

DIVISION 26 00 00—ELECTRICAL

FORMAT

1. Technical specifications content and numbering system shall be based on the most current CSI Master Format.

BASIS OF DESIGN

1. APSU design standards shall not replace fully developed, project and market specific technical specifications, with 3 manufacturers unless indicated otherwise, e.g., Stanley CorMax. Associate shall utilize the standards as a minimum standard to guide the design.
2. Design guidelines supplement building, fire, and other health, safety and welfare codes, and represent practices APSU has adopted regarding the built environment. Where conflicts arise between codes and guidelines, codes take precedent.
3. Coordinate deviation from guidelines with the University Design and Construction (UDC) Department.

RELATED SECTION

1. Reserved

COORDINATION

1. Consult with the University regarding temporary electric service for each individual project, including activation, associated costs, and method of billing. The source should be identified and the voltage and phase specified.

GENERAL PROVISIONS

1. Codes shall be used as minimum requirements. Where APSU Construction Standards call for an installation that exceeds and does not violate the code requirements, the Construction Standards shall be followed.
2. Branch Circuits
 - a. All lighting branch circuits shall be separate from power and receptacle branch circuits.
 - b. All branch circuits serving computer loads shall have a dedicated neutral conductor.
 - c. Refer to APSU ITS standards for describing the use of isolated grounding panelboards and receptacles.
3. All boxes, brackets, bolts, clamps, etc., shall be galvanized, electro- galvanized, metalized, or sherardized.
4. Connect new transformers to the 12.47 kV system. Coordinate with University Design and Construction to determine specific circuits and connection points.
5. Fault Current and Electrical System Evaluation
 - a. Major changes or additions to the electrical system require evaluation of the service and distribution for capacity.
 - b. Designer shall discuss with APSU the need to perform a preliminary fault current and coordination study using a recognized software program to insure that installed

DIVISION 26 00 00—ELECTRICAL

protective devices will properly and safely interrupt electrical faults and overloads, isolating them to the smallest portion of the electrical system to minimize outages. Contractor shall perform a final study to confirm that the installed equipment meets the fault current and coordination study requirements. This final study shall be turned over to the University. Provide PPE labels on all electrical equipment that matches the University standard for layout, style and size.

6. Medium and High Voltage Testing and Termination
 - a. All terminations shall be installed by a journeyman experienced in high voltage termination work. Designer shall require contractor to submit qualifications.
 - b. Field test cables after installation, using ICEA specified direct-current hi- pot cable test voltages, record results and incorporate into the Operation Instructions Manual.
 - c. The cable manufacturer shall furnish recommended D.C. high potential test voltage and corresponding leakage current for field testing after cable installation.
 - d. With special approval by the University, Interlocked Armored Cable Assemblies are acceptable in situations that standard conduit/cable installations are impracticable for high voltage conductors.
 - e. Cable terminations for the conductive shielding of the 15 kV conductors shall be made with factory-molded, preinsulated slip-on terminators with rain shields to provide greater tracking distance. Cable terminators shall be 3-M Series 5600 Quick Term II or PLM Adalet FSD. Cable termination lugs shall be long barrel, 2- hole compression type, with the termination end closed to prevent moisture entrance into the cable.

26 05 19—LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS

1. Minimum size wire for lighting and power feeders and branch circuits (20 Ampere) shall be No. 12 AWG copper. All conductors smaller than No. 2 AWG shall be Type THHN/THWN copper, (per N.E.C.), 600 Volt.
2. Minimum size wire for control circuits shall be No. 14 AWG copper.
3. All conductors for feeders No. 2AWG and larger shall be Type XHHW copper, 600 Volt, unless otherwise noted on the Drawings.
4. A green ground wire, sized according to the NEC Table 250-122, shall be installed in each conduit and kept isolated from the white or gray neutral wire.
5. Feeder phase identification from left to right or front to back facing front of equipment shall be one of the following:

X	Y	Z	N
Black	Red	Blue	White (120/208 Volt Feeders)
Yellow	Brown	Orange	Gray (277/480 Volt Feeders)

DIVISION 26 00 00—ELECTRICAL

6. Wire Connections and Devices:
 - a. Taps and splices in all feeder and branch circuit conductors larger than No. 8 shall be made with approved solderless, pressure type bolted connectors.
 - b. Splices in conductors No. 8 and smaller may be made with preinsulated Scotch lock or Ideal wing-nut spring tension connectors.
 - c. Junctions made in exterior circuits shall utilize setscrew junction connector with three attachment points and a removable gel-filled cap and clamp Raychem Gelcap SL.
7. Aluminum conductors shall NOT be specified.
8. MC Cable may be used for runs under 15'. Conduit and conductors shall be used for the homerun to the panel and into the vicinity where the branch circuit shall be terminated. MC Cable shall not be surface mounted. MC Cable is always allowable for final connections to motors and whips that are supplied with luminaires.

26 05 33—RACEWAY AND BOXES

1. Minimum conduit size shall be 3/4 inch for power and lighting circuits.
2. All rigid conduit and electrical metallic tubing shall be hot-dipped galvanized, sherardized, metalized, or electro-galvanized. Use of aluminum conduit is not permitted.
3. Conduit for circuits below 100V to ground in mechanical equipment rooms, chases, and areas subject to physical abuse shall be electrical metallic tubing.
4. Buried Conduit:
 - a. Exterior conduit below grade shall be minimum 1".
 - b. Concrete-embedded and below grade conduit shall be minimum Schedule 40 PVC minimum.
5. Feeder conduits for medium voltage systems installed below grade shall be encased in red concrete for their entire length.
6. Flexible galvanized steel conduit shall be used for "make-up" connections to rotating machinery equipment or flush lighting fixtures. Flexible conduit in damp or wet locations shall be liquid tight. Flexible conduit at exhaust fans shall allow hinged access into the exhaust fan.
7. Conduits installed surface mounted shall utilize one-hole or two-hole type straps.
8. Pull and Junction Boxes shall be galvanized sheet steel, minimum No. 14 gauge.

26 05 39—UNDERFLOOR RACEWAYS

1. Utilization and design shall be coordinated with the University.

26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

1. Nameplates should be provided on all major equipment, including the following:
 - a. Primary Switches

DIVISION 26 00 00—ELECTRICAL

- b. Circuit breakers & switches in distribution panels
 - c. Disconnect switches
 - d. Panels
 - e. Motor starters
 - f. Motor controls
 - g. Transformers
 - h. Contactors
2. Nameplates shall be plastic laminate, white face with black engraved letters, numbers, etc. for normal power; red face with white letters, numbers, etc. for emergency power, attached with stainless steel screws.
 3. Warning/Sense tape with metal backing shall be installed 12" above exterior below grade feeders.
 4. Provide 'arc flash warning' and 'PPE ratings' (as defined by NFPA 70E) signage on all switchgear, switchboards, motor control centers, distribution panels, panelboards and similar equipment as defined in section 26 05 74 Arc Flash Program.

26 05 74 – ARC FLASH PROGRAM

1. See General Provisions, paragraph 5

26 12 00—MEDIUM VOLTAGE PAD MOUNTED TRANSFORMER

1. Use only oil filled transformer for medium voltage primary (12.47 kv).
2. Center tap shall be reserved for 12.47kv.
3. Primary and secondary coils shall be copper wound.
4. Secondary voltage as specified for project.
5. Insulating oil: R-Temp or Enviro-Temp.
6. Tap changer: one center, two @ +2.5%, two @ -2.5%.
7. Surge arrestors on primary with load break elbows.

26 22 00—LOW-VOLTAGE TRANSFORMERS

1. Transformers 30 kVA through 112.5 kVA shall be 115°C rise with 220°C insulation.
2. Transformers larger than 112.5 kVA shall be 80°C rise.
3. Dry-type transformers shall be two winding, copper, indoor type arranged for floor, Trapeze or wall mounting.
4. Dry type transformers shall be NEMA TP -1 energy efficient type.
5. Provide K-rated transformers where substantial non-linear load is served and where defined by the APSU IT standards.
6. High voltage rating shall be 480 volts with two 2-1/2% full capacity taps above normal and four 2-1/2% full capacity taps below normal voltage. Low voltage rating shall be 120/208 volts wye. Double lugs shall be provided on low voltage side at the transformer locations if required.

DIVISION 26 00 00—ELECTRICAL

7. All transformers 30 kVA and larger shall be mounted on vibration mounts and be connected by using at least 6" of seal-tite flexible conduit on the primary and secondary.
8. All floor mounted transformers shall be mounted on a 4" high concrete house-keeping pad.

26 24 13—SWITCHBOARDS

1. Low voltage switchboards (<600 VAC) shall be dead front, self-supporting, NEMA 1 enclosures that are front accessible, front and rear aligned. Switchboards shall be fully rated for the short circuit current available at the terminals. Series rated equipment is not acceptable. The designer shall include short circuit analysis on the construction documents.
2. Quality Assurance: comply with UL 891 and NEMA PB-2.
3. Typically, switchboards shall be located indoors in locked, dedicated rooms and bolted to a 4" high concrete housekeeping pad.
4. Service voltage shall be 480/277 VAC, 3 phase 4 wire, or 208/120 VAC, 3 phase, 4 wire with ground.
5. Bussing shall be fully rated tin plated copper, Neutral bus shall be 100% rated; ground bus shall be provided and run full length of switchboard.
6. Main Device:
 - a. Draw out circuit breaker.
 - b. Bolted pressure switch.
 - c. Insulated case power circuit breaker, 100% rated.
 - d. Fused switch (less than 1000A main).
7. Feeder Devices:
 - a. Circuit breaker.
 - b. Fused switch.
8. Microprocessor trip on all units 400 A and above.
9. Mains greater than 1000 A (480/277VAC systems): provide integral GFP.
10. Switchboards shall be designed with 20% spare physical and electrical capacity.
11. Panels shall be designed with 20% spare capacity (physical and electrical capacity).

26 24 16—PANELBOARDS

1. The panelboards shall be not more than 92" high and shall be fully rated for the short circuit current available at the terminals. Series rated equipment is not acceptable.
2. Distribution panelboards may be circuit breaker or fusible switch type.
3. Neutral bus shall be fully rated and isolated from the ground, except as service rated equipment.
4. Bus bars shall be extended to the maximum standard height in each section.
5. Sections of distribution panels shall be bussed with full capacity, three-phase, four-wire copper.
6. Equipment supplied with vertical bus sized to accommodate only the branch feeders supplied will be rejected.

DIVISION 26 00 00—ELECTRICAL

7. All panelboard circuit breakers shall be bolt-on type.
8. Panelboards shall be designed with 20% spare capacity (physical and electrical capacity)
9. Panelboards shall be dead front type and equipped with thermal magnetic molded case circuit breaker units, as indicated.
10. Cabinets shall be galvanized, code gauge, sheet steel and shall be minimum of 17" wide and 5-3/4" deep.
11. Provide adequate wiring and gutter space and a means for circuit identification.
12. Provide a glazed, typewritten circuit directory.
13. Breakers shall be common trip, bolt on type, rated a minimum of 10,000 amperes for 208v and 22,000 amperes for 480v interrupting capacity. Breakers shall be rated for the load connected.
14. Provide flush doors with lock and keys. Provide two (2) keys for each panel. All locks shall be keyed alike and match the University Standard.
15. Computer grade panelboards (UL rated for non-linear loads) shall be installed where required by the Bowling Green ITS standards.
 - a. Neutral bus rated 200%.
 - b. Integral TVSS.

26 24 19—MOTOR-CONTROL

1. Motors 2 HP and larger shall be 208V or 480V, three-phase, depending upon voltage of building power.
2. Any motor 5 HP or larger shall be VFD. Smaller motors are at the discretion of the designer.
3. Motors that are an integral part of packaged equipment may vary from the above to meet manufacturing standards.
4. Motor Starters:
 - a. All motor starters and associated controls shall be provided with engraved laminated plastic nameplates.
 - b. All single speed starters for motors smaller than 1/2 horsepower shall be manual starters complete with overload and pilot light.
 - c. All starters and fusible combination magnetic starters for motors 1/2 horsepower and larger shall be magnetic motor starters. Starters shall be full voltage, non-reversing single-speed, NEMA 1 enclosed with overload heaters in each line. Starters shall be complete with 120 volt fused and grounded control transformer and heavy duty H-O-A selector switch mounted in the cover unless otherwise noted. A red pilot light, indicating motor running, shall be installed in the cover of each starter. Starters shall be as manufactured by Square D, General Electric, Siemens or Cutler- Hammer.

DIVISION 26 00 00—ELECTRICAL

- d. Furnish the University ten percent spare fuses of each type and rating of sizes installed, but not less than three (3) of each type, upon completion of the project.
Furnish fuse pullers for each size of fuse provided.
5. Mount the enclosure near the load where practical.
6. Where motors are grouped reasonably close together, motor control centers should be used.
7. The minimum size combination starter shall be NEMA No. 1.

26 27 13—ELECTRICITY METERING

1. Building electrical system shall be monitored by a multi-function (V, A, kW, kVAR, PF, kWh) digital meter (e.g., current transformer or potential transformer) at each service entrance transformer secondary. Meters shall be networked into the campus BCMS systems (BACnet IP).

26 27 26—WIRING DEVICES

2. Switches
 - a. Wall switches shall be 20A, industrial heavy duty Specification grade, nylon toggle, brass binding screws and shall be:
 - b. All wall switches shall be gray unless other colors are approved by the University on a specific project basis.
3. Receptacles
 - a. Duplex receptacles shall be industrial heavy duty specification grade 20A, side and back wired, solid brass mounting strap, fiberglass reinforced housing.
 - b. Duplex receptacles connected to emergency power shall be red. All other duplex receptacles shall be gray unless other colors are approved by the University on a specific project basis.
 - c. GFCI type duplex receptacles shall be feed-thru type.
4. Coverplates
 - a. Switch and receptacle plates shall be Type 302 stainless steel.
5. Installation:
 - a. Feed thru wiring devices shall be pig-tailed.
 - b. Wiring devices shall not be split wired.
 - c. Circuit numbers and panels shall be indicated on the coverplate with white tape with black lettering.

26 28 13—FUSES

1. Breakers are preferred. If fuses are used, coordinate with APSU.
2. Fuses shall be Type R rejection series.

DIVISION 26 00 00—ELECTRICAL

3. All fuses shall be of the current limiting type as follows:
 - a. 0 to 90 amps dual element, time delay Class RK-5.
 - b. 100 to 600 amps dual element, time delay.
 - c. Above 600 amps time delay.
 - d. Motors shall be protected by dual element, time delay fuses.
 - e. Where circuit breaker panels are protected by fuses, they shall be fast-acting, current limiting type.

26 28 18—DISCONNECTS

1. Motors located remote from the combination starters shall have a lockable disconnect in the power feeders, not a lockout stop in the control circuit.
2. Disconnects for exterior equipment and similar applications shall be rain tight, NEMA 3R.
3. All disconnect switches shall have interlock defeaters for maintenance purposes.
4. Fusible switches shall have rejection type fuse clips.
5. Disconnect switches shall be heavy duty type as manufactured by Square D, General Electric, Siemens or Cutler-Hammer.

26 32 13—ENGINE GENERATORS

1. Location of generator requires consideration of air intakes, exhaust, visibility, high profile areas, maintenance access, and proximity to classrooms, dorms, and offices.
2. Consider serving more than one building from a single engine generator set.
3. The generator shall be provided with voltage, amp, frequency, and other necessary meters and all controls necessary for complete and reliable operation.
4. Silencers shall be minimum “residential” grade.
5. Generators located outdoors shall be housed in a sound attenuated, vandal-proof and fully weatherproof enclosure, wind resistant up to 100 mph.
6. Generators shall be installed on reinforced concrete pads which extend 12” beyond enclosure in any direction and 6” above grade.
7. Remote generator annunciator with audible alert shall be located near fire alarm annunciator.
8. Emergency Lights:
 - a. Provide at least one light connected to the emergency generation system in each mechanical room, electrical room, receiving room, and toilet room. Install a red dot (1/4” diameter) on the frame of emergency light fixtures.
9. Emergency Receptacles:
 - a. Provide at least one duplex receptacle connected to the emergency generation system in mechanical and electrical rooms.

DIVISION 26 00 00—ELECTRICAL

26 43 13—TRANSIENT-VOLTAGE SUPPRESSION

1. Surge protection devices shall be provided on each main distribution, and sub- distribution switchboard or panelboard. Surge protection devices shall be provided on branch panels that serve sensitive electronic loads (i.e. computers).
2. TVSS units shall be modular in design and replaceable without interrupting power to the switchboard or panelboard. Provide with non-fused switch or circuit breaker disconnect.
3. The protection levels shall be:
 - a. 200 kA (L-N, L-G, L-L, N-G) MDP
 - b. 100 kA (L-N, L-G, L-L, N-G) SDP
 - c. 60 kA (L-N, L-G, L-L, N-G) Branch Panel

26 50 00—LIGHTING

1. General illumination for new construction shall us 277V unless approved by APSU.
2. Illumination levels shall be as described in the latest edition of the IESNA Lighting Handbook
3. Voltage for lighting fixtures shall not exceed 277 volts to ground unless approved by the University.

26 51 00—INTERIOR LIGHTING FIXTURES

1. All Luminaires shall be Specification grade.
2. APSU prefers LED luminaires as the basis of design. However, if budget constraints prohibit their use, fluorescent luminaires shall be utilized with University approval.
3. Incandescent lamps shall only be utilized with University approval.
4. Fluorescent lamps shall be 3500K and CRI 82 with low mercury content.
5. Fluorescent ballasts shall be electronic, Rapid Start Type, "T8".
6. Luminaires with acrylic lenses shall be "A12" pattern and a minimum thickness of 0.125 inch.

26 51 01—LIGHTING CONTROLS

1. All projects shall provide ASHRAE 90.1 compliant lighting controls as part of the current adopted energy code.
2. Optimize day-light harvesting controls. Review specific design considerations with APSU.
3. Classroom spaces to over-ride "OFF" switch positions when rooms are vacant.
4. Manual toggle switches or four-hour timer with "hold-on" shall be used in all mechanical and electrical rooms.
5. Digital Time Switches shall be used in other non-occupied, enclosed areas.
6. Occupancy Sensors
 - a. Provide in private offices, storage rooms, janitor's closets and classrooms

DIVISION 26 00 00—ELECTRICAL

- b. Sensors shall be dual technology type, ceiling mounted preferred. Sensors shall be 24 V type with power pack. Provide six feet slack of cable at each sensor to allow for adjustments. If required by project, provide auxiliary relay for control of room VAV box.
- c. Provide a manual bypass-to-off switch for all sensors.

26 53 00—EXIT LIGHTS/SIGNS

1. Exit lights shall be scratch resistant high impact thermoplastic with no visible knockouts, diffuse “LED” type with RED lettering. Exit lights in Residence Halls shall be wall mounted and have a clear protective vandal-resistant shield.
2. Exit signs and Emergency lighting units with integral battery packs shall comply with UL 924.
3. In buildings without generator power, provide integral Ni–Cad battery packs with solid state charger, and self-diagnostics.

26 56 00—EXTERIOR LIGHTING

1. Coordinate selection of exterior lighting with University Design and Construction.
2. Exterior lighting shall be on EMS controls.
3. Illumination levels shall be as recommended in the latest edition of the IESNA Lighting Handbook
4. All luminaires shall be “Dark Sky” compliant.
5. Area lighting poles shall be round tapered steel (it is strongly recommended poles be of seamless, extruded Aluminum for durability and longevity) with black finish and cast aluminum base cover.
6. Concrete pole bases shall be formed with a chamfered edge. Grinding of chamfer shall not be permitted. Concrete base shall be rubbed smooth. Finish coatings shall not be used.
7. Each leg of the feed to lighting poles shall be fused in the pole at the handhole.
8. Fuse holder shall be in-line, non-breakaway, copper crimp terminal, weather- resistant, once conductor IN/OUT; Bussman HEB Series.
9. Lighting contactors shall include hand-off-auto control mounted in the face of the contactor.
10. Exterior building mounted light fixtures below 15’-0” shall have full cut-off optics.
11. Exterior building mounted light fixtures mounted above 15’-0” may be cut-off, adjustable flood, or wall-pack. Use of wall-pack or adjustable flood shall be approved by the University on a per incident basis.
12. Each building supplying power to an exterior lighting branch circuit shall have at least one hand hole (12”x24” Tier 5) in a grass area within 10’ of the building’s exterior wall.

EMERGENCY POWER

1. Reserved

End of Section