26 Electrical

NOTE: Significant revisions or additions to the previous standards are highlighted in italics.

GENERAL
Designers shall verify that all applicable portions of these standards are incorporated into the project’s design, drawings, specifications and final construction. Variances from these standards are to be submitted for written approval, using the KU Standards Variance Request Form in Appendix A1.1.

RELATED DOCUMENTS & REQUIREMENTS
Refer to the following for requirements that also apply to work of this section.

- Division 1 - General Requirements: Refer to sections regarding construction testing and field quality control requirements.
  - Comply with KU Strategic Sourcing and preferred vendors/products.
  - Unless directed otherwise, the Owner shall separately contract for quality control testing during construction, not the Contractor. Verify with DCM for each project.

- Division 23 - Mechanical: Review all sections of Division 230000 and 250000 for related work and systems that must be coordinated with provisions of Division 260000.
  - Appendix A23.3, SOP - Commissioning: For projects involving a commissioning agent as part of the project team, the Designer shall coordinate with the commissioning agent for function test procedures for equipment and systems of Division 270000.
  - Appendix A23.4, Design Standards for Energy Efficiency

- Division 26 - Electrical: Refer to the following Standards of Practice appendices:
  - Appendix A26.1, SOP - Emergency Lighting Systems
  - Appendix A26.2, SOP - Electrical Power Metering
  - Appendix A26.3, SOP - Campus Electrical Distribution System
  - Appendix A26.4, Outdoor Lighting Standards

- Division 27 – Telecommunications

- Division 33 – Utilities: Contains information about site utility systems.

METERING REQUIREMENTS
Electrical metering for projects that require new services to be fed from the University distribution system shall be in accordance with requirements of Appendix A26.2, Standard of Practice - Electrical Power Metering.
UTILITY SERVICE PROVIDER

Projects that require new services to be fed from the University distribution system shall be in accordance with requirements of Appendix A26.3, Standard of Practice - Campus Electrical Distribution System.

For projects that require the establishment of new electrical services, the Designer shall determine, by discussions with University personnel, whether the service would be from the campus distribution system or from a utility provider. The Designer will use this information to inform his editing of electrical specification sections references above.

COMMON WORK RESULTS FOR ELECTRICAL – 260500

Basic Minimum Raceway Requirements: In order to facilitate long-term cable management, wiring systems (including but not limited to DDC, fire alarm, telecommunications, security and power) shall be installed in raceways.

Low-voltage systems such as DDC, HVAC, lighting, and telecommunications cabling may be installed in open raceways such as cable tray or j-hooks.

Concealing New Circuits: Electrical work in architecturally finished spaces shall be concealed. The Designer shall obtain University approval for design of new circuits that must be installed in surface raceway systems where concealment is not possible.

Firestopping: Identify and provide installation details for utilization of firestopping materials associated with the particular construction materials that will be encountered. Include details of firestop systems in plans and list specific UL or other approved test assembly numbers. Use removable pillows for cable tray penetration firestop.

Arc Flash Study: Perform arc flash coordination study when installing new switchgear and related panelboards. The need for arc flash study shall be reviewed with the University for each project.

Cathodic Protection: Cathodic protection is required for certain underground piping systems. The need for cathodic protection shall be reviewed with the University for each project.

Electrical Test Data: Specify the operational tests and test methods required for the following equipment and materials:

- Primary cable and equipment.
- Engine-generators and emergency power system.
- Auditorium sound systems
- Audio/Video systems
- Fire alarm systems
- Lightning protective systems
- Transformers
- Ground fault protective systems
- Secondary service conductors/bus duct
- Voice/Data systems
- Electrical grounding systems
MEDIUM-VOLTAGE CABLES – 260513

Voltage Classifications: The Designer shall use this specification section to specify electrical cables carrying power at phase-to-phase or phase-to-ground voltages of between 2001-volts and 35,000-volts. For projects on the main Lawrence campus, this would include any cables installed in the 12,470-volt circuits between the KPL substations and a building service entrance transformer.

☐ Refer to Appendix A26.3, SOP - Campus Electrical Distribution System for additional discussion.

Preferred Manufacturers:

☐ Cable: Okonite.

☐ Terminations: 3M.

Appropriate Cable Assemblies: In general, medium voltage power cables will be installed on the Lawrence main campus, in either underground ductbank systems or in cable tray systems within tunnels and equipment rooms.

☐ Cable installed in underground ductbanks shall be specified as shielded single conductor. Ductbanks shall be in 5x2 configurations, consisting of 5” conduit with a 5” spare. Stub-ups shall be galvanized rigid conduit (GRC) 90-degree elbows.

☐ Ductbank Protection: All underground medium voltage ductbanks shall be encased with red dyed concrete, with a minimum cover depth of 6” on all exposed sides, for their entire length. Install tied conduit separators / spacers and secure to earth, to maintain alignment as concrete is placed. Install #6 x 3’ minimum length rebar dowels poured into ends of concrete pour cold joints.

☐ Bury Depth: 24” minimum to top of concrete encasement.

☐ Cable installed in cable tray systems shall be specified as shielded and armored multi-conductor cable. Armoring shall be specified as interlocking galvanized steel or aluminum with a PVC or PE jacket.

☐ The Designer shall evaluate the project-specific installation requirements and specify, and clearly designate on drawings, the use of single or multi-conductor cable assemblies as appropriate for the project.

☐ Refer to Appendix A26.3, SOP - Campus Electrical Distribution System for specification and installation details.

Submittals - Supplemental Text: Because of the expectations for an extended operating life for these power distribution cable systems, the University is concerned that prospective contractors possess, and be able to demonstrate, a high level of competency in the installation of the systems. The Designer shall include the following supplemental text in the specifications paragraphs related to Submittals:

☐ Prior to scheduling any outage for purposes of completing cable splices or terminations, the contractor shall complete, in the Owner’s presence, the preparation of a sample cable end suitable for installation of a splice or termination kit.
Quality Assurance - Supplemental Text: In addition to the above paragraph, the Designer shall include the following supplemental text in the specifications paragraphs related to Quality Assurance:

- Installer Qualifications: Engage an experienced and certified cable splicer to install, splice, and terminate medium-voltage cable. The installer shall submit, for the Owner’s review, a certificate verifying factory training in the use of the specific splice and termination kits provided for the project.

- KU Facilities Services personnel shall inspect and approve each installer’s qualifications information before final termination work is done.

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES – 260519

- Feeder and branch circuit conductors shall be type THHN/TWHS, or THW-2 for 6 AWG and larger, rated for use at a continuous 90 deg. In wet or dry locations.

- Color coding shall be per latest edition of the NEC.

- MC cable is only allowed for fixture whips and must carry a grounding conductor.

Prohibited Wires and Cables: Aluminum wire is prohibited.

Prohibited Underground Conductors: To facilitate future replacement of conductors and increase conductor life, direct-buried conductor systems for underground wiring are prohibited.

UNDERCARPET ELECTRICAL POWER CABLES – 260519.13 PROHIBITED

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS – 260526

Grounding and Bonding: The building electrical ground shall be exothermically welded to the building steel in the grade beam, the piers, and the columns in at least two different sides of the building in addition to the water pipe ground and any driven rod/counterpoise systems. This applies to all new buildings and additions, and where possible, to renovated buildings. Renovated buildings are usually possible to make at least one steel connection in one location when planned in the design phases.

- Refer to Appendix A26.3, SOP - Campus Electrical Distribution System for a description of the University campus electrical distribution system grounding grid and for details regarding required electrical design practices on the main Lawrence campus.

- Provide ground riser diagrams for power distribution and telecommunications systems in the contract documents.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS – 260533

Limitations of Raceway Use: The Designer shall incorporate the following considerations in the construction documents.

- Nonmetallic raceways are prohibited for use inside of buildings, unless specifically permitted elsewhere in this standard.
❑ Thin-wall indenter, pressure cast, or slip-on metallic fittings are prohibited.
❑ Compression conduit connections shall be utilized. Set screw fittings are acceptable.
❑ Conduits shall not be considered grounding systems. All conduits shall include a separate grounding conductor.
❑ Use of flexible conduit shall be limited to recessed lighting fixtures, motors, and equipment. These connections shall be of minimum length and a maximum of 6'-0”.
❑ Rigid Nonmetallic Conduit. Rigid non-metallic raceways may be used below grade, embedded in concrete, and for special service applications such as corrosive locations.
❑ Elbows in buried PVC conduit runs shall be PVC covered steel.

**Bus Duct and Busway:** Plug-in and feeder busses 225 amp and larger shall have built-in ground bus. Plug-in devices shall have an integral, built-in ground connection for attachment to bus ground.

**Conduit Drainage:** Where probability exists of moisture entering buried conduits and junction boxes/hand holes, provide methods for drainage.

**General Box Requirements:**

❑ Due to safety hazards and maintenance problems, the use of flush-mounted and surface-mounted floor outlets is prohibited.
❑ Surface boxes used on or in exterior building surfaces, or on the site, shall be cast type.
❑ Installation: Provide tile rings over outlet boxes in glazed tile walls and wood paneling.
❑ To reduce sound transmission, wall outlet boxes shall not be installed back-to-back in partitions.
❑ Where boxes are installed in concrete block walls, the box mounting height shall be at the block joint.
❑ Designers shall locate boxes for wall or ceiling-mounted devices so that they don’t compromise the Owner’s ability to install furnishings, marker/bulletin boards, artwork and similar items at those locations in the future.

❑ Wherever possible, locate them along the perimeter of those surfaces. Do not install devices, such as fire alarm devices or thermostats, in the center of those services if they can be located along the perimeter.

**Floor Penetration Details:** Specify concrete curbs and fire barriers where conduit / duct runs pass through concrete floor slabs and fire-rated walls.

❑ All openings through floors for conduit shall be made watertight by detailing or specifying either a concrete housekeeping base or an embedded sleeve, each to be not less than 1-1/2” high above the finish floor, to prevent leaks from penetrating to the floor below.

**VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS – 260548**

**Prohibited Support:** Lead, fiber, or wood anchors are prohibited for support of raceways or equipment.
IDENTIFICATIONS FOR ELECTRICAL SYSTEMS – 260553

Identification: The Designer shall edit specification section 260553 to identify specific requirements for labeling and identifying electrical equipment and devices. All switching, protective devices, and metering on main distribution switchboards shall be identified with engraved black-white-black laminated 1/8 inch thick plastic plates. Plastic identification plates shall be attached to the equipment with screws or rivets. *Adhesive labels not permitted.*

- Identification plates are required for all electrical distribution equipment from the service through branch circuit panelboards and motor control centers. Labels shall identify both the equipment designation and the source supplying the equipment.
- The Designer shall specify both numbering and wording of identification plates.
- Motor and associated equipment numbers shall be the same.
- Raceways shall be labeled where appropriate, i.e., red for fire alarm, RED/GREEN for emergency lighting, etc.

MEDIUM-VOLTAGE TRANSFORMERS – 261200

**Building Service Entrance Transformers:** Refer to Appendix A26.3, SOP - Campus Electrical Distribution System for a description of the specification requirements for campus distribution system transformers.

**Medium Voltage Transformers:** Designers shall specify equipment to be live-front, with dry well fuses, one set of spare fuses, flag type, and copper windings.

**Design for Non-Resistive Loads:** The Designer shall specify transformers and all other components of the electrical distribution systems to be rated for the anticipated non-sinusoidal load currents of modern electrical/electronic equipment.

MEDIUM-VOLTAGE SWITCHGEAR – 261300

**Sectionalizing Switches:** Refer to Appendix A26.3, SOP - Campus Electrical Distribution System for a description of the specification requirements for campus distribution system sectionalizing switches.

*Provide prefab concrete base for the S&C PMH-10 sectionalizers.*

*Provide fault indicators on the S&C PMH-10 sectionalizers.*

LOW-VOLTAGE SWITCHGEAR – 262300 & SWITCHBOARDS – 262413

**Overcurrent Protective Devices:** The design engineer shall conduct short circuit and coordination studies to determine protective device ratings and requirements, and shall not assign the responsibility for this to the contractor.

**Sizing of Secondary Service and Distribution (600 Volt and Below):** The Designer shall specify new secondary service and distribution systems to be of adequate size to provide for load growth during the life of the building. The facility type and use shall be considered in determining capacity to be provided in excess of initial demand. Design criteria documents shall identify to the University the reserve capacity provided in the design.
Ground Fault System: A ground fault protection system, where required by Code, shall be designed to provide minimum possibility of power outage to critical building facilities. Designers, who are involved in switchgear or panelboard upgrades that serve existing feeders, shall consider a coordinated system on the feeders rather than a main service entrance type ground fault system to permit incremental settings thus providing reasonable continuity of electric service.

- Additional ground fault protection may be required at point-of-use receptacles to provide personnel protection. Exterior power outlets and interior uses at lavatories and service sinks shall be provided and shall be GFCI protected and corrosion resistant.

- Current pickup and time delay range shall be specified for all sensors. Construction documents shall state that ground fault sensors shall be set at "0" time delay and "minimum" ground current flow during construction period. When the project is turned over to the University the two settings shall be changed to values selected by the Designer.

- Specifications shall require that the Contractor test the system ground fault performance when first installed and submit a written record of the test to the University. A copy shall be included in final project data O&M submittals. Tripping curves and characteristics shall be submitted to the University. Identify the method to be used to test ground fault protection in the field.

Power Factor Correction: The Designer shall review with the University whether any secondary voltage power factor correction is required. It may not be desired in most locations because medium voltage rated power factor correction is already in place at both main campus substations.

Design for Available Fault Current: The Designer is responsible for determining available fault current at the point of equipment installation and for specifying bracing to withstand the available short circuit current, asymmetrical, RMS at rated voltage. Values shall be specified.

Distribution Switchboards: The Designer shall include the following provisions in construction documents:

- Do not locate plumbing facilities above the vault and switchboard space.

- The phase arrangement on three-phase busses shall be "A-B-C," from left to right as viewed from the front of the switchboard.

- Specify provisions for future protective devices. Base these provisions on the need for possible future increases in electrical requirements. In order to increase flexibility, provide spaces in lieu of spare devices.

- Include continuous ground bus, equipped with bolted pressure clamp type lugs, full length of switchboard.

- Busses shall be copper. Design shall include provisions for future extension of main bus.

PANELBOARDS – 262416

Panelboards and Cabinets: The Designer shall include the following provisions in construction documents:
In order to accommodate future additional wiring; provide spare conduit stubs from flush-mounted panels recessed within walls into adjacent suspended ceiling spaces or other accessible spaces. The spare circuits and spaces available in panel shall determine the quantity.

Each electrical panel shall be furnished with a clear, plastic-covered, typed circuit schedule mounted in a metal cardholder. The schedule shall identify circuits by room number using final room numbers furnished by the University.

- Verify room numbers with the DCM Project Manager.
- Electrical subcontractor shall markup as-built drawings to indicate actual circuiting of devices, for General Contractor to give to Architect/Engineer for their use in updating as-built construction documents.

Provide a number designation on each circuit protective device. Odd numbers shall be used in sequence down left side and even numbers in sequence down right side.

Provide cross breaker connectors and bus for the spare circuit breakers indicated in panelboard schedules. Provide a minimum of 25% spare spaces with single pole 20A circuit breakers.

- Neutral bus shall be rated for 200%.

**MOTOR-CONTROL CENTERS – 262419**

**Motor Control:** The Designer shall review the following for guidance regarding designs and specifications for electrical motor operation and control. *Variable speed drives should be used wherever feasible in lieu of motor starters.*

- **Motor Control Centers:** In areas where there are eight or more three-phase motors, a motor control center shall be provided. MCC bus work shall be braced to withstand the available short circuit current, asymmetrical, RMS at rated voltage. Values shall be specified.

- **Motor Electrical Service:** With the exception of portable maintenance equipment, motors over 1/3-h.p. shall be three-phase.

- **Motor Starters:** Starters shall be full voltage with fusible disconnect except as follows:
  - For 20 HP and larger motors on 208Y/120 volt systems, and for 40 HP and larger motors on 480Y/277 volt systems, starters shall be auto-transformer or part-winding type with fusible disconnect.
  - Coordinate starter type selection for use with specific motor as identified in Division 23000.

- Control circuit voltage shall be 120 volt. Where transformers are needed, fuses shall be employed in both primary and secondary sides.

- Where two pumps are provided, with one intended as a standby, an alternator shall be incorporated which allows the stopping and automatic switching for restart through one BACS stop/start point.

- Magnetic starters shall incorporate a minimum of two auxiliary contacts and a HAND-OFF-AUTO switch.

- A motor control center schedule shall be included on the electrical drawings.
Electrical Interlocks: A schematic wiring diagram of circuits involved in an interlocked system shall be included in the DESIGNER's drawings. Devices used shall be specified.

Starters shall have fusible disconnects rather than circuit breakers or MCPs. Control circuit voltage shall be 120 volt or less. Specify push button start/stop control in lieu of hand/off/automatic control for fan motors controlled through BACS.

WIRING DEVICES – 262726

Ratings of Convenience Receptacles and Lighting Switches: General use receptacles and light switches shall be heavy-duty, 20 amp, grounding type for general service applications. Install power receptacles with the ground pins up.

Surge Suppression Receptacles: One receptacle per office may have surge protection and shall be equipped with both audible and light alarms. Review with DCM Project Manager.

Cover Plates: All cover plates shall be stainless steel, type 302, brushed satin finish meeting Federal Specification W-P-445a, unless aesthetic requirements call for a different type of finish.

Floor Maintenance Equipment Receptacles: For corridors, large assembly areas, and other areas where floor maintenance equipment is used, locate receptacles so that a 45-foot cord will reach any part of the floor. Provide at least one duplex receptacle in each room where floor maintenance equipment is needed and receptacles are not otherwise available in accordance with the NEC.

Devices in Wet Areas: Receptacles, switches, and plates in damp or corrosive areas shall be specifically designed for use in that environment. Exterior power receptacles and interior receptacles at lavatories and service sinks shall be GFCI protected and corrosion resistant.

VARIABLE-FREQUENCY MOTOR CONTROLLERS – 262923

General: Provide Danfoss brand only.

Controllers may be provided by Johnson Controls or Control Service Company (Automated Logic) through State or University Contract. Review with DCM Project Manager.

Designer shall clearly state in construction documents whether controllers are to be provided by electrical subcontractor or by building controls provider.

ENGINE GENERATORS – 263213

General: Provide as appropriate for each project. Review specific criteria with DCM Project Manager and when serving life safety systems, with University Fire Marshal.

Emergency Exit Elevators: New buildings shall provide elevators which can serve as a code-compliant accessible emergency egress path, and generators for new buildings shall provide emergency power to serve all exit elevators.
New emergency power generators serving existing buildings shall be sized to include enough capacity to serve existing or future replacement elevators as emergency exit elevators, even if those elevators are not being improved as part of that project.

EMERGENCY POWER SYSTEMS AND EMERGENCY/EGRESS LIGHTING – 263323

General: The Designer shall refer to Appendix A26.1, SOP - Emergency Lighting Systems for guidance regarding University preferences for design of emergency / egress and exit lighting systems.

Loads Requiring Emergency Power Supplies: In general, the University provides backup electrical power supply capability for the following loads:

- Emergency egress and exit sign lighting.
- Building sprinkler system fire pumps.
- Security systems, fire alarm systems.
- Selected ADA-compliant egress passenger elevators.
- Communications systems equipment, computer workstations, or servers only if required to maintain operation of life safety equipment.

Emergency Power Systems: For projects involving emergency power requirements, an emergency generator shall be utilized.

The preferred fuel is #2 diesel fuel. When diesel generators are used, the fuel shall be and the storage quantity shall be as small as possible and still meet code and maintenance requirements. Fuel storage shall be above ground, typically in generator base. Generators shall be located adjacent to paved area accessible by vehicle for refueling and scheduled maintenance/testing.

Standby generator installations shall comply with NFPA 110. Please specify the NFPA required on site load testing.


Self-Diagnostic Battery Packs: If a generator-based system is not affordable or desirable, self-diagnostic battery packs in dedicated emergency light fixtures shall be utilized. This requires approval from both DCM and the University Fire Marshal Authority. Do not use emergency ballasted type fixtures.

STATIC UNINTERRUPTIBLE POWER SUPPLY – 263353

Provide as appropriate for each project. Review specific criteria with DCM personnel.

LIGHTNING PROTECTION FOR STRUCTURES – 264113

General: All University buildings shall be provided with lightning protection, unless the University waives this requirement.

System Requirements: All new projects will require a complete building lightning protection system. All new systems should have the UL Master Label attached permanently to the building, along with the installer's name plate. The location shall be as determined by the
University. The evaluation and design should, as a minimum, meet the requirements of the NEC, LPI, NFPA 780 and/or UL96 and 96A.

- Down conductors should be hidden from view wherever possible.
- Down conductors shall be selected from copper, tin-copper or aluminum materials that are compatible with roofing or substrate materials.
- Where down conductors extend to grade level, they shall be placed in metallic conduit to protect them for the bottom 8’ above finish grade, which shall be painted to closely match color of substrate materials.
- Air terminals shall be mechanically-fastened to substrates. Adhesive-only attachments are NOT acceptable. Mount above roof and flash or seal fastener penetrations to make watertight. On flat roofs, concrete masonry or precast concrete bases may also be used.
- The lightning protection system ground, the electrical power system ground, and all other system grounds such as telephone and cable television, shall be bonded together per NEC requirements.
- Reroofing projects shall require maintaining the existing lightning protection system and upgrading it as required to meet current codes, or adding one if none currently exists.

**Surge Suppression:** Lightning surge arresters should be installed at all building primary power transformers and all other wire services where they enter the building and they should have the lowest possible voltage breakdown for maximum protection. The electrical primary service system is 12,470 / 7,200 volts, and the surge arrester should be 9KV.

- Where service is provided by the power company at the use voltage, the surge suppression should be located at the point the service enters the building.

**INTERIOR LIGHTING – 265100**

**General:** Project Designers shall coordinate the design of standard interior lighting systems with the requirements of the emergency lighting systems. Refer to Appendix A26.1, SOP - Emergency Lighting Systems for specific KU requirements.

**Fixture Mounting Locations:** Fixture locations requiring special equipment or scaffolding to aid in maintenance or re-lamping increase ongoing operating costs and thus require written approval from the University. Such special equipment and provisions for its storage and access must be provided as part of the project.

- If a man-lift will be required to service or re-lamp light fixtures, Designers shall confirm if an existing lift is readily available for that purpose or if not, shall confirm with the DCM Project Manager the makes/models of lifts that would be suitable and assist DCM/FS in soliciting bids for those lifts.
- Designers shall also confirm during the Design Development phase, which room(s) any required man-lifts or other special equipment will be stored within, and will verify the path of travel can be negotiated by the man-lift/equipment, including by elevator, if required to reach the space to be serviced.

**Lighting Criteria:** The Designer shall coordinate with the University to establish and document design criteria for lighting levels during schematic design. Lighting design shall
follow the recommended and accepted lighting standard levels consistent with energy conservation and visual performance.

- The number of foot-candles of illumination designed for particular functions of the building shall be in accordance with the latest edition of the Illuminating Engineering Society (IES) Handbook in accordance with Kansas Lighting Standards.
  - Furnish design calculations, either by hand or by computer output, to the Office of Design & Construction Management during the design review process to help evaluate compliance with the IES standard.
- Provide exterior emergency egress lighting at all exits to the public way (30' minimum from the building).
- It is presumed that LED lighting will be satisfactory throughout. Specialty lighting may be required for some applications, this shall be discussed with the Building Committee whenever the situation so dictates.
- If necessary, fluorescent lighting shall be with highest-efficiency electronic ballasts available, with a proven two-year or more reliability record. Harmonics shall be less than 20% Total Harmonic Distortion. Although there may be concerns with the noise (audible & EMI) level created by such lighting. This can be reduced to a satisfactory minimum for most applications by proper electrical design.

Light Fixture Switching and Control: The Designer shall use the following guidelines in circuiting, switching, and controlling interior lighting systems.

- Three-way and four-way light switching shall be provided in long corridors, gymnasiums, auditoriums, and other large spaces.
- Provide inboard/outboard multi-level switching or dimming of fluorescent fixtures in private offices, classrooms, laboratories, and conference rooms.
- Occupancy sensors shall be integrated in the control schemes of classrooms, storerooms and multiple occupant office areas. Occupancy or ambient light sensors shall be considered as a means of controlling lights and conserving energy in large rooms.
  - Use sensors with combined ultrasonic/infrared technology, provided with an integral manual over-ride switch and ambient light level sensor.
  - Designers shall not install occupancy sensors on any of the lighting in egress paths, stairwells or public restrooms, or on other emergency lighting fixtures required to achieve 1 fc minimum illumination levels on egress paths.
- The Designer shall review the feasibility of automatic light level control areas with prominent daylighting.
  - If provided, review and verify that the installing contractors adjust settings on sensors per KU user group needs, for each space.

Dimming Systems Designs: For general use, provide dimmable fixtures with wall controller switches. Where specialty systems have been stipulated in a project program, a comprehensive design will be considered to consist of the following, at a minimum:

- Circuiting of fixtures to be dimmed.
- Location of controller modules.
- Location of programmable controllers.
Locations of dimmer panels.
Emergency lighting relay if required.
A detailed written sequence of operation and control modes for the dimming system.

**Lamps:** The use of LED lamps is encouraged. Regardless of type, general lighting fixture lamps shall have a correlated color temperature of 3500K.

Designers shall specify lamps that are readily available and economical to maintain. Special or unique lamps are discouraged, unless specifically required to meet the program / functional needs of the building occupants.

**Lens:** Provide direct/indirect lenses in ceiling fixtures in classrooms and offices to prevent reflected glare and provide enhanced appearance.

**Ballasts and Accessories:** Fluorescent ballasts shall be efficient solid-state electronic ballasts. Electronic ballasts shall have a "true" power factor of .90 or greater with 20 percent or less total harmonic distortion. Fluorescent ballasts for outside applications or in areas where ambient temperature is lower than 50 degrees F shall have a minimum starting temperature of -20 degrees F.

**Removal and Disposal of PCB Ballasts:** On remodeling projects, the Designer shall consult with the University Department of Environment Health and Safety (EHS) for requirements for handling and disposal of PCB ballasts. Removal and disposal of ballasts containing PCB material shall be accomplished per EPA requirements.

The Designer shall note in the construction documents that the Contractor shall examine existing ballasts that are to be removed from service. If ballast is not clearly labeled to indicate that it does not contain PCB, it shall be assumed to contain PCB.

The University's EHS department will provide a ballast collection container at or near the project site. PCB containing ballasts shall be placed in the ballast collection container as they are removed. The University will dispose of the container.

**EXTERIOR LIGHTING – 265600**

**Design of Exterior Lighting:** The Designer shall refer to Appendix A26.4, SOP - Outdoor Lighting Standards for University requirements for lighting of walkways, parking lots, drives, building entrances and building egress paths.

**Building Illumination:** KU policy is to NOT illuminate the exterior of campus buildings. Should the Designer propose to do so, a variance request shall be submitted to KU via the DCM Project Manager, for KU consideration and direction.

**Fixture Mounting Locations:** Fixture locations requiring special equipment or scaffolding to aid in maintenance or re-lamping increase ongoing operating costs and thus require written approval from the University. Such special equipment and provisions for its storage and access must be provided as part of the project.

**Lamps and Accessories:** LED lamps shall be used. Fixtures for outside applications shall be weatherproof and rated for -20 degrees F. Full cutoff, with dark-sky compliant optics. Provide photocell or connection to photocell-controlled system.

**DIVISION 27 - COMMUNICATIONS**
General: The Designer should be aware that the University organizational structure includes a Department of Information Technology (IT), formerly known as Networking and Telecommunications Services (NTS), which is responsible for installation and maintenance of all telecommunications and computer networking systems on campus.

- Refer to separate Division 270000 - Communications for detailed requirements for all University telephone/voice, data, video and other telecommunication systems, as established by KU-IT. Other requirements which affect Division 27 components are listed in this section of the KU Design Standards.

- At the earliest possible stages of programming or design, the Building Committee should review with DCM and KU-IT the options available for each project regarding the provision of telephones and other telecommunication systems, and verify how that project's telecommunication systems shall be designed and constructed.

For projects that involve the addition or relocation of telephone and/or computer communications outlets, the Designer shall review and verify outlet locations with the space occupants. This review shall identify outlets that are needed for immediate program needs, as well as future outlet locations.

- The Designer shall include installation of all conduit, boxes and mounting devices in the project construction documents.

Design of Telecommunications Terminal Rooms: Refer to Division 270000 - Telecommunication Systems for specific requirements.

Provisions for Elevator Communications: The Designer shall review Appendix A14.1 - Elevator Telephones for specific requirements for specifications and design of passenger elevator telephone installation on campus.

MASTER ANTENNA TELEVISION SYSTEM – 274113
Requirements for these systems will be determined on a project-by-project basis. Where applicable, reference the University Media Committee and Information Technology standards.

- Cable and/or satellite television systems require written approval from University Provost prior to installation. University Dean, Department Chair or Building Committee Chair shall submit this request in writing to the Provost.

PUBLIC ADDRESS SYSTEMS – 275116
Requirements for this will be determined on a project-by-project basis.

- Emergency Public Address System (EPAS) for Mass Notification: Refer to fire alarm standards for installation requirements.

SOUND-MASKING EQUIPMENT – 275119
Requirements for this will be determined on a project-by-project basis.
INTERCOMMUNICATIONS AND PROGRAM SYSTEMS – 275123
Requirements for this will be determined on a project-by-project basis. Intercom service may be provided through the phone system.

CLOCK SYSTEMS – 275313
Requirements for this will be determined on a project-by-project basis.

- Master Clock Systems: Due to their high demand on resources to maintain operating accuracy, master clock systems shall not be installed in KU buildings, unless special permission has been granted by the DCM and FS Directors.