continuous conduit and raceways for electrical power wiring and signal systems wiring.
 - Conceal conduits. Exposed conduits are permitted only in the following areas:
 - Mechanical rooms, electrical rooms or spaces where walls, ceilings and floors will not be covered with finished materials.
 - Existing walls that are concrete or block construction.
 - Where exposed conduits are permitted install parallel or at right angles to building lines, tight to finished surfaces and neatly offset into boxes.
 - Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block the area passage's intended usage.



- Do not install conduits on surface of building exterior, across roof, on top of parapet walls, or across floors.
 - Route raceway at least 6 inches from hot surfaces above 120F, including noninsulated steam lines, heat ducts, and the like.
- Below Grade Conduit and Cables:
 - Place a minimum 3 inch cover of sand or clean earth fill around the cable or conduit on a leveled trench bottom. Lay conduit on a smooth level trench bottom, so that contact is made for its entire length.
 - Remove water from trench before electrical conduit is installed.
 - When three or more conduits are in a single trench, use conduit spacers that will maintain 3 inch spacing between the conduits. Provide spacers on 5 foot centers.
- Maximum Bends: Install code sized pull boxes to restrict maximum bends in a run of conduit to 270 degrees.
- Conduit Terminations: Provide conduits shown on Drawings which terminate without box, panel, cabinet or conduit fitting with not less than five full threads. Bushings and metal washer type sealer between bushing and conduit end.
- Flexible Conduit: Install 12 inch minimum slack loop on flexible metallic conduit and PVC coated flexible metallic conduit.
- Conduit Size: Provide conduit in minimum code permitted size for THW conductors of quantity shown. Minimum trade size 1/2 inch.
- Conduit Use Locations:
 - Underground: PVC.
 - Wet Locations, Classified Locations, and Subject to Mechanical Damage: GRC, IMC.
 - Damp Locations and Locations Exposed to Rain: GRC, IMC, and EMT up to 2 inches in diameter.
 - Cast-In-Place Concrete and Masonry: GRC, IMC, and PVC. Horizontal runs of conduit in poured-in-place concrete slabs.
 - Dry, Protected: GRC, IMC, EMT.
 - Sharp Bends and Elbows: GRC, EMT use factory elbows.



- Install pull wire or nylon cord in empty raceways provided for other systems. Secure wire or cord at each end.
- Elbow for Low Energy Signal Systems: Use long radius factory ells where linking sections of raceway for installation of signal cable.
- Motors, recessed luminaires and equipment connections subject to movement or vibration, use flexible metallic conduit.
- Motors and equipment connections subject to movement or vibration and subjected to any of the following conditions; exterior location, moist or humid atmosphere, water spray, oil or grease use PVC coated liquid tight flexible metallic conduit.
- Branch Circuits: Do not change the intent of the branch circuit or controls without approval. Homeruns for 20 amp branch circuits may be combined to a maximum of six conductors in a homerun. Apply derating factors. Increase conductor size as needed.
- Feeders: Do not combine or change feeder runs.
- Unless otherwise indicated, provide raceway systems for lighting, power and Class 1 remote-control and signaling circuits and Class 2 and 3 remote-control signaling and communication circuits.
- Conduit Fittings:
 - Use set screw type fittings only in dry locations. When set screw fittings are utilized provide insulated continuous equipment ground conductor in conduit, from over current protection device to outlet.
 - Use compression fittings in dry locations, damp and rain-exposed locations. Maximum size permitted in damp locations and locations exposed to rain is 2 inches in diameter.
 - Use threaded type fittings in wet locations, hazardous locations, and damp or rain-exposed locations where conduit size is greater than 2 inches.
 - Use PVC coated rigid steel conduit ells for underground power and telephone service entrance conduits. Use 36-inch radius ells for power service conduits and 48-inch radius ells for telephone service conduits.
 - Use insulated type bushings with ground provision at switchboards, panelboards, safety disconnect switches, junction boxes and the like that have feeders 60 amperes and greater.



- Provide bushing or EMT connector for conduits that do not terminate in box, enclosure, or the like.
- Provide conduit expansion fittings at building expansion joints and at locations where conduit is exposed to thermal expansion and contraction.
- Condulets and Conduit Bodies: Do not use condulets and conduit bodies in conduits for signal wiring and in feeders 100 amp and larger.
- Sleeves and Chases - Floor, Ceiling and Wall Penetrations: Provide necessary rigid conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceiling or walls.
- Conduit crossing building seismic joints:
 - Provide box on either side of joint and flexible conduit between the box.
 - Coordinate with structural engineer and/or architect to determine movement at the seismic joint.
 - Rigid conduit crossings at seismic joints are not acceptable.

Approved Manufacturers:

- Allied Steel
- Certainteed
- Jones & Laughlin
- Carlon
- Kraloy

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards and Specifications:

- 26 05 26 – GROUNDING



- 26 05 34 – BOXES

End of Document



DESIGN STANDARD for Boxes

Purpose:

This design standard has the purpose of creating a consistent application for the installation of electrical boxes throughout the Solano Community College District therefore achieving a standard of quality for maintenance, reliability, and operation throughout all renovation and new building projects.

Design Standard:

Provide electrical boxes and fittings for a complete installation. Include but not limited to outlet boxes, junction boxes, pull boxes, bushings, locknuts, and other necessary components.

- Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.
- Avoid using round boxes where conduit must enter through side of box, which would result in a difficult and insecure connection with a locknut or bushing on the rounded surface.
- Secure boxes rigidly to the substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.
- Provide weatherproof outlets for locations exposed to weather or moisture.
- Provide knockout closures to cap unused knockout holes where blanks have been removed.
- Mount center of outlet boxes, unless otherwise required by ADA, the following distances above the floor:
 - Control Switches: 46 inches.
 - Receptacles: 18 inches.
 - Telecom Outlets: 18 inches.
 - Other Outlets: As indicated in other sections of specifications or as detailed on drawings.
- Coordinate electrical device locations (switches, receptacles, and the like) with architectural elevations to prevent mounting devices in mirrors, back splashes, behind cabinets, and the like.



All outlet boxes to meet the following requirements based on Code requirements and industry standard of care:

- Luminaire Outlet: 4-inch octagonal box, 1-1/2 inches deep with 3/8-inch luminaire stud if required. Provide raised covers on bracket outlets and on ceiling outlets.
- Device Outlet: Installation of one or two devices at common location, minimum 4 inches square, minimum 1-1/2 inches deep. Single- or two-gang flush device raised covers. Hubbell.
- Signal and communications systems outlet: 4-inches square, minimum 2-1/8 inches deep. One- or two- gang raised device cover. Hubbell.
- Multiple Devices: Three or more devices at common location. Install one-piece gang boxes with one-piece device cover. Install one device per gang.
- Masonry Boxes: Outlets in concrete, Hubbell.
- Construction: Provide galvanized steel interior outlet wiring boxes, of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.
- Accessories: Provide outlet box accessories for each installation, including mounting brackets, wallboard hangers, extension rings, luminaire studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.
- For weatherproof outlet boxes, provide corrosion-resistant cast metal weatherproof outlet wiring boxes, of the type, shape and size, including depth of box, with threaded conduit ends, cast metal face plate with spring-hinged waterproof cap suitably configured for each application, including face plate gasket, blank plugs and corrosionproof fasteners. Weatherproof boxes to be constructed to have smooth sides, gray finish.
- For junction and pull boxes, provide ANSI 49 gray enamel painted sheet steel junction and pull boxes, with screw-on covers; of the type shape and size, to suit each respective location and installation; with welded seams and equipped with steel nuts, bolts, screws and washers.
 - Install junction boxes above accessible ceilings for drops into walls for receptacle outlets from overhead.
 - Install junction boxes and pull boxes to facilitate the installation of conductors and limiting the accumulated angular sum of bends between boxes, cabinets and appliances to 270 degrees.



- Provide diecast aluminum box extension adapters as necessary and install over flush wall outlet boxes to permit flexible raceway extension from flush outlet to fixed or movable equipment. Bell 940 Series, Red Dot IHE4 Series.
- For conduit fittings, provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and plastic conduit bushings of the type and size to suit each respective use and installation.

All floor boxes and poke-thrus to meet the following requirements based on Code requirements and industry standard of care (device numbers noted are Wiremold. Provide equivalent as noted under approved manufacturers):

- Multi-Gang Box, Slab on Grade: Wiremold RFB4-CI series cast iron housing with S36CCTC series, steel flanged activation for use with matching carpet or tile insert. Rubber gasket protects interior from water and debris. Provide with two duplex receptacles and blank inserts for two future data outlets.
- Multi-Gang Box, Slab above Grade: Wiremold RFB4 series steel housing with S36CCTC series, steel flanged activation for use with matching carpet or tile insert. Rubber gasket protects interior from water and debris. Provide with two duplex receptacles and blank inserts for two future data outlets.
- Multi-Gang Box, Concrete Finish Floor: Same as above, except use Wiremold S36BBTC series, steel flanged activation.
- Single Gang Box, Slab on Grade: Wiremold 880CM (cast-iron) series with 817 series flange suitable for both carpet and tile floors, and 828GFI cover plate insert.
- Single Gang Box, Slab above Grade: Wiremold 880S (stamped steel) series with 817 series flange suitable for both carpet and tile floors, and 828GFI cover plate insert.
- Poke-Thrus: Fire rated for 4 hour, dual service, flush brass cover and service fitting prewired specification grade receptacle, voice/data jacks, Hubbell PT7 Series, or approved.
- Provide floor boxes sized minimum 3-7 /16 inches deep with 1-inch factory knockouts.
- Brass or Aluminum finish for flanges will be determined per specific installation and as directed by the architect.



Approved Manufacturers:

- Outlet Boxes:
 - Bowers
 - Hubbell
- Weatherproof Outlet Boxes and Box Extension Adapters:
 - Bell
 - Red Dot
 - Carlon
- Junction and Pull Boxes:
 - Circle AW
 - Hoffman
- Conduit Fittings:
 - O-Z Gedney
 - Thomas & Betts, or approved.
- Floor Boxes:
 - Wiremold/Walker
 - Hubbell
 - Steel City

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards and Specifications:

- 26 05 26 – GROUNDING



- 26 05 34 – BOXES

End of Document



DESIGN STANDARD for Supporting Devices

Purpose:

This design standard has the purpose of creating a consistent application for the installation of supporting devices throughout the Solano Community College District therefore achieving a standard of quality for maintenance, reliability, and operation throughout all renovation and new building projects.

Design Standard:

Supporting devices shall have a safety factor of 4 required for every fastening device or support for electrical equipment installed. Supporting devices are to withstand four times the weight of equipment it supports. Bracing shall comply with Seismic Zone 4 requirements.

- Provide electrical equipment supports.
- Verify mounting height of luminaires or items prior to installation of supporting devices when heights are not detailed.
- Install vertical support members for equipment and luminaires, straight and parallel to building walls.
- Provide independent supports to structural member for electrical luminaires, materials, or equipment installed in or on ceiling, walls or in void spaces or over furred or suspended ceilings.
- Do not use other trade's fastening devices as supporting means for electrical equipment materials or fixtures.
- Do not use supports or fastening devices to support more than one particular item.
- Support conduits within 18 inches of outlets, boxes, panels, cabinets and deflections.
- Maximum distance between supports not to exceed 8 foot spacing.
- Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from the floor above or roof structure to prevent sagging and swaying.
- Provide seismic bracing per CBC requirements.



Approved Manufacturers:

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards and Specifications:

- 26 05 34 – BOXES

End of Document



DESIGN STANDARD for Electrical Identification

Purpose:

This design standard has the purpose of creating a consistent application for the identification of electrical equipment and devices throughout the Solano Community College District therefore achieving a standard of quality throughout all renovation and new building projects.

Design Standard:

All identification material and methods to meet the following requirements based on Code requirements and industry standard of care:

- Coordinate names, abbreviations and other designations with equipment specified in this or other Divisions of the Specification or identified by the District.
- Fasten labels to equipment in a secure and permanent manner.
- Mark underground utilities in conformance with APWA.
- Conform to requirements of the CEC, latest adopted version with amendments by local AHJs.
- Furnish products listed by UL or other testing firm acceptable to AHJ.
- Where signs are to be applied to surfaces which require finish, install identification after completion of painting.

All engraved labels to meet the following requirements based on Code requirements and industry standard of care:

- Melamine plastic laminate, white with black core, 1/16-inch thick.
- Engravers standard letter style, minimum 3/16-inch high capital letters.
- Drill or punch labels for mechanical fastening except where adhesive mounting is necessary because of substrate. Use self tapping stainless steel screws.
- Dymo tape labels are not acceptable.



- Install an engraved label on each major unit of electrical equipment indicating both equipment name and circuit serving equipment (e.g. "EF-1, CKT. 2P1-1,3,5), including but not limited to the following items:
 - Disconnect switches, identify item of equipment controlled.
 - Relays.
 - Contactors.
 - Time switches.
 - Override switches.
 - Service disconnect and distribution switches, identify connected load.
 - Branch circuit panelboards.
 - Central or master unit of each electrical system including communication/signal systems, unless the unit incorporates its own self-explanatory identification.
- Install engraved on the inside of flush panels, visible when door is opened. Install label on outside of surface panel.

All conductor numbers to meet the following requirements based on Code requirements and industry standard of care:

- Manufacturers standard vinyl-cloth self-adhesive cable and conductor markers of the wraparound type. Preprinted black numbers on yellow field.
- Apply markers on each conductor for power, control, signaling and communications circuits where wires of more than one circuit are present.
- Match conductor identification used in panelboards, shop drawings, contact documents and similar previously established identification for division 26 work.

All branch circuit schedules to meet the following requirements based on Code requirements and industry standard of care:

- Provide branch circuit identification schedules, typewritten, clearly filled out, to identify load connected to each circuit and location of load. Numbers to correspond to numbers assigned to each circuit breaker pole position.
- Provide two columns, odd numbers in left column, even numbers in right column, with 3-inch-wide line for typing connected load information.



All relay panel schedules to meet the following requirements based on Code requirements and industry standard of care:

- Provide typewritten schedule to identify the incoming circuit, the controlled load, and the controlling devices for each relay.

All identification for circuit breakers to meet the following requirements based on Code requirements and industry standard of care:

- Provide permanent identification number in or on panelboard dead-front adjacent to each circuit breaker pole position. Square D adhesive is approved, other adhesives by specific prior approval only.
- Horizontal centerline of engraved numbers to correspond with centerline of circuit breaker pole position.

Provide underground utility markers to meet the following requirements based on Code requirements and industry standard of care:

- Inert polyethylene plastic ribbon, 6-inch wide by 4 mil thick.
- Color code as recommended by APWA. Safety Red for electric power distribution. Safety Alert Orange for telephone, signal, data and cable TV.
- Imprint over entire length of ribbon in permanent black letters, the system description, selected from manufacturer's standard legend which most accurately identifies the subgrade system.
- Install continuous tape, 6 to 8 inches below finish grade, for each exterior underground raceway.
- Where multiple small lines are buried in a common trench and do not exceed an overall width of 16 inches, install a single marker. Over 16 inch width of lines, install multiple tapes not over 10 inches apart (edge to edge) over the entire group of lines.

Approved Manufacturers:

- Engraved Labels: Lamicoid
- Conductor Numbers: Brady
- Underground Utilities Ribbon: Allen Systems, Inc.



Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards and Specifications:

- 26 05 26 – Grounding
- 26 05 34 – Boxes

End of Document



DESIGN STANDARD for Electrical Acceptance Testing

Purpose:

Provide testing, evaluation and calibration of equipment provided, installed and connected in Division 1. This design standard has the purpose of maintaining a consistent method for electrical acceptance testing throughout all renovation and new building projects for the Solano Community College District.

Design Standard:

- Acceptance Testing Criteria: Latest edition of Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, published by IETA.
- System Description:
 - Performance Requirements:
 - Retain the services of a recognized independent testing firm for the purpose of performing inspections and tests as specified herein.
 - Independent test firm providing report direct to Architect.
 - Material, equipment, labor and technical supervision to perform tests and inspections provided by testing firm.
 - It is the intent of these tests to assure that electrical equipment, Contractor or Owner supplied, is operational within industry and manufacturer's tolerances and is installed in accordance with design Specifications.
 - Tests and inspections determine suitability for energization.
 - Supply to the independent testing organization complete sets of approved shop drawings, coordination study (provided by Contractor's equipment supplier under Contractor's direction, setting of adjustable devices and other information requested by testing agency).
 - Scope of Testing, Evaluation and Calibration:
 - Power transformers.
 - Distribution transformers.



- Low voltage circuit breakers (greater than 100 amp).
- Medium voltage circuit breakers.
- Metal enclosed switchgear.
- Switchboards.
- Ground fault protective signaling.
- Protective relays and associated instrument transformers.
- Medium voltage cables.
- Bus duct.
- Grounding systems.
- Motor control centers.
- Generators.
- Automatic transfer switches.
- Test Reports:
 - Maintain written record of tests.
 - At completion of project, assemble and certify a final test report. Submit report to Architect prior to final acceptance to include:
 - Summary of project.
 - Description of equipment tested.
 - Visual inspection report.
 - Description of tests.
 - Test results.
 - Conclusions and recommendations.



- Qualifications of Testing Firm:
 - Corporately independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers and installers of equipment or systems evaluated by testing firms.
 - Independent organization as defined by OSHA Title 29, Part 1936 and IETA.
 - Regularly engaged in the testing of electrical materials, devices, appliances, electrical installations and systems for the purpose of preventing injury to persons or damage to property and other equipment.
 - Engaged in testing practices for minimum of 2 years.
 - Use only full-time technicians, regularly employed by firm for testing services. Electrically unskilled employees are not permitted to perform testing or assistance of any kind. Electricians and line workers may assist, but may not perform testing or inspection services.
 - Submit proof of above qualifications with Bid Documents.

The following tests are required for field quality control based on industry standard of care:

- Contractor's Responsibilities:
 - Perform routine insulation resistance, continuity and rotation tests for distribution and utilization equipment prior to and in addition to tests performed by testing firm.
 - Notify the testing firm when equipment becomes available for acceptance tests. Coordinate work to expedite project scheduling.
- Testing Firm's Responsibilities:
 - Notify District prior to commencement of any testing.
 - Report directly to District any systems, material or installation found defective on the basis of acceptance tests.
 - Provide auxiliary portable power supply necessary for conducting tests.

Associated Design Standards and Specifications:

- 26 05 26 - GROUNDING
- 26 05 33 – RACEWAYS



- 26 05 48 – SUPPORTING DEVICES
- 26 05 53 – IDENTIFICATION

End of Document



DESIGN STANDARD for Occupancy Sensors Standards

Purpose:

Provide occupancy sensors, combined occupancy sensors/wall switches, and/or automatic switches to sense the presence of human activity within the desired space and enable or disable the on/off manual lighting control function provided by local switches. This design standard has the purpose of creating a consistent application of the lighting control requirements throughout the Solano Community College District therefore achieving a standard of quality for maintenance, reliability, and operation throughout all renovation and new building projects.

Design Standard:

- Occupancy Sensors
 - Passive Infrared Sensors:
 - Sensor Function: Detects human presence in the floor area being controlled by detecting changes in the Infrared energy. Sensor detects small movements, i.e., when a person is writing while seated at a desk.
 - i) Ultrasonic Occupancy Sensors:
 - Sensor Function: Detects human presence in the controlled floor area by detecting Doppler shifts in 40kHz ultrasound created by sensor.
 - Dual Technology Sensors:
 - General: Sensor has combined capability of passive infrared and ultrasonic sensors as described above.
- Combined Occupancy Sensor/Wall Switches (“Sensor Switches”):
 - Completely self-contained sensor system that fits into a standard single gang box. Internal transformer power supply, latching dry contact relay switching mechanism compatible with electronic ballasts, compact fluorescent, and inductive loads. Triac and other harmonic generating devices are not allowed.
- Upon detection of human activity by the detector, sensor initiates a time delay to maintain the lights on for a preset period of time. The detector shall have field adjustable time delay settings from 30 seconds to 30 minutes.



- Factory set sensors for maximum sensitivity.
- LED lamp built into sensor indicates when occupant is detected.
- Provide zero cross relay control with sensors and sensor/switches; relay contacts close and open when AC voltage signal is at zero.
- Where line voltage sensors and sensor/switches are used, provide to match voltage of controlled circuit.
- Install occupancy sensors as directed by manufacturer's instructions. Provide connections to control circuits, occupancy sensors, power supply pack and low voltage wiring.
- Provide power packs for the sensor to control the number of circuits and/or switch legs within its area of coverage.
- Field adjust each sensor to maximize its coverage of the room space.
- Relocate sensors with ultrasonic technology to avoid being closer to HVAC diffusers and power packs than recommended by manufacturer.
- Field set time delay for each device as noted below:
 - Classrooms and Conference Rooms: 30 minutes.
 - Restrooms: 15minutes. 30 minutes if interlocked with the exhaust fan.
 - Storage Rooms, Janitor's Closets, Unisex Restrooms: 5 minutes.
 - All Other Spaces: 15 minutes.
 - Timer Switches: 2 hours.
- Prior to applying dimming controls, maintain fluorescent lighting at full output for minimum of 100 hours. If this is not done, replace lamps and ballasts of affected luminaires at no cost to Owner.
- Parking lot lighting controlled by occupancy sensor: Provide two occupancy sensors per pole for 360-degree coverage at each pole. Mount sensors at 10 to 15 feet above grade (minimum 5 feet below pole lighting). Provide HID bi-level controller for each luminaire, mounting controller to adjoin luminaire and securing to pole arm. Provide liquid-tight, flexible metallic conduit and raintight junction box as needed to splice wiring between occupancy sensor and HID bi-level controller per manufacturer's installation instructions, and as allowed by luminaire manufacturer. Paint exposed conduit and junction box to match pole finish.



Approved Manufacturers:

- WattStopper

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards and Specifications:

- 26 50 00 – LIGHTING

End of Document



DESIGN STANDARD for Daylighting Controls

Purpose:

This design standard has the purpose of creating a consistent application of daylighting controls for the Solano Community College District therefore achieving a standard of operation, reliability and quality throughout all renovation and new building projects.

Design Standard:

Daylighting control systems include the following but not limited to:

- **Continuous Dimming Daylighting Controller:** Provide dimming control systems capable of controlling 10VDC control input fluorescent dimming ballasts in three output zones via one photocell, with system adjustments capable of being made at control module instead of remote photocell.
- **Switched Daylighting Controller:** Provide switched control systems capable of controlling three output zones via one photocell with system adjustments capable of being made at control module instead of remote photocell.
- **Local Continuous Dimming Photocell:** Provide local daylighting photocell capable of directly controlling up to fifty 10VDC control input fluorescent dimming ballasts.
- **Local Switched Photocell:** interfaces with room occupancy sensor power pack, where available.
- **HID High/Low Ballast Switching:** Provide HID bi-level HID controller for each HID luminaire in switched daylighting control area. Controller to contain both capacitor and control module, allowing HID ballast to be switched to 50 percent of full power output based on 24VDC control signal.
- Daylighting controls to be UL listed and carry factory warranty for minimum 5-year duration.

All daylighting controls to meet the following requirements based on Code requirements and industry standard of care:

- **Continuous Dimming Daylight Controller:**
 - Provide dimming control of interior lights in response to light level data, compatible with 0 to 10VDC dimming ballasts. Control system to be open loop, and will provide three output control zones consisting of a 0 to 10VDC signal compatible with fluorescent



dimnable ballasts. Control system includes three relay outputs capable of switching each of the three output zones off after an adjustable time delay when a given channel is fully dimmed.

- Installation
 - Install photocells as directed by manufacturer’s instructions. Complete connections to control circuits, photocells, control modules, power supply pack and low voltage wiring.
 - Verify with manufacturer’s representative that the sensors and photocells are laid out in compliance to manufacturer’s published sensing distribution. Provide additional sensors for complete coverage of the space being served.

Approved Manufacturers:

- Wattstopper

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards and Specifications:

- 26 50 00 – LIGHTING

End of Document



DESIGN STANDARD for Liquid-Type Transformers

Purpose:

Provide liquid-type transformers to step-down high voltage power for exterior installations. This design standard has the purpose of providing liquid-type transformers with a level of quality which meets the requirements throughout the Solano Community College District for all renovation and new building projects.

Design Standard:

The liquid-type transformers shall have the following characteristics based on Code requirements and standard industry practices:

- Provide compartmental type, self cooled, tamperproof and weatherproof with pad mounting provisions. Comply within the latest applicable standards of NEMA and ANSI. Provide transformer with no exposed screws, bolts or other fastening devices which are externally removable.
- Voltage: Unless otherwise indicated on Drawings, operate transformers at 3 phase, nominal delta primary to 3 phase wye secondary. Provide standard NEMA, ANSI 3 phase primary taps; that is, 10 percent range of tap voltage adjustment for transformers smaller than 30KVA and 15 percent range tap voltage adjustment for 30KVA and larger.
- Rating: Unless otherwise indicated on Drawings, provide transformer ratings continuous, with an average temperature rise, by resistance, not to exceed 65C in a 30C ambient with 100 percent of rated nameplate load connected to the secondary.
- Provide sealed tank construction of sufficient strength to withstand a pressure of 7 psi without permanent distortion. Provide welded cover with the fastening tamperproof. Provide exterior cooling panels, lifting eyes, jacking pads, and welded cover.
- Provide core and coil assembly core type with aluminum windings. Where wye wye is specified or required provide triplex or 5 legged core design.
- Provide tap changing mechanism for de-energized operation only and externally operable with two 2.5 percent full capacity taps above and two 2.5 percent full capacity taps below normal rated primary voltage.



- Provide high and low voltage compartments located side-by-side separated by a steel barrier. Provide full height air filled terminal compartments with individual doors. Provide high voltage door fastenings which are not accessible until the low voltage door has been opened. Provide the low voltage door with a three point latching mechanism with vault type handle having provisions for a single padlock. Provide doors with lift off type stainless steel hinges and door stops. Provide removable front sills and ANSI tank grounding provisions in each compartment.
- Provide dead front construction with load break gang operated immersed switch with switch hand located in the high voltage compartment for operating with distribution hot stick. Provide 2 position on-off for radial feed unless loop feed is indicated on Drawings. If loop feed is indicated provide 4 position switch. Provide dry well canister mounted current limiting fuses externally replaceable with distribution hot stick. Size fuses to manufacturer's recommendation to final design load. Provide Series NX Arc-Strangler fuses. Provide distribution class lighting arrester mounted in the high voltage compartment.
- Provide low voltage bushings, 6 hole spade, molded epoxy with blade type spade terminals for NEMA standard hole spacing arranged for vertical take-off. Provide low voltage neutral with insulated busing grounded to the transformer tank by removable grounding strap. Wye-wye connected transformers are provided with the high and low voltage neutrals internally tied with a removable link for testing.
- Provide the following accessories:
 - 1 inch drain valve/sampling device
 - Dial type thermometer
 - Magnetic liquid level gauge
 - Pressure/vacuum gauge
 - Pressure relief valve
 - 1000KVA and larger provide sudden pressure relay
- Provide transformer coils of continuous wire wound construction.
- Provide each coil layer with end fillers or tie-downs to provide maximum mechanical strength. Braze tap terminations directly to bus stubs or lugs firmly mounted.
- Provide windings continuous from start to finish. Splicing is unacceptable. Materials incorporated must have at least a minimum of 1 year of proven field usage. Accelerated laboratory test not acceptable.



- Degrease, clean, phosphatize, prime and finish enclosures with a gray, baked enamel. Visibly ground the core of the transformer to this enclosure by means of a flexible ground strap.
- Mount transformers core and coil on vibration mounting pads designed to suppress transmission of 120 cycle frequencies and harmonics thereof. Arrange and select pads in consideration of core and coil weight. Provide additional noise suppressing mountings external to transformers where transformers are located in mechanical spaces.
- Sound levels guaranteed by manufacturer, 45dB through 150KVA and 50dB through 300KVA.

Liquid-type transformers shall meet the following installation requirements based on Code and standard industry practices:

- Provide transformers with a concrete reinforced pad.
- Mount transformers not closer to combustible materials than allowed by CEC and NFPA. Provide adequate ventilation, mount transformers away from structure as recommended by manufacturer and power utility.
- Provide transformers with 8 inch round by 24 inch (above and below grade) concrete and steel bollards where subject to vehicular traffic.
- Where transformers are grouped exterior together or with switchgear, refinish transformer or switchgear resulting in transformers and switchgear finishes matching in color and type.
- For field quality control:
 - Check for damage and tight connections prior to energizing transformers.
 - Measure primary and secondary voltages and make appropriate tap adjustments.
 - Revise the installation of noisy units to achieve an acceptable noise level or replace with a new unit with an acceptable sound level.

Approved Manufacturers:

- Square D
- General Electric
- Cutler-Hammer



Substitutes Allowed:

Upon review and approval.

Associated Design Standards and Specifications:

- 26 00 00 – Basic Electrical Requirements

End of Document



DESIGN STANDARD for Dry-Type Transformers

Purpose:

Provide dry-type transformers to step-down high voltage power to end-user voltages (ex. 277V for lighting, 120V for convenience receptacles). This design standard has the purpose of providing dry-type transformers with a level of quality which meets the requirements throughout the Solano Community College District for all renovation and new building projects.

Design Standard:

- Provide transformer coils of the continuous wire wound construction and impregnate with nonhygroscopic, thermosetting varnish prior to baking.
- Maximum temperature rise at full load: 150 degrees above 40C ambient temperature. NEMA TP-1 compliant.
- Provide windings continuous from start to finish. Splicing is unacceptable. Materials incorporated must have at least a minimum of 1 year of proven field usage. Accelerated laboratory test not acceptable.
- All cores manufactured from a high-grade, nonaging silicon steel with high magnetic permeability, low hysteresis and eddy current losses. Magnetic flux densities are kept well below saturation to allow for a minimum of 10 percent over-voltage excitation.
- Ventilated openings must be designed in a manner as to prevent accidental access to live parts.
- Transformers shall be dry-type, with copper windings.
- In locations where the transformer serves computer classrooms, the transformer shall at the least be "K13" rated. Due to code requirements for California, all transformers shall be energy efficient and be rated, TP-1.
- Mount all transformers, core and coil, on vibration mounting pads designed to suppress transmission of 120 cycle frequencies and harmonics thereof. Arrange and select pads in consideration of core and coil weight. Provide additional noise suppressing mountings external to transformers where transformers are located in mechanical spaces.
- Maximum case temperature, 35C above ambient.
- Sound levels guaranteed by manufacturer, 45dB through 150KVA and 50dB through 300KVA.



- Winding Taps:
 - Less than 15KVA: 4-2-1/2 percent FCBN, FCAN.
 - 15KVA and Larger: 4-2-1/2 percent-2+2-.
- Where possible; all transformers shall be placed within the building or below grade.
 - Only under special circumstances and as approved by the District, shall a transformer be allowed to be exterior pad mounted. If the design team provides an exterior yard for equipment, pad mounted transformers may be considered.
 - Provide weather resistant enclosure and factory rating for exterior where shown at exterior locations.
 - Provide transformers with 8-inch round by 24-inch (above and below grade) concrete and steel bollards where subject to vehicular traffic.
- Transformers up to 45KVA may be floor mounted, wall mounted or suspended. Floor mount all transformers above 45KVA rating.
- Transformer Supports: Provide additional vibration isolation hangers and pads, brackets and supports as may be required for a complete installation.
- Provide transformers with concrete working or housekeeping pad minimum 8 inches larger than transformer and minimum 3 inches above finish grade. Install plumb and level. Provide exterior pads of 2500 to 3000 psi concrete reinforced with 8 gauge wire fabric or No. 6 reinforcing bars on 12-inch centers. Provide 10-inch thick base of gravel below pad for support. Pad extends 6 inches on all sides from the exterior most prominent dimension. Provide 3/4-inch by 10-foot ground rod at each corner thermally bonded to No. 2 copper ground conductor, bonded to transformer, and concrete reinforcement.
- Do not mount transformers closer to combustible materials than allowed by CEC.
- Provide adequate ventilation, mount transformers away from adjacent surfaces as recommended by manufacturer.
- Use flexible conduit, 18 inches minimum length, for connections to transformer case. Make connections to side panel or bottom of enclosure. Include ground conductor in flex.
- Mount wall mounted transformers with a minimum of 6'-6" headroom below unit.
- Provide seismic restraints per local requirements.



Approved Manufacturers:

- Square D
- General Electric
- Cutler-Hammer

Substitutes Allowed:

Upon review and approval.

Associated Design Standards and Specifications:

- 26 00 00 – Basic Electrical Requirements

End of Document



DESIGN STANDARD for Switchboards and Distribution Panelboards

Purpose:

Provide switchboards, distribution panelboards, and branch panelboards for all power and lighting distribution sources to individual buildings and facilities requiring voltages under 600V. This design standard has the purpose of providing switchboards and distribution panels with a level of quality which meets the requirements throughout the Solano College District for all renovation and new building projects.

Design Standard:

All switchboards to meet the following requirements based on Code requirements and industry standard of design and care:

- Install equipment in conformance with work space requirements of CEC.
- Locate equipment in rooms or spaces dedicated to such equipment.
- Enclosures:
 - Free standing, dead front with front accessibility.
 - Framework constructed of formed, code gauge steel, rigidly welded and bolted together to support coverplates, bussing, and component devices during shipment and installation. Bolt steel base channels to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting.
 - Provide each section with individually removable top plate and open bottom to permit installation and termination of service and feeder raceways.
 - Removable Front Covers: Screw attached.
 - Provide removable hinge pins on hinged doors.
 - Paint interior and exterior surfaces. Medium light gray finish, applied by electro-deposition process over an iron phosphate pretreatment.
 - All panel boards, switchboards, motor control centers and other components of electrical systems shall be Nema 1 when enclosed within a building. Except when subjected to moisture, the housing shall be Nema 3R.



- All floor standing equipment shall be mounted on a minimum 6" reinforced concrete pad. All panelboards shall be provided with a minimum of 30% expansion capacity.
- Bussing:
 - Material: Plated copper.
 - Ground Bus: Full length of switchboard, 50 percent of phase bus capacity.
 - Neutral Bus: 100 percent rated, full length of switchboard.
- Provide fully rated integrated equipment rating greater than the available fault current. Series rated switchboards are not acceptable. Coordinate with serving electric utility.
- Lugs: Compression type rated for both aluminum and copper conductors.
- Molded Case Circuit Breakers are to be NEMA AB 1, with standard frame sizes, trip ratings, and number of poles, and interrupting capacity to meet available fault currents. Molded-case circuit breakers are also identified as:
 - Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250A and larger.
 - Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - Instantaneous trip.
 - Long- and short-time pickup levels.
 - Long- and short-time adjustments.
 - Ground-fault pickup level, time delay, and I^2t response.
 - Current-Limiting Circuit Breakers: Frame sizes 400A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.



- Enclosed, Insulated-Case Circuit Breaker: Fixed mounting, manually closed, fully rated, encased-power circuit breaker with interrupting capacity rating to meet available fault current.
 - Two-step, stored energy closing.
 - Microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and the following field-adjustable settings:
 - Instantaneous trip.
 - Long- and short-time pickup levels.
 - Long- and short-time adjustments.
 - Ground-fault pickup level, time delay, and I^2t response.
 - Remote trip indication and control capability.
 - Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

All lighting and appliance branch panelboards to meet the following requirements based on Code requirements and industry standard of design and care:

- Enclosures:
 - Flush Panelboards Rated 400 Amp or Less: Maximum enclosure depth, 5-3/4-inches.
 - Wiring Gutter Size: 5 inches at sides, 6 inches top and bottom.
 - Finish: Galvanized steel constructed in accordance with UL 50 requirements. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - Hinged door with door-in-door construction, flush lift latch and lock, two keys per panel. Key panelboards alike.
- Interior:
 - Copper bar with suitable electroplating (tin) for corrosion control at connection.
 - Provide copper ground bar to accommodate specified terminal lugs.
 - Predrill bus for bolt-on type circuit breakers.

- Provide double lugs or landing pads for feed through feeders.
- Provide feed through feeder lugs for field connection of multi-section flush panel sections, where applicable.
- When distribution panel is feeding isolated ground circuits, provide isolated ground bar, insulated from panelboard enclosure, to accommodate specified terminal lugs.
- Provide fully rated integrated equipment rating greater than the available fault current. Coordinate available fault current with serving electric utility. Minimum rating is 10,000 amps.
- Lugs: Compression type rated for both aluminum and copper conductors.
- Provide interior wiring diagram, neutral wiring diagram, UL listed label and short circuit current rating on the interior or in a booklet format inserted in a sleeve inside the panel cover.
- Main Circuit Breaker, Where Applicable:
 - UL listed to accept solid or stranded, aluminum or copper conductors. Lugs: suitable for 90C rated wire sized according to the 75C temperature rating per CEC.
- Branch Circuit Breakers:
 - Bolt-on type bus connectors.
 - UL listed to accept solid or stranded, aluminum or copper conductors. Lugs: suitable for 90C rated wire sized according to the 75C temperature rating per CEC.
 - UL listed for use with the following factory installed accessories: shunt trip, auxiliary switch and alarm switch.
 - UL listed with the following ratings:
 - 15 to 125 amp breakers: Heating, Air Conditioning, and Refrigeration (HACR).
 - 15 to 30 amp breakers: High Intensity Discharge (HID) lighting.
 - 15 to 20 amp breakers: Switch Duty (SWD).
 - When indicated on drawings, provide 200 percent rated copper neutral assembly.
 - When indicated on drawings, provide an isolated ground bus in addition to the equipment ground bus.



All power distribution panelboards to meet the following requirements based on Code requirements and industry standard of design and care:

- Enclosures:
 - Provide boxes with removable blank end walls and interior mounting studs. Provide interior support bracket for ease of interior installation.
 - Finish: Galvanized steel constructed in accordance with UL 50 requirements. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - Hinged door with door-in-door construction, flush lift latch and lock, two keys per panel. Key panelboards alike.

- Interior:
 - Copper bar with suitable electroplating (tin) for corrosion control at connection.
 - Provide copper ground bar to accommodate specified terminal lugs.
 - Panelboard interior: three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. Molded polyester insulators shall support and provide phase isolation to entire length of bus.
 - Predrill bus for bolt-on type circuit breakers.
 - Provide double lugs or landing pads for feed through feeders.
 - Provide feed through feeder lugs for field connection of multi-section flush panel sections.
 - When distribution panel is feeding isolated ground circuits, provide isolated ground bar, insulated from panelboard enclosure, to accommodate specified terminal lugs.
 - Fully equip unused spaces for future devices, including manufacturer required connectors and mounting hardware.
 - Provide fully rated integrated equipment rating greater than the available fault current. See drawings for available fault current. Coordinate available fault current with serving electric utility. Minimum rating is 10,000 amps.
 - Lugs: Compression type rated for both aluminum and copper conductors.
 - Provide interior wiring diagram, neutral wiring diagram, UL listed label and short circuit current rating on the interior or in a booklet format inserted in a sleeve inside the panel cover.



- When indicated on drawings, provide 200 percent rated copper neutral assembly.
- When applicable, provide an isolated ground bus in addition to the equipment ground bus.

All instrumentation equipment to meet the following requirements based on Code requirements and industry standard of design and care:

- Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
- Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - Phase Currents, Each Phase: Plus or minus 1 percent.
 - Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - Phase-to Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - Megawatts: Plus or minus 2 percent.
 - Megavars: Plus or minus 2 percent.
 - Power Factor: Plus or minus 2 percent.
 - Frequency: Plus or minus 0.5 percent.
 - Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.
 - Accumulated Energy, Megawatt Hours: Plus or minus 2 percent. Accumulated values unaffected by power outages up to 72 hours.

Approved Manufacturers:

- Square D
- General Electric
- Cutler-Hammer



Substitutes Allowed:

Upon review and approval.

Associated Design Standards and Specifications:

- 26 00 00 – Electrical Basic Requirements

End of Document



DESIGN STANDARD for Motor Control Centers

Purpose:

This design standard has the purpose of creating a consistent application of motor control centers throughout the Solano Community College District therefore achieving a standard of maintenance, reliability and quality throughout all renovation and new building projects.

Design Standard:

All motor control centers to meet the following requirements based on Code requirements and industry standard of care:

- **Regulatory Requirements:** The MCC must conform to Underwriters Laboratory (UL) 845, current revision, CSA, EEMAC, NEMA ICS-2, the latest version of the National Electrical Code. The MCC must be manufactured in an ISO 9001 certified facility.
- Do not place motor control centers in hazardous locations. The area chosen shall be well ventilated and totally free from humidity, dust and dirt. The temperature of the area shall be no less than 32F and no greater than 104F. For indoor locations, protection must be provided to prevent moisture entering the enclosure.
- Locate motor control centers in an area which allow a minimum of 3 feet of free space in front of front-of-board construction. An additional 3 feet should be allowed in the rear of back-to-back construction. This free space will give adequate room to remove and install units. Provide a minimum of 0.5-inch space between the back of front-of-board MCCs and a wall (6 inches required for damp locations).
- Assemble the MCCs in the factory on a smooth level surface so that sections are properly aligned. Provide a similar smooth and level surface for installation. The surface under a MCC shall be of a noncombustible material unless bottom plates are installed in each vertical section.

Motor control centers shall include and have the following characteristics but not limited to:

- **Materials:**
 - Each MCC shall consist of one or more vertical sections of heavy gauge steel bolted together to form a rigid, free-standing assembly. Mount a removable 7 gauge structural steel lifting angle full width of the MCC lineup at the top. Mount removable 7 gauge bottom channel sills underneath front and rear of the vertical sections extending the full



width of the lineup. Vertical sections made of welded side-frame assembly formed from a minimum of 12 gauge steel. Internal reinforcement structural parts shall be of 11 gauge steel to provide a strong, rigid assembly. Construct and package the entire assembly to withstand stresses included in transit and during installation.

- MCC Finish:
 - Provide steel parts with UL and CSA listed acrylic/alkyd baked enamel paint finish, except plated parts used for ground connections. Painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.
 - Pretreatment shall include:
 - Hot alkaline cleaner to remove grease and oil.
 - Iron phosphate treatment to improve adhesion and corrosion resistance.
 - Apply paint using an electrodeposition process to ensure a uniform paint coat with high adhesion.
 - Test the standard paint finish to UL 50 per ASTM B117 with no greater than 0.125 in loss of paint from a scribed line.
 - Paint Color: No. 49 medium light gray per ANSI standard Z55.1-967 on surfaces unless specified otherwise.

- Structures:
 - Totally enclose structures, dead-front, free-standing assemblies. Structures capable of being bolted together to form a single assembly.
 - The overall height of the MCC shall not exceed 90 inches (not including base channel). Base channels, of 1.5 inches in height, shall be removable. The total width of one section shall be 20 inches.
 - Structures: NEMA/EEMAC 1 general purpose, 12 (industrial duty), or 3R non-walk-in (rainproof) depending on installation.
 - Each 20-inch wide standard section shall have the necessary hardware and bussing for modular plug-in units to be added and moved around. Cover unused space with hinged blank doors and equipped to accept future units. Cover vertical bus openings with manual bus shutters.



- Each section shall include a top plate. NEMA/EEMAC 12 shall also include a bottom plate. Top and bottom plates removable for ease in cutting conduit entry openings.
- Wireways:
 - Structures shall contain a minimum 12-inch high horizontal wireway at the top of each section and a minimum 6-inch high horizontal wireway at the bottom of each section. These wireways shall run the full length of MCC to allow room for power and control cable to connect between units in different sections.
 - Provide a full-depth vertical wireway in each MCC section that accepts modular plug-in units. The vertical wireway shall connect with both the top and bottom horizontal wireway and isolated from unit interiors by a full height barrier. The vertical wireway 4 inches wide minimum with a separate hinged door. There should be a minimum of 4,000 in³ of cabling space available. Access to the wireways shall not require opening control unit doors. Structures that house a single, full section control unit are not required to have vertical wireways. Those control units must open directly into the MCC horizontal wireways.
- Barriers:
 - Isolate power bussing and splice connections from the unit compartments and the wireways. Mount the horizontal bus onto a glass filled polyester support assembly that braces the bus against the forces generated during a short circuit. Isolate the horizontal bus from the top horizontal wireway by a two-piece grounded steel barrier. Provide removable barrier to allow access to the bus and connections for maintenance.
 - House the vertical bus in a molded glass-filled polyester support that provides bus insulation and braces the bus against the forces generated during a short circuit. These supports shall have openings every 3 inches for unit stab-on connections. Provide each opening with a manual shutter to close off the stab opening. Attach these shutters to the structure so that when they are removed they are retained in the structure and are readily accessible for use should a plug-in unit be removed from the MCC.
 - Provide barriers in the vertical structure and unit designs to prevent the contact of any energized bus or terminal by a fishtape inserted through the conduit or wireway areas.
- Bussing:
 - Bussing and Connectors: Tin-plated or silver-plated copper.
 - Main Horizontal Bus: Rated at 600A, 800A, 1200A, 1600A, or 2000A continuous and shall extend the full length of the MCC. Base bus ratings on 65C maximum temperature



rise in a 40C ambient. Provide provisions for splicing additional sections onto either end of the MCC.

- Horizontal Bus Splice Bars: Preassembled into a captive bus stack. This bus stack is installed into the end of the MCC power bus to allow the installation of additional sections. The main bus splice shall utilize four bolts, two on each side of the bus split, for each phase. Additional bolts must not be required when splicing higher amperage bus. The splice bolts shall secure to self clenching nuts installed in the bus assembly. It shall be possible to maintain any bus connection with a single tool. "Nut and bolt" bus connections to the power bus shall not be permitted.
 - Provide each section that accepts plug-in units with a vertical bus for distributing power from the main bus to the individual plug-in starter units. This bus shall be of the same material and plating as the main bus, and rated at 300A or 600A continuous. Connect the vertical bus directly to the horizontal bus stack without the use of risers or other intervening connectors. It shall be possible to maintain the vertical to horizontal bus connection with a single tool. "Nut and bolt" bus connections to the power bus are not permitted. When a back-to-back unit arrangement is utilized, provide separate vertical bus for both the front and rear units.
 - Provide a tin-plated copper ground bus that runs the entire length of the MCC. Ground bus: 0.25 by 1 inch and rated for 300 amps. Provide a compression lug in the MCC for a 4/0-250 kcmil ground cable. Provide the ground bus with six 0.38-inch holes for each vertical section to accept customer-supplied ground lugs for any loads requiring a ground conductor.
 - Each vertical section shall have a copper vertical ground bus that is connected to the horizontal ground bus. Install this vertical ground bus so that the plug-in units engage the ground bus prior to engagement of the power stabs and shall disengage only after the power stabs are disconnected upon removal of the plug-in unit.
 - Brace the power bus system for a short circuit capacity as determined by information from the utility and a short circuit study.
- Unit Construction:
 - Units with circuit breaker disconnects through 250A frame, and fusible switch disconnects through 200A, shall connect to the vertical bus through a spring reinforced stab-on connector. Connect units with larger disconnects directly to the main horizontal bus with appropriately sized cable or riser bus. Stabs on plug-in units shall be solidly bussed to the unit disconnect. Cabled stab assemblies are not permitted.



- Conducting parts on the line side of the unit disconnect shrouded by a suitable insulating material to prevent accidental contact with those parts.
 - Unit mounting shelves shall include hanger brackets to support the unit weight during installation and removal. Plug-on units shall use a twin-handle camming lever located at the top of the bucket to rack in and out the plug-on unit. The cam lever shall work in conjunction with the hanger brackets to ensure positive stab alignment.
 - A cast metal handle operator must be provided on each disconnect. With the unit stabs engaged into the vertical phase bus and the unit door closed, the handle mechanism shall allow complete ON/OFF control of the unit disconnect with clear indication of the disconnects status. Circuit breaker operators shall include a separate TRIPPED position to clearly indicate a circuit breaker trip condition. It shall be possible to reset a tripped circuit breaker without opening the control unit door.
 - A mechanical interlock shall prevent the operator from opening the unit door when the disconnect is in the ON position. Another mechanical interlock shall prevent the operator from placing the disconnect in the ON position while the unit door is open. It shall be possible for authorized personnel to defeat these interlocks.
 - Provide a nondefeatable interlock between the handle operator and the cam lever to prevent installing or removing a plug-on unit unless the disconnect is in the OFF position.
 - The plug-in unit shall have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors.
 - Provide provisions for locking disconnects in the OFF position with up to three padlocks.
 - Locate handle mechanisms on the left side to encourage operators to stand to the left of the unit being switched.
 - Unit construction shall combine with the vertical wireway isolation barrier to provide a fully compartmentalized design.
- High Density Unit Construction:
 - Units with circuit breaker disconnects through 100 A frame, and fusible switch disconnects through 100 A, shall connect to the vertical through a spring-reinforced stab-on connector. Cable connect stabs on plug-on units to the unit disconnect. High density units shall accept Class J fuses only and to be rated for 100,000 AIR (amperes interrupting rating) at 600 volts. Rate high density units with breakers for 65,000 AIR at 480 volts.



- Conducting parts on the line side of the unit disconnect be shrouded by a suitable insulating material.
- Unit mounting shelves shall include hanger brackets to support the unit weight during installation and removal. High density units installable without the assistance of a camming device so as to allow maximum accessibility with the unit installed.
- Provide a cast metal handle operator on each disconnect. With the unit stabs engaged into the vertical phase bus and the unit door closed, the handle mechanism shall allow complete ON/OFF control of the unit disconnect with clear indication of the disconnects status. Circuit breaker operators shall include a separate TRIPPED position to clearly indicate a circuit breaker trip condition. It shall be possible to reset a tripped circuit breaker without opening the control unit door.
 - A mechanical interlock shall prevent an operator from opening the unit door when the disconnect is in the ON position. Another mechanical interlock shall prevent an operator from placing the disconnect in the ON position while the door is open. It shall be possible for authorized personnel to defeat these interlocks.
 - Provide a nondefeatable interlock between the handle operator and the structure to prevent installing or removing a plug-on unit unless the disconnect is in the OFF position. The plug-on unit shall have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors.
- Provide provisions for locking disconnects in the OFF position with up to three padlocks.
- Locate handle mechanisms on the bottom left side of the unit and operate horizontally to encourage operators to stand to the left of the unit being switched.
- Unit construction shall combine with the vertical wireway isolation barrier to provide a fully-compartmentalized design.
- Up to a maximum of 12 high-density units can be installed per vertical section without placement restrictions in new or existing applications.
- Components:
 - Combination Starters:
 - Combination starters shall utilize a unit disconnect as specified in the previous article. Furnish magnetic starters in combination starter units. Starters shall



utilize NEMA/EEMAC rated contactors. Provide starters with a 3 pole, external manual reset, overload relay for thermal overload units.

- When provided, control circuit transformers shall include internal primary protection 208V to 480V (separate primary fuse on 600V) and one secondary fuse (in the nonground secondary conductor). Size the transformer to accommodate the contactor(s) and connected control circuit loads. The transformer rating fully visible from the front when the unit door is opened.
 - When a unit control circuit transformer is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.
 - Provide auxiliary control circuit interlocks where indicated. Auxiliary interlocks field convertible to normally open or normally closed operation.
 - Mount NEMA/EEMAC Size 1-4 starters directly adjacent to the wireway so that power wiring (motor leads) shall connect directly to the starter terminals without the use of interposing terminals. Arrange larger starters so that power wiring may exit through the bottom of the starter cubical without entering the vertical wireway.
- Terminal Blocks:
- Provide Type B wiring. Provide starter units with unit control terminal blocks.
 - Terminal Blocks: Pull-apart type 600 volt and rated at 25 amps. Tin plate current carrying parts. Terminals accessible from inside the unit when the unit door is opened. Terminal blocks shall be DIN rail mounted with the stationary portion of the block secured to the unit bottom plate. Use the stationary portion for factory connections, and shall remain attached to the unit when removed. The terminals used for field connections shall face forward so they can be wired without removing the unit or any of its components.
 - When Type C wiring is specified, provide starter units with unit control terminal blocks as described for Type B wiring. Provide an additional set of identical terminal blocks in a terminal compartment located in each section. Prewire these terminal blocks to the unit terminals so that field control connections can be made at the terminal compartments.



- Components For High Density Units:
 - High Density Combination Starters:
 - High density combination starters shall use a unit disconnect as specified in the previous article. NEMA rated units shall use magnetic starters and furnished in high density combination starter units. Starters shall use NEMA/EEMAC-rated contactors. Provide starter units with a 3 pole, external manual reset, overload relay for motor overload protection.
 - When provided, control circuit transformers shall include internal primary protection 280V to 480V, and one secondary fuse (in the nonground secondary conductor.) Size the transformer to accommodate the contactor(s) and connected control circuit loads.
 - When a unit control circuit transformer is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.
 - Provide auxiliary control circuit interlocks. For NEMA rated starters, auxiliary interlocks field convertible to normally open or normally closed operation.
 - Mount NEMA/EEMAC size 1 starters directly adjacent to the wireway so that power wiring (motor leads) will connect directly to the starter terminals.
 - Terminal Blocks for High Density Units
 - Provide starter units with unit control terminal blocks.
 - Terminal Blocks: Pull-apart type, 250V, and rated for 10 amperes. Tin plate current-carrying parts. Terminals accessible from inside the unit when the unit door is opened. Use the stationary portion of the terminal block for factory connections and will remain attached to the unit when the portion used for field connections is removed. The terminals used for field connections accessible so they can be wired without removing the unit or any of its components.
 - Pilot Device Control Panel: Provide each unit with a control panel for up to a maximum of four pilot devices. Control panel to be removable by loosening two semi-captive fasteners for customer access.



Approved Manufacturers:

- Square D
- General Electric
- Cutler-Hammer

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards and Specifications:

- 26 00 00 – Electrical Basic Requirements

End of Document



DESIGN STANDARD for Wiring Devices

Purpose:

This design standard has the purpose of creating a consistent application of wiring devices throughout the Solano Community College District therefore achieving a standard of maintenance, reliability and quality throughout all renovation and new building projects.

Design Standard:

Wiring devices are identified as the following but not limited to:

- Wall Switches:
 - Toggle type
 - Pilot light toggle type (handle is on when load is energized)
 - Lighted handle toggle type (handle is on when load is not energized)
 - Key switches
- Receptacles:
 - Duplex receptacles
 - Isolated ground receptacles
 - Ground Fault Circuit Interrupter (GFCI) receptacles
 - Tamper Resistant receptacles
 - Special Purpose Receptacles (NEMA type as applicable)
- Wall Dimmers

All wiring devices to meet the following requirements based on Code requirements and industry standard of care:

- For Wall Switches:
 - Characteristics: Toggle type, quiet acting, 20 amp, 120/277 volt, UL listed for motor loads up to 80 percent of rated amperage.



- Pilot Light Switches: Lighted handle, toggle type, red unless noted otherwise, neon pilot lamp. Pilot lamp energized when load is energized.
 - Lighted Handle Switches: Lighted handle, quiet acting, 20 amp, 120/277 volt, toggle type, red unless noted otherwise, neon lamp. Lamp energized when load is not energized.
 - Key Switches: 20 amp/120-277 volt, black key guide.
 - Finish: As selected by District. Provide District with optional colors for selection prior to ordering.
 - Appearance: Provide lighting switches and receptacles of common manufacturer and appearance.
- For Receptacles:
 - Commercial Grade: Riveted. Brass ground contact on steel mounting strap. 20 amp.
 - Decorative Type: Back and side wired. 20 amp.
 - Isolated Ground Receptacle: Isolated ground "delta" on receptacle face, same finish as standard duplex receptacles, 20 amp.
 - Ground Fault Circuit Interrupter (GFCI) Receptacle: Meets or exceeds UL943 (Class A GFCI), UL498. Feed through type, back-and-side wired, 20 amp, 125VAC.
 - Tamper-Resistant Receptacle: 20 amp, 125VAC, complies with CEC requirements for tamper-resistant outlets in areas where children are cared for.
 - UL Wet-Listed Covers While-In-Use: NEMA 3R when closed over energized plug. Vertical mount for duplex receptacle. Provide continuous use cover with cover capable of closing over energized cord cap with bottom aperture for cord exit.
 - Coverplates shall be nylon thermoplastic.
 - For Wall Dimmers, size dimmers to accept connected load. Do not cut fins. Where dimmers are ganged together, provide a single multigang coverplate.
 - Conform to requirements of the CEC, latest adopted version with amendments by local AHJs.
 - Furnish products listed by UL or other testing firm acceptable to AHJ.
 - Federal Specification Compliance: Comply with Federal Specification WS896 and WC596 for switches and receptacles respectively.



- NEMA Configuration: Comply with NEMA configurations and standards for general and special purpose wiring devices.
- Orientation:
 - Wall-Mounted Receptacles: Install with long dimension oriented vertically at centerline height shown on Drawings or specified herein.
 - Vertical Alignment: When more than one outlet is shown on Drawings in close proximity to each other, but at different elevations, align the outlets on a common vertical center line for best appearance. Verify with Architect.
- Locate receptacles in convenient locations for the users. Do not locate receptacles where they will be inaccessible or inconvenient to the users.
- For quality control, provide testing of wiring devices to ensure electrical continuity of grounding connections, and after energizing circuitry, to demonstrate compliance with requirements. Test receptacles for line to neutral, line to ground and neutral to ground faults. Contractor to correct any defective wiring.

Approved Manufacturers:

- Cooper
- Hubbell
- Leviton
- Pass & Seymour

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards and Specifications:

- 26 05 34 – BOXES

End of Document



DESIGN STANDARD for Overcurrent Protective Devices

Purpose:

This design standard has the purpose of creating a consistent application of overcurrent protective devices throughout the Solano Community College District therefore achieving a standard of maintenance, reliability and quality throughout all renovation and new building projects.

Design Standard:

Overcurrent protective devices are identified as the following but not limited to:

- Fusible switches.
- Fuses.
- Circuit breakers.
- Fuse cabinet.

All overcurrent protective devices to meet the following requirements based on Code requirements and industry standard of care:

- For each class and ampere rating of fuse installed, provide the following quantities of spares for quantity of fuses installed:
 - 0 to 24: Provide 6 spare.
 - 25 to 48: Provide 9 spare.
 - 49 and Above: Provide 12 spare.
- Provide testing of ground fault interrupting breakers.
- Provide circuit breakers for installation in panelboards, individual enclosures or combination motor starters.
- Provide ground fault interrupter circuit breakers for equipment in damp or wet locations.
- Provide device on handle to lock breaker in "ON" position for breakers feeding time switches, night lights and similar circuits required to be continuously energized.



Approved Manufacturers:

- Fuses:
 - Bussmann Division
 - McGraw-Edison
 - Shawmut Division
 - Gould Electronic
 - Littelfuse

- Circuit Breakers and Fusible Switches:
 - Eaton Electrical
 - General Electric
 - Siemens
 - Square D

- Fuse Cabinet:
 - Bussmann
 - Circle AW
 - Ferraz-Shawmut
 - Littelfuse
 - Siemens
 - Square D

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.



Associated Design Standards and Specifications:

- 26 00 00 – Basic Electrical Requirements

End of Document



DESIGN STANDARD for Circuit and Motor Disconnects

Purpose:

This design standard has the purpose of creating a consistent application of circuit and motor disconnects throughout the Solano Community College District therefore achieving a standard of maintenance, reliability and quality throughout all renovation and new building projects.

Design Standard:

Circuit and motor disconnects are identified as the following but not limited to:

- Toggle type disconnect switches.
- Manual motor starters.
- Safety switches.

All circuit and motor disconnects to meet the following requirements based on Code requirements and industry standard of care:

- Provide disconnect switch in sight of each motor location unless otherwise noted.
- Motors within sight of and not more than 20 feet from motor branch circuit device do not require a disconnect switch at the motor. Provide locking device on circuit protective device.
- Provide disconnect switch in site of each motor controller. Motor controller disconnect equipped with lock-out/tag-out padlock provisions do not require a disconnect switch at the controlled motor location.
- Recessed fractional horsepower exhaust ceiling or wall fan units; no disconnect switch required at motor if unit is recessed.
- Switches disconnect phase legs.
- Coordinate fuse ampere rating with installed equipment. Fuse ampere rating variance between original design information and installed equipment, size in accordance with Bussmann Fusetron 40C recommendations. Do not provide fuses of lower ampere rating than motor starter thermal units.



- For toggle type disconnect switches:
 - Rating: 120 volt, 1 pole, 20 amp, 1 HP maximum.
 - Enclosure: NEMA 1 indoors, NEMA 3R raintight outdoors.
- For manual motor starters:
 - Characteristics:
 - Quick-make, quick-break.
 - Thermal overload protection.
 - Clearly label device for maximum voltage, current and horsepower.
 - Square D, Class 2510.
 - Enclosure: NEMA 1 indoors, NEMA 3R raintight outdoors.
- For safety switches:
 - Heavy duty, fused type, dual rated, quick-make, quick-break with fuse rejection feature for use with Class R fuses only, unless other fuse type is specifically noted.
 - Enclosures: NEMA 1 indoors, NEMA 3R raintight outdoors.
 - Switches clearly marked for maximum voltage, current and horsepower.
 - Equip enclosure with defeatable cover interlock.
 - Switches rated for maximum available fault current.
- For combination starters:
 - Heavy duty, fused type, dual rated, quick-make, quick-break with fuse rejection feature for use with Class R fuses only, unless other fuse type is specifically noted.
 - Enclosures: NEMA 1 indoors, NEMA 3R raintight outdoors.
 - Clearly mark switches for maximum voltage, current and horsepower.
 - Provide coil voltage coordinated with control requirements.
 - Provide thermal overload units sized to equipment nameplate rating.
 - Provide one N.C. and one N.O. auxiliary contacts.



- Provide prewired hand/off/auto switch and start button.

Approved Manufacturers:

- Toggle Type Disconnect Switches:
 - Cooper
 - Hubbell
 - Leviton
 - Pass & Seymour
 - Slater
- Manual Motor Starters:
 - Eaton Electrical
 - Siemens
 - Square D
- Safety Switches:
 - Eaton Electrical
 - General Electric
 - Siemens
 - Square D

Substitutes Allowed:

Yes, if performance and quality equivalency can be evidenced.

Associated Design Standards and Specifications:

- 26 00 00 – Basic Electrical Requirements

End of Document



DESIGN STANDARD for Lighting

Purpose:

This design standard has the purpose of specifying complete luminaires with a level of quality which meets the requirements throughout the Solano Community College District for all renovation and new building projects.

Design Standard:

- All lighting shall be designed per Title 24 and follow the recommendations of the Illuminating Engineering Society (IES).
- All lighting fixtures, and their placement in the building, shall be selected with future maintenance in mind.
 - No fixtures shall be selected or mounted that will require more than one person to service the fixture
 - Nor shall they be located where a 6-10 foot ladder can not readily access the fixture for re-lamping or other maintenance.
 - For 2'x2' fixtures, U-tube fluorescent lamps are not allowed.
- Comply with applicable ANSI standards pertaining to lamp materials, lamp ballasts and transformers, and luminaires.
- Comply with applicable NEMA standards pertaining to lighting equipment.
- Provide luminaires and lampholders which comply with UL standards and have been UL listed and labeled for location and use indicated.
- Provide spares as noted:
 - Furnish 2 percent extra lens or louvers for each size and type of fluorescent luminaire.
 - Furnish 10 percent extra lamps for each size and type installed.
 - Furnish 5 percent extra ballasts for each size and type.

- Comply with CEC as applicable to installation and construction of luminaires.
- Comply with fallout and retention requirements of CBC for diffusers, baffles, louvers, and the like.
- Provide recessed fluorescent luminaires with four supports as required by DSA.

Interior Lighting shall be designed with the following considerations:

- Where lighting control systems are required per Title 24, the system shall include lighting relay control panels, switch inputs, intertie to other building systems (fire alarm, security and energy management system for HVAC).
- The District prefers 2x4 fixtures (not 2x2) to reduce tube stocking.
- For classroom and offices, direct/indirect fixtures are recommended.
- For corridors, use standard lay-in with acrylic prismatic lenses.
- For classrooms supporting AV presentations, describe difficulties in switching for daylight sensing, bi-level switching, and need to switch front third of class differently to support AV presentations while still allowing some light for note taking in classrooms. Switches needed at front of class for control by instructor.
- Restroom lighting is recommended to be specified with lenses for ease of cleaning. Avoid installation of lighting over stalls (hard to relamp).
- Non-electric supplied exit signs shall be non-radioactive photoluminescent signs. Titanium powered (radioactive) exit signs are prohibited for installation on campus.

Exterior Lighting shall be designed with the following considerations:

- Confirm color of lights for exterior fixtures on each of the campuses with respect to security, proximity to observatories and as directed by the District.
- There is a need to connect exterior fixtures on site lighting circuits, some on night lighting circuits. To be defined by each of the campuses or as directed by the District.
- Provide accent lighting for building (i.e. entrances). Entrance lighting is important as there are as many night school students as day.
- Add provision for art and accent landscape lighting to surrounding area from any renovation, remodel or new construction including, but not limited to controls of lighting and point of connection.



- Provide documentation regarding dark sky issues and write up requirement that lights must have cut offs to cover intended area but no more. Comply with Title 24 and consider minimizing light pollution.
- Parking Lot lighting shall use metal halide lamps.
 - At Fairfield campus use 1000W metal halide lamps on 40' poles, located 200' apart.
- Exterior Walkway lighting shall use metal halide lamps with 250W lamps.
- Roadway lighting shall use cobra type pole mounted fixtures with 400W metal halide lamps.

All luminaires to meet the following requirements based on Code requirements and industry standard of design and care:

- Where recessed luminaires are installed in cavities intended to be insulated, provide IC rated luminaires or other code approved installation.
- UL label luminaires installed under canopies, roof or open porches, and similar damp or wet locations, as suitable for damp or wet locations.
- Recessed Luminaires: Frame compatible with ceiling material installed at particular luminaire location. Provide proper factory trim and frame for luminaire to fit location and ceiling material.
- Finishes:
 - Manufacturer's standard finish (unless otherwise indicated) over a corrosion resistant primer.
 - Interior Light Reflecting Finishes: White or specular finish with not less than 85 percent reflectances.
 - Exterior Finishes: As detailed in luminaire schedule or on Drawings. Refer cases of uncertain applicability to Architect for resolution prior to release for fabrication.
- Light Transmitting Components:
 - Plastic diffusers, molded or extruded of 100 percent virgin acrylic.
 - Prismatic acrylic, extruded, flat diffusers, 0.125 inch overall thickness, unless otherwise noted.



- Fluorescent Luminaires:
 - Provide open lamp fluorescent luminaires without diffusers or guards with turret type, spring loaded sockets.
 - To facilitate multilevel lamp switching with adjacent fixtures, multi-lamp fixtures and tandem fixtures, provide a master/slave installation with the ballasts to maximize the capability of switching and providing uniform lighting distribution.
 - For T5HO lamps, provide twist and lock design sockets, socket body rated to 110C and socket rotor rated to 140C.
- Provide wire lamp guards on exposed lamp fluorescent luminaires.

All ballasts to meet the following requirements based on Code requirements and industry standard of design and care:

- Provide ballasts UL rated for specified lamps.
- Thermal Protection: Internal UL Class 'P' with automatic reset.
- Sound Ratings: Class 'A'. Where not available as standard product from any specified manufacturer, provide quietest rating available.
- Total Harmonic Distortion: Not to exceed 20 percent of the input current unless otherwise indicated.
- Input Voltage: Provide universal voltage ballast matching branch circuit supply voltage.
- Provide quantity of ballasts to provide switching as indicated on Drawings.
- Provide factory printed wiring diagram on ballast housing.
- Ballasts used in enclosed and gasketed luminaires shall be of Type 1 construction.
- Comply with FCC rules and regulations Part 18, Class A concerning generation of both electromagnetic interference and radio frequency interference.
- Provide 3-year warranty against defects in materials and workmanship, including either a USD 10 replacement labor allowance or complete replacement including labor by an agent of the manufacturer.
- Ballasts for Linear Fluorescent Lamps:
 - Power Factor: Minimum 97 percent.

- Do not provide magnetic fluorescent ballasts.
- Nondimming Electronic:
 - Tandem wiring between luminaires may be used to minimize the number of ballasts while accomplishing the switching requirements shown on Drawings. Provide label in lamp compartment of luminaire to identify the function of ballast. Label shall not be visible from room.
 - Provide ballasts that meet requirements of UL 935, ANSI C82.11 and bear the appropriate UL label.
 - Provide ballasts that withstand input power line transients as defined in ANSI C62.41, Category-A and IEEE 587.
 - Provide series wired programmed start ballast unless noted on drawings.
 - High frequency operation: Not less than 42kHz.
 - Lamp Crest Factor: Maximum 1.7 for programmed rapid start ballasts and maximum 1.85 or less for instant start ballasts.
 - Average Ballast Factor (BF): Minimum 88 percent.
 - Provide 0 degree Fahrenheit minimum starting temperature ballasts for luminaires installed where exposed to anticipated ambient temperature less than 55F.
 - Manufacturers: Advance, Universal Lighting Technologies, OSRAM/Sylvania, or approved.
- Dimming Electronic:
 - Shall meet requirements of nondimming electronic ballasts.
 - Do not use tandem wiring between luminaires.
 - Ballast shall start lamp at any preset light output setting and provide continuous, square law dimming from 100 percent to specified low-end output.
 - 10 Percent Dimming: Control protocol shall be 0-10V type with positive line voltage On/Off. Manufacturers: Lutron TVE, OSRAM/Sylvania Pho-Dim, Advance Mark VII, or approved.



- 1 Percent Dimming: Control protocol shall be 0-10V type with positive line voltage On/Off. Manufacturers: OSRAM/Sylvania Pho-Dim or approved.
- Ballasts for Compact Fluorescent Lamps:
 - Power Factor: Minimum 97 percent.
 - Provide ballasts which meet requirements of UL 935, ANSI C82.11 and bear the appropriate UL label.
 - With integral end of lamp life detection and shutdown circuit with automatic reset.
 - Nondimming Electronic:
 - Series wired, programmed rapid start circuitry.
 - High frequency operation: Not less than 50kHz.
 - Lamp Crest Factor: Maximum 1.5.
 - Average Ballast Factor (BF): Minimum 98 percent.
 - 0 degree Fahrenheit minimum starting temperature.
 - Manufacturers: Advance, OSRAM/Sylvania, Universal Lighting Technologies, or approved.
 - Dimming Electronic:
 - Must meet requirements of nondimming electronic ballasts.
 - Ballast start lamp at any preset light output and provide continuous, square law dimming from 100 percent to specified low-end output.
 - Supply line voltage controls with air-gap disconnect.
 - 5 Percent Dimming Manufacturers: Lutron Compact SE, Lutron Tu-Wire, Advance MarkX, or approved.
 - 1 Percent Dimming Manufacturers: Lutron Hi-Lume or approved.
- Ballasts for High Intensity Discharge (HID) lamps:
 - Power Factor: Minimum 90 percent.
 - Provide HID ballasts with end of life anti cycling protection technology where available.



- Do not use tandem wiring between luminaires.
- Provide proper ANSI-series designation for specified lamp.
- Average Ballast Factor (BF): Minimum 98 percent.
- Minus 20F minimum starting temperature.
- Pulse-start types specifically for pulse-start lamps.
- Provide electronic ballast for Metal Halide lamps up to 150 watts.
- Constant Wattage Autotransformer (CWA):
 - With fully wired, integral dry-film type capacitor and potted ignitor (where applicable).
 - Lamp Crest Factor: Maximum 1.6.
 - Metal Halide (MH) lamps: Ballasts shall tolerate input voltage variation of plus or minus 10 percent with less than plus or minus 5 percent variation in output voltage.
 - High Pressure Sodium (HPS) lamps: Ballasts shall tolerate input voltage variation of plus or minus 10 percent with output voltage within trapezoidal limits of lamp operating voltage over lamp life.
 - Manufacturers: Advance 73B Series, Holophane, Universal Lighting Technologies, or approved.
- High leakage reactance high power factor (HX-HPF) equal to Advance 72C Series acceptable for 100 watt or less HPS lamp.
- Nondimming Electronic:
 - With integral end of lamp life detection and shutdown circuit with automatic reset.
 - High frequency operation: not less than 170Hz.
 - Ballast shall tolerate input voltage variation of plus or minus 10 percent with less than plus or minus 0.5 percent variation in output voltage.
 - Lamp Crest Factor: Maximum 1.3.
 - Manufacturers: NAI S Aromat or approved.



All lamps to meet the following requirements based on Code requirements and industry standard of design and care:

- Provide similar lamps by a common manufacturer.
- Incandescent: Not allowed unless approved by the District.
- LED: Not allowed unless approved by the District.
- Tungsten Halogen Incandescent:
 - Line voltage:
 - PAR lamps: Provide HIR technology, medium screw base, size, wattage and beam spread as applicable.
 - Tubular: Provide HIR technology, wattage and base configuration as applicable.
 - Low Voltage: Wattage, voltage, beam spread, base style and type as applicable.
- Fluorescent:
 - Provide 4100K fluorescent lamps unless approved by the District.
 - Linear Fluorescent:
 - T-8: Provide the following:
 - Bi-pin base, tri-phosphor coated
 - CRI equal to or exceeding 85.
 - 30000 hours rated on 3 hour switching cycle when used with programmed start ballast.
 - Compatible with dimming ballasts.
 - 25W for 4-foot T8 lamps.
 - T-5: Provide the following:
 - bi-pin base, tri-phosphor coated
 - CRI equal to or exceeding 85.
 - Compatible with dimming ballasts.

- Length and wattage as applicable.
 - Do not provide T-12 lamps.
 - For fluorescent lamp fixtures installed in art, multi-media, and any space where accurate color rendition (i.e. cosmetics, painting, paintshops, video production, and graphic arts work) is required, lamp CRI is to equal or exceed 90.
- Compact Fluorescent:
 - Single ended, four-pin plug-in base, tri-phosphor coated, CRI exceeding 81, CCT, wattage and configuration as applicable.
 - Do not provide self ballasted screw-in type unless applicable.
 - Do not provide magnetic starter type luminaires, ballasts or lamps.
 - For compact fluorescent lamp fixtures installed in art, multi-media, and any space where accurate color rendition (i.e. cosmetics, painting, paintshops, video production, and graphic arts work) is required, lamp CRI is to equal or exceed 90.
- Induction:
 - Tri-phosphor coated, CRI exceeding 80, CCT, wattage and configuration as applicable.
 - Factory provide lamp module and generator assembly with lead length for proper operation. Do not modify lead length.
- High Intensity Discharge (HID):
 - Rate lamps used in open luminaires for such use.
 - Provide coated or clear lamps as recommended by the luminaire manufacturer for maximum luminaire efficiency and distribution.
 - Lamps installed in common interior areas shall be of the same manufacturer's production run.
 - Provide self extinguishing lamps or lamps with protective shroud in open luminaires
 - Ceramic arc tube metal halide:
 - CRI exceeding 80, CCT, wattage, configuration, and base style and type as indicated in luminaire schedule.
 - Maximum plus or minus 200 Kelvin color shift over rated lamp life.



- Provide lamp base and orientation compatible to luminaire.
- Quartz arc tube metal halide:
 - CRI exceeding 64, CCT of 4000 Kelvin, wattage, configuration, and base style and type as indicated in luminaire schedule.
 - Maximum plus or minus 600 Kelvin color shift over rated lamp life.
 - Provide pulse-start type when at least one approved manufacturer supplies specified lamp with that technology and where burning position is compatible with luminaire.
- High Pressure Sodium: Ceramic arc tube type, mogul or medium screw base, universal burn rated, wattage and configuration as applicable.
- Do not provide mercury vapor lamps.

All emergency fluorescent lamp power supplies to meet the following requirements based on Code requirements and industry standard of design and care:

- Description: Self-contained, battery-operated power supply for operating one T8 or compact fluorescent lamp for a minimum output of 90 minutes.
- Provide access hatches for emergency battery backup ballasts, adjacent to recessed 6-inch or less diameter downlights installed in inaccessible ceilings.
- Central battery inverter is not allowed unless approved by District.

All lighting poles to meet the following requirements based on Code requirements and industry standard of design and care:

- Provide exterior light poles with concrete bases when installed in vehicle traffic area or direct buried in pedestrian or landscaped areas and which are structurally supportive of pole under design loading.
- Provide exterior poles clean and scratch free with base bolt covers to match pole and luminaire finish.
- Provide poles and pole bases rated for area's minimum wind EPA loading for quantity and type of luminaire it supports with a 1.3 gust factor.
- Provide poles with gasketed handholes, stainless steel tamper resistant hardware and ground lugs.



- Provide concrete footings for pole-mounted lighting units and bollard lights at locations shown on site plan Drawings. Provide concrete footings as shown on Drawings or as recommended by manufacturer if not shown on Drawings. Minimum base height above grade in automobile areas is 30 inches. Install luminaire poles plumb and straight.
- In-grade exterior uplights are not allowed.

Approved Manufacturers:

- General Electric
- Philips
- OSRAM/Sylvania (OSI)
- Venture
- Ushio (MR only)
- EYE (MR only)

Substitutes Allowed:

Upon review and approval.

Associated Design Standards and Specifications:

- 26 05 19 – WIRES, CABLES, AND CONNECTORS
- 26 05 48 – SUPPORTING DEVICES
- 26 56 00 – SITE LIGHTING

End of Document